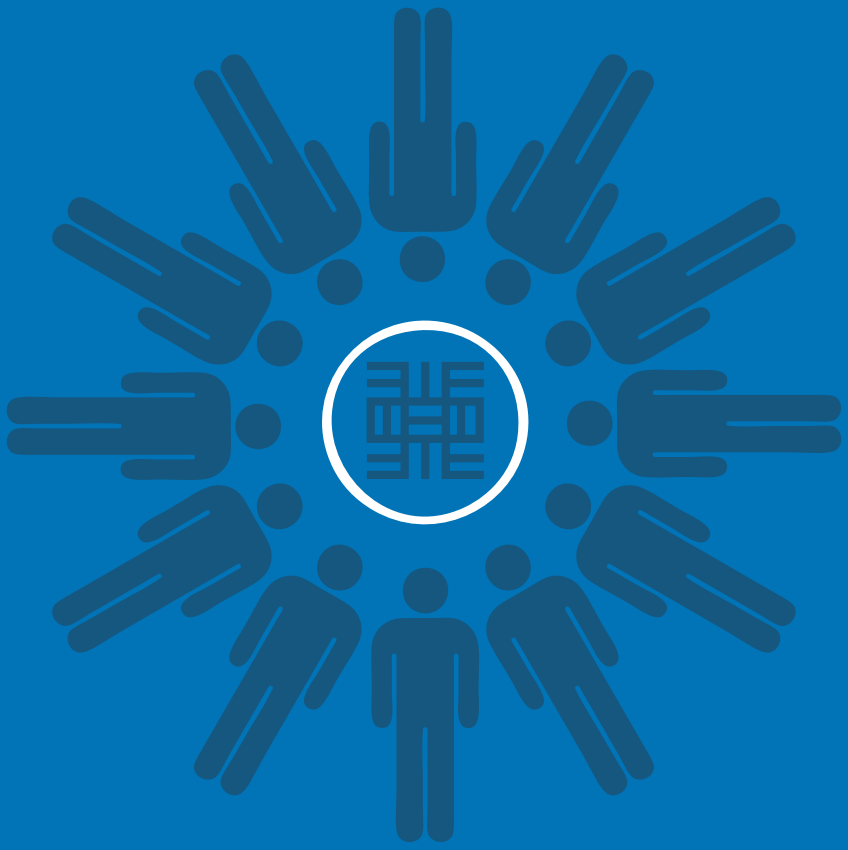
WABER CONFERENCE

10th Anniversary Conference



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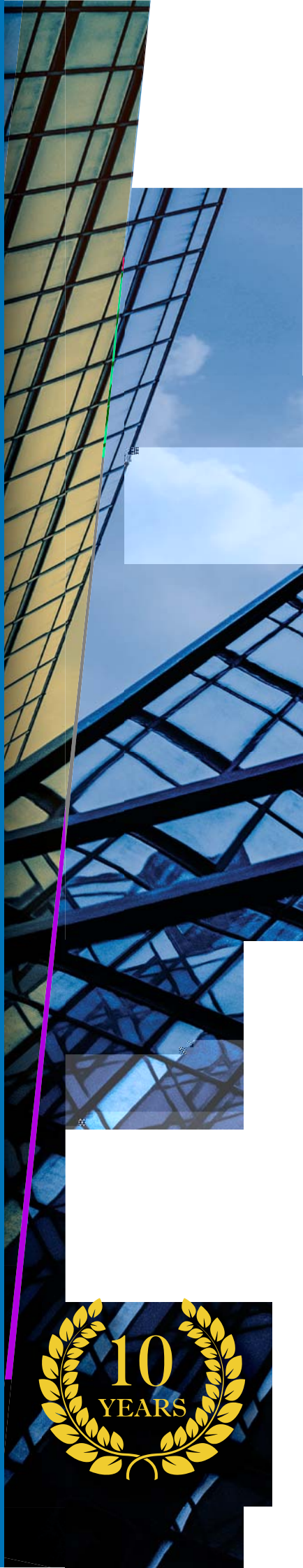
Editors:
S. Laryea
E. Essah

5-7 August 2019
Ghana Academy of Arts and Sciences
Accra, Ghana



WEST AFRICA BUILT ENVIRONMENT RESEARCH (WABER) CONFERENCE
Knowledge, Interaction, People & Leadership

PROCEEDINGS OF THE WABER 2019 CONFERENCE

5th-7th August 2019
Ghana Academy of Arts and Sciences
Accra, Ghana

EDITORS

Sam Laryea
Wits University, South Africa

Emmanuel Adu Essah
University of Reading, United Kingdom

Proceedings of the West Africa Built Environment Research (WABER) Conference 2019

5th - 7th August 2019

Ghana Academy of Arts and Sciences, Accra, Ghana

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Declaration

All papers in this publication have been through a review process involving initial screening of abstracts, review of full papers by at least two referees, reporting of comments to authors, revision of papers by authors and re-evaluation of re-submitted papers to ensure quality of content.

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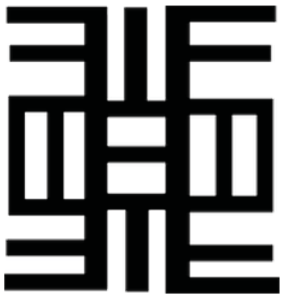

NEA ONNIM NO SUA A, OHU

"***He who does not know can know from learning***"

This is the Adinkra symbol of knowledge, life-long education and continued quest for knowledge. The Akan people in West Africa believe that the search for knowledge is a life-long process. This is evident from the Akan saying "Nea onnim sua a, ohu; nea odwen se onim dodo no, se ogyae sua a, ketewa no koraa a onim no firi ne nsa" which translates into "He who does not know can become knowledgeable from learning; he who thinks he knows and ceases to continue to learn will stagnate".

FOREWORD

I would like to thank and commend the authors of all 84 papers in this Conference proceedings. If the research paper writing process was compared to a marathon, the authors of the 84 papers in this publication would be adjudged as the ones who have endured and finished the race.

We opened the call for papers for this Conference in September 2018 and 176 abstracts were submitted by authors. However, it is one thing to propose to write a paper, and it is quite another thing to actually write the paper. Therefore, I would like to congratulate all authors who succeeded in completing the process of getting published in this conference proceedings.

To enhance visibility and keep in line with current scientific publishing trends, one of the important steps we have taken in the past year is to register WABER Conference as a member of Crossref. Since the beginning of this year, we have been assigning Crossref DOIs to all papers we publish (journal papers and conference papers) in our two main outlets:

- African Journal of Built Environment Research (AJOBER) www.waberjournal.com
- WABER Conference Proceedings www.waberconference.com

We register the metadata of all our journal and conference papers with Crossref. The metadata is then distributed widely by Crossref, helping with discoverability of your papers online. The metadata of all papers in the WABER 2019 Conference proceedings have been registered with Crossref and it is our expectation that this step will provide greater online visibility to all our authors.

This year's conference is our special 10th anniversary conference.

It is befitting that we have an excellent range of interesting topics in the 84 papers to be discussed at this conference.

We are honoured to welcome Professor SN Odai, Vice Chancellor of Accra Technical University, to give us a welcome address. We are also honoured to welcome Professor Kwesi Yankah again to give an opening address for this special 10th anniversary conference.

In the three days of this conference, we will be addressed by five experienced international academics. It is a pleasure to welcome you and I thank each of you sincerely for being with us.

- Professor Roger Flanagan, University of Reading, UK
- Professor Kabir Bala, Ahmadu Bello University, Nigeria
- Associate Professor Carmel Lindkvist, Norwegian University of Science and Technology, Norway
- Professor PD Rwelamila, University of South Africa
- Associate Professor Kathy Michell, University of Cape Town, South Africa

In addition to our five main speakers, we have several other speakers addressing various topics that should be of interest to many of us.

WABER Conference is about knowledge, interaction and leadership around research matters. I hope that you enjoy the conference, interact with colleagues to develop relationships, and engage with our exciting speakers and the diverse topics and over 150 people expected here for this 10th anniversary conference.

Sam Laryea
University of the Witwatersrand, Johannesburg, South Africa
Chairman of WABER Conference
August 2019

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PEER REVIEW AND SCIENTIFIC PUBLISHING STATEMENT

5th August 2019

TO WHOM IT MAY CONCERN

The scientific information published in peer-reviewed outlets carries special status, and confers unique responsibilities on editors and authors. We must protect the integrity of the scientific process by publishing only manuscripts that have been properly peer-reviewed by scientific reviewers and confirmed by editors to be of sufficient quality.

I confirm that all papers in the WABER 2019 Conference Proceedings have been through a peer review process involving initial screening of abstracts, review of full papers by at least two referees, reporting of comments to authors, revision of papers by authors, and re-evaluation of re-submitted papers to ensure quality of content.

It is the policy of the West Africa Built Environment Research (WABER) Conference that all papers must go through a systematic peer review process involving examination by at least two referees who are knowledgeable on the subject. A paper is only accepted for publication in the conference proceedings based on the recommendation of the reviewers and decision of the editors.

The names and affiliation of members of the Scientific Committee & Review Panel for WABER 2019 Conference are published in the Conference Proceedings and on our website www.waberconference.com

Papers in the WABER Conference Proceedings are published open access on the conference website www.waberconference.com to facilitate public access to the research papers and wider dissemination of the scientific knowledge.

Yours Sincerely,

Sam Laryea, PhD
Chairman of WABER Conference

SCIENTIFIC COMMITTEE AND REVIEW PANEL

WABER Conference is very grateful to each of the following persons for your expert review of papers during the peer review process. Thank you.

Assoc. Prof. Sam Laryea, Wits University, Johannesburg, South Africa
Assoc. Prof. Emmanuel Essah, University of Reading, UK
Dr Eng L Ofetotse, Kingston University, London, UK
Dr Haruna Musa Moda, Manchester Metropolitan University, Manchester, UK
Dr Mehdi Shahrestani, University of Reading, Reading, UK
Dr Collins Ameyaw, Kumasi Technical University, Kumasi, Ghana
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Dr Noor Azeyah Khiyon, University of Reading-Malaysia, Johor , Malaysia
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Dr Sarfo Mensah, Kumasi Technical University, Kumasi, Ghana
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Dr Emmanuel Selorm Adukpo, Oxford Brooks University , Oxford, UK
Dr Hafizah Latif, Universiti Teknologi MARA, Perak, Malaysia
Dr Obinna Ozumba, Wits University, Johannesburg, South Africa
Dr Cynthia Adeokun, Colman Architects Ltd, London, UK
Dr Laura Maftei, University of Reading, Reading, UK
Dr Ronan Champion, University of Reading, Reading, UK
Dr Oluseyi Odeyale, University of Ibadan, Ibadan, Nigeria
Dr Razaq Sheriff, Abuja Metropolitan Management Council, Abuja, Nigeria
Dr Jesse Nor, Abuja Metropolitan Management Council, Abuja, Nigeria
Dr Shabnam Kabiri, University of Reading, Reading, UK
Dr Ian Ewart, University of Reading, Reading, UK
Dr Bismark Duodu, The University of Hong Kong, Hong Kong
Dr Maxwell Antwi-Afari Fordjour, Hong Kong Polytechnic University, Hong Kong
Dr Folake Ekundayo, Architect, Berkshire Healthcare NHS Foundation Trust, Slough, UK
Dr Amos Darko, Hong Kong Polytechnic University, Hong Kong
Asso. Prof Carmel Lindkvist, Norwegian University of Science and Technology (NTNU), Norway
Asso. Prof Norhayati Mahyuddin, University of Malaya, Kuala Lumpur, Malaysia
Dr Humphrey Danso, University of Education, Winneba, Ghana
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Dr Christopher Fapohunda, Federal University Oye-Ekiti, Oye-Ekiti, Nigeria
Dr Sena Agbodjah Agyepong, Ashesi University, Accra, Ghana
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Prof Eziyi Ibem, Covenant University, Ogun State, Nigeria

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Thank you to all sponsors and partners of the WABER Conference.

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SHELTER AFRIQUE
Financing Affordable Housing for Africa

SHELTER AFRIQUE PROFILE

Shelter Afrique is a pan-African finance institution that exclusively supports the development of affordable housing in Africa. A partnership of 44 African Governments, the African Development Bank (AfDB) and the Africa Reinsurance Company, Shelter Afrique builds strategic partnerships and offers a host of products and related services to support the efficient delivery of affordable housing in Africa.

Shelter Afrique products includes the following:

Institutional Lending: Shelter Afrique provides lines of credit, corporate loans and credit guarantees to financial institutions and specialised housing institutions for on-lending, in local and foreign currencies, to developers and individuals for new mortgages, refinancing of existing mortgages, and construction finance.

Trade Finance: Shelter Afrique trade finance products help developers and financial institutions involved in the construction sector support the procurement cycle of building materials and equipment. Through our trade finance solutions, Shelter Afrique supports financial intermediaries, manufacturers and exporting and importing companies, by providing pre-export or import finance, medium term supplier and buyer credits, issuance and confirmation of short term letters of credit and guarantees.

Public Private Partnerships (PPP): Innovative financing strategies through PPPs are a key strategic focus of Shelter Afrique towards achieving the organization's vision for affordable housing delivery in Africa.

Shelter Afrique's PPP product is designed to support government and government agencies wishing to partner with credible private sector players to deliver affordable housing units and related urban development at scale.

The Shelter Afrique PPP product is designed in two phases:

- Pre-development Advisory Services
- Project Implementation

In line with these, the PPP housing delivery model provides a set of unique opportunities which aligns with the organization's 2019 – 2023 strategic goals in terms of financing, technical advisory and advocacy; As such strategically positioning the organization in providing innovative solutions to the housing and urban challenges facing the African region.

Microfinance Housing Initiative: Shelter Afrique has partnered with the Terwilliger Centre for Innovation in Shelter (TCIS) Habitat for Humanity towards providing Housing Microfinance Solutions in Africa.

TCIS facilitates efficient and inclusive housing market systems for making affordable housing possible.

Habitat for Humanity formally launched the TCIS at the historic Habitat III, which took place in Quito, Ecuador, in October 2016. The TCIS is one of Habitat's key commitments toward the implementation of the United Nation's member states' New Urban Agenda.

The TCIS consolidates more than a decade of experience in developing market-based solutions for housing, through the TCIS, Habitat for Humanity will accelerate and facilitate better functioning inclusive housing markets to enable more than 8 million people access to improved shelter solutions by 2020.

The collaboration between Shelter Afrique and TCIS majorly focuses on the following:

- Establishment of a Housing Microfinance Fund for Africa
- Capacity Building in Housing Microfinance
- Technical Assistance Facility

Some of Shelter Afrique's Success Stories

- **Karibu Homes:** 1,074 housing units and related infrastructure located at Athi- River, Machakos County, Kenya.
- **Richland Pointe:** 240 housing units and related infrastructure services located in Kamiti, Nairobi, Kenya.
- **Izuba Project:** 304 housing units located in the Gasabo suburb of Kigali, Rwanda.
- **Rehoboth Project:** 103 housing units with related infrastructure located at Oyarifa, Greater Accra Region, Ghana.
- **Sifma S.A. Project:** 350 housing units with related infrastructure located at Bamako, Mali.
- **Sebel Invest S.A Project:** 120 housing units located at Dakar, Senegal.

PRIZES TO BE AWARDED AT THE WABER 2019 CONFERENCE

10th Anniverary Awards

- **Outstanding Researcher Award**

The purpose of this award is to recognise built environment academics in West African institutions who have made an outstanding contribution to research in their field. Many West African universities structure their built environment departments around six academic disciplines and the nature of research in each discipline may vary so the pragmatic approach taken is to identify outstanding researchers in each of the following six disciplines: Architecture; Building Construction / Technology; Construction Project Management; Estate Management/Real estate; Quantity Surveying; Urban and Regional Planning

- **Outstanding Postgraduate Researcher Award**

We have two categories for this award

- Masters
- PhD

- **Outstanding Msc Researcher Award**

The main thing we are looking for in determining a recipient for this award is evidence of a Researcher who has identified a topic that is of significant interest to academic or industry practitioners, demonstrated knowledge of the relevant literature and formulated a structured problem statement and a central research question, and conducted a methodologically rigorous study underpinned by theory to arrive at meaningful conclusions that provide a basis to address the research problem originally identified. For design-based Masters dissertation, we are looking for evidence of proper identification and articulation of an architectural design problem and how it was systematically addressed in an architectural design project. Therefore, the following criteria apply for the nomination of candidates for this award

- Only Masters students who studied in a West African university are eligible
- Must have done the Masters in a built environment discipline
- Must have completed within the last 3 years. We will also consider those who have recently submitted their research dissertation and are awaiting graduation
- The Masters dissertation must contain all of the essential elements outlined above including a demonstrated ability to select suitable methods of scientific investigation and analysis
- Publication of a research paper out of the Masters research will be advantageous but not an essential criteria

Outstanding PhD Researcher Award

A PhD is about rigorous application of scientific methods to make a contribution to knowledge. The main thing we are looking for in determining a recipient of this award is evidence of a researcher who has generated a research question that is of significant national or international interest, and formulated a robust methodology to conduct a comprehensive study which provides new insights of international significance. The following criteria apply for the nomination of candidates for this award

- Only PhD students who studied in a West African university are eligible

- Must have completed the PhD research degree within the last 5years. We will also consider candidates in the process of completion who have already published a journal article from their PhD research
- •Must have produced at least one published article from the research
- The PhD must contain all of the essential elements outlined above including a demonstrated ability to select suitable methods for conducting robust scientific investigation and analysis
- •Evidence of a growing h-index is advantageous but not an essential criteria

Regular Awards

- **Best Research Paper**

This prize is awarded to recognize the author(s) of an original piece of research which contributes a better understanding of the research question/problem investigated and demonstrates a high degree of scientific quality and innovative thought. This prize was created to acknowledge the continuing importance of high quality research to academic institutions, a researcher's reputation and the development of the built environment field.

- **Best Oral Presentation**

This prize is awarded to recognise the presentation which is the most coherent, clearly enunciated, well-paced, easy to understand, and effective. The award is given on the basis of quality of the presentation and not the written paper. It recognizes the best presentation based on communication of the content of a paper and the ability of the speaker to deliver an impactful, authoritative and engaging presentation. The award looks to encourage researchers to put as much effort as possible into the presentation of their work.

- **Best Poster Presentation**

This prize is awarded to recognise the poster which presents the most effective snapshot of the work being reported. The award is given on the basis of the quality of the poster presentation and not the written paper. The award is to be presented to the poster that provides the best snapshot of researcher's work, which engage colleagues in a dialogue about the work, and provides a summary that will encourage the reader to want to learn more about the study. The award looks to encourage researchers to put as much effort as possible into their poster presentation.

- **Gibrine Adam Promising Young Scholar Award**

This prize is awarded to recognize and encourage exceptional young researchers. The recipient should be a young academic who demonstrates promise, such that he/she is likely to become established as a research leader. The prize is provided by Mr Gibrine Adam – President of Zenith University College and CEO of EPP Books Services – who has made significant contributions to the education sector through his educational establishments and philanthropic work. Awarding this prize each year will serve as an important inspiration for young African built environment academics.

MEET OUR SPEAKERS FOR WABER 2019 CONFERENCE

We would like to thank our keynote speakers for accepting our invitation to come and interact with delegates at the WABER Conference 2019. A brief profile of each keynote speaker is given in this section.

ROGER FLANAGAN

Professor of Construction Management

School of Construction Management and Engineering

University of Reading, UK

ROGER FLANAGAN is one of our most notable academics in the built environment field internationally. He is a Professor of Construction Management at the School of Construction Management and Engineering, University of Reading, UK. He is a Visiting Professor at Tsinghua University, Beijing and Chongqing University, Chongqing, China as well as at the Universiti Teknologi Malaysia, and University of New South Wales, Australia. He has previously been a Visiting Professor in Hong Kong, USA, Sweden, Norway, Kenya, South Africa, Turkey, and Croatia. He was President of the Chartered Institute of Building in 2007. Roger's industrial experience includes previously being a member of the Board of Directors of Skanska AB and a non-executive member of the Board of Directors of Halcrow Group. He has been a member of Board of Directors and Advisory Board member in USA, Hong Kong, South Africa, Switzerland, Canada, and UK. He has undertaken studies for the development of the construction industry in the UK, Canada, Malaysia, South Korea, Japan, China, Sweden, Norway, Libya, and Estonia.

KATHY MICHELL

Associate Professor

Department of Construction Economics and Management

University of Cape Town, South Africa

KATHY MICHELL is Head of the Department of Construction Economics and Management at the University of Cape Town. After graduating with her undergraduate degree, Kathy worked as a quantity surveyor. She joined the University of Cape Town as a Lecturer at the beginning of 1995. She has a Master of Philosophy degree, awarded with distinction, in cost and systems engineering from the University of Cape Town and a Doctorate in property and facilities management from the University of Salford. She is a core member of the Urban Real Estate Research Unit at UCT. Her research area is in sustainable urban development and management. She serves on the editorial board of a number of international journals and is the regional editor (Africa) for the Journal of Facilities Management. Kathy is the immediate Past-President of the South African Council for the Quantity Surveying Profession and recently completed a four year term as a Council Member on the Council for the Built Environment in South Africa. She is also a member of The Royal Institution of Chartered Surveyors, the Association of South African Quantity Surveyors and the South African Facilities Management Association.

KABIR BALA

Professor of Construction Management

Department of Building

Ahmadu Bello University, Nigeria

KABIR BALA is a Professor of Construction Management from Ahmadu Bello University Zaria, Kaduna State Nigeria. He graduated with B.Sc. (Hons) Building in 1985 from the Department of Building, Ahmadu Bello University, Zaria. He worked briefly at Amana Development Company in Kaduna before joining the Department of Building as a Graduate Assistant in 1987. He obtained Masters of Science Building Services in 1990, another Masters in Business Administration in 1998 and Doctor of Philosophy (PhD) in Construction Management in 2001; all from Ahmadu Bello University. He was at the Department of Civil Engineering, Surveying and Building, University of Alberta, Dundee Scotland as a Visiting Scholar in 1995. He rose through the ranks and was appointed Professor of Construction Management in 2007. He has taught and examined several undergraduate and postgraduate courses and has successfully supervised over 10 PhDs and over 30 M.Sc. candidates to graduation. He has over 80 publications in national and international academic journals and referred conference proceedings to his credit; with at least 40% published after attaining the rank of Professorship. He is the former Deputy Vice Chancellor (Administration) at Ahmadu Bello University, Nigeria

CARMEL M. LINDKVIST

Associate Professor

Department of Architecture and Planning

Norwegian University of Science and Technology, Norway

CARMEL LINDKVIST has spent fourteen years working in the Norway (NTNU) and UK (University of Reading) researching and publishing on facilities management and sustainable approaches to building/infrastructure projects. She draws on organizational management theories to understand the interplay of practices, clients, facilities managers and end users involved in the construction industry. Her portfolio of research projects includes +Cityxchange (EU funded Smart City Project), EU FP7 Near Zero Energy Neighborhood (renovation on neighbourhood scale to reduce energy demand) and London 2012 (data handover from design to operations). Much of her work in research takes a qualitative perspective and she is interested in methods that enable the researcher to go behind the scene of a given topic. She has published in many journals which include Engineering Project Organization Journal and Technological Forecasting and Social Change. In addition to her research, she lectures on facilities management and research methods at NTNU.

P. D. RWELAMILA

Professor of Project Management and Procurement

Graduate School of Business Leadership

University of South Africa (UNISA)

P. D. RWELAMILA is a National Research Foundation (NRF) rated researcher and Professor of Project Management and Procurement in the School of Business Leadership, University of South Africa (UNISA). He is joint co-ordinator for CIB W107 – Construction in Developing Countries. He formerly taught at University of Zambia and Copper Belt University in Zambia, University of Botswana and University of Cape Town in South Africa. Professor Rwelamila has also taught during short periods in several universities including: The Royal Institute of Technology in Sweden; University of Manchester, University of West of England and University of Bath in the United Kingdom; Queensland University of Technology in Australia; and Heriott Watt University – Dubai Campus. Professor Rwelamila has authored more than 200 peer reviewed journal and conference proceeding publications, research and study reports. He is a Past President of The South African Council for Project and Construction Management Professions (SACPCMP) (2005 -2009); and Past Vice President, Chartered Institute of Building (Africa). In 2005 at the CIB W92 Conference -University of Arizona, USA, Professor Rwelamila was named as the second most cited researcher in project procurement in the world.

DAY 1 - MONDAY, 5TH AUGUST 2019

Time	Event	Venue /Chair
07:30 – 08:45	**Registration** Register and collect your conference materials Welcome tea and coffee and koko Social interaction, Viewing of Posters, and Short video on WABER over the years while we get ready for the Welcome Session	Reception area Main Auditorium
08:45 – 09:00	**Welcome Session** Welcome remarks, Introduction of our Main speakers, Acknowledgement of sponsors and partners, Programme for the day	Main Auditorium Sam Laryea
09:00 – 10:00	**Paper presentation session for doctoral researchers** ¢ Built environment education for green building development in Nigeria, Comfort Olubunmi Ade-Ojo, Federal University of Technology, Akure, Nigeria ¢ Making a case for modular integrated construction in West Africa: rethinking of housing supply in Ghana – Wuni, I. Y. and Shen, G. Q. ¢ Transaction costs characteristics effects on contracting business in Nigeria - Yahaya, M. L. and Oyediran, O. S. ¢ Understanding building price forecasting based on organisational behaviour – Yakubu Michael Zaki, Baba Adama Kolo, Yakubu Gimson Musa-Haddary, Ibrahim Biye Abdullahi Constructive feedback will be provided on each presentation by a panel of experienced international academics led by Professor PD Rwelamila, Joint Coordinator of CIB W107 Construction in Developing Countries and Professor at Graduate School of Business Leadership, UNISA, South Africa	Main Auditorium Chaired by Prof PD Rwelamila, UNISA GSBL, South Africa
10:00 – 10:30	**Refreshments break**	**Outside lawn**
10:30 – 11:00	Plenary session on tropical building design **Re-examining the appropriateness of current tropical design practices** **Mr Ben Adarkwa PGDIP.ARCH, RIBA** Principal at Benson Architects	Main Auditorium Chaired by Prof GWK Intsiful, KNUST, Ghana
11:05 – 11:45	1st Keynote Session **The next generation of African Built Environment Professionals** **Prof Kabir Bala** Professor of Construction Management, Ahmadu Bello University, Nigeria	Main Auditorium Chaired by A/Prof Kathy Michell, UCT, South Africa
11:50 – 13:00	**Official Opening Session of WABER 2019 Conference** Introduction of invited guests and dignitaries by Sam Laryea, Conference chair **Welcome address by Chairman of the Opening Session – Prof SN Odai, Vice Chancellor of Accra Technical University** **Special address by Minister of State in Charge of Higher Education – Prof Kwesi Yankah** Cutting of WABER 10th Anniversary Celebration Cake Official WABER 2019 Group Photograph	Main Auditorium Prof SN Odai, VC of Accra Technical University, Ghana
13:00 – 14: 00	**Lunch Break**	**Dining Room**

14:00 – 15:30	**Paper Presentations (three Parallel Sessions)**			Three separate rooms
Parallel Sessions	**STREAM 1** **Auditorium** **Chair: Dr Cynthia Adeokun, Colman Architects, UK**	**STREAM 2** **Seminar Room 1** **Chair: Dr Sena Agyepong, Ashesi University, Ghana**	**STREAM 3** **Seminar Room 2** **Chair: Prof GWK Intsiful, KNUST, Ghana**	
14:00 – 14:10	The nexus of the infrastructure sector, employment and economic growth – Dlamini, S. and Root, D.	Assessing the skills and competency required of Nigerian quantity surveyors in practicing sustainability advisor in the construction industry - Ali, A. A., Ayobami, I. F., Christian, B. and Salawudeen, A.	An appraisal of the maintenance management practices of high rise residential buildings in Nigeria - Opara, V. I., Idowu, F. O., Hungbo, A. A. and Akinsanya, K. O.	
14:10 – 14:20	Performance benchmarking system for the Nigerian construction industry - Akinradewo, O., Aigbavboa, C. and Oke, A.	Students' perception on the quality of teaching of architecture in south-east Nigeria - Chukwuma-Uchegbu, M. I.	Improving maintainability of public buildings in Owerri Nigeria - Okpoechi, C. U. and Nwankwo, S. I.	
14:20 – 14:30	**Q&A**	**Q&A**	**Q&A**	
14:30 – 14:40	Effect of internal environment and project-related determinants on business strategy of small and medium construction enterprises in Nigeria - Akinkunmi, O. A., Idoro, G. I., Ameh, O. J. and Zakariyyah, K.I.	The leaky pipeline between construction education and women in the construction industry - Moraba, Y. and Babatunde, O.	Establishment of baseline data for deformation monitoring of administrative block of Waziri Umaru Federal Polytechnic, Birnin Kebbi, Kebbi State, Nigeria – Bello, M. N. and Umar A. A.	
14:40 – 14:50	Dominant innovations of successful construction micro, small, and medium enterprises (CMSMEs) in northern Nigeria - Tsado, A. J., Shakantu, W. M. and Alumbugu, P. O.	Explaining the factors' influencing young females' interest in the construction industry using Maslow's hierarchy of needs - Rasheed, E. O., Yu, J., Hale, S., Booth, N. and Shahzad, W.	Dampness pattern in halls of residence in selected educational institutions in Lagos, Nigeria - Zakariyyah, K. I., Faremi, O. J., Soyingbe, A. A., Ajayi, O. O., John, I. B., Aregbesola, G. T., Aderogba, M. A., Tijani, M. S., Simeon, R. D. and Bolajoko, A. T.	

14:50 – 15:00	**Q&A**	**Q&A**	**Q&A**	
15:00 – 15:10	Cost of construction projects in Nigeria -challenges and ways forward- - Ojo, S. M.	Challenges confronting the quantity surveying profession in Nigeria: perspective of the education system – Awolesi, J. A.	An exploratory study of the relationship between urban form and travel behaviour in Kaduna, Nigeria - Bununu, Y. A.	
15:10 – 15:20	Premature project closure: the role of consultants and contractors - Akinshipe, O., Aigbavboa, C., Thwala, W. D. and Madidimalo, M.	Quantity surveying education for sustainable development: industry perception - Adekunle, S. A., John, I. and Aigbavboa, C.	Sustainable urban development and the challenges of urban sprawl in 'Abuja' the federal capital city of Nigeria - Hussaini, I. U., Abubakar, S. K., Danmaraya, M. A., Sumaila, S. A. and Ibrahim, S. K.	
15:20 – 15:30	**Q&A**	**Q&A**	**Q&A**	
15:30 – 16:00	**Refreshments break**			**Outside lawn**
16: 00 – 17:30 Includes 25 mins for Q&A	WABER 10th Anniversary Public Lecture **Imagination, inspiration, innovation: the challenge for design and construction teams in Africa** **Professor Roger Flanagan** Professor, School of Construction Management and Engineering, University of Reading, UK			Main Auditorium Chaired by Mr. Rockson Dogbegah, President, Institute of Directors, Ghana
17:30	Close for day 1			Main Auditorium

DAY 2 - TUESDAY, 6TH AUGUST 2019

Time	Event			Venue /Chair
07:30 – 08:30	**Registration and welcome tea and coffee and koko**			
08:30 – 08:45	**Video highlights of Day 1 and orientation to day 2**			Main Auditorium
08:45 – 10:45	1st Research Skills Workshop **Modern ways to conduct literature reviews and use theory in research** **Associate Professor Carmel M. Lindkvist** Norwegian University of Science and Technology, Norway			Main Auditorium Chaired by A/Prof Kulomri J. Adogbo, Ahmadu Bello University, Nigeria
10:45 – 11:15	**Refreshments break**			**Outside lawn**
11:15 – 12:00	2nd Keynote Session **Sustainable urban development and management in African cities** **Associate Professor Kathy Michell** Head of Department of Construction Economics and Management, University of Cape Town, South Africa			Main Auditorium Chaired by Prof GWK Intsiful, KNUST
12:05 – 12:40	Panel discussion on affordable housing in African cities **Critical rethink of affordable housing understanding and initiatives in African countries** **Question for the panel discussion: How do we address the challenge of affordable housing for lower and middle income workers in African countries?** **Andrew Chimpondah**, Managing Director of Shelter Afrique (15 minutes presentation) **Sammy Amegayibor,** Executive Secretary of Ghana Real Estate Developers Association (10 minutes presentation) Q&A (10 minutes)			Main Auditorium Chaired by Prof GWK Intsiful, KNUST / Dr Cynthia Adeokun, Colman Architects, UK
12:40 – 13:25	**Lunch break**			**Dining Room**
13:30 – 14:00	Plenary session on research in the Nigerian built environment **Trumping our Game: Refocusing current challenges in the Nigerian construction industry into national discourse** **Dr Joy Maina** Assistant Dean, Faculty of Environmental Design, Ahmadu Bello University, Nigeria			Main Auditorium Chair: Rev. Dr Joseph Buertey, Pentecost University College, Ghana
14:00 – 16:00	**Paper Presentations (three Parallel Sessions)**			Three separate rooms
14:00 – 16:00	**STREAM 1** **Auditorium**	**STREAM 2** **Seminar Room 1**	**STREAM 3** **Seminar Room 2**	

PARALLEL SESSIONS	Chair: Prof PD Rwelamila, UNISA	Chair: Dr Sitsabo Dlamini, Wits University	Chair: Dr Stephen Agyefi Mensah, Cape Coast Technical University	
14:00 – 14:10	Effects of motivation of operatives on productivity in the Nigeria construction industry - Opara, V. I., Apete-Adebola, L. A., Sofolahan, O. and Akinsanya, A. Y.	Tenant's demand for structural attributes in residential properties: the case of Ede, Nigeria – Chiwuzie, A. et al.	Influence of organizational sub-culture on total quality management practices in Nigerian construction firms - Olaleye, Y. O., Ibrahim, Y. M., Ibrahim, A. D. and Adogbo, K. J.	
14:10 – 14:20	The use and effects of cannabis among construction workers in South Africa: a pilot study - Haupt, T. C., Akinlolu, M. and Raliile, M. T.	The influence of GDP on rental growth of residential properties in Ede, Nigeria - Chiwuzie, A., Dabara, D. I., Prince, E. M. and Aiyepada, G. E.	Identifying barriers to total quality management implementation in the construction industry using the delphi technique - Ansah S.K., Thwala D. W. and Aigbavboa C.O.	
14:20 – 14:30	**Q&A**	**Q&A**	**Q&A**	
14:30 – 14:40	Development of sustainable training models from task characteristics for improved performance of site supervisors in construction firms – Ijaola, I. A. and Idoro, G. I.	Real estate investment trusts in Nigeria and the structure-conduct-performance paradigm – Dabara, D. I. and Ogunba, O. A.	Assessing the level of adoption of TQM practices in Nigerian construction firms - Olaleye, Y. O., Ibrahim, Y. M., Ibrahim, A. D. and Adogbo, K. J.	
14:40 – 14:50	Overexertion-related construction workers' activity recognition and ergonomic risk assessment based on wearable insole pressure system - Antwi-Afari, M. F., Li, H., Luo, X. E., Edwards, D. J., Owusu-Manu, D., and Darko, A.	Pricing of property valuation services in Nigeria: an evaluation - Oladokun, S. O. and Mooya, M.	Quality control in Abuja mass housing – Dadu, D. W., Stanley, A. M., Usman, J., Sa'ad, M. M. and Ogunsanya, K. I.	
14:50 – 15:00	**Q&A**	**Q&A**	**Q&A**	
	Chair: A/Prof Emmanuel Essah, University of Reading	**Chair: Prof GWK Intsiful, KNUST, Kumasi, Ghana**	**Chair: Rev Dr Joseph Buertey, Pentecost University College**	

15:00 – 15:10	Sustainable urban green infrastructures as a remediation tool for enhanced environment and local air quality for metropolitan Lagos - Uduma-Olugu, N. and Adesina, J. A.	Innovative architecture for flood resilience: a response to submerged Nigerian cities – Durowoju, A. T.	Strategies for enhancing extended producer responsibility enforcement: a review - Mwanza, B. G. and Mbohwa, C.	
15:10 – 15:20	Barriers of implementing green walls in the urban environment in developing countries - Terblanche, R.	Size and adequacy of living space in the home: an evaluation of public apartments in Cape Coast, Ghana, based on space per person (SPP) - Agyefi-Mensah, S. and Kpamma Z. E.	Information and Communication Technology (ICT) application on construction supply chain management: evidence from Nigeria - Amade, B., Ononuju,C. N., Adu, E. T. and Ogbu, J. M.	
15:20 – 15:30	**Q&A**	**Q&A**	**Q&A**	
15:30 – 15:40	Evaluating the impact of climate change on the quality of ground water – case study of a coal enriched environment in Enugu Urban - Nnaemeka-Okeke, R. C., Eze-Steven, P. E. and Ugwu, C. C.	Industrialized building systems: prospects and problems within the Nigerian construction industry - Emma-Ochu, C. A. and Onwuka, E. O.	Assessing the strategic supply management capabilities of public clients for construction procurement in developing economy - Kolo, B. A. and Bala, K.	
15:40 – 15:50	An investigation into energy consumption profile of University of Lagos students' hostel - Faremi, O. J., Ajayi, O. O., Zakariyyah, K. I., John, I. B., Alimi, O. M., Oginni, O. A. and Adegoriola, M. I.	Challenges and enhanced measures for implementation of industrialized building system in Lagos metropolis - Ajayi, O. O., Faremi, O. J., Zakariyyah, K. I., John, I. B., Anifowoshe, F. A., and Alimi, O. M.	Assessment of stakeholders' perception of risk factors associated with the adoption of e-procurement in the Nigerian construction industry - Gambo, M. M., Dodo, M. and Yusuf, H	
15:50 – 16:00	**Q&A**	**Q&A**	**Q&A**	
16:00 – 16:30	**Refreshments break**			**Outside lawn**
16:30 - 17: 30	3rd Keynote Session **New frontiers of risk in delivering successful projects for clients and profits for constructors** **Prof Roger Flanagan** Professor, School of Construction Management and Engineering, University of Reading, UK			Main Auditorium Chaired by Mrs. Rosemargaret Esubonteng, Vice President of GhIS
17:30	Close for day 2			Main Auditorium
18:45 – 21:30	**WABER 2019 Conference Dinner**			
	Presentation of WABER 10th Anniversary Recognition and Awards			**Atrium, Ghana Academy of Arts and Sciences**

DAY 3 - WEDNESDAY, 7TH AUGUST 2019

Time	Event			Venue
07:30 – 08:30	**Registration and welcome tea and coffee and koko**			Main Auditorium
08:30 – 09:30	**One-on-one mentoring session** Professional and career development one-one-one sessions in different areas of academic practice development (Coordinated by A/Prof Emmanuel Essah, University of Reading, UK)			Main Auditorium
09:30 – 11:00	2nd Research Skills Workshop **Doing qualitative research (collecting and analysing qualitative data appropriately)** **Dr Carmel M. Lindkvist** Norwegian University of Science and Technology, Norway			Main Auditorium Chaired by Dr Cynthia Adeokun
11:00 – 11:30	**Refreshments break**			**Outside lawn**
11:30 – 13:30	**Paper Presentations (three Parallel Sessions)**			Three separate rooms
11:30 – 13:30 **PARALLEL SESSIONS**	**STREAM 1** **Auditorium** **Chair: A/Prof Kathy Michell, University of Cape Town**	**STREAM 2** **Seminar Room 1** **Chair: Dr Gabriel Nani, KNUST, Ghana**	**STREAM 3** **Seminar Room 2** **Chair: Dr Joy Maina, Ahmadu Bello University**	
11:30 – 11:40	Conceptions of sustainability amongst post graduate (MSC) construction management students - Doamekpor, N. A. A-M. and Duah D.	Study on influence of different curing regimes on the mechanical properties of metakaolin based geopolymer concrete - Alhaji, M. A., Tersoo, K. E., Aliyu, L. M. and Almustapha, T.	Building collapse in Nigeria and development control, the missing link - Okeke, F. O., Okeke, F. I. and Sam-Amobi, C.	
11:40 – 11:50	Appropriate drivers for sustainable construction practices on construction sites in Nigeria - Omopariola, E. D. , Albert, I., and Windapo, A.	Strength properties of locally produced reactive powder concrete with unrefined metekaolin - Ibrahim, A. G., Garba, M. M., Okoli, O. G., Zubairu, I. K., Dahiru, D. and Usman, J.	Crime prevention through environmental design: what works and what does not? - reflections from a Nigerian city - Adzande, P.	
11:50 – 12:00	**Q&A**	**Q&A**	**Q&A**	

12:00 – 12:10	Sustainable building practice: an assessment tool for Ghana – Ako-Adjei, J. T. and Danso, H.	Factors affecting the use of Expanded Polystyrene (EPS) for sustainable housing construction in Nigeria - Mansir, D., Gambo, M. M., YarAdua, F. H. and Abduljabbar, K. F.	Assessment of internal marketing relationship of quantity surveying firms in southwestern Nigeria - Ojo G.K and Ebunoluwa E.I	
12:10 – 12:20	Sustainable materials and role of professionals in built environment sustainability - Ajala, A. O., Kashim, I. B., Akinbogun, T. L. and Aramide, F. O.	Factors influencing consumer preference for ceramic sanitary ware in south-west, Nigeria - Fadairo, O. O., Akinbogun, T. L. and Kashim, B. I.	An appraisal of effective organization processes in integrated change control performance for public construction project - Abdullateef, A. J., Ilias, S., Adegboyega, A. A., Muhammed, E. A. and Inuwa, B.	
12:20 -12:30	**Q&A**	**Q&A**	**Q&A**	
	Chair: A/Prof Kathy Michell, University of Cape Town	**Chair: Dr Cynthia Adeokun, Colman Architects, UK**	**Chair: Dr Sarfo Mensah, Kumasi Technical University**	
12:30 – 12:40	Sustainable solid waste management in Nigeria: reviewing the contributions of social networks in informal solid waste collection activities - Kwaghsende, F. K.	Evaluation of clay roof tiles produced with makuba as a binder - Lawal, M. A., Kasim, A. and Alhaji, M. A.	Automation in construction materials handling: the case study in north central Nigeria - Alumbugu, P. O., Shakantu, W. W. M., Tsado, A. J. and Ola-Awo, A. W.	
12:40 – 12: 50	Knowledge and awareness on Plastic Solid Waste (PSW) management in Zambia: where are we? - Mwanza, B. G. and Mbohwa C.	Enhancing the performance of walls built with laterite-cement bricks: a conceptual design and specifications writing approach - Alao, T. O. and Ogunbode, E. B.	An investigation into the performance of Dutse (Nigeria) as a growth centre of Jigawa State - Jolaoye, A. A.	
12:50 – 13:00	**Q&A**	**Q&A**	**Q&A**	
13:00 – 13:10	Framework for sustainable infrastructure development in border communities of Akamkpa local government area Nigeria	A structural analysis of an adjustable docking system for multiple aircraft	Assessment of internal marketing relationship of quantity surveying	

	- Onyekwere, E., Okpoechi, C. U. and Ajom, S. K.	models: case study – Mushiri, T., Maswera, M. and Mbohwa, C.	firms in southwestern Nigeria - Ojo G.K and Ebunoluwa E.I	
13:10 – 13:20	Rethinking the challenges to attaining sustainable cities and communities: lessons from social norms and status quo bias - Hammond, S. F., Gajendran, T., Maund, K. and Savage, D. A.	Design of a composite timber-concrete footbridge across Sakubva River, Mutare. Case of Nyanhongo Village Dora. – Mukura, T. E., Mushiri, T. and Shumba, S.	An appraisal of effective organization processes in integrated change control performance for public construction project - Abdullateef, A. J., Ilias, S., Adegboyega, A. A., Muhammed, E. A. and Inuwa, B.	
13:20 – 13:30	**Q&A**	**Q&A**	**Q&A**	
13:30 – 14:15	**Lunch Break**			**Dining Room**
14:15 – 14:50	4th Keynote session **Making Sense of the Ailing African 'Elephant' – New perspectives for a more sustainable pathway into the future** **Professor PD Rwelamila** Joint Coordinator of CIB W107 Construction in Developing Countries and Professor at UNISA Graduate School of Business Leadership, South Africa			Main Auditorium Chaired by Prof Victor K.B. Micah, Takoradi Technical University, Ghana
15:00 – 16:15	5th Keynote Session **Trends shaping the global construction industry: the race to the future** **Prof Roger Flanagan** Professor, School of Construction Management and Engineering, University of Reading, UK			Main Auditorium Ing. Kwabena Agyepong, Executive Secretary of Ghana Institution of Engineers (GhIE)
16:15 – 16:45	**Refreshments break**			**Outside lawn**
16:45 – 17:20	**Closing Session** Conference summary Vote of thanks and Appreciation of WABER 2019 keynote speakers Presentation of prizes and certificates			Main Auditorium Sam Laryea, Chairman of WABER Conference
17:20	Close			

CONTENTS

SECTION 1: KEYNOTES

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SECTION 1: KEYNOTES AND RESEARCH SKILLS WORKSHOPS

- *Social sustainability* refers to the creation of communities and equitable access to the utilisation of the natural and built environment,
- *Economic sustainability* pertains to the ability of a local economy to sustain itself,
- *Ecological/Environmental sustainability* is primarily focused on the impact of urban production and consumption on the integrity and health of the local environment,
- *Physical sustainability* focuses on the ability and capacity of man-made structures and the urban built form to support productive activities and the capacity for human life, and,
- *Political sustainability* concerns an understanding of the tension that exists in achieving the optimal balance between the social, economic, environmental and physical (i.e., institutional and governance frameworks that regulate the performance of the other four dimensions).

The above five dimensions to sustainable urban development are encapsulated in The Habitat III – New Urban Agenda which makes significant strides in addressing the narrower definition of sustainability. What the majority of this work fails to do is to articulate the actual implementation of these policies and strategies. More often than not the policies also fail to articulate how the sustainable developments are to be managed and more importantly, do not require built environment professionals to be cognizant of the management of property and urban precincts in the development phases of projects. What is needed are frameworks that are capable of accommodating the uniqueness and complexities of different urban environments in a way that focuses on mobilising community resources and social capital. More importantly, what is required are innovative new ways to promote urban sustainability within cities of the global south need to be developed. It is critical that these frameworks draw on the experiences of local stakeholders to generate participatory, collaborative and integrated initiatives to drive sustainability and alleviate urban poverty whilst remaining grounded in good governance that is characterised by decentralisation, responsiveness and flexibility (Tanner et al., 2008). Furthermore, these frameworks need to be founded on the premise that the built environment disciplines cannot operate and exist independently, especially when driving urban sustainability. The systemic nature of the issues associated with sustainability requires unity and collaboration in the pursuit of equitable and environmentally conscious development (Stephens, 2000).

Towards a framework for sustainable solutions

This raises a question as to how one begins to pull the sustainable development agenda into a management framework that can begin to provide a holistic response to the challenges outlined above. Research to date has highlighted a series of imperatives that we ‘need to get right’ in order to achieve sustainable urban development and, more importantly, sustainable urban management. These are depicted in Table 1 below with the associated possible policy implications.

true social, economic and environmental value embedded in the sustainable development and management process.

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SECTION 2: PLENARY SESSION PRESENTATIONS

hand their food source which is basically fungi that can only thrive below certain temperatures and on the other hand their queen and nursery at the core of each colony. Termites rely on the buoyancy of hot air to rise and provide natural ventilation through the holes in the mound as well as harnessing cool night air to flush the mound and replace hot stale air when temperatures drop at night. This feat is achieved by plugging and unplugging the holes in the mounds, working round the clock. It was a secret uncovered with the help of modern technology using thermal imagery and air sensors placed strategically inside termite's mounds. Further, the mound is constructed out of a mixture of clay, termite saliva and dung and known to have better thermal resistance properties (U-value) than most building materials.

This study focuses on buildings design practices in the Tropics of Africa and re-examines:

1. The appropriateness of building materials, their usage and availability
2. The indiscriminate use of certain architectural forms in the tropical zone
3. The energy footprint and adoption of an ingenious termite's cooling strategy

With such inspiration from nature, it is hoped that by imitating members of the wild community in our Eco-system, coupled with the application of environmental science principles, the 'SASCH' Project would lead the way forward to building environmentally friendly dwellings in African as well as adoption of sustainable living standards. Instead of dependency on unreliable energy sources for artificial cooling, the air-condition which brought us the 'Sick Building Syndrome', we must focus on reduction of energy consumption to decrease global warming potential of our Built Environment.

SECTION 3: CONFERENCE PAPERS

Modular system

Figure 3: Modular system

Little differences can be cited between modular and scaffold systems. The major difference is that modular systems, since they are smaller in size, can be combined with other platforms to suit specific jobs. This makes them suitable for different models of aircrafts if they get the perfect and most appropriate combinations. Modular systems is shown in figure 3.

Teleplatform

Figure 4: Teleplatform

Teleplatform is a fairly modern system as far as aircraft maintenance is concerned. It involves structures attached to the roof of the hangar which operate from an aerial point. Mechanics will be standing in a cage like structure at the bottom end of a vertical member whose height can be varied to the desired level depending on the point of work (Sauvage, 1989). This system is usually integrated to the hangar and it therefore turns out to be space saving compared to other systems. In most cases it is not fully automated, requiring operators to sometimes climb up to the cages and lower or lift the cage to the desired height by use of electronic controls. However, its design has to be integrated into the hangar design and

pulled into the hangar and positioned for the scheduled maintenance. The platforms are then fit into their appropriate position.

Aim of the study
To design a docking system which is adjustable to meet the specifications of different models of airplanes. This is to do a structural analysis of an adjustable docking system for multiple aircraft models: case study.

Objectives of the study
The docking system designed must

- Be manufactured at minimum cost
- Require less labour for set up as compared to the current one
- Have less setup time than the existing one
- Be flexible and sustainable i.e. must be flexible enough to be modified in case a new model with unseen dimensions has been released
- Be cheap to maintain
- To come up with a prototype which illustrates the major principles of operation of the platforms.

DESIGN FORMULAE

The basic formula for designing scaffolding is as follows which is used to determine the weight of the aeroplane under design.

Equation 1: Scaffold equation design.

$$W = W_T(N_L + N_D)\left[1.5H + nH + \frac{2}{3}D + B\right] + 3W_C(N_L + N_D) + 0.75w_D BDN_D + nN_L W_C$$

Where ώ$_l$ = unit weight of each tube;
ώ$_ّ$ =average weight per coupler;
ŭ$_ؤ$ =number of lifts;
ŭ$_ّ$ =number of loaded lifts;
è=number of standards per standard group;
Ŏ=lift height;
Ŏ=c/c of standard transversely;
ŏ=c/c of standard longitudinally;
ú$_ّ$ =uniformly distributed deck load (Brown, 2013)

For structural engineering we use the following;

Equation 2: Simple bending equation $\frac{ؤ}{آ} = \frac{ّ}{ؤ} = \frac{ك}{ذ}$

Where;
M-applied bending moment
E- Young's modulus of elasticity
σ- Stress at distance y from the neutral axis
I- second moment of area of the beam cross-section about the neutral axis
R-radius of curvature of the neutral axis at the section
y- distance from the neutral axis of the beam cross-section (Hearn 1978)
Equation 3: Moment of simple beam

this will be the design weight. Appendices are further expanded to show exactly what was under study.

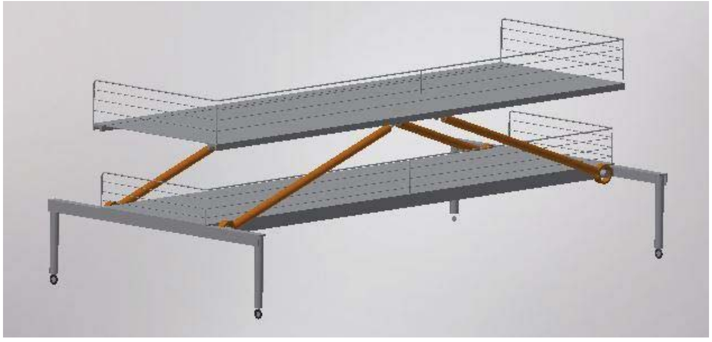


Figure 7: Collapsed Dock

SELECTED DESIGN

Calculations and design

Each will be made of an aluminium alloy. One bay will be designed for 7200N. However, since this is equal to the weight of 9 grown-ups, the weight will be assumed to be uniformly distributed at 800N/m. Designing for a maximum length of 15m, the calculation is as follows. Assuming the uniformly loaded structure with fixed ends,

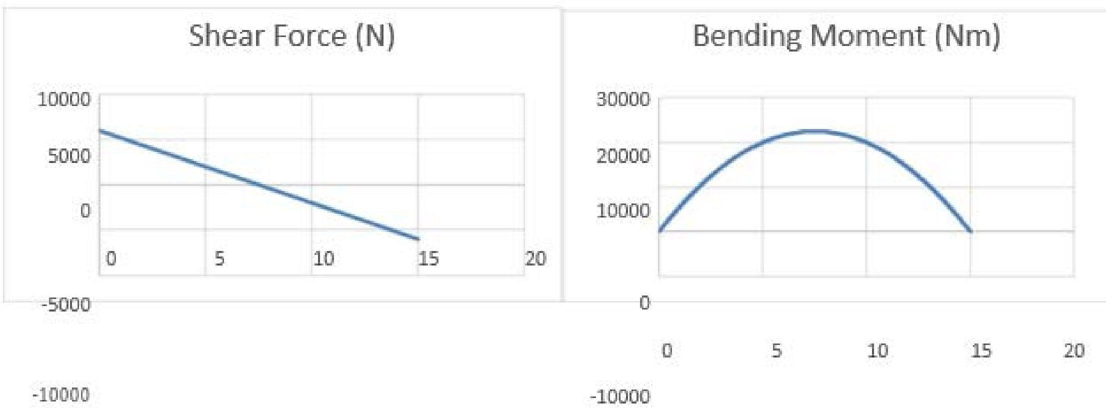


Figure 8:a.) Shear Force diagram with Shear Force/N (y-axis) plotted against distance/m (x-axis) b.) Bending Moment Diagram showing Bending Moment/Nm (y-axis) vs Distance/m (x-axis)

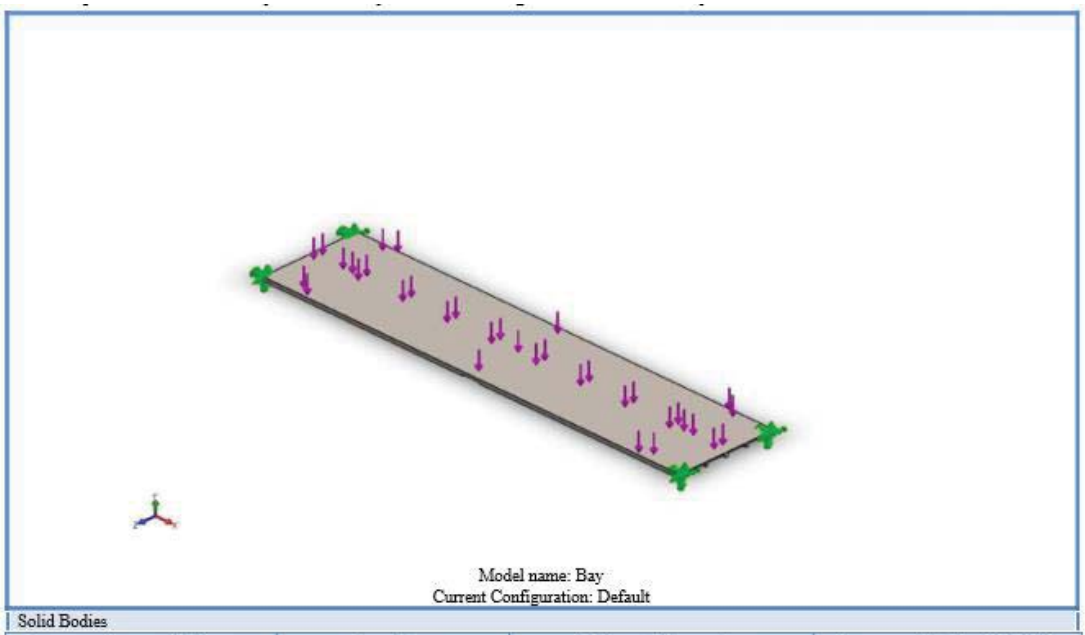
Assuming the uniformly loaded structure with fixed ends,

ὅ8 Ü سي φπππὼ طي τππὼ˙

where B.M is the Bending Moment and x is the distance from one end of the platform taken to be the reference i.e. the left end.

Integrating once ؤ8=م / ذم سي φπππ طي τππὼ. By equating this to zero to find the value of x at the turning point, x=7.5m. By substituting this value into equation 6.1, B.M=22500Nm. This is used as M in ؤ/آ سي ˚/ؤ سي ؤ/ذ.

The shear force and bending moment diagrams are shown in figures 6.1 and 6.2 respectively.



Solid Bodies

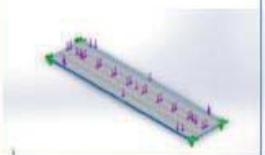
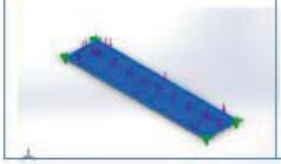
Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Cut-Extrude7 	Solid Body	Mass:27772.4 kg Volume:3.47155 m^3 Density:8000 kg/m^3 Weight:272170 N	C:\Users\DELL\Documents\Engi n eering Platform\Bay frame.SLDPRT May 18 14:45:50 2017
Boss-Extrude1 	Solid Body	Mass:1074.15 kg Volume:0.27125 m^3 Density:3960 kg/m^3 Weight:10526.7 N	C:\Users\DELL\Documents\Engi n eering\HENMECH\Level 4\ME460\Final Platform\Bay\Bay.SLDPRT May 18 02:52:51 2017

Fig. 10. Solidworks analysis

Table 2. Study Properties

Study name	Static 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFFPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off

Table 6. Reaction forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	-0.643555	7200.73	-0.108887	7200.73
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

Table 7. Stress analysis

Name	Type	Min	Max
Stress1	VON: von Mises Stress	5729.76 N/m^2 Node: 1775	3.31493e+007 N/m^2 Node: 4448

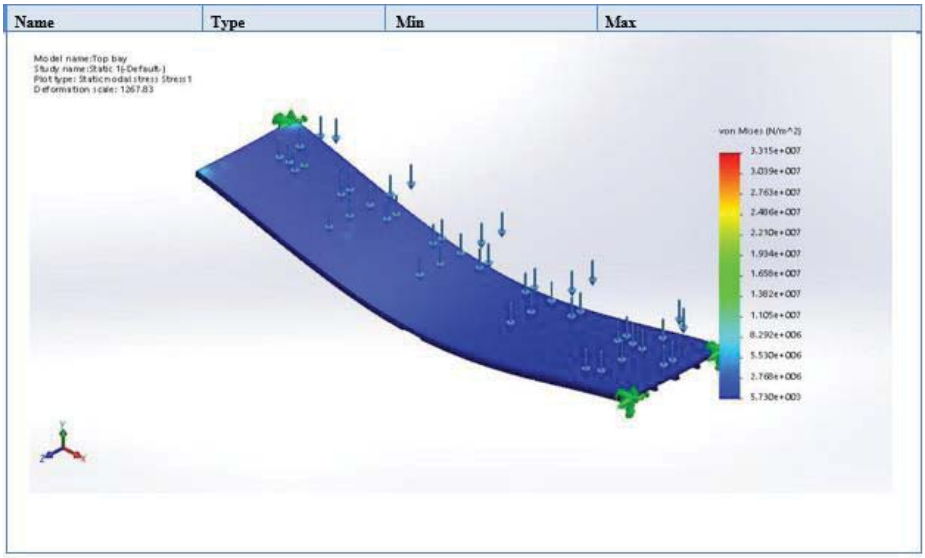


Fig. 11. Stress analysis results

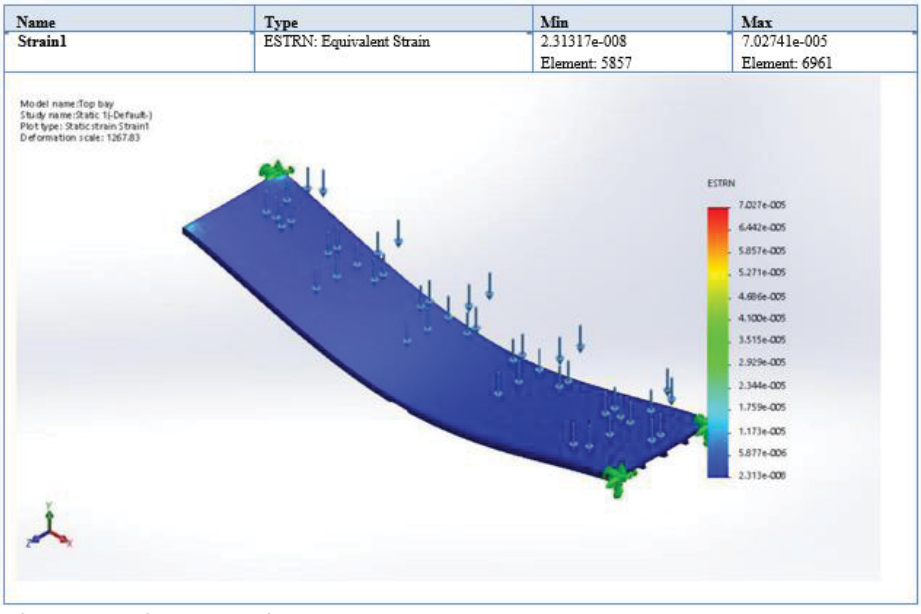


Fig. 12. Maximum Strain

It should be noted that whilst only one platform was used in this illustration, several platforms might be used to service many parts of the aircraft at once. The major advantage of this system is that only the necessary platforms are used at a time.

The Prototype

A mechanical Prototype was developed to illustrate the working principal of the dock. The two extreme stages of the Prototype will be illustrated in this section

Figure 16: Prototype manufactured

Figure 17: With the highest deck at the highest position

CONCLUSION AND RECOMMENDATIONS

The aim and objectives have been achieved. The implementation of this project can result in huge savings to the airline which can be seen in the long run. A model was manufactured even though due to financial lack, only the mechanical aspect of it was tackled. This means that a docking system is designed for safety

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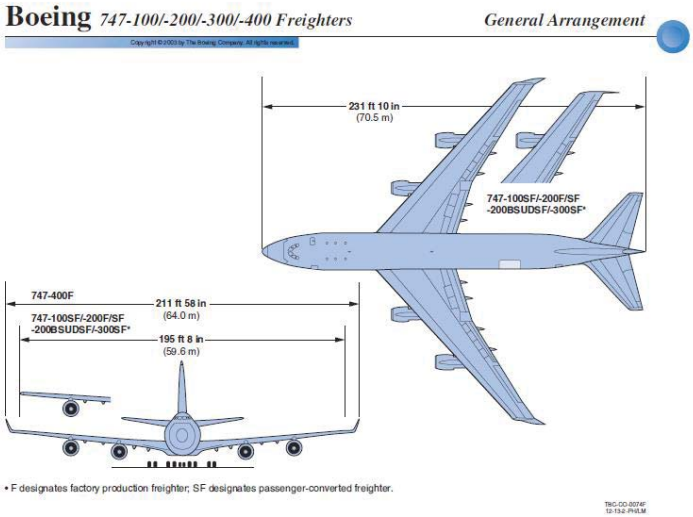
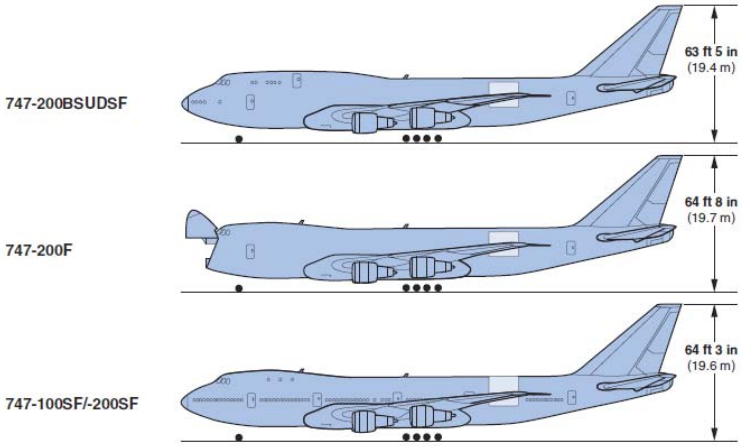


Appendix 4: Boeing 747 dimensions



Appendix 5: Boeing 747 variants and dimensions

Appendix 6: Fully Closed Platform

Appendix 10: The highest platform elevated to maximum height

Appendix 11: The middle platform with the safety rails in place

Appendix 12: Maximum possible working heights

INTRODUCTION

It is obvious that changes to a project just must occur; one can term it as a necessity, particularly in complex projects. It is quite possible for change to spring up as a result of the incompetency of the personnel handling the project, poor scope definition of the work or probably a major corrective measure considered to require a complete overhaul of the work while the project is going on. Several of these factors lead to changes in the project delivery process. It was stated by Darter (2014) that there are chances that if change of any magnitude is allowed in a project it could disrupt the smooth sailing of such a project in terms of the established plan and scope, the team doing the work, for these reasons he believed changes should not be for mere changing sake, for definitely it will be a bad idea. He is of the view that any change should be thought through thoroughly if at all it is considered as warranted in a project, the entire project stakeholder should be consulted before any decision is taken. The biggest concerns for any construction project are cost and schedule, though, unfortunately, the most vulnerable to project changes. Change on the schedule of project consumes floats if related to the critical paths chart and the total duration of the project changes. It can be viewed as additive nature, how the overall costs of the project are significantly impacted by changes (Zou and Lee, 2008). One may be tempeted to ask what is the level of knowledge of project stakeholders and the importance of perform integrated change control to organizations?

Therefore, the aim of the study is to explore the significance of perform integrated change control to organization processes for public project delivery. The objectives of this study is to characterize the level organizations has attended in term of knowledge of perform integrated change control and to determine the importance of integrated change control performance to organizations, professionals and other project stakeholders.

According to Markus and Hajo (2013), several organizations has now decided to be process-oriented. They explained process orientation (PO) as a focus being placed on the business processes, and this range from customer to customer, instead of emphasizing an organization's functional and hierarchical structures (McCormack and Johnson, 2001). A process-oriented organization can also be referred to as a "horizontal organization" (Ostroff, 1999), "process centered organization" (Hammer, 1996), "process enterprise" (Hammer and Stanton, 1999), "process focused organization" (Gardner, 2004) or simply "process organization" (Osterloh and Frost, 2006; Gaitanides, 2007). Markus and Hajo (2013) while citing Armistead and Machin (1998) postulated further that a firm that is process-oriented is duly concerned with the management of its cross-functional business processes regardless of whether it has already run through business process reengineering and/or process improvement projects or not. Business process management incorporates the discovery, design, deployment and execution of business processes on the one hand, and the interaction, control, analysis and optimization of these processes on the other (Smith and Fingar, 2003).

The study focuses on the significance of organization process assets in performing integrated change control on public construction projects in Nigeria. Some Tertiary Education Trust Fund (TetFund) construction projects were selected as case study

For procurement-related Projects:
a) Inventory of items to be procured should be submitted and it should contain quantity of items to be purchased, unit rate and total cost b) Genuine Proforma Invoice, with cost submission quoted in the Nigerian c) Submission of Manufacturer's Catalogue/Brochure of technical specifications d) Sample Photographs of the items to be purchased e) Inclusion of VAT where applicable. Withholding Tax (WHT) inclusion is not acceptable f) Installation requirements with cost (where applicable) g) Non-inclusion of consumables

Post AIP stage and requirements for disbursement of funds
Holds installment is done after the AIP has been permitted and the Due Process necessities have elegantly happened. For Construction-related endeavors, conveyances are in three (3) tranches of half, 35% and 15%; while for Procurement-related endeavors, installment are in two tranches of 85% and 15%. The Due Process prompts getting to the (main) Tranche of advantages and should be finished as per the plans of the Public Procurement Act 2007.

Due Process Requirements for Accessing the (first) Tranche of Funds are as Follows: A) Advertisement B) Pre-Qualification C) Tender Action D) Bid Evaluation E) Letter of Commitment.

Interventions involving projects with construction and procurement components:
Keeping in mind the end goal to facilitate the issue of non-arrival of assets at the last tranche arrange due to issues related with respectful fruition periods on a given intercession where construction and procurement are included, such mediation might be part into two (2) – Construction on one hand and Procurement on the other, so they keep running as parallel intercessions inside a similar mediation. The accommodation on such intercession will never again be as a solitary accommodation, however as two (2) and not more than two (2) batches, which would be accommodated and processed thusly. This is to take out the long-standing issue of contractors who have possessed the capacity to completely entire their fragment of the mediation yet can't get to the last tranche in light of the fact that the construction/procurement part inside a similar intercession is still on-going (TetFund Guideline, 2015).

CHANGE AND ORGANIZATION'S PROJECT DELIVERY PROCESS

Project control in an organization
Spring (2016) stated that project controls are important to the project delivery process because they ensure that work progresses on time as well as on budget. Project controls also help to ensure that the design of project is according to the need; constructed as provided in the drawings, plans and specifications; and the required quality standards is met. A review of the change request is carried out at this stage of the process, by an approved authority using the information provided by the project manager and the person to request for consideration. The decision will either be:

a) Accepted
b) Accepted with comments and special conditions

to consider and approve each change with utmost care and diligence. The project management uses change control process to ensures that very change initiated in a project is adequately defined, expertly reviewed, then approved before implementation. Haughey (2011) affirmed that the change control process can be used to avoid unnecessary changes that might at the long run disrupt services and also ensures the efficient in the use of resources for successful project delivery. According to Cantarello, Martini and Nosella (2012), nowadays, firms are strongly challenged by global competitive pressures in a context that often becomes unstable as a result of changes that are difficult to foresee.

As discusssed in the PMBOK (2013), any party to a development at any time has the right to request for change. This do not neccessarily have to be in written form, we do find some issue of change initiated verbally, the only necessary thing is, it should be recorded in a written form and entered the change into the change Log. Change requests has to be set down in an acceptable change control and configuration control systems. Time and estimated cost impacts are essential information the change request processes may require.

There are some contrary views to the importance of, or even the existence of the concept of change control. Among the notable opinions are that of the Kelvin Aguanno (Vice President and the Project Management Director of Professional Development for Association of Canada) where he believed that “there is no such thing as change control” and the idea that change can be controlled is a mere myth (Aguanno, 2010). He argues further that, the project manager and also the project client have little control over any kind of change that can occur in the project, believing changes just happens therefore all we can do is to learn to adapt to it quickly. But most importantly he acknowledged that perhaps the most important difference to be noted in the industry between "change management" and "change control" is one of attitude. "Change control" is usually the method found on projects being managed using models of deterministic planning such as the ubiquitous "Waterfall Method”.

Usmani (2012), on the contrary, stated that performance reports are an output of the Monitor & Control Project Work process, and input to various managing and controlling processes.

Impact of project change on project constraints

Haughey (2011) while summarizing the impact of change control stated that, the project manager is saddled with the responsibility at certain stage of the process, where he would be expected to consider the overall effect the change request will have on the project, this is done through considering the following items: a) Extra resources needed b) New risks and issues c) Legal, regulatory or other unquantifiable reason for change d) Estimated cost of the change e) Quantifiable cost savings and benefits f) Impact on timescales g) Impact on business activities and other projects. The project manager is expected to recommend or otherwise, to carryout the changes(s) after this assessment.

There would certainly be a direct impact of the changes made in a construction projects on the project constraints, and these includes cost, time and scope. It is also further emphasized that project change cost performance is one of the most essential metrics in project delivery, and this is so because they are used as a

Perform Integrated Change Control according to PMBOK (2013) is a formulated process that specifically has an Input, Tool and Technique and output to review all the various submitted requests for changes or modifications to the work at hand, as stated earlier for approval or rejection. Among the many benefits is that this process makes the work of documented changes in an integrated and coordinated fashion and tends to reduce the project risk, which are fond of popping up due to any form of changes made in the overall project without any due consideration to objectives or plans. Stackpole (2013) postulated that treating all change requests, considerations for necessary approvals of changes and managing changes to deliverables by the project experts and other related aspects to project delivery are all the activity in this process. The Fig. 2 depicts the process of inputs, tools and techniques, and outputs.

Fig. 2: Inputs, Tools & Techniques, and Outputs of Perform Integrated Change Control: (PMBOK, 2013)

It is best to prevent changes as much as possible, where it is not possible to prevent it, then make those changes as soon as possible. If one cannot avoid making the change, then a need for analyzing what impact the whole changes is expected to bring is the next line of action on the project.

Integrated change control and organization process assets

The Perform Integrated Change Control process has identified benefits, like allowing for documentation of changes which is already considered in an integrated fashion, project risk reduction, which are common with changes devoid of attention to the overall project objectives or plans.

Greco et al. (2013) stated that achieving competitive advantage (CA) by organizations requires that they try to ensure they gain market shares, make more profits, and as well as boost their success in the business. They stated further that it is necessary for an organization to identify what influences the sustainability of CA, out of the available tangible assets (TA) and intangible assets (IA). The PMBOK (2013) describes organizational process assets (OPAs) are “the plans, processes, policies, procedures, and knowledge bases specific to and used by the performing organization”. These include all artifact, practice, or knowledge at the disposal of an organization which are used to execute projects. The components of organizations’ process assets include any formal and informal plans, processes, policies, procedures, and knowledge bases, usually deployed into use in a performing organization. The process assets also include the organization’s knowledge bases such as lessons learned and historical information. It is firmly affirmed that Firms’ organizational designs is a tool which can significantly facilitate the interactions a firm with external knowledge sources which would serve as a means for opportunity exploitation (Teece, 1998). In Foss, Lyngsie and Zahra (2013),

project executions and are well versed with design and construction issues. Therefore, each and every organization is able to respond to the questionnaire by participating in the study.

From the data collected, 5 institutions were identified as case study, having fulfilled the potentials of meeting the requirement for TetFund interventions, therefore, suitable for the research. Therefore, 31 (institutions and company organizations) personnel from 5 case studies implies 155 respondents. While, the TetFund organization have 15 respondents sampled.

Using the formula:

n = N/1+N(e2)

Where n= Sample size

N = Population size (155)

1 = constant

e = desired confidence level of 0.05 (@95% accuracy)

Therefore, n = 111

The research arrived at a sample size of 126 (111+15) as target respondents identified and sent an online questionnaire accompanied with a letter explaining the authenticity, details and purpose of the research. Out of the responses, 109 responses were selected representing 86.5% response rate.

Data analysis procedure

Some of the questions in the questionnaire are analyzed using simple descriptive statistics by percentages of responses in a table and chart. Analysis used also involved assessing the importance of perform integrated change control on a five (5) point Likert's scale. The data analysis therefore employed the following steps.

a. Computation of the mean using the weighted average formula

$$\text{Mean } (\bar{x}) = \frac{\Sigma fx}{\Sigma f}$$

Where:

x = points on the Likert's scale (1, 2, 3, 4 and 5)

f = frequency of respondents' choice of each point on the scale

b. Computation of the relative importance index (RII) for each item of interest, using the formula

$$RII = \frac{\Sigma fx}{\Sigma f} \cdot k^{-1} = \frac{\bar{x}}{k}$$

Where k= maximum point on the Likert's scale (in this case, k= 5)

Level of Knowledge of organization on integrated change control

Figure 3 shows the level of knowledge of organizations of the respondents in perform integrated change control process. The result of the survey shows that most the organizations are at the entry level with 60%. 32% of the respondents' organizations are at proficient level, 8% at novice, while only 9% are at an advanced level of knowledge of the integrated change control process. This implies that presently the organization's knowledge is at a very low level.

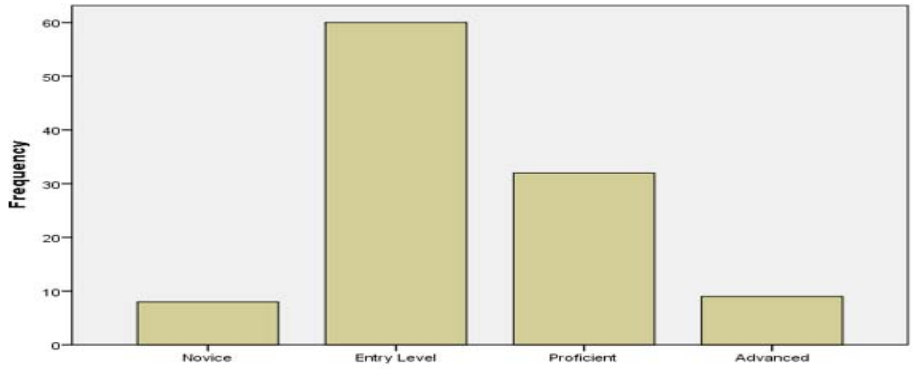


Figure 1: Level of Knowledge of organizations in Integrated Change Control Process

Table 3: Importance of Integrated Change Control Performance for Costs Saving and Quality Delivery Benefits to an Organization

S/no	Importance indices	Weighting (x)/Response Frequency (f)								
		1	2	3	4	5	Σf	$\bar{x}$	RII	Rank
1	Change control process and/or procedure to an organization	2	10	17	21	59	109	4.15	0.83	1st
2	Having a change control unit wthin an organization	2	7	28	34	38	109	3.91	0.78	2nd
3	Consistent use of a change control process in acceptance and implementation of all change(s)	5	15	36	28	25	109	3.49	0.70	3rd

Source: Researcher's Field Survey (2017)
1 = very unimportant; 2 = unimportant; 3 = fairly important; 4 = important; 5= very important

Table 3 shows the respondents' opinion on the the importance of a change control process and/or procedure to an organization, importance of having a change control unit wthin an organization, importance of frequent use of a change control process in acceptance and implementation of all change(s). The results from collected responses shows that it is "Very important" for an organization to have a change control process and/or procedure with RII value at 0.83 ranked 1st on the ranking. Also, having a change control unit is considered to be "important" (0.78), while on if it is important to use change control in the acceptance and implementation of all change(s) the result was predominantly "Important".

DISCUSSION OF RESULTS

Level of knowledge of the organizations in perform integrated change control

The study revealed that the level of knowledge of the organizations in perform integrated change control process was still, mostly, at "Entry level" only a few of

dedicated change control unit by organizations would yield several costs saving and quality delivery benefits.

Recommendation

The study, haven explored several aspects of the integrated change control performance recommends that construction professionals, most especially project managers should seek to acquire and develop their knowledge of integrated change control. The use of a dedicated change control unit by organizations would yield several costs saving and quality delivery benefits. Organizations should adopt the use of a formal change control process or procedures for any aspect of related to acceptance and implementation of change.

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maintenance is effective in preventing age related failures of the equipment. Scheduled maintenance is a stitch-in-time procedure and incorporates inspection, lubrication overhaul and equipment. If neglected can result in breakdown. In predictive maintenance, machinery conditions are periodically monitored and this enables the maintenance crews to take timely actions, such as machine adjustment, repair or overhaul. Yung and Suliman (2015) asserts that Time to response to the maintenance request is almost based on the emergency. If emergency work happened, the response of the maintenance work will be carried out immediately, while if the problems are minor, the response of the maintenance work will be taken some time due to budget constraints. In Nigeria, the culture of maintenance is very poor except in emergency situations when it might have become too late and even costly to achieve the desired results (Olanrewaju, Sharafadeen and Ojo 2015) The users do not always make use of the property and the services in good condition, often users do not obey the information contained in the maintenance manual of the building if it exists at all, (Siyanbola, Ogunmakinde and Akinola, 2013). Maintenance work is considered waste of money and time by most property owners, funds are usually directed towards new buildings rather than the upkeep of existing ones. To each resident, it is required to pay service charge with regard to the services given (that is, maintenance of the building). Unfortunately, to collect this fee is no easy task (Olanrewaju, Sharafadeen and Ojo, 2015) (Olarenwaju, 2008) revealed in a study, that there is a huge backlog of building maintenance in Malaysia even though expenditure on maintenance is on the increase. Certainly, the maintenance backlog will continue to increase, as buildings require maintenance to be functional. Buildings require effective maintenance; otherwise they become a burden to clients, users, and the general public. Building maintenance management should be extended beyond the current condition, based on the availability of funds. According to (Yahya and ibrahim 2012) the fundamental aspect in building management is to develop communication system between maintenance management and building occupants in order to support value aspect in the building. (Clowes, 2000) stated that lack of information is a significant factor that contributes to miscommunication in operation and maintenance processes. According to (Ali, Sun, Petley and Barrett 2002) a lack of knowledge sharing and poor communication between maintenance management teams and building occupants had caused main problems specifically on technical and documentation aspect. As (Lee and Wordsworth, 2000) noted, poor communication between maintenance management group and building occupants is one of the factors that affect working efficiency and is a reason for the relatively low productivity of the building maintenance.

Based on a study determining the problems faced by property managers in managing high-rise condominiums in Malaysia, it was concluded that the most frequent complaints lodged by the tenants were defects not being attended to within the time specified, poor workmanship, and services and facilities not being in good condition even when taking over the building from the developers (Noraziah, 2006). Also, (Abdul Lateef, Khamidi and Idrus 2010) opined that Maintenance management seeks to plan, control, coordinate and organize maintenance activities focusing on efficient allocation and utilization of resources in order to improve the value of a building. Consideration of funding for future maintainability is a critical factor because some of the earliest high rise buildings

with selecting the respondents based on the researcher's knowledge on the appropriateness and typicality of the sample selected (Cohen, Manion and Morrison, 2005). The focus on this Area was based on its commercial/economic status and concentration of high-rise buildings, professionals and good representation of the population. The reliability and validity of the data collected stem from the fact that the tests conducted using Statistical Package for Social Sciences (SPSS 19) showed that, cronbach alpha > 0.6 and the correlation value is > r table respectively, it is concluded that the data is reliable and valid.

DATA COLLECTION

Data collected from secondary sources include, interview section with property and facility managers, archival information on maintenance schedule details of public residential high rise buildings (Ministry of Works & Structures and Ministry of Housing in Lagos State). Other sources of secondary data are publications, textbooks, research works, conference/seminar papers, etc. Data from primary sources were those collected through questionnaires administered on owners, occupants, maintenance managers, estate managers and facility managers

ANALYSIS AND RESULTS

The data collected for the study was processed using descriptive statistics method; percentages, mean, and Relative Significant Index (RSI) was determined.

Bakhary (2005) gave an equation that was used in determining the Relative Significant Index (RSI)

$$\text{The Relative Important Index is expressed} = Ø\,w = \frac{5\,n5+4\,n4+3\,n3+2\,n2+1\,n1}{5N \qquad 5N}$$

Where, n1 = Number of respondents who answered the negative option, n2 = Number of respondents who answered for less negative option, n3 = Number of respondents who answered for neutral option, n4 = Number of respondents who answered for less positive option, n5 = Number of respondents who answered for most positive option, A is the highest weight and N = Number of Respondents. The relative importance index ranges from is 0 to 1 (Tam and Le, 2006)

The demographic features of the respondents as shown on Table 1 reveal that 24.6% of the respondents are home owners, 45.9% are occupants, 13.1% are maintenance managers, 11.5% are facility managers and 4.9% are public administrators. The study also showed that 31.1% are female while 68.9% are male. The years of occupancy/ownership shows that 72.1% are above 5 years. 19.7% of the respondents are builders, 13.1% are estate managers, 4.9% are maintenance managers, 8.2% are civil/structural engineers, 6.6% are services engineers, 13.1% are property managers/developers and other professional backgrounds are 34.4%.

From Table 3 above, it shows that emergency maintenance was ranked 1st with a Relative Significant Index of 0.88, meaning that emergency maintenance is frequently practiced. This implies that urgency or quick response is usually attached to maintenance related issues here as any deal could lead to damage to the building element or pose threat to life or security of the occupants of the building, it is followed by routine maintenance which was ranked 2nd with a Relative Significant Index of 0.82 and corrective maintenance which ranked 3rd with a Relative Significant Index of 0.74, in the level of usage of maintenance management practices

Table 3: Level of usage of the Identified Maintenance Management Practices.

S/N	Maintenance management practices	Level of Usage					Total	RSI	Rank
		1	**2**	**3**	**4**	**5**			
1	Planned Maintenance	19	24	6	5	7	61	0.46	6
2	Corrective Maintenance	4	3	11	31	12	61	0.74	3
3	Preventive Maintenance	14	23	11	6	7	61	0.50	4
4	Periodic Maintenance	18	15	14	11	3	61	0.49	5
5	Routine maintenance	3	5	5	17	31	61	0.82	2
6	Emergency Maintenance	1	4	4	14	38	61	0.88	1

From Table 3 above, it shows that emergency maintenance was ranked 1st with a Relative Significant Index of 0.88, meaning that emergency maintenance is frequently practiced. This implies that urgency or quick response is usually attached to maintenance related issues here as any deal could lead to damage to the building element or pose threat to life or security of the occupants of the building, it is followed by routine maintenance which was ranked 2nd with a Relative Significant Index of 0.82 and corrective maintenance which ranked 3rd with a Relative Significant Index of 0.74, in the level of usage of maintenance management practices

Table 4: Maintenance Work

S/N	Maintenance work	1	2	3	Total	%	RSI	Rank
1	Day to day mopping/Sweeping and cleaning of the building	28	26	68	122	57.73	0.78	1
2	Mechanical cleanup	30	22	70	122	57.38	0.778	1
3	Services cleanup, repair and replacement	46	34	42	122	34.43	0.66	3
4	Elemental (ceiling, door, window, roof, etc) replacement	42	34	46	122	37.70	0.68	2
5	Re-painting	54	24	44	122	35.07	0.64	4
6	All of the above	64	46	12	122	9.84	0.52	5

From table 4 above, it described the nature and types of maintenance works often carried out by users of the residential buildings. The result showed that 122 respondents, 57.73% carried out daily mopping/sweeping and cleaning of the building, 57.38% carried out mechanical clean up, 34.43% carried out services clean up, repair and replacement, 37.7% carried out elemental(ceiling, door, window, roof, etc) replacement, 35.07% carried out repainting and 9.87% showed that they carry out all the maintenance work indicated above.

Table 7: Challenges encountered when undertaking maintenance work in high rise residential buildings.

S/N	Challenges	1	2	3	4	5	Total	RSI	Rank
1	Lack of discernible maintenance culture	8	4	6	44	60	122	0.836	5
2	Improper management of the facilities	4	18	4	54	42	122	0.784	9
3	Absence of a form of planned maintenance programs	8	4	2	48	60	122	0.843	3
4	Attitude of users towards maintenance and misuse of the building	4	2	2	66	48	122	0.849	2
5	Difficulty in procurement of spare parts due to unavailable funds	6	60	52	88	32	122	0.656	14
6	Lack of communication between users and maintenance managers/personnel	4	6	4	70	38	122	0.816	7
7	Natural deterioration due to age and environment	6	22	18	54	22	122	0.705	12
8	Lack of skilled personnel in maintenance department	8	18	8	66	22	122	0.725	11
9	Lack of skilled manpower to maintain works in buildings designed and constructed by expatriates	10	14	8	68	22	122	0.728	10
10	No long-term arrangements made for the supply of essential parts for replacements	9	32	24	46	14	122	0.649	15
11	Use of poor quality components and materials	4	12	0	50	56	122	0.833	6
12	Complexity of design and non-involvement of maintenance experts during design stage	0	4	18	66	34	122	0.813	7
13	Level of technology, cultural background and environment not been considered	2	4	8	62	46	122	0.839	4
14	Inflation of cost of maintenance by the operatives	16	32	16	40	18	122	0.620	16
15	Frequent shortage of materials and spare parts due to absence of efficient inventory system	6	34	14	44	24	122	0.675	13
16	Lack of consideration for future Maintenance requirement and budget	24	28	20	34	16	122	0.584	17
17	Accessibility to the property	10	0	2	30	80	122	0.879	1

Table 8 suggested solutions that that can further improve the maintenance management practices of high rise residential buildings. Awareness of discernable maintenance culture to users ranked 1st with RSI value of 0.947, Consideration for future maintenance requirement and budget ranked 2nd with RSI value of 0.944, Availability of planned maintenance programs ranked 3rd with RSI value of 0.941, Frequent Use of good quality components and materials and Proper communication between users and maintenance managers/personnel ranked 4th with RSI value of 0.938, Consideration towards level of technology, cultural background and environment ranked 5th with RSI value of 0.836.

that they respond to maintenance work splendidly as one of the parties involved towards the maintainability of high rise buildings. This can be attributed to their near or ever presence within high rise buildings. The most encountered challenge facing the Maintenance managers and the workers was identified as accessibility to the property. This authenticates (Nayanthara, 2013) who stated, that accessibility plays a vital role in the maintenance of high rise buildings. Loss of lives and properties are often recorded, when accessibility to high rise buildings become difficult during emergency or hazardous situations. Other challenges include attitude of users towards maintenance and misuse of building, absence of a form of planned maintenance programs. Solutions were, thus proposed in order to mitigate the challenges encountered and to further improve the maintenance management practices of high rise residential buildings, which includes, Awareness to discernable maintenance culture, consideration for future maintenance requirements and budget, frequent use of good quality components and materials and proper communication between users and maintenance managers/personnel

CONCLUSION AND RECOMMENDATION

The overall objectives of this research was to identify and assess the maintenance management practices used in maintainability of high rise residential buildings in Lagos State and finally to identify and assess the challenges or problems encountered in the maintainability of the building. This research has given an insight to users, building management professionals, as well as public administrators on the need for maintenance on a building. The study showed that emergency maintenances practices are mostly used and also some of the users of the high-rise buildings are aware of maintenance management practices used in the maintainability of a building.

Based on the findings of this research, it is recommended that, to improve the maintenance management practices of residential high rise buildings, awareness of discernable maintenance culture to users, consideration for future maintenance requirement and adequate funds should be provided for effective maintenance practices. Also allocating balanced budgets in every maintenance task, participation of tenants and residents in housing maintenance works, including educating tenants and residents on the need for maintenance should be put in place by the maintenance stakeholders. The maintenance team should ensure that there are precautions to be taken to guaranty quality of materials when they are purchased for maintenance work and also carry out regular inspections of the existing buildings and not to wait until structure needs repairs. They should maintain and repair as urgent as timely any tasks, before further defects occurs. The is a need to develop a standard building maintenance policy to be enforced legally by the appropriate agency, in order to ensure quality, safety and good service of the building and ensure adaption to planned maintenance practice. The implication of this research is that stakeholders in the maintenance practice are now aware of solutions that will be employed to further improve the maintenance management practices of high rise residential buildings.

This study was limited to Victoria Island district of Lagos State, Nigeria in the South west geopolitical zone of the Country due to its high concentration of public

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the tendency of the city to sprawl as environmentally untenable because they create the need to commute for longer distances using self-owned motorized means of travel (Curtis, 2011). These initiatives are guided by urban development principles and concepts that have been inspired by the desire to achieve sustainable development such as New Urbanism, Smart Growth, Transit-Oriented Development and Low Carbon Development (Levy, 2009; Owen 2009).

Generally speaking, strong and negative relationships are desired between vehicle miles travelled; which is the total distance travelled by individuals for work and non-work purposes (VMT) and urban form variables such as population density, land use mix and accessibility. This is because the objective of sustainable urban forms is a reduction in trip lengths. For public mode choice and non-motorized modes of travel like walking and cycling, it is desired that there exists a strong and positive relationship with urban form variables. Results from previous studies reveal varied patterns in these relationships. Bhatia (2004) and Albayati et al. (2015) reported a p-value of -0.34 for the relationship between population density and VMT while Kuzmyak (2009) and Liu et al. (2016) reported a p-value of -0.04 suggesting a statistically weak relationship in the case of the former and a statistically strong relationship in the case of the latter. This is rather odd, as the expectation is that there would be some significant relationship in all cases but the variation should be in terms of the direction of the relationships either positive or negative.

Similarly, VMT and job density relationships have also shown these kinds of variations in previous studies. Low but positive elasticity or p-values were established with respect to job density and VMT by Boarnet et al. (2004), Zhou and Kockelmen (2008) and Greenwald (2009). Negative values were obtained for the same relationship by Chatman (2008), Ewing et al. (2009) and Currie & Gruyter (2018). For trip lengths or VMT and land use mix, the values established by previous studies range between +0.03 in Greenwald (2009) to -0.27 in Kuzmyak (2009 although there is a lot of instances where an average of -0.10 was obtained (Kuzmyak et al., 2006; Sun et al., 1998 and Pushkar et al., 2000; Albayati et al. 2015). The key thing to note with these elasticity values is that they suggest statistically weak relationships between the dependent and independent variables. However, these relationships still have a lot of useful application in sustainable urban land use and transportation planning with overall objectives being a reduction in transportation energy use and a shift to non-motorized modes of transportation such as walking and cycling (Naess, 2012; Creutziga et al., 2015).

The argument on the need to use built form and its relation with transport to reduce energy consumption is well recognized in developed countries but perhaps less so in developing countries like Nigeria. This is in spite of Nigeria being a signatory to all the global environmental and sustainable development conventions and treaties including the Bali Action Plan agreed to in December, 2007. This plan stresses the need for nations to transition towards comprehensive Low-Carbon Development Strategies (LCDS). The Nigeria National Transport Policy recognizes the need to promote energy conservation and environmental protection in transportation systems (FMWHUD, 2006) but says nothing about the relationship between the built environment and urban transportation and how

positively by neighbourhood design and land use mix to a large extent and by residential population density to a lesser extent.

Different results have been reported by individual investigations into the relationship between urban form and travel behaviour. The observed relationships range between strong in some cases and weak in others. Furthermore, some parameters found significant in some respect can be found insignificant in some others. For instance, the relationship between population density/household/job and vehicle miles travelled is usually generally unidirectional, but in Bhatia (2004) and Kuzmyak (2009) variations in elasticity values ranged from -0.34 to -0.04 for the former and latter respectively. Same can be said of the VMT and job density relationship where very low but positive elasticity values were established by Boarnet et al. (2004), Zhou and Kockelman (2008), Greenwald (2009) and Stojanovski (2018). Negative elasticity values for the relationship were established by Chatman (2008) and Ewing et al. (2009). In the case of trip lengths and diversity relationship, elasticity values established by past studies range from +0.03 in Greenwald (2009) to -0.27 in Kuzmyak (2009) even though it is frequently determined at an average of -0.10 (Kuzmyak et al., 2006; Sun et al., 1998 and Pushkar et al., 2000). Access to destination in relation to VMT has been observed to produce more consistent elasticity values averaging around -0.20 as reported in Pushkar et al. (2000), Boarnet et al. (20004) and Zegras (2007). Liu et al. (2016) established that urban form variables (density, land use mix and accessibility) have a strong and negative effect on VMT and by implication a reduction in CO2 emissions using Structural Equation Modelling in a study conducted in Beijing.

The importance of these relationships, practical or statistical, underscore their usefulness in sustainable urban planning. These relationships signified by the average weighted elasticity values can be applied in the evaluation of urban development plans and policies with respect to how they impact vehicle miles travelled, public transit ridership and use of non-motorized modes of travel. This is important because the aforementioned travel behaviour variables have impacts on energy used in transportation, and determine to some extent the level of urban greenhouse gas emissions and pollution. The results of the urban form and travel behaviour relationship from other parts of the world discussed in this section will be used as a good reference point for the evaluation of the results obtained for Kaduna. Comparisons will also be made between Kaduna and other cities and inferences will be drawn.

The methods employed in studies on the urban form and travel behaviour relationship are presented in Table 1 (pg. 6) (Joo, 2008; Kono, 2010; Tracy et al., 2011; Munshi, 2013; Zhang et al., 2018). It is clear from the information in Table 1 that multi-variate and logistic regression analysis are the most commonly used methods in these types of studies. Travel characteristics are cast as the outcome variable and urban form measures are cast as the predictor or independent variables. Multi-variate linear regression is mostly applied in investigating the VMT and urban form relationship while logistic regression is used in investigating the mode choice – urban form relationship.

Travel behaviour is represented by total distances travelled by individuals for work (VMT) and the modes used for such travels. Therefore, travel behaviour is a

probit-demand model (Zito et al., 2011), artificial neural networks (Dia and Panwai, 2010), structural equation modelling (Lee, 2009; Liu et al., 2016) and the extended multiple discrete-continous choice model (Wang and Li, 2011). However, the studies that have employed these approaches are most often concerned with the influence of multi-faceted categories of predictor variables like social, economic, demographic as well as physical factors on travel behaviour. Therefore the research concern is usually centred on investigating the complex interactions simultaneously between endogenous variables as well as between endogenous and exogenous variables. This study being an exploratory one employed the most basic of analysis methods, which is the multiple regression analysis in order to test the relationship between urban form and travel behavior in Kaduna. This is because of the simplified research question and the non-inclusion of complex and diverse variables that would have required more sophisticated methods of analysis.

THE STUDY AREA

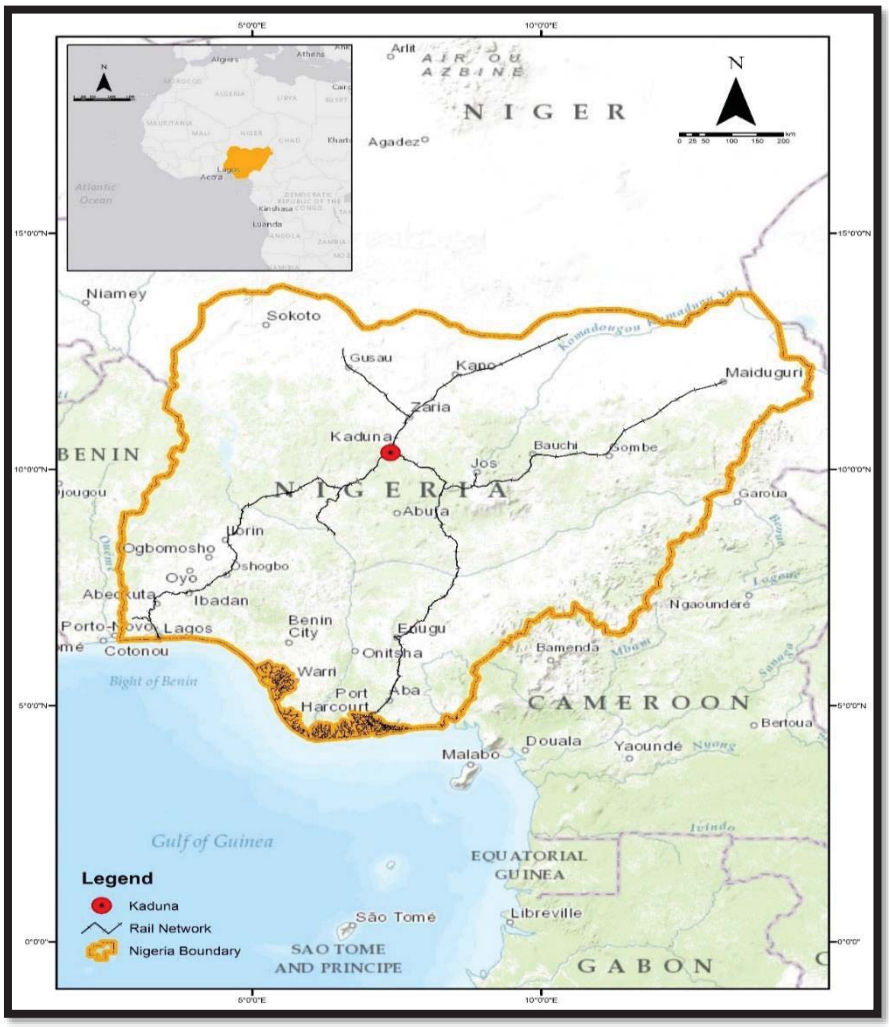

Figure 1: Kaduna in the Nigerian national context

The study area is Kaduna in northwest Nigeria (figure 1). In the hierarchy of Nigerian cities, Kaduna is considered a relatively young city. It was established by the British colonial administration headed by Lord Frederick Lugard in 1912 (Haruna, 2012). By 1919, 7 years after its establishment as the capital of the

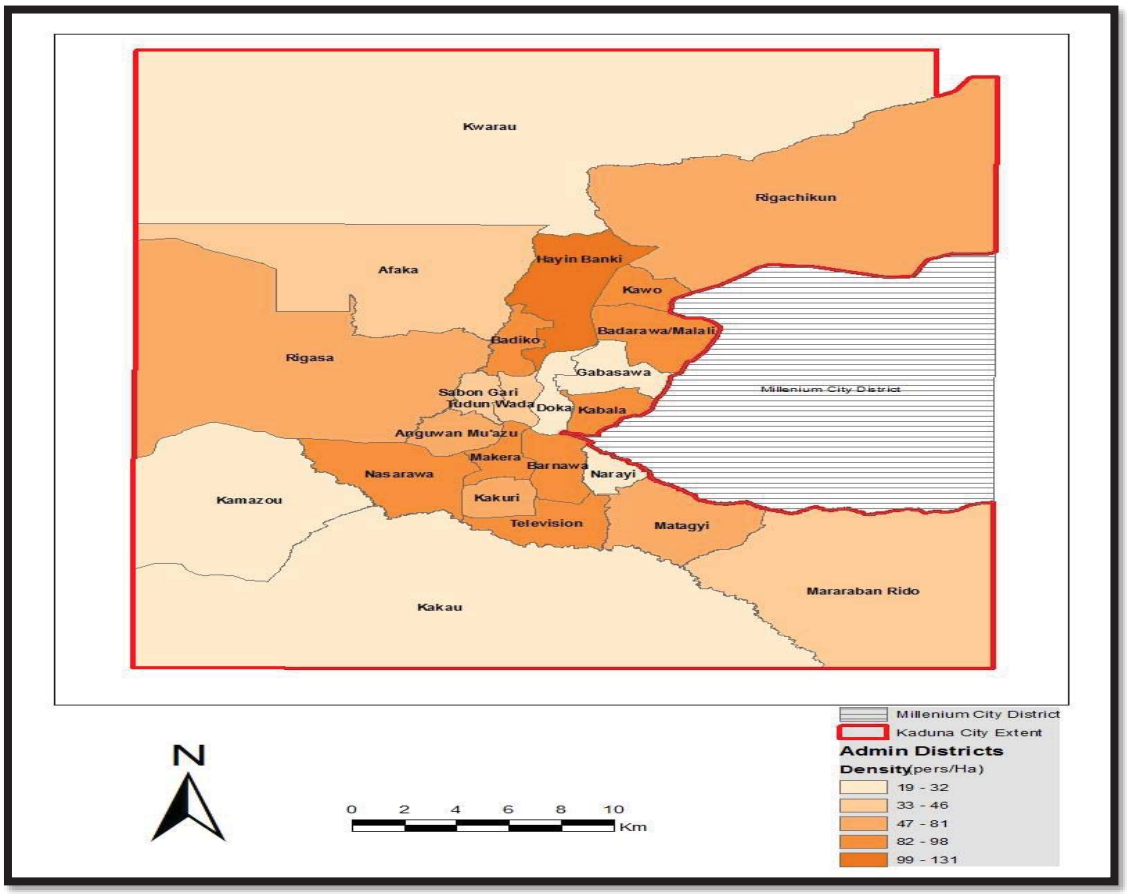

Figure 3: Mean residential density at district level in Kaduna

However, because population data is not readily available at disaggregated levels in Kaduna, there was the need to use proxy data to arrive at reasonable and acceptable estimates. A household survey conducted in 2010 by Max Lock Consultancy Nigeria created geocoded vector point data of the location of households which can be used as an excellent proxy for determining population distribution and residential population density. Population density is then computed by superimposing a Fishnet grid of 100m x 100m (1Ha) on the point dataset of all households in Kaduna and the point dataset of the surveyed households. For any grid cell where there is a surveyed household, the population density is calculated by counting the number of households in that grid cell and multiplying that sum by the average household size in the city. The average household size for Kaduna is estimated at 6 persons per household (The Consortium, 2008). In doing that, population density values were then derived for all grid cells (figure 3) where at least one household had been interviewed in the travel behavior survey and there were 614 of them in total. The use of a 1 sq. hectare grid cell for computing population density and land use diversity was informed by the fact that a city's net population density is conventionally expressed as a function of 1Ha of urban built space.

Land Use Diversity

Land use diversity is calculated based on the dissimilarity index following the work of Cervero and Kockelman (1997). It is expressed as a function of the difference between the land use type of a focal cell and that of its eight neighbours in a Moore neighbourhood arrangement. Where a focal cell's land use is residential and that

the results of the interim and final multivariate regression analysis for the relationship between the dependent variable (VMT for work trips) and the independent variables (urban form). Only density had a p-value suggesting a statistically significant relationship with the dependent variable, VMT. The non-significant predictor was excluded from the final regression analysis and the result shows that the p-value obtained for density in the second step of analysis implies a statistically significant relationship with the dependent variable. The Beta coefficient for density has a negative sign suggesting that it has a significant negative relationship with VMT. This implies that a unit increase in density for the area under study will result in a corresponding decrease in VMT. This goes in line with general expectations because the more compact and densely built a city is the higher the density of activities within it and also the closer together the different activity locations within it would be (Ewing and Cervero, 2010).

Table 4: The interim VMT model

Dependent Variable	Independent Variables	Beta Coefficients (unstandardized)	Beta Coefficients (standardized)	Sig.
	Density	-397.80	-.172	.000
VMT	Land use mix	-3.218	-.027	.480

Table 5: The final VMT model

Dependent Variable	Independent Variables	Beta Coefficients (unstandardized)	Beta Coefficients (standardized)	Sig.
VMT	Density	-450.253	-.166	.000

DISCUSSION AND CONCLUSION

The regression models developed for the urban form and travel behaviour relationship provide the elasticity values that show how urban form affects travel behavior. The results obtained for Kaduna which show that population density has a strong and negative relationship with VMT bridge an essential knowledge gap in the Nigerian context and is in line with expectations as established in the literature by previous studies in other parts of the world (Chatman, 2008; Ewing et al., 2009; Kuzmyak, 2009). Some other studies have established a positive and statistically weak relationship between VMT and population density (Boarnet et al., 2004; Zhou and Kockelmen, 2008 & Greenwald, 2009). This shows that there can be variations in the strength and direction of the relationship between population density and VMT depending on where the test is conducted.

Similarly, in the case of land use diversity and VMT, the results of the regression analysis show a statistically weak and positive relationship (0.48) suggesting that land use diversity does not have any significant effect on trip lengths or VMT in Kaduna. This result is in line with those of similar studies carried out in some other cities that resulted in elasrticity values within a range between 0.03 in Greenwald (2009) to -0.27 in Kuzmyak (2009) although there is a lot of instances where an average of -0.10 was obtained (Kuzmyak et al., 2006; Sun et al., 1998 and Pushkar et al., 2000). Notwithstanding these variations and the lack of strong connections in the urban form and travel behavior relationship in some instances, Newman,

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INTRODUCTION

Globally, energy is very vital in driving the growth and development of any economy as it is an important input to a nation's growth and development. Energy equally plays a major role in increasing the competitiveness of any nation among the committee of nations (Alege, 2014). In Nigeria, the provision of energy remains epileptic despite several reforms and the government's huge investment in the energy sector (Somefun, 2016). Buildings account for between 20 to 40 per cent of global energy demand (Ürge-Vorsatz et al., 2012). Olaoye, Ajilore, Akinluwade, Omole, and Adetunji (2016) explain that energy inadequacy crises have been a concern for both the Nigerian government and the people for the past four decades. Despite the gross inadequacies in the provision of energy from the national grid, a significant proportion of available energy especially in public buildings is poorly utilized with a significant amount of waste.

Large institutions, such as universities, consume a large amount of energy on a daily basis (Oyedepo, Adekeye, Balogun, & Akhibi, 2015). Improving the energy practices at post-secondary institutions can directly decrease the environmental impact associated with the use of energy and equally act as an example for a change of people's attitude in the use of energy across the country. Therefore, energy availability, optimization, consumption and its attending costs in public buildings often constitute a major challenge to administrators and top management of public buildings (Oyedepo, Adekeye, Balogun, & Akhibi, 2015). Much can, therefore, be achieved towards improving energy availability if energy is conserved in public buildings with a significant level of occupancy such as the university students' hostel.

Adetunji (2005) posits that energy conservation aims at the reduction in the consumption of non-renewable resources. It is the practice of reducing the amount of energy used for different purposes rather than the use of energy efficient appliances (Iguchi, 2005). Typically, university campus consumes a large amount of energy in providing essential services such as lighting, water supply, ventilation, and air conditioning (Oyedepo et al., 2015).

The task of meeting the demands for energy comes at a significant cost to universities and contributes to the reduction of natural resources. It is therefore important that energy conservation practices be identified and promoted in universities students' hostels. Energy conservation practices result in low energy consumption in buildings, such practices should include estimations about energy cost savings and the payback time (Stewart et al., 2016). The problem of this study, therefore, is to investigate the energy consumption profile of universities students' hostel and energy conservation practices that could improve the use of energy within the study area. Furthermore, studies investigating energy consumption and practices by which energy can be conserved in hostel buildings are rare as previous studies relating to energy and buildings such as Olaoye et al. (2016), Stewart (2016), Forsström et al. (2011) and Nielsen (2002) focused on the use of renewable sources of energy and energy optimization practices in commercial buildings.

building and allied household characteristics, such as family size and income are significantly associated with residential buildings' energy consumption.

Energy Consumption and its Environmental Impact

The huge quantity of energy consumption has contributed significantly to climate change and constitute a severe threat to further environmental pollution and adverse impact on human health (Alege, 2014). Chun-sheng, Shu-wen and Xin (2012) explain that a lot of noxious waste from household energy consumption is harmful to human health, particularly for women and children in rural areas. Excess energy consumption also affects the economic growth of a nation due to the impact of energy on social, economic and welfare development in the country (Onakoya & Odedairo, 2015).

Akpan and Akpan (2012) also point out that energy consumption contributes to pollution, environmental deterioration, and global greenhouse emissions. They further opine that the increase in energy consumption is driven by population growth and economic development that tends to increase energy use per capita. Lowering energy consumption in public buildings would, therefore, contribute significantly to freeing public resources for other purposes (Stewart et al., 2016).

According to Panwar, Kaushik and Kothari (2011), the primary environmental effect of energy overuse is an increase in the carbon footprint. A common poor energy utilisation practice in buildings include keeping devices plugged in and running when not in use, which results in an increase in electrical use and, consequently, a bump in the number of greenhouse gases that goes into the atmosphere. A natural consequence of excess energy use is increased cost which comes in the form of fuel and energy bills. This also increases the risk of a low expected lifespan of home appliances and other electronics in buildings (Abbakyari & Taki, 2016).

Energy Optimization in Buildings

Optimization is often used interchangeably with improvement (De Boeck, Verbeke, Audenaert, & De Mesmaeker, 2015). Optimization of Energy Systems comprehensively describes the thermodynamic modelling, analysis and optimization of numerous types of energy systems in various applications. It provides a new understanding of the system and the process of defining proper objective functions for the determination of the most suitable design parameters for achieving enhanced efficiency, cost-effectiveness and sustainability (Carabin, Wehrle, & Vidoni, 2017). Examples of objective functions for energy systems include maximization of efficiency, minimization of fuel consumption, maximization of the net power density, minimization of emitted pollutants, maximization of the internal rate of return (IRR), minimization of the payback period (PBP), among others.

Various energy optimization methods have been discussed in the literature with specific emphasis on energy efficiency and energy performance of buildings. De Boeck, Audenaert, and De Mesmaeker (2013) argue that the energy performance of buildings can be improved by modifying different building characteristics with a view to minimizing energy consumption and accompanying costs. Guerra Santin, Itard and Visscher (2009) conducted a survey on the impact of occupant behaviour on space heating energy consumption in Dutch residential stock by controlling the

RESEARCH METHODOLOGY

The study focuses on students' hostels at the University of Lagos. The University is located in the South-Western geopolitical zone of Nigeria. A cross-sectional survey research design was adopted for this study. The study was carried out on the University of Lagos students' hostels at the main campus, Akoka, Lagos State. The choice of the University of Lagos as the study area was influenced by its population of over 44,602 and 12,581 undergraduate and postgraduate students respectively. The University has a total of eighteen halls of residences comprising; thirteen halls of residence for undergraduate students and three halls of residence for postgraduate students respectively.

The population of the study comprises of the entire 8,000-bed space owners across the eighteen hostels. Using the simplified formula for proportions (Israel, 2013) at a 90% confidence level, a sample size of 90-bed spaces was determined for the study. A structured questionnaire was developed as an instrument for collecting primary data for the study. The questionnaire consists of open and close-ended questions which were categorised into three sections. Section A consists of questions relating to the demographic data of the respondents. Section B consists of questions on the type and number of each of the electrical appliances been used by respondents in the hostel, the power rating of each of the appliances as stipulated on the specification data sticker on the appliance and the average daily duration of use of each appliance. Section C consists of questions on potential measures for conserving energy in the hostels.

A total of 150 questionnaires were self-administered randomly to the respondents in their respective hostel rooms. All administered questionnaires were retrieved but twenty of the retrieved questionnaires were poorly completed and were discarded for use for the study. A total of 130 questionnaires were adequately completed and used for the study representing 87% response rate. Furthermore, the dimensions of the floor and window area of each of the respondents' room were measured to represent the characteristics of each of the hostel rooms.

Using the Statistical Package for Social Sciences (Version 23) and Microsoft Excel, the data collected for the study were analysed. Tables, bar-chat, mean and sum were used as tools of analysis for the descriptive statistics while Person correlation and Analysis of Variance were used as the tools of analysis for the inferential statistics respectively.

RESULTS OF ANALYSIS

The following focuses on the analysis of various responses from the administered questionnaires and deductions made from the analysis:

Table 1 shows the characteristics of respondents for this study. The analysis shows that the population of male respondents was marginally higher than that of female respondents with 52% and 48% respectively. This implies that both genders were adequately represented in the study and thus eliminating the tendencies for gender bias, Also, the majority of the respondents are above 19 years and are old enough to provide adequate responses to the questions of the study.

Figure 1 shows that the use of electric hot plate cooker in the student's hostel consumes the highest quantity of energy, consuming about 918 kWh of energy daily. This was followed by the use of pressing iron, Fans, Light bulbs and Laptops with daily kWh consumption of 584.63, 405.78, 279.55 and 238.68 respectively.

The study also examined the type of electrical appliance(s), the number of appliances, the power rating and the average daily duration of use of each of the appliances in the course of the study. The respondents were equally asked questions on the pattern of use of energy in the hostel. The result is presented in Table 3.

Table 3: Breakdown of Appliances and their Energy Demand

Appliances	Number	AV. Power Rating (W)	AV. Power Rating (kW)	AV. Daily Use (Hr.)	AV. Daily Consumption (kWh)
Fans	141	131	0.13	22	405.78
Electric kettle	57	1785	1.78	2	175.49
Boiling ring	3	1160	1.16	2	6.96
Pressing iron	136	2000	2.00	2	584.63
Laptop	306	65	0.07	12	238.68
Hairdryer	11	1245	1.25	1	17.44
Hot plate	87	1449	1.45	7	917.99
Television	34	115	0.12	5	19.55
Light bulbs	192	70	0.07	21	279.55
Rechargeable lamp	46	161	0.16	3	20.65
Toaster	14	2000	2.00	2	43.08
Blender	7	1971	1.97	2	21.69
Radio/Music player	8	220	0.22	2	3.52
Cumulative daily energy consumption (in kWh)					2,734.99

Table 3 reveals that appliances with high power ratings include pressing iron, toaster, blender and electric cooking hot plate. Although the average power rating of the electric hotplate was 1449 watts it accounts for the highest energy demand (917.99kWh). The result shows that the cumulative daily energy consumption for the 130-bed spaces that were surveyed was 2,734.99 kWh. This implies that the average daily energy consumption per bed space in the hostel is 21.04 kWh. The result further implies that each of the hostel bed spaces utilises about =N=595.00 worth of energy on a daily basis at the residential tariff rate of =N=28.28K.

The respondents were asked to assess 16 hypothesised practices that could improve energy optimization in a student's hostel. The respondents were asked to evaluate 16 active energy optimization practices. The result of the analysis is presented in Table 4.

Table 4 shows some of the practices that could improve the energy performance of students' hostels. The highly ranked practices include; reducing heat generated in hostel rooms (M=3.68), routine energy audit exercise (M=3.52), use of large window sizes to aid ventilation (M=3.40) and better energy management practices in the hostels (M=3.38). Furthermore, in the course of the interview session, the hostel managers are of the opinion that there is the need for the University management to establish wattage threshold for the various categories of

Test of Hypothesis Two:

Ho: There is no statistical difference in the perception of respondents on practices for conserving energy across the various student hostels.

The second hypothesis was analysed using ANOVA. The result of the analysis is shown in Table 6.

Table 6: ANOVA on practices for energy conservation across the various student hostels

Energy conservation practices	DFb	DFw	DFt	F	*p.*	Remark
Awareness of wattage for electronic appliances brought in by students in the hostel.	10	119	129	2.648	.006	S
Turning off appliances, switches and sockets after use	10	119	129	1.728	.082	NS
Periodic audit of students' appliances	10	119	129	3.334	.001	S
Enlightenment by school authorities on energy saving practices	10	119	129	1.221	.285	NS
Routine maintenance and servicing of fixtures and fittings in the hostel	10	119	129	5.383	.000	S
Reduction of miscellaneous loads on electrical systems	10	119	129	1.011	.438	NS
Adequate supervision on the overall running of systems in the hostel by management	10	119	129	4.728	.000	S
Frequent replacement of damaged or faulty electrical appliances by management	10	116	126	7.164	.000	S
Routine energy audit exercise	10	117	127	2.409	.012	S
Use of appliances with lower wattage	10	119	129	2.525	.009	S
Use of large window sizes to aid ventilation	10	119	129	8.459	.000	S
Upgrade of light bulbs to efficient light bulbs	10	119	129	9.093	.000	S
Better management practices	10	119	129	7.213	.000	S
Reducing cooling demand	10	119	129	4.687	.000	S
Use of highly efficient appliances in hostels	10	119	129	8.217	.000	S
Reducing heat generated in hostel rooms	10	119	129	1.602	.114	NS

Note: p is significant at pÓ 0.05. DFb= Degree of Freedom between groups, DFw= Degree of Freedom within groups, S= Significant difference exist, NS= There is no significant difference.

From the results in Table 6, there are significant differences in the perception of respondents, based on the hall of residence, on 12 out of the 16 hypothesised energy conservation practices.

Energy conservation practices for which there are significant differences and for which the null hypothesis is rejected include; awareness on wattage for electronic appliances, periodic audit of students' appliances, routine maintenance and servicing of fixtures and fittings in the hostel, adequate supervision on the overall running of systems in the hostel by management, frequent replacement of damaged or faulty electrical appliances by management, routine energy audit exercise, use of appliances with lower wattage, use of large window sizes to aid ventilation, upgrade of light bulbs to efficient light bulbs, better management practices, reducing cooling demand and use of highly efficient appliances in hostels.

Whereas, energy conservation practices for which there are no significant differences and for which the null hypothesis is accepted include; turning off appliances, switches and sockets after use, enlightenment by school authorities on

with fan, ironing of clothes, hair drying, blending, water heating, refrigeration among others.

The study recommends practices for improving the energy performance of the students' hostel. Topmost recommended practices include; reducing heat generated in hostel rooms, routine energy audit exercise, the use of large window sizes to aid ventilation and the use of daylight to complement the artificial lighting systems in students' hostel. The study further recommends that the University management should standardize appliances to be used in the students' hostels. The standardization should define the power rating (in wattage) for appliances to be brought in for use by students in the hostels. This would be a major active energy optimization drive at improving the energy performance of hostels.

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while the findings was presented in chart and tabular forms. Among some other key findings, the study reveals that more than half of the industrialists' employees (labour) were from Dutse Capital (the growth centre). This reduces the economic impacts of the growth centre on some other setlements within the region in term of the spendings that could emanate from the employees of the industrialists. It was also discovered that the unstable government administrative policy has brought about an irregular rate of influx of the masses to the growth centre over time. The regional movement discontinuity has implication for regional growth. Some vibrant settlements such as Kano and Mai'adua play the role intervening opportunity for the industrialists in sourcing for raw materials. This has notably reduced the effectivenes of economic vibrancy within the region.

Keywords: growth centre, industrial linkage, population movement, region, trickle-down effect

through the Brundtland Commission released their report titled "our common future." In that report, sustainability was described as development that meets the present needs while also contributing to future needs (Brundtland, 1987). The need to live both for the present and future generations constitutes the core of a sustainable environment. The consciousness of sustainable built environment promotes design that accommodates and enhances the occupant's comfort and health, better employee productivity and improves the quality of life for the community (Bolis et al., 2014). Sustainable construction aims to minimize harm to the environment and also ensuring that new buildings do not have negative effects in social terms (crime, noise pollution, and health) (Leibrock and Harris, 2011). A good understanding of the site and its environmental conditions influences the design and leads to immediate environmental benefits such as energy savings through the consideration of simple factors such as orientation (Robichaud and Anantatmula, 2010).

Building and their infrastructure have a significant impact on the use of non-renewable materials and resources and the local environment (Augenbroe et al., 1998; Horvath, 2004). The construction industry while contributing to overall socio-economic development in the country is a major exploiter of non-renewable natural resources and a polluter of the environment. It contributes to the environmental crisis through resource depletion, energy consumption, air pollution and generation of waste in the acquisition of raw materials, the construction site processes, as well as the utilization of the resultant facilities (Windapo, 2014). A building can, therefore, be constructed in a way that is sustainable in environmental and economic terms (Windapo and Rotimi, 2012). Buildings could also be sustainable in social terms by adding value to the quality of life for the individual and the community (Windapo and Goulding, 2013). A key element of sustainable construction is a more strategic approach to material waste (Sodagar and Fieldson, 2008). To facilitate cultural change, it is necessary to integrate the various interests of the construction, demolition, haulage, and waste management sector. This requires a strategic alliance where the costs and rewards are shared and where continual improvement is ensured.

Currently, the construction process is full of wasteful activity with a focus on profitability without reflection of its long-term impacts (Kibert, 2013). For example, the land that is constructed on, the fuel to construct and sustain the building, waste removal, and water are all provided by nature (Abolore, 2012). Nonetheless, the construction process undesirably influences nature in numerous ways: causing erosion, desertification, generating waste, destroying the health and safety of the inhabitants, creating pollutants, and altering the balance of natural systems (Destatte, 2010). The solution to this challenge is the incorporation of the principles of sustainable development into the construction process. According to Abolore (2012), incorporating the principles of sustainable development into construction process will transform the architecture, engineering, construction industry and the number of green projects upsurges in industrialized countries as a result of market changes.

In spite of the benefits of sustainable construction practices, evidence suggests that the practice is not receiving adequate attention in Nigeria. The majority of building development is initiated, designed, permitted, built, operated and

Sustainable construction processes comprise stages from the selection of the raw materials to manufacture of construction materials, components thereof and completed building materials; and to the design of streets, highways, drainage systems, final garbage dumps for liquid and waste and pavements. Also included is preparedness for the development and agglomeration of people and vehicles to avoid or mitigate environmental contamination. A key point for sustainable construction is the consideration to minimize energy wastage, taking rational advantage of the natural conditions without altering them and allowing other living forms to live and be preserved (Flint, 2013). Ameen, Mourshed and Li, (2015) remark that sustainable construction processes introduced within the design of the elements of urbanization (buildings, streets, transport services, public spaces), criteria for recycling, the use of energy saving technologies and interaction with nature in urbanization and socialization processes, provides the necessary spacers and landscapes for human harmony and balance.

Barriers to Sustainable Construction Practices in Nigeria

Over the years, indigenous contractors in Nigeria have recorded a low level of input and have often been sidelined in large scale construction operations. Due to several factors such as mismanagement of funds and working capital which makes them prone to insolvency, with poor project execution and abandonment the possible outcome (Chukwudi and Tobechukwu, 2014). Dependent on foreign building and construction firms compared to qualified local contractors is on the high side. Ibrahim (2011) posits that shortages in home-grown construction capacity in Nigeria have caused an unpleasant dependence on imported inputs (such as construction materials, machinery, and the skilled manpower) that is requiring to carry out much-needed infrastructure for economic growth and to improve living conditions. Thus, foreign contractors carry out significant proportion (90%) of construction works in monetary terms across the three tiers of government in which their numerical strength is only about 7% of the total number of contractors in Nigeria (Ibrahim, 2011). Subsequently, Oribuyaku (2011) asserts that if the predisposition continues, the Nigerian construction industry may continually be foreign dominated.

Lack of National Building code is also another factor hindering against the development of construction sustainability in Nigeria (Dahiru et al., 2012). Poverty and low urban investment also have been identified as a factor militating against the development of construction sustainability. This includes perception of higher investment costs in the urban area, long pay-back period, client fears about viability, poor knowledge of life cycle cost and difficult access to financial resources (Alsand et al., 2011). The apparent high cost of carrying out sustainable construction is a challenge to its operation. Higher costs of applying sustainable construction may be seeming as more exclusive than conventional construction because of increase in consultancy fee (Alsand et al., 2011). Also, the long-term gains of sustainability are problematic to express in terms of financial gains (Dzokoto and Dadzie, 2013). Other major barriers to the development of construction sustainability are the poor awareness level. Numerous stakeholders in construction companies lack adequate information on sustainable construction (Williams and Dair, 2007). Abolore (2012) and Al-Sanad (2015) posit that the level of construction sustainability awareness among developing countries such as Nigeria and Kuwait are low. Previous research by Abolore (2012) confirmed that

consumption that are amidst the greater trajectory of urban development and management (UNEP, 2015). Hence, construction organization that wishes to align their strategies and operations with the principles of construction sustainability needs to understand and manage how their economic impacts link to environmental outcomes (Abolore, 2012). This necessity will be marked for those construction organisations that have the most vital economic influences.

Previous research by Darko et al. (2017) highlight cooperation and partnership among the project participants as a driver that influence and encourage the adoption of certain sustainable construction practices and can include the possible benefits or decisions or actions that persuade professionals in the implementation of green building. Partnerships support the means of implementation and revive the global partnership for sustainable development (Davis, 1999). Action by individual companies is essential but not adequate to drive transformational and complete change toward sustainable development. Cooperation, partnership, and participation will be essential (Fiszbein, and Lowden, 1999).

The current faced with the effects of global warming, ozone depletion, destruction of natural habitats and loss of biodiversity on the world (Oke et al, 2019). The construction industry must consider enhancing or at least protecting biodiversity as it considers all things and their habitats (OGC, 2005) in other to achieve sustainable construction development. More also, this can be achieved through the adoption of a multi-disciplinary approach covering several features such as energy saving, improved use of materials, reuse and recycling, innovation design, and emission control (Aigbavboa et al., 2017; Oke et al., 2019). There is a need for obligation in other to consider biodiversity and conservation of natural resources in developments in terms of good design and landscaping (OGC, 2005).

Building sustainability assessments are the most broadly adopted approach for implementing a construction sustainable development and assessing building performance against sustainability criteria. Building sustainability assessment remains the vital instruments in acknowledging and institutionalizing the importance of assessing building(s) across a broad range of considerations beyond establishing the single performance criteria such as energy (Cole, 2001). These appraisals help to provide awareness and understanding amid the building professionals as to the significance of sustainable buildings (Cole, 1998; Ding, 2008). Larsson and Cole (2001) assert that the research community and government agencies see assessment and labeling systems as the most efficient system of driving market transformation. With the misperception that surrounds the definitions and boundaries of sustainable construction, building assessment tools propose a standard definition in terms of performance requirements and assist construction companies to interpret the confusing requirements of sustainable buildings into action (Yu and Jeong Tai Kim, 2011).

RESEARCH METHOD

Normal paragraph text This study surveyed on-going building construction projects in Abuja, the Federal Capital Territory of Nigeria. The decision to use on-going building construction projects was informed by the need to identify unsustainable construction practices and relates the responses of the respondents

findings suggest that the respondents agree that unsustainable construction practices on construction sites are relatively high.

Table 2: Unsustainable construction practices on construction sites

Unsustainable construction practices on construction sites	Mean
Misuse of natural resources	3.4
Land misuse (erosion, desertification)	3.3
Air pollution	3.3
Energy wastage	3.2
Noise pollution	3.2
Non-management of health and safety of workers	3.1
Material waste	3.1

Barriers to sustainable construction practices on construction sites

Respondents were asked to indicate the barriers to sustainable construction practices on construction sites. The result is summarized in Table 3. The results show that all the barriers are significant with a minimum mean score of 3.0.

Table 3: Barriers to sustainable construction practices on construction sites

Barriers to sustainable construction practices on construction sites	Mean
Need for work and task simplicity	3.4
Lack of professional to hand the task	3.2
Lack of efficiency	3.2
Unavailability of national building code	3.1
Poverty and low urban investment	3.1
Lack of awareness	3.0
Lack of expertise for sustainable construction	3.0

Drivers of sustainable construction practices on construction sites

As explained in Table 4, respondents agree that Education, training, and awareness (mean score=3.4) is a key driver of sustainable construction practices on construction sites. This is closely followed by environmental and economic integration (mean score=3.3), Cooperation, partnership and participation (mean score= 3.2), Protection of biodiversity and conservation of natural resources (mean score=3.1) and Precaution and evaluation (mean score3.0).

Table 4: Drivers of sustainable construction practices on construction sites

Drivers of sustainable construction practices on construction sites	Mean
Education, training, and awareness	3.4
Environmental and economic integration	3.3
Cooperation, partnership, and participation	3.2
Guidelines on the protection of biodiversity and conservation of natural resources	3.1
Sustainability assessment	3.0

industry; while cooperation among the project participants provides the required supports and innovation for sustainable construction practices. Studies by Yu et al. (2011) and Darko et al. (2017) provides support for this argument.

CONCLUSIONS AND RECOMMENDATIONS

The aim of this study is to identify the unsustainable construction practices on construction sites as well as established the barriers and suitable drivers for sustainable construction practices on construction sites in Nigeria. The study concludes that the misuse of natural resources is predominant on construction sites in Nigeria and that human resources are inefficiently utilized. The inefficient use of both natural and human resources is a major unsustainable construction practice in Nigeria. The study also concludes that contractors are reluctant to be innovative with construction systems on construction sites. The use of innovative construction systems would have ushered in sustainable construction practices. However, this was not the case on construction sites in Nigeria.

Sustainable construction is not being practiced on construction sites as a result of the use of conventional construction system, poverty, lack of expertise for sustainable construction, and unavailability of National Building Code. Finally, the study concludes that education and training, sustainability assessment system and National Building Code are suitable for driving sustainable construction practices in Nigeria.

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Nigerian construction has been associated with poor quality of finished products (Okunola & John, 2017). Researches have been carried out in the subject area in Nigeria, but not specifically focused on the Construction Industry, (Chukwuka 2016; Umar, 2010; Mohammad, 2010) concluded that TQM has not yet attained a satisfactory level in Nigeria, studies by Salami et al (2013), Oguntade, (2015) addressed the challenges of TQM in Nigerian organisations Nigeria and concluded that there is a need to create awareness of the concept. Ringim (2015) evaluated the TQM concept at a national level and recommends the need to assess the level of adoption of TQM practices. Quality practitioners and researchers have put considerable efforts to identify TQM factors that influence the quality of products and services provided by the firms. Recently, concepts in the TQM studies are based on subjective indications and recommendations of the quality gurus. Thus, there is a little consensus on the factors that are critical to the success of the concept. Attempts have been made to scientifically synthesize bases for measuring quality in form of quality awards such as the Deming Prize, the Malcom Baldrige National Quality Award (MBNQA) and the European Foundation for Quality (EFQ) as the most popular ones (Flynn & Saladin, 2016; Aliyu et al, 2018). This study collected the TQM constructs from the MBNQA, these practices have been adopted in previous studies (Zu et al, 2010; Valmohammadi & Roshamir, 2015; Aliyu et al, 2018; Jaca & Psomas, 2015) as a basis for the study. The TQM practices identified are:

TQM Practices

Top management support
Customer focus
Workforce management
Strategic planning
Process management
Measurement analysis

Top management support

Literature places emphasis on the vital role of top management in TQM implementation as a prerequisite for effective and successful implementation (Kantardhieva, 2015; Merih, 2016). This evidence is provided in previous research projects stressing that the role of leadership in TQM successful implementation. Top management takes the center stage and must show strong evidence of commitment for the initiative to be successful (Isaac, & Thomas, 2018; Valmohammadi & Roshamir, 2015). Leadership must emphasize that quality initiatives are not just programmes of the year but a lifelong commitment by the firms to ensuring quality is attained in the products and processes of the firms (Talib, Rahaman & Quresh, 2012). Top management supervises, participates in the planning processes, ensures that policies are adhered to and properly implemented and provides support and motivation for the entire workforce. Leadership is expected to provide a conducive environment for success to be achieved in the proposed quality initiative. According to Das, Kumar & Kumar (2011) and Hokoma, Khan, & Hasan (2010), top management is the basis of TQM in the first instance and the role of leadership cannot be overemphasized as the vision for quality is established by top management. Objectives for performance is also developed by top management.

fail in their quest for TQM implementation and of which the commonly cited is lack of effective strategic planning. When strategic plans are not clearly defined, it is difficult to implement quality plans. According to Gimenez-Espin et al, (2013), it is also important for strategic plans to be customer driven that is, customers must be at the center of strategic plans of any organisation.

Process management

In any organisation, processes especially those that involve quality initiatives should include all functions and departments as the central focus of production (Albayak &Albyak, 2014). A combination of process understanding and process improvement is the lifeline of any organisation seeking to implement TQM. Process is what transform the input (i.e., actions, methods and operations) into output and should be error proof (Das et al, 2011). For organisations that are quality focused, the customer should be at the center of the process; that is, the output must satisfy or exceed the needs and expectations of their customers. At every stage of the process whether it is documented or not, several processes take place. Processes interact with each other throughout an organisation because the output from a process can be the basis of input to another process (Talib et al, 2011).

Measurement analysis

Measurement analysis is a detailed assessment of a measurement process that include research that is designed to identify variations that occur in the production process (Yasin et al, 2007). similar to the production process that varies, the process of data collection and analysis also varies and can generate wrong results. Measurement analysis checks the method used to conduct the test, the instrument used to conduct the test and the process of collecting the data to ensure the integrity of the data for analysis (Jaca et al, 2015). A careful assessment of the implication of errors is dome prior to decision making about the product or process. measurement analysis is vital for quality management and six sigma methodology. The personnel, the software and procedure are all important in measurement analysis (Tapalovic, 2005).

The six practices identified (Top Management support, customer focus, workforce management, strategic planning, process management and measurement analysis) formed the bases of the questionnaire, Top Management support, customer focus, workforce management and measurement analysis had six questions each, while strategic planning and process management had seven questions each.

PROBLEM STATEMENT AND RESEARCH QUESTION

The construction industry in Nigeria has been associated with poor quality of construction products (Akinola, Akinderawo, & Olatunji, 2012). A general decline in performance of the construction industry has been observed in recent past, perhaps exacerbated by the rash of collapsed building, prevalence of abandoned construction sites and general poor quality of completed projects (Sanni & Windapo, 2008). The concept of TQM is relatively new in Nigeria (Orumwense 2014); thus, it is not progressing at the same rate as in developed countries. TQM focuses on improved customer satisfaction; however, there is no commitment to the cause among organizations in Nigeria (Chukwuka , 2016). Previous research projects have viewed TQM as generic across industries and have classified firms as

support in all the firms studied. This means that the respondents agree that top management of construction firms adopt TQM. The findings are line with some other exiting findings (e.g. Das et al, 2011; Hokoma et al, 2010; Valmohammadi, 2011 & Talib et al, 2012)

Customer focus

The mean of the response's ranges from 4.27 (under C for firms with 4 departments) and 2.65 (under BD for firms with 1 department). In summary, the average mean of all the firms studied is 3.77, this implies that the firms agree that they execute the activities that make up customer focus practice. The findings confirm the findings by Talib et al (2012) whose findings show a high degree of customer focus in the firms' studies. He further confirmed that customer focus is important for TQM implementation in UK organisations

Workforce management

The grand mean of the responses is between 4.38 as the highest (under a combination of all construction types for firms having 1 department) and 3.25(under Building construction for firms having 8 departments) with an overall average of 4.04. The findings of this study are in agreement with the conclusion by Sumukadas, 2006 and Das et al, 2011, whose findings conclude that workforce involvement is important for TQM to be effectually realized, their findings indicates a high level of workforce commitment to quality in the firms studied.

Strategic planning

The findings show that the grand mean of strategic planning ranges between 4.34 as the highest (under building construction for firms having 5 departments) and 2.67 as the lowest (under with an overall average of 4.00 for the firms studied. This implies that the respondents agree with the strategic planning practice. The findings are in line with the findings of Hokoma et al (2010) and Tablib et al (2010).

Process management

The grand mean of the responses range between 4.49 as the highest (under D in firms having 6 departments) and 3.17 as the lowest (under D in firms having 4 departments). the average grand mean for the 46 classes of firms is 4.09. The findings by Kaluarachchi(2010) who studied Sri Lankan firms and Wu (2014) who studied Chinese firms.

Measurement analysis

The grand mean of the practice ranges from between 4.53 as the highest (under C in firms having 9 departments and 2.71 as the lowest (under B in firms having 6 departments) with an overall average of 3.95 for the 46 classification of firms. The findings are consistent with the findings of Joseph et al (2010), Jaca et al (2015) and Topalovic (2005) whose findings show high level of measurement analysis practice in the firms studied

CONCLUSION AND RECOMMENDATION

This study is aimed at assessing the level of TQM implementation in Nigerian construction firms. six practices (top management support, customer focus, workforce management, strategic planning, process management and measurement analysis). The findings of the study indicate that the level of TQM

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INTRODUCTION

Economic indicators put developing economies, with a growth of 4.7%, at the epicentre of accelerating global economic growth which is at 3%. For instance, Africa growth rate is 3.7% (ranging between 2.5 and 6.2%) compared to that of the developed economies with a 1.9% growth rate (United Nations, 2018). Within the African sub-regions, the public sector invests 95% of the total investments on infrastructure (Global Infrastructure Hub, 2018). Put within the context of achieving value-for-money i.e. providing, for instance, functional buildings by judiciously, equitably and transparently using the least amount of taxpayers' money (which is the fundamental of construction procurement for the public client); economic growth may come at some huge costs particularly when project objectives are not fully met. Ironically, projects undertaken by public clients in most developing economies have been reported as underperforming (Nigeria having a 2.1 procurement performance rating on a 5 point scale) compared to those undertaken by private clients (Global Infrastructure Hub, 2018). While the 'below average' performance in public procurement is recognised as a global phenomenon, developed economies have rethought their procurement strategies to adopt a long-term approach to procuring public/institutional buildings (e.g. by adopting PPP/PFI), most economies in the African sub-regions still adopt the short-term approaches to construction procurement (Laryea & Watermeyer, 2014; Watermeyer, 2015).

The traditional method e.g. design-bid-build is still the most commonly used for procuring institutional buildings in most economies within the African Sub-regions which is largely influenced by their procurement laws. However, Laryea (2017) did demonstrate that the tendering procedure (and not just the procurement method) adopted could potentially affect procurement cost and hence value-for-money. Despite the use of what may seem an appropriate procurement method, the 'below average' performance of projects procured by the public sector still persists. One of the steps undertaken by developed economies to improve public clients' capacity for achieving value-for-money in construction procurement was adopting a strategic approach. This necessitated recognising public clients as being solely responsible for the success or otherwise of their construction supply chains, thereby up-skilling and empowering them appropriately (Briscoe, Dainty, Millett, & Neale, 2004; Boyd & Chinyio, 2008; Commission of Architects for the Built Environment, 2010; Construction Clients' Group, 2013; Hermans & Eisma, 2015). Hence, to achieve value-for-money in construction procurement public clients in developing economies must possess the needed capabilities to manage their construction supply chain.

Managing the supply chain for construction procurement can be viewed from two perspectives – client-led and contractor-led (Pryke, 2009). Research on SSM (also known as supply chain management) has largely focused on contractor-led while client-led perspective has received very little attention. Studies on the contractor-led perspectives focus on the adoption of SSM in construction with mixed findings. Some studies indicate that while the expected improvements have been very slow some forms of progress have indeed been made (Wolstenholme, 2009; Manu, 2014; Safa, Shahi, Haas, & Hipel, 2014; Behera, Mohanty, & Prakash, 2015). Others have however established that the existing concept of SSM will not give the expected

achieving the local balance between economy, efficiency and effectiveness [that is] spending less, spending well and spending wisely'. Within the context of infrastructure delivery, Watermeyer (2015) describes value-for-money as the "optimum use of resources to achieve intended outcomes by ensuring that the best results possible are obtained from the money spent or maximum benefit is derived from the resources available". Hence, value-for-money in public construction procurement is not just about costs but taking into account the mix and balancing of cost, quality, resource use, fitness of purpose and timeliness amongst other dimensions. For public projects the basis of such considerations is contained within the client value system.

The concept of client value system has over the years come to be considered as a main determinant for construction procurement success or otherwise. And what explicitly constitutes value-for-money for a public client is firstly dictated and influenced by its value system, and then transmitted along the core supply chain through the project's value thread (Kelly, Male, & Graham, 2015). While the theories explaining client value system provides a link between the public client and its supply chain (National Audit Office, 2003; Thomson, Austin, Mills, & Devine-Wright, 2013; Kelly, Male, & Graham, 2015), they remain silent on specifically situating the public client's role (and the capabilities required) within the supply chain. This has largely being ignored within construction management literature. A comprehensive review of related and relevant literature carried out in order to draw insights from supply (chain) management for construction (Kolo, 2016) reveals amongst others that successful construction procurement is highly dependent on the extent public clients accept sole responsibility of success and also manage their supply chain. This, inevitably bestow on the public client the sole responsibility of strategically managing their core supply chain via SSM. However, successfully managing the supply chain requires certain capabilities, which is the main focus of the Cousins, Lamming, Lawson, & Squire (Cousins, Lamming, Lawson, & Squire, 2008) model for successful SSM. The next sections conceptualise three of these capabilities based on the Cousins et al.'s model indicating how they fit within the public client's construction procurement in terms of achieving value-for-money.

Strategic supply management and required capabilities

Contextualising supply management within the purchasing lexicon, Cousins et al. (2008) indicate that the term 'supply' has over the years been linked to 'purchasing' described as the 'integral nature of buying something and having it provided or bought' (p. 7). Over time, supply management evolved from mainly technical considerations i.e. purchasing operations (which tends to characterise construction procurements in most developing economies), to address more strategic issues i.e. purchasing strategies and viewing supply management as a strategic function (Cousins et al., 2008). The ability of, and extent to which, the 'purchasing unit' of an organisation contribute to the organisation's strategy and impact on its performance has long been recognised in construction management literature (Pryke, 2009; Booth, 2010; Behera, Mohanty, & Prakash, 2015). Strategy is defined as set of 'plans for achieving organizational goals [that have] a major impact on what the organization does and how it does it [in the] long term, intermediate term, or short term' (Stevenson, 2009, p. 43).

communicating the constituents of value-for-money), sourcing and engaging with members of the supply chain on behalf of the public client amongst other responsibilities. While several names are used in identifying such a unit – physical planning, procurement unit, estate department etc, in this paper they are referred to as supply management units (SMUs). Hence reference to public clients within this paper is specifically targeted at their respective SMUs.

Supply Management Maturity

The growth of SMU and its development can be evaluated based on the role they play in enabling and implementing a firm's strategy. This is possible since the priorities of supply management must be derived from the firm's overall strategy. Reck and Long (1988) cited in Cousins et al. (2008) developed a four-stage model for SMU development which can be used to evaluate the competitive and/or contributory role of SMU to public clients, and thus determine its maturity level. These stages are: Stage 1 – Passive is the poorest level of contribution by SMU, having no strategic direction for itself with little opportunity to add value to the organisation; Stage 2 – Independent is the level where SMU continuously embrace latest purchasing techniques and tools used within industry, though it may not necessarily contribute to advantage with efficiency still been the primary focus but now they are seen as 'professional'; Stage 3 – Supportive, at this level purchasing function is 'supportive' of the firm's strategy in terms of consistency when making purchasing decisions given that top management views it as an essential business function; Stage 4 – Integrated, SMU would have attained the status of forming the basis of its firm's competitive success; thus viewed as an integral part of the firm's competitive strategy by looking to long term, and likely changes in supply markets and being 'one step ahead' of competitors.

Relating the aforementioned to the characterisation of SMUs within public clients in terms of approaches, strategy and development, parallels can easily be drawn to suggest the maturity level that SMU should assume to ensure the achievement of value-for-money in their public construction procurements: that the SMU should be at least of the '2nd generation', adopt the 'supporting strategy' at the minimum, should have developed to 'Stage 4 – Integrative' on the Rock and Long's four-stage development model and classifiable as a 'Strategic Purchaser' on the Cousins et al.'s taxonomy. These benchmarks are used as the basis for characterising client organisations (i.e. their SMUs) during the case study phase. SMUs in client organisations that are benchmarked lower gives an indication of their inferred incapability of/immaturity toward influencing the supply team towards achieving value-for-money in public projects. Hence, SMUs at Stages 1 and 2 on the Reck and Long Four-stage model are classified as 1stgeneration; those at Stage 3 as 2nd generation while those at Stage 4 as 3rd generation.

Strategic consideration & alignment

Considering and aligning corporate strategy with that of supply represents the hub of the Cousins et al.'s (2008) strategic supply model and is also considered the most important of its six constituting elements. Two basic aspects that impacts on strategic consideration and alignment include: levels within organisations and strategic alignment along organisational levels. For the purpose of supply management, three levels at which strategy is developed within organisation are corporate, business and functional. Corporate-level strategy asks 'what business

Cousins et al., 2008 for details of the matrix) with selected competencies. This effort produced the strategic supply competency table that can be used to classify SMU into four broad categories with each category containing the required competencies. The four categories are: tactical acquisition, tactical profit, strategic security, or strategic critical. Each of these categories is described based on how they measure on two dimensions namely: relative cost or value of the procurement and supply exposure of the supply management unit of the organisation. The category 'tactical acquisition' depicts a situation where relative cost is low and supply exposure is low; 'tactical profit' where relative cost is high and supply exposure is low; 'strategic security' where relative cost is low and supply exposure high; and lastly, 'strategic critical' where relative cost is high and supply exposure is high.

However, due to the wide variance observed across companies in the identification of competencies, Cousins et al. (2008) concludes that it is very difficult to identify list of generic competencies that is supportive of effective purchasing behaviour for all firms. Hence, competencies should be viewed as 'situation specific' and for this study a list of generic competencies is attempted for public client in tertiary institutions based on data collected in Nigeria. Further to these competencies categories, Cousins et al. (2008) outlines key competencies required of purchasing professionals within five areas namely: 1) strategic planning comprising planner, goal setter, completer-finisher; 2) communication comprising of presenting, public speaking, listening and writing; 3) financial consisting of cost accounting, making a business case, and economics; 4) technical involving computer literacy, mathematics, and process development; and 5) team building: leader, decision maker, and influencer.

RESEARCH DESIGN AND METHOD

The main thrust of this study is to appraise client organisation practices, particularly public clients, in terms of their supply management in construction procurement To achieve this, exploratory multi-case study strategy was adopted. This is consistent with strategies adopted by similar studies (Manu, 2014; Pero & Cagolini, 2015).Multiple-case studies can be accomplished by going through three steps: defining and designing, preparing and collection, and analysing and concluding. For this study these steps were implemented as follows: Firstly, in defining and designing the cases studied the purpose of the study required that the rationale for selecting the case organisations be based on their uniqueness as clients of the construction industry – their high and consistent volume of procurement. The education sector (tertiary) in Nigeria provides a robust and reliable source and was specifically targeted due to its continued and sustained access to intervention funds for public construction procurement e.g. TETFund Intervention Programmes. Five (5) universities were selected for the cases studied based on the total amount they spent on construction procurement within 2010 – 2017. In each of the universities, the persons in charge of the SMU provided the information required for the field study.

Secondly, in preparing and collecting of data, an interview protocol was developed accompanied by a checklist to elicit semi-structured information from the head of the SMUs. These were mainly targeted at exploring their practices in terms of:

undertook in 2013. Interviewee A explained the reason for this 'we had a grant from an International agency to jointly undertake a specialised programme which required a specialised building. To do this and get it right first time, we had to think outside the box'. In terms of alignment of strategies between those of the SMUs and that of their respective organisation, firstly, all the cases studied demonstrated the existence of corporate-level strategies for construction procurement. For some universities, their corporate strategies are design specific rather than been generic, for instance that of Case E 'To explore ways of reducing energy consumption and promote energy efficient buildings, innovative design solutions must be sought to reduce energy use of buildings by 10 - 20% while providing buildings that promotes and enhance service delivery, which are attractive and provide comfort to users'. Three organisations have specific supply management strategies i.e. Case A, Case B, and Case E but are rather developed informally i.e. the structure for developing and aligning strategies as suggest by Cousins et al. (2008) is not strictly adhered to by these organisations. In all the instances where supply management specific strategies exist, it was discovered that they were aligned with corporate strategies of the universities investigated.

Competencies and skills

In terms of the existing competencies and skills base of client organisations and using Cousins' et al. (2008) Strategic Supply Competency Table, 7 out of the 10 Cases studied exhibited competencies and skills in two areas – tactical acquisition and tactical profit i.e. Case A, Case B, Case C, Case D, Case G, Case F and Case I. The specific competencies and skills of these client organisations are as follows: for tactical acquisition – computer literacy, negotiation skills, assertiveness, impact on price margin or profitability analysis; and for tactical profit – numeracy, ability to aggregate needs, impact of volume on cost and profit, negotiation and competitiveness. Of the remaining three client organisations, Case E showed some level of competencies and skills in strategic critical area, while the dominant competencies and skills of Case H and Case J falls within the tactical profit and strategic security areas. The strategic security area is made of these competencies and skills: relationship management skills, inventory management skills, forecasting ability, risk assessment and supply industry knowledge.

Looking at perceptions of the ideal competencies and skills required for contemporary strategic management, interviewees in all the client organisations investigated agreed on two areas i.e. the strategic critical and strategic security and as such clearly indicates the deficiency of the current competencies and skills within client organisations pursuant to SSM. However, interviewees C1 and D1 indicated that competencies and skills are needed in the tactical profit area for contemporary supply management. The competencies and skills required for strategic critical include: relationship management skills, product/service knowledge, risk assessment, strategic thinking, cross-functional working, and communication skills while those for strategic security are as listed in the previous section.

Apart from the normal competencies and skills set needed for supply management, specialised skills are also required and these were investigated. Interactions with the interviewees reveal two main areas in which competencies and skills are either non-existent or inadequate in client organisations. These are strategic planning competencies and skills, and team building competencies and skills. Competencies

to guarantee improvements but also the understanding and working around the complex nature of the client organisation too (Green, 2006; Bresnen, 2010; Hermans & Eisma, 2015). Hence, the implication of the outcome of this research for supply management theory in construction is that SSM considerations do not and should not apply equally to all organisations. Their consideration should be dependent on the nature of the organisation in terms of its role in the supply chain, and the side of the market it is domiciled in whether client-led or contractor-led (with the latter being mostly tier determined).

CONCLUSION AND RECOMMENDATION

The study sets out to investigate SSM capabilities of public clients towards achieving value-for-money in their construction procurement in terms of three aspects viz SMU maturity, strategic considerations and competences and skills. Despite that public clients are known to have a poor reputation in achieving value-for-money in their public construction procurement, they make some efforts at managing their supply chains. However, rather than been strategic in nature, these efforts are more tactical. The lack of a strategic approach to supply management by public clients is occasioned and particularly challenged by the following: 1) immature levels at which their SMUs are operating at; 2) discordance in their views of the determinants of strategic sourcing and sourcing structure, and mismatches within and between sourcing strategies and sourcing structures; 3) non-existence of supply specific strategies (compared to corporate strategies); 4) lack of competence and skills in both the strategic critical and strategic security categories, and those specially required for strategic planning and team building, while adequately sufficient in tactical/operational competence and skills. These deficiencies further explain the reasons for public clients in developing economies having a bad reputation in achieving value-for-money in their construction procurement, due to the fact that current value perspectives in construction are viewed using strategic lenses. This would not be the case were they viewed from the tactical lenses – public clients reputations would have been so much better. However, global construction procurement has moved on and so should public clients in developing economies!

Hence, to improve upon the public clients capacity to achieving value-for-money in public procurements via their SSM capabilities, firstly researchers and practitioners in developing economies would need to take proactive and dedicated swipes at re-examining the current theories of SSM due to its perceived ‘inappropriateness’ for application in construction particularly for public clients. And in so doing, specific attention should however be focused on aspects of the theories that relate to: differentials in the public and private sectors, intra-firm alignment of strategies; strategic consideration to supply management i.e. cost minimisation and differentiation; and sourcing strategies. Secondly, public clients needs to have a cultural change towards managing their supply chain by adopting strategic approaches particularly in their sourcing strategies and sourcing structure. Improvement in this regard is possible when public clients put deliberate efforts at: improving their maturity levels from 1st generation to 3rd generation, re-engineer their approaches to strategic considerations and alignment, and lastly up-skilling their competence and skills level toward those required for SSM. Finally, rather than allow public clients go the whole hull individually and severally, central

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environment had call for better marketing practice which could be better achieved in the atmosphere of a good and healthy relationship. Pheng and Gracia (2010) established that, there is strong correlation between the type of services delivered to the client and relationship that exists among the parties involves in delivering such services. Nevertheless, internal marketing is a relationship in a relationship types that comprised two entities participating in it. It is the concept that described interaction between the firm (Principal Partner/MD/Employer) and its employee. This concept holds that for an organization to deliver excellent service client; both the employer and its employee must have good, strong and healthy relationship within the firm (Kaylene, 2017). Guzonni (2005) and Yadav and Dabhade (2013) explained internal marketing to be an organizational activities performed so as to educate, motivate and reward its employees in order to delivered best service to customers. Berry (1981) critically pointed out that, internal marketing has to do with firm seeing its employee as internal customers who can be satisfied through their job and in the end achieve the goal of the firm (client satisfaction). To achieve good relationship within the firm, the employer must displayed good attributes that will motivate its employer to perform better. Morealso, employee must adequately satisfy its employer by displaying worthy attributes to the employer. With this, best and healthy relationship will be achieved which Kotler and Armstrong (2006) described as strong internal marketing.

Roles of firm (employer' attributes) for successful internal marketing relationship

Firm (employer/MD/PP) is the determinant of a good internal marketing. Firm managed and controls all employees and their activities. The focus of an employer is to deliver excellent service to its client. One of the effective ways of achieving this goal is to motivate, train and see employee as an asset to the firm (Guzzoni, 2005; and Kotler and Armstrong, 2006). Adelmoti, Abdullah and Kalil (2011) affirmed that, clients' satisfaction rests on the successful internal marketing. Adelmoti et al. (2011) further established that, improving human resources and rewards from the firm mostly determines the level of employee's performance and productivity of the firm. Therefore, is a matter of necessity for any firm to satisfy its employees by displaying good attributes to them such as training, teaching and motivation e.t.c (Thomas, 2017 and Kaylene, 2017). This helps in satisfying the needs and expectations of the clients. Certain numbers of attributes expected of a good firm were identified from literature; these included: favourable working environment which entails seeing employee as an asset who can contribute positively to the success of the firm. Neglecting employee's contributions in decision making can limit the growth of such firm. Good working environment speaks more than word to the employee. Merchant (2016) and Michele (2017) suggested that employers should allow their employees to feel free and secured in their working place. Revealing the goal and objectives of the firm to the employee is another attribute that should be the habit of a good firm. Proper job descriptions should be established so that employees know what is required of them. If there are changes that need to be made employee should be carrying along by communicating directly and clearly to them (Thomas, 2017). Furthermore, open and honest working environment had been seen as a good attribute of an employer; it involves given the feedback to the employees on services delivered to the client. Hiding some issues from employee might not improve the company's

2015), dependability and responsibility, constructive attitude (Melissa, 2017), honesty and integrity, self-motivated, ability to grow and learn, strong self-confidence and professionalism among others. In summary, the attributes expected by the main actors of internal marketing should be displayed adequately which will help them to achieve the goal of the firm (clients' satisfaction). Obviously, the goal of any firm is to deliver service that has value to its client. Therefore, this study claimed that client satisfaction is a function of internal marketing relationship (Coper and Cronin , 2000) (Equation 1 and Figure 1).

$$CS = f(F_a + E_a) \text{ ----------Eqn. 1}$$

Where CS = Client Satisfaction; F_a = firm's attributes; E_a = Employee's attributes; and $(F_a + E_a)$ = Internal Marketing Relationship

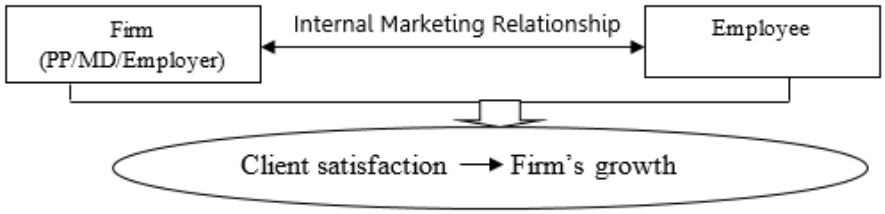

Fig. 1: Internal Marketing Relationship Practice

METHODOLOGY

The methods adopted for this study comprised a review of literature, administration of questionnaire to the two set of respondents i.e. QS firm (employer) and the employee QS within the firm and a statistical analysis of the survey data. The questionnaire were design such that firm assess its employees (2 per firm) while employees assess their employer based on the attributes displayed. The questionnaire consisted of two sections. Section 1 focused on the profile of the respondents while section 2 addressed the subject matter. Fifty-six (56) registered quantity surveying firms and one hundred and twelve (112) employee QS were sampled randomly in southwestern Nigeria through questionnaire, given a total population of one hundred and sixty-eight (168) respondents. In all, one hundred and thirty-one (131) questionnaire were found useful from the retrieved questionnaire, comprising QS firms (46) and employee QS (85) given a response rate of 76.19% which is adequate for this study (Moser and Kalton, 1979). Twenty-seven (27) attributes of employee were assessed by the employer while thirty-four (34) attributes of employer were assessed by their respective employees. Data collected on profiles' respondents were subjected to descriptive analysis while data on subject matter were analysed using Mean Response Analysis (MRA).

Reliability and validity measure

Cronbach's alpha was performed so as to ascertain the reliability of the items (attributes). This tool has been described by various researchers as the most common measure of reliability of multiple Likert questions in questionnaire survey. Luno (n.d) asserted that alpha greater than or equal to 0.800 confirms the reliability of the questionnaire. The results obtained revealed the alpha of 0.969 and 0.939 for firms and employees' attributes respectively as presented in Tables 1a and 1b.

others. The data collected were subjected to descriptive statistics and the results obtained were presented in Table 3 (Firm) and Table 4 (Employee).

Table 3 Background information of QS firms (Employer/PP/MD)

S/N	Profile of Respondents (QS Firms)	Frequency	Percentage (%)
1	Location of the Firm		
	Lagos	32	69.6
	Oyo	12	26.1
	Ondo	2	4.3
	Total	46	100.00
2	Years of existence of the firm		
	<10	4	8.7
	11-20	17	37.0
	21-30	15	32.6
	>30	10	21.7
	Total	46	100.0
	Mean		21years
3	Highest Academic Qualification of the Respondents		
	HND	7	15.2
	B.Sc.	7	15.2
	PGD	7	15.2
	M.Sc.	21	45.7
	PhD	4	8.7
	Total	46	100.0
4	Professional qualification of the respondents		
	MNIQS	25	54.3
	FNIQS	21	45.7
	Total	46	100.0
5	Years of professional experience		
	1-5	2	4.3
	6-10	3	6.5
	11-15	5	10.9
	16-20	9	19.6
	above 20	27	58.7
	Total	46	100.0
	Mean		18 years
6	Position in the firm		
	Principal Partner (PP)	31	67.4
	Managing Director (MD not owner)	15	32.6
	Total	46	100.0

The result from Table 3 revealed that, thirty-two (32) QS firms participated from Lagos state, twelve (12) from Oyo state with two (2) from Ondo state. This trend could be described moderate because the focus of this study was on Lagos (38), Oyo (14) and Ondo (4). Likewise, 91.3% of the firms had been in existence for more than 10 years with 37% of them existing between 11-20 years; 32% of the firms existing between 21 and 30 years while 21% had been established for over 30 years. Average year of existence of the surveyed firms was 21 years. It can be inferred from the result that, most of the firms surveyed were matured organization with expected experience on relationship issue when it comes to managing employees. Similarly, the results obtained on academic qualification showed that the PP/MD of the surveyed QS firms had required qualification with 84.8% of them had minimum of B.Sc, 69.6% had additional higher degree comprising 15.2% PGD, 45.7% M.Sc and 8.7% PhD. None of them possessed a qualification below HND as the highest academic qualification. The respondents are adequately qualified in providing

additional higher degree comprising 9.4% PGD, 27.1% M.Sc and 3.5% PhD. None of the respondents' employees had below HND, this signifies that they are adequately qualified in providing information needed for this study. Equally, 75.3% of them were Members of the Nigerian Institute of Quantity Surveyors (MNIQS) while 2.4% were Fellows of the Nigerian Institute of Quantity Surveyors (FNIQS). This is an indication that the employees were professionally qualified. Nevertheless, 22.4% were probationer members of the Institute. The result further revealed that 5.9% of the employees had more than 20 years of professional experience with 31.8% having between 11 and 20 years of experience. This depicted a good image of employee QS; hence, they are suitable in providing information needed for the study. Conversely, 21.2% had less than 5 years working experience which might be as a result of number of the probationer members in the earlier mentioned. Moreover, 20% of the respondents were chief QS of the firm, 62.4% of them were quantity surveyors while 17.6% were assistant QS. Result on employees' monthly income revealed that 71.8% of them earned more than N60, 000.00, this confirmed the result of good relationship. Also, 17.7% earned between N20,000 and N40,000 while 10.6% earned between N50,000 and N60,000. A well paid employee will be motivated to do more than the firms' expectation in terms of services delivered while those that were less paid may perform below expectations. Hence, quantity surveying firms in Southwestern Nigeria should try to motivate their employees by paying them well as they are the one who do the major works within the firm. Equally, information obtained on nature of the job of the employee revealed that, most of the respondents were a full-time (94.1%) employee which is very adequate. Few of them were part-time (5.9%); this reason might be that firm engaged them any time their services are needed due to their previous performance and competency. The result obtained showed that, quantity surveying firms are part of the organizations that contributes tremendously to the development of Nigerian economy especially in the area of employments.

In summary, the result obtained on the profile of employee QS showed that they are capable, competent and knowledgeable in providing dependable information required for this study.

Assessment of firm and employee attributes for healthy internal marketing relationship

The attributes of both the firm and employee were assessed; the employees were assessed by firm and vice versa. The firms, represented by principal partner (PP) or managing director (MD), were asked to rate on a scale of 0-5 the level of importance of identified attributes that denotes good, strong and healthy internal marketing relationship. This is to know the attributes that are paramount to the quantity surveying firms which their employees must display for the firm to achieve an enhanced service delivery which is marketing outcome. Moreover, the extents to which these attributes were displayed by employees QS were as well rated by the firm. The data obtained on these were subjected to Mean Response Analysis (MRA) and the results of the analyses were presented in Table 5.

The result presented in Table 5 showed that 19 out of 27 attributes expected of employee QS had mean value of 4 and above which showed that firm (PP/employer/MD) attached very high importance to these attributes. The five (5) top employees' attributes included: honesty and integrity (MS=4.76) , trust worthy

employees were also rated very high which signifies that employees displayed them adequately. Considering the individual display, honesty and integrity which ranked 1st under level of importance ranked 2nd under extent of display (MS = 4.24); this is considered adequate. Trust worthy Ranked 2nd under level of importance and ranked 3rd under extent of display (MS=4.20). Strong and good communication skills ranked 3rd under level of importance but ranked 1st (MS = 4.26) under extent of display. Equally, 'professionally sound' and 'responsible and reliable' that ranked 4th and 5th under level of importance ranked 5th and 5th under extent of display respectively (MS=4.15). it can be seen that none of this highly ranked variables had mean below 4.00 (see 4.4 summary of results for information on rating scale).

However, conclusion on healthy internal marketing relationship cannot be drawn without assessing firm's aspect of it. Kotler and Armstrong (2006) emphasized that firm should build long-term relationship with its customers. Meanwhile, Berry (1981) established that, employees of firm are the first customers that must be well satisfied if the external customers are to get the best services. The satisfaction of an employee within the firm depends on the way and manner in which firm treated its employee which will reflect on clients' satisfaction. Therefore, employee QS were asked to rate the firm (PP/MD) on a scale of 0-5 the level of importance of attributes that firms must possessed as well as extent to which those attributes were displayed by the firm. The responses of the employees were subjected to MRA and the results obtained are as presented in Table 6.

Table 6 presents thirty-four (34) attributes of a good employer to its employee, from these, employees considered almost twenty-six (26) attributes very important as they have mean value of 4.00 and above. This showed that the surveyed employees attached very high importance to these firm's attributes. The table revealed trustworthy (MS = 4.46) as the most important attributes that QS firm should possessed followed by recognized and reward for good work (MS = 4.35). Other important attributes included creation of favourable working environment (MS = 4.34), be patient with its employee (MS = 4.31), effective leadership (MS = 4.28), open communication by the employer (MS = 4.26) and motivation approaches like salary increment among others. Furthermore, the extent to which firm displayed those important attributes were assessed by the employees. The result in Table 6 showed that 32 out of all the 34 firms' attributes had a mean value of 3.00 and above. This is an indication that these attributes were not highly displayed by the firm because none of the variables had mean up to 4.00 (Whereas, the level of importance and extent of display were both rated on the same scale – see 4.4 summary of results). Considering the order of individual display, it can be seen from the table that the highly important attributes as rated by the employees were less displayed by the firm. Trustworthy and good initiative (MS =3.75) were well displayed as it ranked 2nd. However, recognize and reward for good work ranked 25th which ranked 2nd under level of importance. This is not a good one because, motivating the employee who does most of the firms' work will make them to do better. Whereas, motivation is an essential element that needs to be displayed by the firm in order to achieve good employee performance (Emeka and Eyuche, 2014). Moreover, theory of motivation according to Fredrick Herzberg has to be applied by QS firm.

which could bring about job satisfaction and invariably lead to clients' satisfaction. Therefore, there is a relationship between satisfaction and performance. This implies that, employee's performance is a function of firm's attitude; hence, satisfaction is a function of healthy internal marketing relationship. Similarly, dedication of employer to work ranked 8th under level of importance but ranked first under extent of displayed. This implies that firm value its work more than motivating the employees who in most cases market the firm on its behalf. In all, it may be seen from the results obtained on firm and employee assessment that employee satisfied the firm (employer) to some extent while employees were less satisfied. It can be deduced that firm did not satisfied the employees as expected because the important attributes to be displayed by the firm towards employees were less displayed by them. Therefore, it can be concluded that, the relationship that exists between the firm and its employees is not a healthy one. Whereas, marketing start within the organization. (Kotler and Armstrong, 2006) established that, favourable relationship within the firm will determine the type of services that will be given to the client who happen to be the external customer to the firm. The study of Armstrong and Kolter (2006) affirmed that, marketing may not yield any good result if the internal marketing (firm-employee relationship) fails; hence, quantity surveying firms should try to satisfy their employees by displaying attributes expected of them. This practicing was affirmed by Ballatyne (1995) as an open system operation. It can be concluded from the results that quantity surveying firms in Southwestern Nigeria does not have healthy internal marketing relationship.

Summary of Results

The level of importance and extent of display of firms and employees' attributes were rated on the same scale of 0-5; where 0 = not applicable, 1= not important/not displayed, 2= less important/less displayed, 3 = averagely important/averagely displayed, 4 = important/displayed and 5= very important/highly displayed.

It can be discovered from the results that some of the employees' attributes had mean above 4.00 which signifies that they are very important under level of importance. On extent of display, some of the attributes had mean above 4.00 which signifies that they were highly displayed by the employees as rated by the firm. Similarly, some of the firms' attributes were rated high (mean above 4.00) which signifies that they are very important. However, none of those attributes have mean up to 4.00 under extent of display. This implies that the attributes were averagely displayed by the firm.

CONCLUSIONS AND RECOMMENDATIONS

The study focused internal marketing relationship practiced by quantity surveying firms. Relationship between two or more parties is a way to either strong or weak marketing. The finding showed that, the relationship that exists between the firm and its employees is weak. In all, the following conclusions were drawn from the analysis: Firstly, employees displayed some of their expected attributes to the firm. In contrast, firm did not displayed attributes required by them to their employees. Finally, in internal marketing relationship of quantity surveying firms is weak. Therefore, this study recommended that quantity surveying firms should see their

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2019). The built environment is noted to have both positive or negative effects on the environment, and simultaneously improving and degrading human health and well-being (Younger et al., 2008; Bartuska, 2011). The outcome in each case depends on choices and actions taken to address needs for enhanced livability and comfort (Bartuska, 2011). Due to limitations in choices and actions, most efforts at conventional and sustainable designs focus on improving the efficiency of components (Zari, 2010; Craft et al., 2017). This focus on 'efficiency' in design is said to be responsible for the separation of humans from nature (Ives et al., 2018). Humans commoditise and exploit the natural systems instead of co-existing with them, which results in deterioration of human and ecological systems (Zari, 2012; Lehmann, 2019; Opoku, 2019). Consequences include poor physical and psychological health, poor human development, and environmental crises (Dias, 2015; Ives et al., 2018). Thus, current sustainable design approaches emerged to address the impact of the hitherto unsustainable development perpetuated by mankind, in order to ensure livelihood for future generations (EPA, 2011; Mang and Reed, 2012b). Therefore sustainable design approach is focused on mitigating existing impacts and sustaining the existing environment, which is already degenerated (Owen, 2009), and to best aim at conservation which is argued as being insufficient to sustain life (Singer, 2010; Conte and Monno, 2016). Apart from concerns for efficiency, existing sustainable design, is said to aim at reconnecting the environment to the socio-political components instead of the ecological concerns (Hodges, 2006; Howard et al., 2008). Other authors point to the weaknesses of current sustainable design approaches (Craft et al., 2017), and persistent negative environmental impact (Axinte et al., 2019), and poor human and natural well-being (Ives et al., 2018). According to (Boehnert, 2019), the main issue is that current sustainable design fails to include ecology in its principles. Ecological inclusion in design offers valuable response to environmental issues where conventional sustainability agendas prove inadequate. The inclusion of ecological principles in sustainable design of the built environment implies the wellbeing of ecosystems and human systems. The scenario can be achieved through the co-evolution of the built, natural and socio-cultural systems as described by authors such as Mang and Reed (2012a); Bartlett and Gauthier (2013); Boehnert (2019); Axinte et al. (2019); Opoku (2019). The concept of regenerative design emerged from the aforementioned thinking (Mang and Reed, 2012b; Axinte et al., 2019). It developed as a necessary advancement in sustainable design with a focus on self-renewing capacities for the constructed human and natural systems (Mang and Reed, 2012a; Axinte et al., 2019). It is a more integrated and comprehensive approach to sustainable design and construction (Trombetta, 2018), which inherently facilitates human reconnection with nature (Ives et al., 2018). In contrast, while sustainable design sustains an already deteriorated environment, regenerative design seeks to regenerate and/or restore the environment by improving the mutual relationships of the building, nature and human development processes within the context of place (Mang and Reed, 2012b; Girardet, 2017; Trombetta, 2018; Axinte et al., 2019).

The advancement and acceptance of regenerative design facilitated the development of strategies for successful implementation, adoption of the concept, and transition from conventional design approaches to regenerative design methods (Hodge, 2006), and inform the reconnection of humans with nature (Roös

strategy claims that nothing in nature is a waste, and that everything has the potential to bring about a required change in the environment.

Table 1: A comprehensive summary of regenerative design strategies

Strategies	Authors
Attention to the distinctiveness and image of a place	Zari (2010), Haggard (2002), Litman (2009), Du Plessis (2012), Mang and Reed (2012a), Hes-Stephan-Moosavi (2017)
Ecological Inclusion	Lyle (1994), Zari (2010), Litman (2009), Trombetta (2018), Orr (2018), Craft et al., (2017)
Natural systems optimisation and enhancement	Thayer (1994), McDonough-Braungart (2001), McDonough (1992), Orr (2018), Roös and Jones (2017), Hes-Stephan-Moosavi (2017), Trombetta (2018), Craft et al., (2017)
Maintenance of cultural identity	Thayer (1994), Zari (2010), Litman (2009), Hes-Stephan-Moosavi (2017)
Integration of resource, material and landscape scale	McDonough (1992), Litman (2009), Zari (2010), Hes-Stephan-Moosavi (2017), Trombetta (2018), Craft et al., (2017)
Human and natural ecosystems co-evolution and mutual relationship	McDonough (1992), Zari (2010), Lyle (1994), Du Plessis (2012), Roös and Jones (2017), Hes-Stephan-Moosavi (2017), Craft et al., (2017)
Conservation, restoration and recycling	Thayer (1994), Zari (2010)
Multiple pathways, flexibility	Lyle (1994), Gabel (2009), Litman (2009), Roös and Jones (2017), Trombetta (2018)
Application of appropriate technology	Thayer (1994), Gabel (2009)
Support on feedback	Lyle (1994), Zari (2010)
Storage as sustainable	Lyle (1994)
Prioritizing sustainability	Lyle (1994)
Matching technology to need	Lyle (1994), Gabel (2009)
Design with nature	Lyle (1994), McDonough (1992), Zari (2010), Orr (2018), Roös and Jones (2017), Hes-Stephan-Moosavi (2017), Trombetta (2018)
Optimise full product life cycle/ eliminate waste	Thayer (1994), McDonough-Braungart (2001), McDonough (1992), Gabel (2009), Orr (2018), Roös and Jones (2017), Craft et al., (2017)
Diversification of interests	McDonough-Braungart (2001), Zari (2010), Orr (2018), Trombetta (2018)
Whole system design integration	Lyle (1994), Litman (2009), Zari (2010)
Economic enhancement through ecological efficiency	McDonough-Braungart (2001), Gabel (2009), Hes-Stephan-Moosavi (2017)
Intelligent and Integrated design and construction approach	Zari (2010), Litman (2009), Trombetta (2018), Craft et al., (2017)
Integration of project to place	Haggard (2002)
Stakeholdership and community participation and integration	Zari (2010), Haggard (2002), Litman (2009), Gabel (2009), Orr (2018), Hoxie et al., (2012), Mang and Reed (2012a)
Multiple and shared goals	Lyle (1994), Gabel (2009)
Acceptance of design consequences	McDonough (1992)
Create long-term value systems	McDonough (1992), Gabel (2009), Trombetta (2018), Craft et al., (2017)
Understand the limitations of design	McDonough (1992), Hes-Stephan-Moosavi (2017)
Landscape scale and community Integration	Litman (2009), Zari (2010), Trombetta (2018), Craft et al (2017)
World as unit for problem solving	Gabel (2009), Hes-Stephan-Moosavi (2017)
Vision to realty	Haggard (2002), Gabel (2009)
Redundancy and resilience	Gabel (2009), Litman (2009), Orr (2018), Trombetta (2018)
Beauty and affordability	Orr (2018)
Design for disassembly and repair	Orr (2018), Craft et al., (2017)
Awareness, education, and transparency	Gabel (2009), Hes-Stephan-Moosavi (2017), Lyle (1994)

involved direct observations and the administration of survey questionnaires. Direct observations focused on a regenerative design evaluation of existing physical conditions of the estate. The questionnaire was used to assess the experience of the occupants. A final step using another survey of construction professionals within the geographical context of the study, was used to refine and validate the final set of selected strategies, and determine avenues for promoting their adoption.

For the surveys, the population of occupants (households) of Ngozika Housing Estate, according to the housing units is (1000). Similarly, the number of registered construction professionals in the host state was 240 for the practitioner survey. A combined simple random sampling size of (377) participants comprising (150) construction professionals, and (285) households from the estate was derived, using Yaro Yamane's formula (Israel, 2013). Considering that the sample size for the registered professional gives proportionately more information for a small specific location in the state, Cochran's equation was also used to generate the sample size for the specific study area (Israel, 2013). The questionnaire was administered in person. From a total of 377 questionnaires that were distributed, 207 complete responses were retrieved. Construction professionals accounted for 62 responses while Ngozika Housing Estate residents accounted for 145 responses. The combined responses amount to a response rate of about 55 percent, which is acceptable in the field of organisational research, according to Bryman and Bell (2003). The two survey instruments shared commonalities substantially. A combination of multi-choice, closed ended, and open-ended questions were used, in addition to likert-type ranking questions to provide rating data in some instances. However, the questionnaire for construction professional differed in having a section for evaluating selected strategies and the proposed framework. Completed questionnaires were retrieved and analysed using descriptive analysis with percentage rating, mean score and ranking in order to identify the set with the highest mean value, and relative importance index to rank the strategies based on importance. The selected key strategies were finally tested for significance using the z-test. The results are presented according to specific aspects investigated in the walkthrough and surveys.

RESULTS

Results of analysis are presented according to the following objectives derived from the study purpose: To determine existing Regenerative design strategies, and a frame work of generic best practices for adoption; to assess the level of regenerative design implementation in projects; to determine key regenerative design strategies and their applicability beyond the study context; and to find out possibilities for promoting regenerative design.

Regenerative design strategies and practices and framework of generic best practices

The identified strategies were further categorized into six themes: environmental, cultural, social, experiential, and educational and economic, as described in Hodges (2006). Table 2 shows the comparative summary of the identified strategies analysed under related thematic areas to enable a comprehensive evaluation of the specific regenerative design strategies.

Table 3: First derivation of framework of regenerative design best practices from Table 2

Environment	Cultural	Social	Experiential	Educational	Economic
Attention to the uniqueness and sense of a place	Human and ecological co-evolution	Stakeholders and community participation and collaboration	Create systems of long-time value	Dissemination of information and Feedback	Eliminate waste
Optimise and enhance natural environment	Integrate/ maintain cultural identity and image of a place	Integrate and utilize the natural systems and landscape	Landscape and community connectivity	Encourage awareness and education of developers and users	Integrated and Intelligent design & construction
Design with nature					Promotion of diversity/ Flexibility Redundancy and resilience

Contextual assessment of the implementation of regenerative design in projects – the case study

Ngozika Housing Estate which was selected as case study for this research, is one of the neighbourhoods in Awka capital city of Anambra State in Nigeria. Awka is one of the major communities and ranks as one of the oldest formal settlements in Igboland with a population above one million as at NPC (2006). It lies between latitude 6.22oN and longitude 7.07oE (Iloeje, 2001), and is situated within the flood plain of Udi escarpment (Iloeje, 2001). Nigeria is found in West Africa, within the latitudes 4° and 14° N of the Equator and longitude 2° 2' and 14° 30' E of the Greenwich Meridian (Helmer and Hespanhol 1997). It is made up of 36 states including Anambra state, located in the south-eastern region. The case study involved a walk-through survey of the neighbourhood and its immediate environs, and a survey by questionnaire. Respondents for the questionnaire were people residing in the Ngozika Housing Estate, at the rate of one response per household.

Walkthrough survey results

Ngozika Housing Estate is situated along Enugu-Onitsha express way and covers about 141.9 hectares with a total of about 961 plots. The estate is divided into 3 phases; I, II, and III. Phase 1 consists of 441 plots, phase II has 71 and phase III has 449 plots, and about half of the estate is surrounded by gully erosion. Another important feature of the estate is the subdivision into different sizes for different economic classes. It comprises one bedroom, two bedroom and three bedrooms, for low and middle classes, while duplexes and luxury duplexes for the high class and the elites. Figure 4 below illustrates the layout plans for the phases I, II, and III of the Ngozika Housing Estate. The growing city of Awka is already host to many such residential neighbourhoods, such as Ahocol Housing Estates, Udoka Housing Estate, Commissioners Quarters, Esther Obiakor Housing Estate, G. R. A. Agu-Awka. there are some environmental features distinct in the neighbourhood area. From the walkthrough, the estate has facilities such as open spaces, churches, schools, major and minor roads, 2 main access routes. In terms of environmental features that can be harnessed for regenerative design, it has a nearby stream which serves as landmark and boundaries between each phase. Other natural features include

Application of regenerative design – combined survey results (occupant & professionals)

Further analysis of the incorporation of available natural systems supports the indication that the neighbourhood/estate design did not consider the use of existing natural systems. The optimization of renewable energy and material resources was not considered.

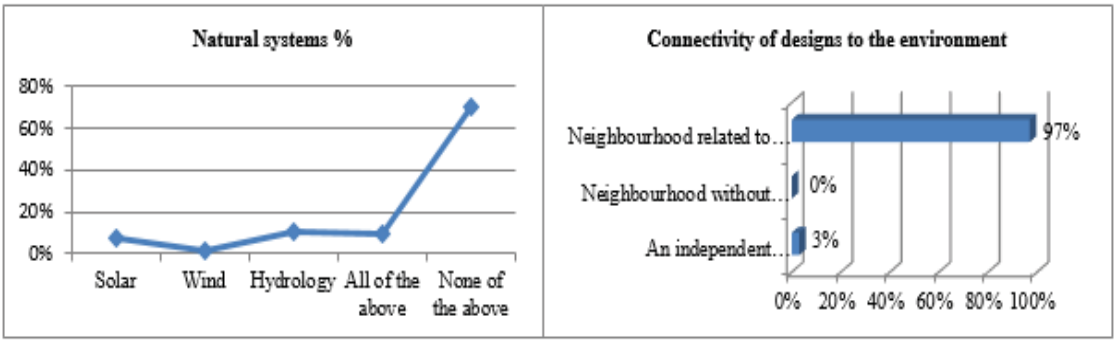

Figure 2: Use of available natural systems and the need to connect designs with the environment

Figure 2 also agrees with the results in Table 4. It also shows that respondents understand and agree with the need to reconnect the neighbourhood design with nature. This indicates an agreement that designs should not be independent of the natural systems that form an image of a place.

Questions specific to construction professionals

The remaining results of analysis focus on critical questions which were addressed to construction professionals in the second survey. The questions are about co-evolution design, promotion of regenerative design for adoption, and an evaluation of the proposed framework of best practices that can be implemented beyond the study context. Table 5 relates to the co-evolution of humans and nature. This question was only answered by the construction professionals within the study area. From the analysis, respondents strongly agreed with the idea of co-evolution of humans and nature.

Table 5: The need to facilitate for co-evolution of humans and nature in the study area

Options	Response in Numbers	Response in Percentage
Strongly Agree	55	89
Slightly Agree	3	5
Disagree	2	3
Strongly Disagree	2	3
Total	62	100

Table 6 relates the possible ways to promote the adoption of the regenerative design concept in the study area. This question applied to the construction professionals only. The respondents were asked to rate in a four-point scale, methods to promote regenerative design. From the analysis, awareness and education ranked the highest, followed by the collaboration between stakeholders and communities, then incorporation as an approval process and last is the change of assumptions and behavior. In table 7 below, a framework of selected strategies for adoption of regenerative practice is presented. The strategies were ranked on the basis of responses, using the Relative importance index (RII). All strategies examined were found to be important and worthy of adoption.

feedback; collaboration/ stakeholders' participation; communities and socio-ecological unit integration; etc. Clearly knowledge and awareness are highly favoured as the first and most important to take. Considering the proposed framework of strategies, there is obvious applicability beyond the study context. This framework could function in a generic sense, outside limitations by context. Even where the strategy refers to existing natural and human systems, it is still generic in description, and therefore can be interpreted to accommodate the vagaries of each context when applied.

FINDINGS AND CONCLUSION

From the analysis above, inadequate sensitivity to natural and human systems is demonstrated in the residential neighbourhood design. As such there is a failure to use design to reconnect the user with nature. In this case the built asset essentially exists independent of the landscape as highlighted by Ives et al., (2018), and in the analysis Table 3 and Figure 2. This approach is noted as contributing to degenerating effects on human and natural systems, and environmental well-being (Lehmann, 2019; Opoku, 2019; Zari, 2012). There is an agreement among participants, of the need to reconnect human activities with nature and co-evolution. This result highlights the underlying connectivity with the environment which helps in building the sense of place. An implication is that ecological components which support regeneration of life support systems should be considered in designs. Another insight from the study is that irrespective of contextual inclinations, there is some level of relativity in all identified strategies. This creates an opportunity for comparative analysis of such strategies, under related themes, from which a framework has been proposed. In addition, the study shows that there is still need for awareness and education in order to achieve good dissemination and ease of transition for the regenerative design practice. The awareness level would influence the level of regenerative design interpretation, stakeholder and community participation, and collaboration. Other ways to promote the concept include the incorporation of regenerative design as part of the approval process. Furthermore, from the comparative analysis of strategies in the study, a framework of some strategies of regenerative design was presented, which could be adopted across many contexts, irrespective of the specific climate and environment. The framework includes education and awareness, and other identified factors which will develop positive attitudes towards the transition of designs and the desire of the stakeholders to participate in the regenerative design activities.

In conclusion the current study shows that regenerative design practices may be in very poor implementation, especially in the study context and related cases. However, the proposed framework of strategies can be adopted to promote regenerative design, regardless of the location. It is important that designs should encourage the co-evolution of nature and humankind in order to revitalize the environment. For the adoption of regenerative design and development, designs should be sensitive to the need for ecological inclusion to sustain life supporting systems. The transition to regenerative design practices can be facilitated by adopting quality awareness and education as major factors; encouraging collaborative actions and community participation to sustain regeneration; incorporating regenerative design practice as part of the approval process for

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al. (2017) considered the key stakeholders of the industry to be contractors, consultants, regulatory bodies and government agencies. They come together at the beginning of the project with different objectives, same goal and disengage at the completion of the project.

E-procurement

E-procurement is an automated, Internet-based way for a company to purchase the goods and services it needs to carry out businesses (Salkute, 2013). The systems facilitate direct links with suppliers of goods, thereby reducing the paperwork. Construction companies use E-procurement to reduce original procurement cost. In this study, the definition of e- Procurement adopted is in line with Regulation 340 of the Tanzania Public Procurement Regulation, in the study of Makoba et al., (2017), which defined e-procurement as the use of information and communication technology in conducting procurement functions such as e-Planning, e-Advertising, e-Submission, e-Tendering, e-Auction, e-Purchasing, e-Awarding, e-Contracting and e-Payment.

E-procurement is not about “electronic” but procurement because of its processes and end results. The use of the term “electronic” is more of a catalyst than a factor. The benefit of the system determines the level of its adoption. Nawi et al. (2016) in his research identified cost savings and increased efficiency, faster government procurement process and higher transparency compared to the traditional procurement and tendering methods, as the benefits derived from adopting the e-Procurement strategy in the Malaysian construction industry. Salkute et al. (2013) explored the adoption of the e-Procurement strategies in India and China with respect to the tangible benefits and the associated risks by using Indian and Chinese firms as a case study. The authors identified tangible cost benefits as the drivers for companies to implement the e-Procurement solution. In another research by Akpehe (2016) which explored the value benefits of e-Procurement in the Nigerian construction industry with emphasis on the quantity surveying firms operating in Nigeria, it was revealed that the majority of respondents demonstrated a good knowledge of e-Procurement especially e-tendering and e-notification. The benefits associated with these were identified to include improved communication, reduced paper work, improved data management, reduced bottle necks, operational costs and lower procurement cost. The drawback of the research was the restriction to only quantity surveying firms in the Nigerian construction industry.

Barriers to e-procurement refers to those factors that inhibit the uptake and smooth implementation of the e-Procurement technologies, tools, and processes by organizations (Ibem et al., 2016). Barriers to e-Procurement adoption include: lack of e-procurement knowledge; lack of a recognized legal frame work; lack of data exchange standards; lack of business relationships with suppliers; lack of capital; lack of technologies and tools; resistance to change; and lack of top management support; and security concerns (Hawkling et al., 2004; Gunasekaran, 2009). In Nigeria, internal and external interoperability of e-procurement software; complicated procedures and extended relationships; confidentiality of information; prevention of tampering with documents; resistance to changes; and enforceability of electronic contracts were considered barriers to the adoption of e-procurement in the construction industry (Bello and Iyagba as cited in Ibem et al., 2016).

2) Transfer: Shifting the responsibility of responding to a risk or the negative impact of the risk to a third party. However, risk should be transferred to the party who can best control it.
3) Reduce: Stakeholders may decide to split the risk between them through a contractual agreement, and
4) Accept: This refers to accepting or retaining a risk in cases where it cannot be avoided or transferred. In these instances, a contingency response is implemented in case the risk becomes a reality. It is considered as an action to reduce the negative impact on the project if the risk materializes.

RESEARCH METHODS

The data used for the research were collected through literature review and questionnaire. The first was to facilitate the research work in achieving the first objective, "Identifying risk factors associated with the adoption of e-Procurement. Fifteen (15) risks of e-Procurement and four (4) response strategies were identified, which provided the basis for the formulation of the questionnaire.

Subsequently, a quantitative research approach was adopted for the conduct of the study. Quantitative research technique is described as an investigation into an identified problem, based on testing a theory, measured with numbers or other known numerical entities, and then the data obtained are analyzed using statistical techniques or methods (Saunders et al., 2007). As such, the approach adopted abides with the various states of scientific research and data analysis and subsequently having findings that are considered generalizable data as it relates to the practice of e – Procurement in the Nigerian construction industry.

Survey questionnaires were sent to 139 target respondents who were identified based on purposive sampling technique, where the respondents were selected based on their direct involvement in e procurement in the study area. The target population are the clients', contracting firms and consulting firms in Nigeria and specifically Kaduna state. Purposeful sampling is described as that which selects information rich and appropriate cases for the conduct of a study. The primary logic of purposeful sampling in research lies in selecting information-rich cases or sources of data. Sourcing data from information-rich cases or respondents yields more reliable data as the respondents are considered to be well versed, knowledgeable, and experienced with respect to the subject, and thus provides an opportunity of providing relevant and effective feedback (see Patton, 2002). The adoption of the purposive sampling in this research is borne out of the reason that with respect to the Nigerian practice of e-Procurement in the construction industry; it is considered a specialized research area, thereby limiting the population size.

Descriptive statistics is used to analyze the data collected. Furthermore, analysis of variance was used to know the significant difference in the perception the stakeholders. These analyses were conducted using the Statistical Package for Social sciences (SPSS version 20.0) software.

Table 4; Work section of respondents in the organization

Work Sections	Number	Percentage
Physical Planning	13	22%
Procurement Unit	19	33%
Others	26	45%
Total	58	100%

Awareness of e-procurement solution

The research deemed it's essential to know the level of awareness of e-Procurement solution amongst the respondents. The essence of this is to ensure that the respondents have the basic idea of the technological innovation of e-Procurement. It was observed that 32 (55.2%) of the respondents indicated they have good knowledge of e-Tendering; while 23 (39.7%) have knowledge of e-Information/Notification; 15 (25.9%) e-Contract Management and E-ordering; 14 (24.10%) e-Awarding; 12 (20.7%) e-Sourcing,; 11 (19.0%) e-markets; 9 (15.5%) e-invoicing; 4 (6.9%) E-MRO and Web-Based Enterprise Resource Planning (ERP) and the least with 2 (3.4%). E-Reverse Auctioning. This demonstration of significant awareness of E-Tendering was expected as it is an aspect of e-Procurement solutions that has attracted much attention by both researches and practitioners in the construction industry (Gandu, Musa, Chindo & Abdu, 2017). Aside from being aware of e-procurement, to further demonstrate knowledge of e-procurement tools, the respondents were also asked whether their organization exchange project data electronically. The result revealed that 55(94.83%) of the respondents admitted exchanging project data electronically, while 3(5.17%) responded to the contrary. The tools predominantly used for the electronic data exchange were: Email 55(94.83%); static website 43(74.14%); fax 2(3.45%); social media (0.00%); and others 12(20.69%).

Risk factors associated with the adoption of e-procurement

In line with objective 2 of this study, results of the impact of the risk factors associated with the adoption of the e-procurement by the individual stakeholders are presented in Table 5.

From Table 5, it can be deduced that the top risk factors associated with e-Procurement from the client perspective are: Lack of clear understanding of the e-Procurement technologies, unreliable power supply; lack of skilled personnel; lack of enough training on the use of e-Procurement; security and control of the e-Procurement process. While inadequate financial resources and software non-compatibility happens to be the least.

The top risk factors from the contractors perspective are: unreliable power supply, lack of enough training on the use of e-Procurement, lack of widely accepted standards, inadequate technological infrastructure, and unreliable internet and telephone connectivity. While, unsupportive organization, lack of suppliers capability, and software non-compatibility happens to be the least.

risk factors. Moreover, the client and contractor stakeholders do have a similar view on software non compatibility as the least risk factor associated with the adoption of e-Procurement.

Table 6; General Assessment of Risk Factors Associated with the Adoption of E-Procurement

Risk factor	Mean	Std. Deviation	Rank
Unreliable power supply	3.62	1.254	1
Lack of enough training on the use of e-procurement	3.55	0.976	2
Unreliable internet and telephone network	3.53	1.173	3
Lack of clear understanding of the e-Procurement Technologies	3.45	1.062	4
Security and control of e-procurement process	3.36	1.180	5
Lack of skilled personnel	3.34	0.965	6
Inadequate technological infrastructure	3.33	1.176	7
Lack of widely accepted standards	3.24	1.113	8
Insufficient/ lack of upper management commitment	3.16	0.841	9
Unsupportive organization	3.16	1.182	10
Inadequate financial resources	3.07	1.122	11
High cost of training	3.05	1.067	12
Computer virus and worm attacks	3.04	1.267	13
Regulatory and legal control	3.03	1.092	14
Lack of supplier capability	2.98	1.192	15
Software non- compatibility	2.91	1.189	16

From Table 6, it is evident that unreliable power supply (mean 3.62); lack of enough training on the use of e-procurement (mean 3.55); unreliable Internet and telephone connectivity (mean 3.53); clear understanding of the e-procurement technologies (mean 3.45) and security and control of e-procurement process (mean 3.36) are the most important factors that influence the implementation of e-Procurement while lack of supplier interest (mean 2.98) and software non-compatibility (mean 2.91) are the least.

Comparison of perception of major stakeholders on risk factors associated with the adoption of e-procurement in Nigerian construction industry

Table 7 presents a comparison of the perception of major stakeholders (clients, contractors and consultants) across the risk factors associated with adoption of e-Procurement in Nigerian Construction Industry using ANOVA.

Table 7: Comparison of the perception of major stakeholders

Anova: Single Factor

Summary

Groups	Count	Sum	Average	Variance
Clients	18	51.27586	3.204741	0.049698
Contractors	18	51.21429	3.200893	0.138244
Consultants	18	53.4619	3.341369	0.091446

Anova

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	0.204883	2	0.102441	1.099991	0.341657	3.204317
Within Groups	4.190815	45	0.093129			
Total	4.395698	47				

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time (Kim, 2006). So, there is a necessity for efficient materials handling with the purpose of control, productivity and cost in construction projects (Patel, Pitroda and Bhavsar , 2015). However, there are monetary trade-offs between high capital costs of mechanised systems, and increased labour costs in manual systems and types of manual handling that occur in such places (Webster etal., 2014). The next section focused on the sub-themes, automation and manual order picking, material handling equipment and storage equipment

Automation and Manual order picking

The factors that impact the measure of manual handling inside warehouses and distribution centres are multifaceted and inter-locking. The main element is the strategy of the order picking system, especially how much automation is utilised and whether pickers move between pick spaces or whether items are automatically delivered to them (Webster et al., 2014). Order picking typically account for 50-75% of the total operational expenses for a warehouse (De Koster, Le-Duc, and Roodbergen, 2007). Any inefficiency in order picking can lead to unsatisfactory service and high operational expenses for the warehouse, and the entire supply chain (De Koster, Le-Duc and Roodbergen, 2007).

Manual order picking methods are slower as the picker must handle and read the paper, while if picking orders are given by a pick by voice method, this operation is removed. Systems, for example, pick to light, that show automatically where the picker can expect to locate the next item to pick, are likewise faster since they remove the operation of searching for the correct pick slot (Webster et al., 2014). Where order pickers need to move from the storage area, the movement time is an increasing dimension of the travel distance (De Koster, Le-Duc and Roodbergen, 2007). In addition; the conventional manual method utilised occasionally gives unreliable information with respect to the materials. Problems concerning the monitoring and locating of materials on-site have become an incredible concern in construction industry as materials always come in bulk without proper identification (Kasim et al., 2012).

On the other hand, bar coding alludes to the fixing of computer decipherable codes on items, cartons, containers and trucks. These bar codes increase efficiency in three ways: speed, accuracy and reliability (Sople, 2010). In addition, automated methods are beneficial, as the processes of both order pickers and operatives moving new stock to storage locations are documented by the Warehouse Management System (WMS). Most importantly, Aberdeen Group (2009) observed that 70 % of best-in-class organisations are more probable than other organisations to accept products without utilising paper documents. All have moved to the utilisation of barcodes, RFID or voice technology. In a similar study by Gwynne (2014) it was shown that various producers have presented a joined voice and automated guided vehicle (AGV) or laser guided forklift truck system. By implementing both systems simultaneously, productivity improved by up to 70%. A related investigation by Tambovcevs (2012) establishes that Enterprise Resource Planning (ERP) system merchants need to work with manufacturing and construction industry professionals to improve more customised results for manufacturing and construction companies. In addition, the recommended that the application of ERP can give considerable benefits (Tambovcevs, 2012).

RESEARCH METHODOLOGY

This study is an objective problem in need of observation and measurement; hence a quantitative research method was adopted. A case study research approach was employed, where six construction material (cement, reinforcement bar, ceramic tiles, gravels, hollow sandcrete block and sand) manufactured and distributed within five states capital and Abuja in the North-Central Nigeria were selected for this study. The study used purposive sampling method because the study obtained information from specific group of manufacturing industries. Multistage sampling was used, which comprised of 10 manufacturer's warehouses/plants, 42 distribution centre/ warehouses and retailer stores and 30 construction sites. This is supported by Yin (2009) that a flawless case study should use a research plan including multi-sites to be examined, and different strategies to examine the data collected.

The node versus links method is by far the most suitable way to observe the logistics system in a construction context (Shakantu and Emuze, 2012). Thus, the unit of analysis was the current material handling operations at the manufacturers' warehouse (node) and their transport delivery (link) to the distribution centres/ warehouses, retailers store and sites provided the starting point to understanding the context of the problem. The data was collected using primary records through non-participant observations and measurement of material handling operations in a form of template. This is in consonant with the recommendation by Kamali, (2018) that a different method like the observation could help more to understand how the on time delivery performance is implemented by firms. A modified pallet equipment used in the study by Baker and Perotti (2008) was adopted for material handling equipment and storage equipment.

To conduct a valid field study, the variables used in the research instrument includes; order picking methods, material handling equipment, storage equipment/methods, type of vehicle, actual volume/capacity of vehicle, quantity of material driven per vehicle, vehicle loading and offloading time, loading equipment, the number of staff used for material loading/ offloading, the cost of loading/offloading each vehicle, cost of transport per each delivery and location of delivery. These were for72 orders processed and delivered by transport providers to the various locations within the study area. The descriptive method of data analysis was employed using percentage and results presented in a form of bar charts and interpreted directly.This kind of descriptive study can be informative when there is little knowledge and understanding of a phenomenon (Loeb, Dynarski, McFarland, Morris, Reardon, and Reber, 2017).

ANALYSIS AND RESULTS

The analysis was done using percentage. A percentage is calculated by dividing the number of times a value for a variable observed, by the total number of observations in the population, then multiplying this number by 100. The result is then presented in a form of bar chart which represents the proportional value of the variable. The result of analysis of automation in construction material handling utilised by the material manufacturing companies is presented in this under the

Storage Equipment used in Manufacturer's Warehouses

Another, impetus for the study was an evaluation of the automation of warehouse, such as types of storage equipment and efficient utilisation of storage space. Pallet storage equipment used in UK warehouse by Baker and Perotti (2008) was adopted for storage equipment. Figure 3 established 88%, 6% and 6% of the companies used floor/ block, double deep and pallet floor racking storage equipment respectively. The major finding was majority of the companies used floor/block storage method which suggest low take up of pallet storage equipment in the warehouses. With the low adoption of storage equipment and racks give less support to loads as well as make the load accessibility and handling problematic.

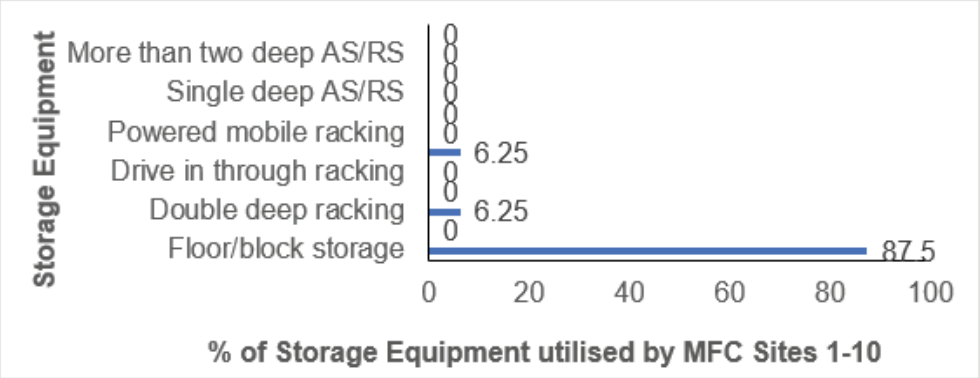

Figure 3 Storage Equipment used in Manufacturer's Warehouse

Method of Loading and Offloading Vehicle

The study sought to understand the type and level of automation adopted to increase efficiency in loading and offloading vehicle. Therefore, data on the method of loading vehicle at the manufacturers warehouses and offloading of vehicles at the Distribution Centres /Warehouses (DC/WH), retailers stores, and construction sites were analysed and presented in figure 4.

The analysis results indicated that 40% of the companies used manual methods of loading at the manufacturer's warehouses and sites. The other companies used pay loaders (16.67%), forklift trucks (14.29%), high level cranes (14.29%) and automatic loaders (14.29%) to load material. The major finding was that more than half (60%) of the company warehouses were automated. This signify operational efficiency, in terms of increase in speed, accuracy and productivity while reducing repetitive or potentially unsafe manual labour.

In addition, the findings established that 75% of DC/WHs, retailer stores and sites used manual methods of offloading material. But, 25% used the tipping method, which was basically for sand and parts of granite. It was also observed that trailers were used to transport granite. Since they cannot tip off, the material was manually offloaded. This signify high operating time, cost, multiple handling and low productivity.

Cost of Loading and Offloading material

The relationship of average cost to load and offload individual material per ton is shown in Figure 6. The results confirmed that the average cost of loading per ton at the manufacturer's warehouses were as follows: cement (₹56.62/ton), reinforcement bars (₹425.63/ton), ceramic tiles (₹507.99/ton), granite (₹78.16/ton), blocks (₹179.73/ton) and sand (₹151.66/ton).

In addition, the chart reveals that the average cost of offloading at the distribution centres, warehouses, retailers stores and construction sites were as follows: for cement (₹274.70/ton), reinforcement bars (₹861.24/ton), tiles (₹537.31/ton), granite (₹150.07/ton), blocks (₹179.37/ton) and sand (₹25.53/ton). The average cost of offloading reinforcement bars per ton was the highest, probably because this involves offloading, bending and stacking them. However, it should be noted that ceramic tile companies used both forklift trucks and manual labour when loading at the manufacturer warehouses.

The major finding was that the average cost of offloading materials/ton was higher than the average cost of loading, except for blocks and sand. This may be explained by the fact that blocks are both loaded and offloaded manually. The cost of loading sand is higher because most companies did this manually, but they offloaded mechanically by tipping off.

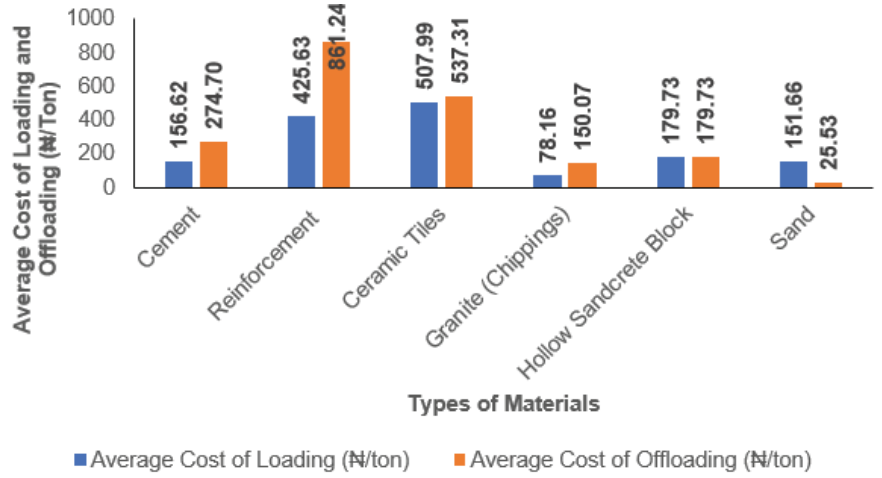

Figure 6 Average Loading and Offloading Cost Per Ton

DISCUSSION OF RESULTS

Order Picking Method Use in Warehouses

The study established that most of the companies used the paper-based picking method. This confirmed submission by Webster et al., (2014) that manual order picking methods are slower as the picker must handle and read the paper. This could lead to error if the writing is illegible or if there is confusion over the way it is written. This all adds time to the operation (Gwynne, 2014). This slow manual operations lead to low throughput, long lead time and high labour costs in the warehouse operations. In addition; it creates problems of monitoring and locating of materials on construction site because materials always come in bulk without proper identification (Kasim et al., 2012). Which is contrary to the use of bar codes that will lead to a reduction in human mistakes, and an increase in the speed,

handling equipment at terminals should be provided for rapid loading and offloading to save time and cost. More so, it also contradicted the view that block manufacturers normally use self-loading vehicles with cranes mounted on the edge or on a removable mounting (Vidalakis and Sommerville, 2013). This truck equipment allows for extra grades of movement for handling unit loads (Hannan, 2011).

It can now be deduced that the use of loading equipment at the manufacturer warehouses was minimal, while there was no offloading equipment at the distribution centres/ warehouses, retailer stores and sites. Hence, loading processes at the manufacturer plant/warehouses, and offloading of vehicle processes at the distribution centres/ warehouses, retailer stores and sites were inefficient.

Load and Offloading Time

The study sought to confirm the average time taken per ton for loading and offloading each material. The results revealed much disparity in the average time taken per ton for loading and offloading each material. It took much lesser time per ton to load at the manufacturer plants where the loading was done mechanically. On the contrarily, it took more time per ton to offload at the distribution centres/ warehouses, retailer stores and sites where most offloading was done manually. These processes combined used fewer machines, but more manual labour that involved multiple handling.

These findings contradict the assertion by Pienaar (2016) that using high capacity technology to carry and handle large bulk loads can help in minimising loading and offloading times. However, the offloading process can be more efficient and enhanced by 61% if it improves its information systems (Andrejić and Kilibarda, 2016). Therefore, the efficiency of loading and offloading processes time per ton is sub-optimal.

Loading and Offloading Costs

The study also revealed much disparity in average cost per ton for loading and offloading individual materials. It costs less per ton to load than to offload in companies where most of the loading was done mechanically at manufacturers warehouse, as against most offloading being done manually at the distribution centres/ warehouses, retailer stores and sites. This findings supports the fact that the use of automation in material handling can increase efficiency, control costs, and optimise productivity (Bouh and Riopel, 2015)

The findings corroborate Michaels' (2015) submission that the more multiple handling of material, the more the overall logistics expense. The implication is that the touch time costs are non-value-added costs that will never be recovered when an invoice is calculated for the load (Niggi, 2017). Thus, for construction material handling, the efficiency of loading and offloading cost per ton were sub-optimal.

CONCLUSION AND RECOMMENDATION

Automation of construction material handling is usually considered as a method of reducing cost. However, the study concluded that the combined processes of order picking, handling equipment, storage, loading and offloading used less

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The essence of all site investigations is to obtain data which will adequately quantify the variability of the geotechnical properties of the site. Standard Penetrometer Testing (SPT) provides a rapid and cost effective means by which this objective can be achieved. There are several techniques available for the interpretation of the settlement behaviour of saturated soils (Poulos and Davids, 2005). These procedures or techniques are also conventionally used by the practicing engineers towards the estimation of the settlement behaviour of soils that are in a state of unsaturated condition. Vanapalli et al. (2008) suggest that such a practice is due to the following reasons; (i) the estimated bearing capacity and settlement of the unsaturated soils based on conventional soil mechanics for saturated soils provide conservative analysis, and (ii) the lack of a valid framework to interpret the bearing capacity and settlement behaviour of unsaturated soils.

In Nigeria, soils in some engineering construction sites are problematic and create serious threats and adverse effects to foundations of structures and the structures themselves. These soil problems have led to excessive settlement, tilting and collapse of many buildings not only in Nigeria but also around the world (Salahudeen et al., 2016). For successful analyses to be performed, the behaviour of soil should be modelled realistically. Numerical modelling is a powerful mathematical tool that makes it possible to solve complex engineering problems. The constitutive behaviour of soils can be successfully modelled with numerical analyses using some basic soil properties as input data. The finite element method is one of the mathematical methods in which continuous media is divided into finite elements with different geometries. It provides the advantage of idealizing the material behaviour of the soil, which is non-linear with plastic deformations and is stress-path dependent, in a more rational manner (Ornek et al., 2012).

Numerical modelling method that better represents soil constitutive behaviour is required to develop an improved approximation of foundation soil axial compression. Also, there is need to investigate and determine the most appropriate methods that are most suitable to Nigerian soil peculiarities and distinctions based on SPT results, been the most common and economical geotechnical field test technique used in Nigeria. This study focused on the prediction of foundation axial compression using conventional models (analytical methods based on developed formulae) and Plaxis 3D numerical modelling. The specific objectives were to estimate the axial compression of foundation soils from measured penetration resistance in terms of the SPT N-values at varying depths, to evaluate conventional design equations for foundation settlements based on different constitutive models and to model foundation axial compression numerically using PLAXIS 3D software and compare the results of the conventional methods with those of numerical analysis.

RESEARCH METHODOLOGY

This study made use of Standard Penetration Test (SPT) data conducted at five boring depths of 0.6, 2.1. 3.6. 5.1 and 6.6 m. Computations of foundation soil axial compression were done at footing thickness of 0.35 m and applied foundation pressures of 10, 50, 100, 200 and 300 kN/m2 which represent the applied structural loads on the foundation. A square footing with plan dimension of 1.5 m2 was considered for the study.

more reliable semi-empirical methods for estimating the elastic settlements. Based on the results of a study of the observed settlements at 48 sites, Schultze and Sherif (1973) developed an empirical method to estimate the settlement of shallow foundations on sand using SPT results. The analytical models used in this study were considered based on their recommendations in literatures.

Numerical Modelling

The numerical analysis of foundation settlement was performed with finite element method (FEM) using 3-D non-linear finite element analysis software, Plaxis, a finite element code. The input data in Plaxis were from the processed SPT results. The Soil properties and material properties of the footing used for numerical analysis and general computations are presented in Tables 2. The software portfolio includes simulation of soil and soil-structure interaction. Soil layers were defined by means of boreholes which is a method specific with Plaxis 3D. Structures were defined in horizontal work planes. Details on this topic can be found in Plaxis 3D Manual (2010). The boundary conditions used in this study is a situation where the soil model bottom is restricted from movement in all directions (fixed in all of x, y and z-axes), the two sides are horizontally fixed and restrained from movement but vertically freed to move (fixed in x, and z axes but free in y-axis). The mesh type used throughout the study was medium mesh which was found most suitable for the soil type considered for the study.

Table 2: Soil properties for numerical analysis and general computations

Parameter	Unit	Values according to depth of SPT boring				
		0.6 m	2.1 m	3.6 m	5.1 m	6.6 m
SPT N-value (N)	-	10	16	22	27	34
Corrected N-value (N_{60})	-	8.93	14.28	19.64	24.10	30.35
Unit Weight	kN/m^3	19.88	17.32	18.18	18.27	20.43
Friction angle	Degree	29.73	31.27	32.78	34.02	35.71
Cohesion	kN/m^2	9.20	12.90	12.30	10.80	15.92
Young's modulus	kN/m^2	4463	7140	9818	12049	15173
Poisson's ratio	-	0.171	0.194	0.217	0.235	0.261
Soil model	-	Mohr-Coulomb				
Soil behaviour	-	Drained				

Standard Penetration Test

The standard penetration test (SPT) was conducted in accordance with ASTM D-1586-99 (2001). The N-value was first corrected to an average energy ratio of 60% (N60) before used to correlate soil properties. Because of the greater confinement caused by the increasing overburden pressure, Bezgin (2010) recommended a correction to average energy ratio of 60% (N60) to the field values of the SPT N-values. The correction factors used in the study are those proposed by Das (2011) to standardize the field penetration number as a function of the input driving energy and its dissipation around the sampler into the surrounding soil. SPT was conducted at five depths at interval of 1.5 m. It should be noted that this study was focused on the use of SPT data to generate soil properties that are used for the

strain curves show a tendency to decrease with increased depth which implies that higher values of settlements are expected from the soils in the southern zones compared to the northern zone. The variations of vertical strain and Poisson's ratio with SPT depth are shown in Figure 2.

For the calculation of elastic settlement, relations for the theory of elasticity are used in most cases. These relations contain parameters such as modulus of elasticity and Poisson's ratio. Poisson's ratio of a material is the ratio of lateral strain to longitudinal strain resulting from a change in normal stress and also presents the elastic behaviour of the material. The nearer the Poisson's ratio to 0.5, the more plastic the material will be and the nearer the Poisson's ratio to 0, the less plastic that material will be. The value of Poisson's ratio in soils ranges extensively from 0.1 to 0.5 (Kalhor and Azadi, 2013). Essien et al. (2014) attributed the low values of Poisson's ratio in Akwa-Ibom state (south-south zone of Nigeria) to the complex muddy materials and flooding events in this region. The results of Poisson's ratio in this study, 0.171 to 0.261 respectively at 0.6 and 6.6 m depths, show that soil is not truly an elastic material but rather elasto-plastic in nature.

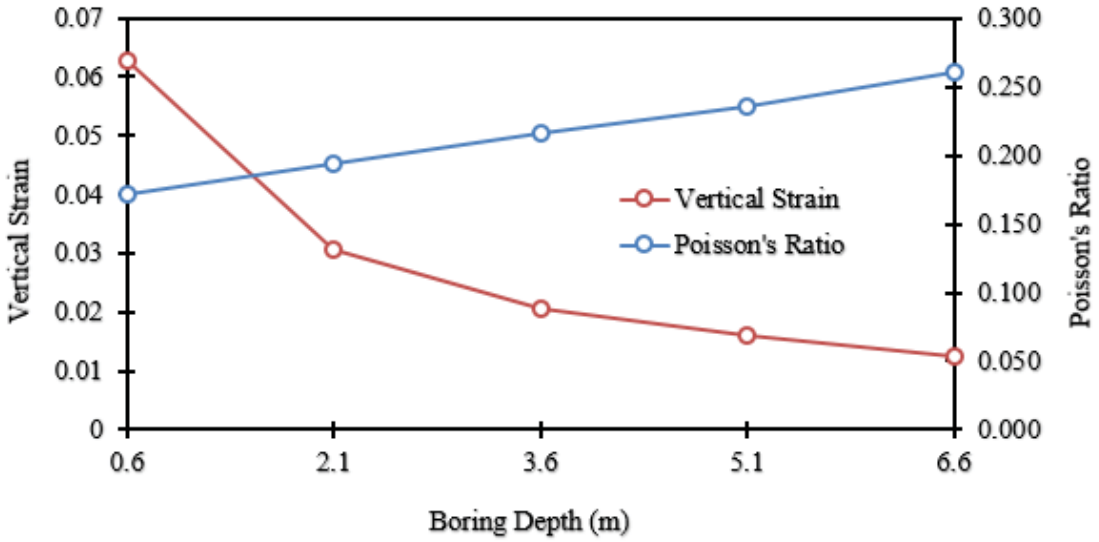


Figure 2: Variation of vertical strain and Poisson's ratio with boring depth

Compressibility Index and Coefficient of Volume Compressibility

Compressibility characteristics of soils are often the most important parameters for axial compressibility evaluation of the founded layers. The compressibility of a soil mass is its susceptibility to decrease in volume under pressure. The main source of inaccuracy in the prediction of both magnitude and rate of consolidation settlement in the laboratory compared with in-situ measurements are the inaccuracies in the measurement of consolidation characteristics such as compressibility index and coefficient of volume compressibility (Aysen, 2002). The variations of compressibility index and coefficient of volume compressibility respectively with boring depth are shown in Figure 3. The values of compressibility index and coefficient of volume compressibility respectively decreased from 0.07983 to 0.01439 and 2.08 x 10-4 to 5.38 x 10-5 m2/kN.

The observed trend is in line with observations of Rasin (2009). A comparison carried out by Shahin et al. (2000) based on field measurement and artificial neural networks (ANN) results of three settlement prediction methods rated the Schltze and Sherif (1973) method as the best for estimating shallow foundation settlements. Ahmed (2013) rated the semi-empirical method proposed by Schmertmann et al. (1978) as best among others. In a study carried out by Salahudeen et al. (2017) in the South-East region of Nigeria based on 425 case history and 3825 database, a comparison of fifteen empirical/analytical methods was made and methods proposed by Schmertmann et al. (1978), Burland and Burbidge (1985), Terzaghi et al. (1996), Mayne and Poulos (1999) as well as Canadian Foundation engineering Manual (CFEM) (2006) were considered to give good estimations of foundation settlement. This could be due to consideration of several conditions that applied in all types of soils in the development of these models. In a detailed study by Raymond (1997) and Salahudeen and Sadeeq (2016; 2017) comparing several elastic methods of predicting foundation settlement rated the method proposed by Steinbrenner (1934) as best of all elastic methods. This could be due to the fact that Steinbrenner's method considered all the footing dimensions in addition to several other considerations which is rarely done in most other methods.

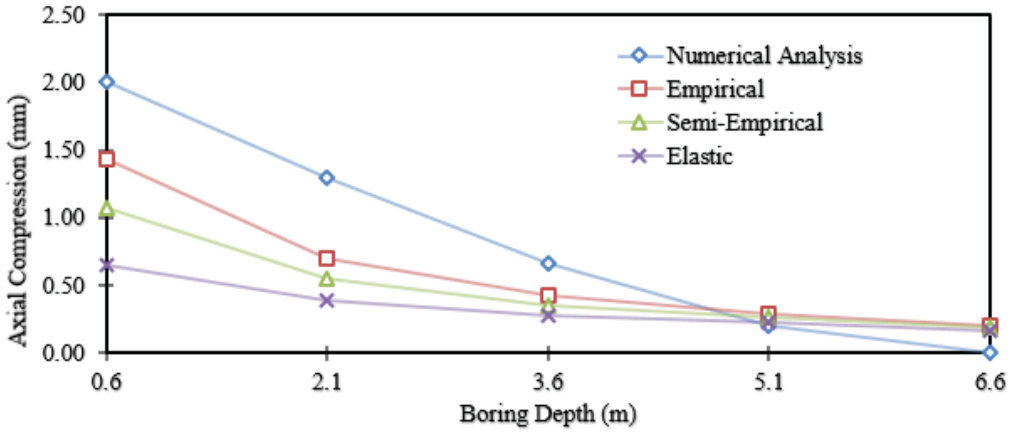


Figure 4: Variation of axial compression with boring depth for 10kN/m^2 loading

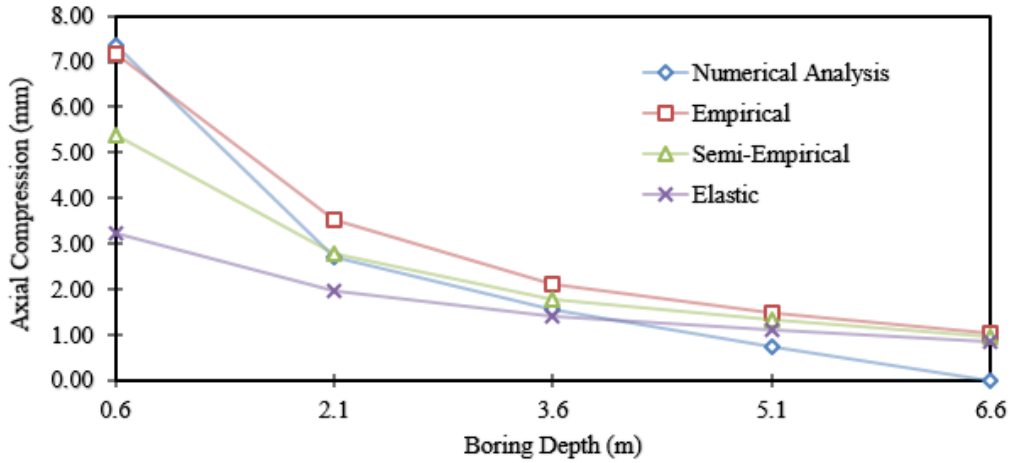


Figure 5: Variation of axial compression with boring depth for 50kN/m2 loading

Numerical Analysis Soil Models

The numerical analysis results of soil models showing the different soil layers, unstructured mesh and soil body deformation at collapse of the soil body at 0.6 m foundation embedment depth is shown in Figures 9.

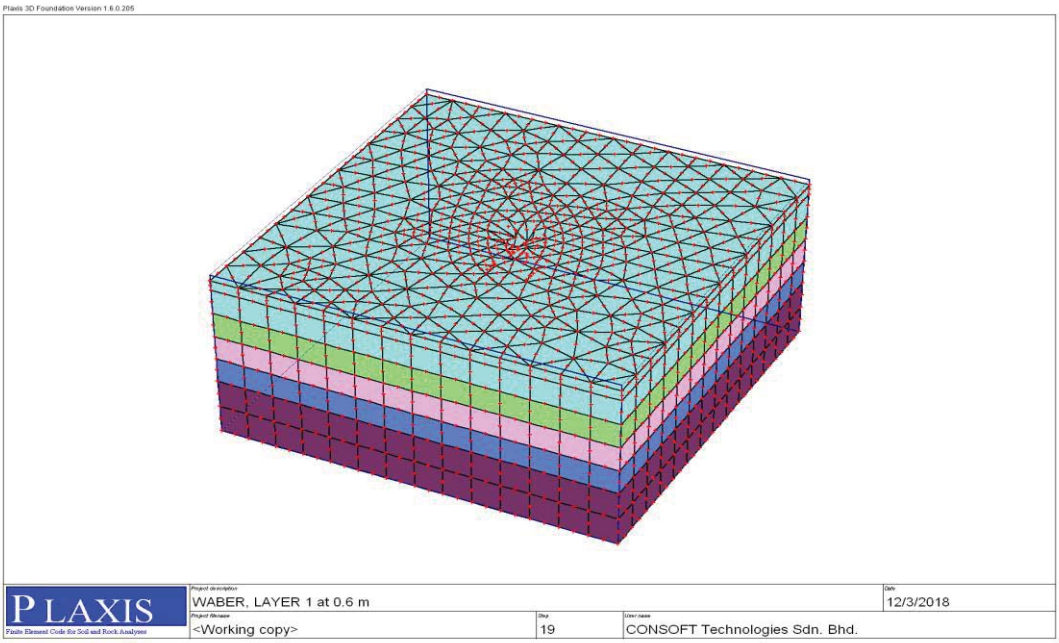
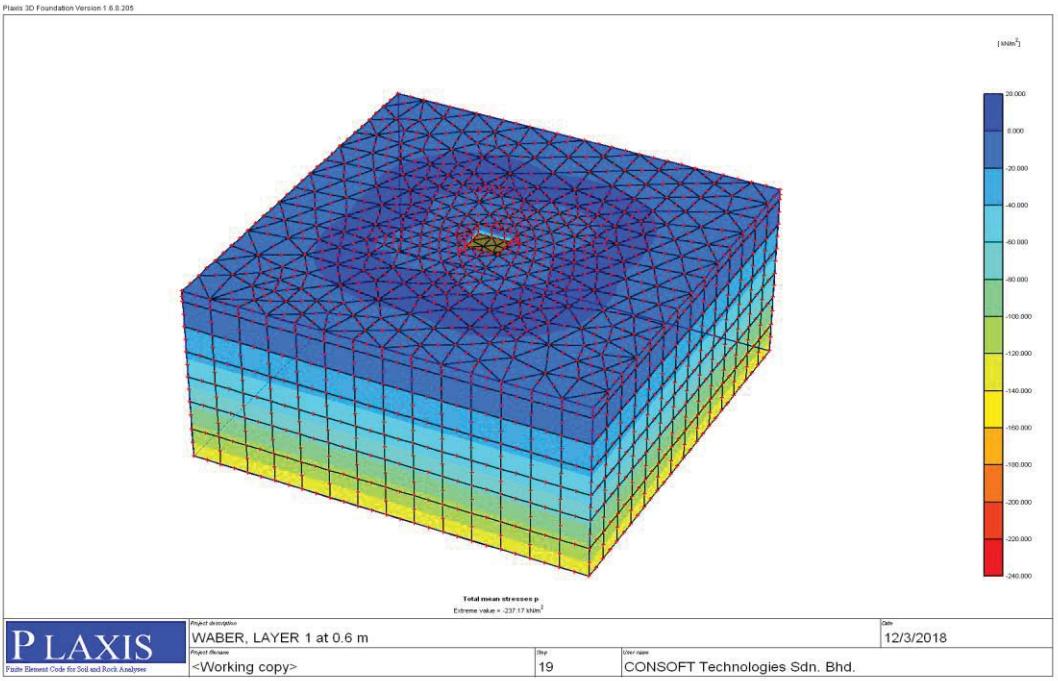


Figure 9: Numerical analysis mesh showing deformation of the soil body

The numerical analysis results of soil models showing stresses distribution in the soil body at collapse at 0.6 m foundation embedment depth is shown in Figures 10.



modelling, as an emerging technology is very useful for predicting the actual and exact value of foundation settlement owing to its consideration of the actual soil constitutive model.

RECOMMENDATIONS

Based on the results of the study carried out, it is recommended that foundation settlement be modelled numerically for both research and real life design.

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INTRODUCTION

The United Nations Environment Programme (UNEP) reports that the built environment contributes approximately 40% to global energy consumption and approximately 36% in greenhouse gas emissions [1]. Johannesburg, a metropole in South Africa, has been ranked as one of the most polluted cities in the world. This is due to the heat island trapping dust from mining, carbon emissions form factories and vehicles, domestic coal burning and waste disposal and incineration [2]. According to the World Health Organisation, Pretoria is the second most polluted city in South Africa, followed by Cape Town and Durban [3]. Urban areas not only see an increase in the carbon dioxide emission and Urban Heat Island Effect, but also see a decrease in vegetation and biodiversity [4].

The increasing number of studies on living walls in the recent decade indicates the increasing interest regarding the environmental benefits of this greenery system [5]. Greenery systems such as green roofs and green walls have been around for centuries and provide a sustainable solution to mitigate the negative impacts that the built environment has on the surrounding environment [1]. Although they have been around for centuries, urban vegetation systems are a relatively new concept in South Africa, a developing country. Currently there is a demand for green urban systems in South Africa and the materials are readily available to have the systems constructed, however industry professionals lack knowledge thereof [6]. Developing countries like South Africa are facing certain barriers that demote the development of green walls. As South Africa has one of the most polluted cities in the world [2], it is imperative to develop green sustainable urban buildings, however the barriers needs to be overcome. Green walls are seen as a green sustainable development that could mitigate the negative effects of the built environment [1][5][7][8][9][10], and this study attempts to present green walls as a viable solution for developing countries.

The aim of this research is to determine the barriers of implementing green walls in the urban environment in developing countries. The objectives are to define and categorise green walls; investigate the advantages of green walls; determine the barriers for the implementation thereof; and finally present solutions for the barriers. A systematic literature review will be done in order to achieve the aim and objectives.

LITERATURE REVIEW

Defining green walls

A green wall is defined as a wall that is both partially or completely covered with greenery that includes vegetation and a growing medium e.g. soil, substrate and or water. Green walls have been around for centuries and date back to the Hanging Gardens of Babylon [1]. Green walls can be divided into two categories: green facades and living walls [7][8][9] as illustrated in figure 1.

Fig 2: Photo of a living wall indoors (left), indirect green façade (middle) and direct green façade (right)

Advantages of green walls

Green walls have various advantages depending on the type of green wall system. An experimental greenery system on an urban watershed was constructed in order to do a cost benefit analysis. From the experiment it is clear that the vegetation increases the albedo of the vegetation covered areas. Increasing the albedo of a surface allows for a greater amount of the incoming solar energy to be reflected rather than absorbed [12]. The size of the watershed is however smaller than the standard building and the experiment is limited to one climate. Nevertheless, green facades contributes to lower temperatures around buildings due to a higher albedo on the wall. Over and above the albedo effect, green walls create an insulating layer for the building, provides additional shading as well as evapotranspiration. A simulation study was done with the aim to determine the level of mitigation of heat stress by the addition of green walls. Is is found that green walls mitigate heat stress by 5-10% due to insulation, shading and evaporation [13]. The critic of the research is that it is only a simulation and real life measures should be done. Nevertheless, green facades leads to the mitigation of the heat island effect and the reduction of energy usage by the building, however the extent of the energy savings will differ with other climates. Djedjig, Belarbi and Bozonnet [14] did a comparative study on the energy savings potential between living walls and green facades. Both systems have a high potential of energy saving. The living wall system provided the highest cooling performance and achieved energy savings of 58.9% and the green facade reached an energy saving of 33.8%. Green walls thus contributes to the reduction of operational costs of a building [1]. Wind speeds are reduced between buildings [15]. Carbon sequestration occurs due to the vegetation that forms part of green walls [5]. This means that some carbon dioxide, a greenhouse gas, is taken out of circulation. In addition to the uptake of carbon dioxide, plants have long been observed to capture a variety of pollutants, and even partly bio-transform them with the aid of microorganisms that coexist in their microbiome [16]. Wolverton, Douglas and Bounds used a sealed experimental chamber with various plant types and various toxins and measured the amount of

The climate is the next difficult barrier to overcome. There are three climatic factors to take into consideration when designing green living walls: temperature and humidity levels; orientation; and wind [38]. Derkzen, van Teeffelen and Verburg [39] did a study on green infrastructure and concluded that people's awareness of climate impacts and their understanding of the benefits of green infrastructures, influence their preferences for green infrastructure measures. The general consensus remains that people are willing to support climate adaptation through green infrastructure as long as the green infrastructure is multifunctional, i.e., comes with recreational and aesthetic benefits. Lack of awareness and not understanding the benefits that comes with green walls serves as a barrier toward the implementation thereof.

Plants are dependent on light and the available light needs to be utilized effectively and the expected light conditions for living walls must be calculated prior to the plant selection. Light for plants is measured in terms of its quantity, quality and duration. The quality of light for plants is defined by its colour or wavelength. The quality of light is measured in lux and the duration of light is the amount of time per day that the plant has exposure to light [40]. Insufficient quantity of light is one of the drawbacks of living walls and the maintenance thereof.

It has been found that some cities have an uneven distribution of urban green infrastructure. Low green space cover have been linked to residents with lower socio–economic status of which includes Johannesburg in South Africa [41]; This is seen as a general challenge for future green infrastructure installations [42]. Unfortunately, the national building regulations of South Africa does not include any reference to green walls [43]. In South Africa, it is thus not compulsory by national regulations to develop and include greenery systems. This leads to slow adaptation and implementation.

Various benefits have been identified for sustainable development, nevertheless, stakeholders, especially in Africa, have not yet realised the claims as such [44] [45]. Barriers to implement green infrastructure in South Africa includes the perception of costs being higher than it actually are. Over and above that, the lack of incentives for greenery systems in South Africa contributes to this problem [46]. Urbanisation in Africa has generally been criticised for its perceived failure to contribute to sustainable development [47], however, limited guidance is available to African governments, planning institutions, and policy makers regarding how to address the sustainability concerns [48].

Solutions to implementing green walls

Governmental incentives and regulations strengthened by discounts and fines is one of the most effective stimuli to promote and help pay for sustainable living walls [49]. To increase the awareness of green infrastructures, however, educational programs could improve residents' willingness to support urban greening. Policy makers could also consider subsidies for example rent assistance or electricity subsidies [50].

The standardization of the metrics used to quantify living wall performance to compare data between systems will influence living wall optimization. Koehler cited in [28] begun to establish the criteria that includes appropriate units of measure and methodologies.

absorption and reduction of storm water run-off and provides greater biodiversity. Although the extent of the advantages are greater for the living walls, the barriers are also greater. Living walls are more expensive, requires more maintenance and water usage, as well as expertise. Even though the exact quantities and measures of units are not available, from the table it is clear which type of green wall system has greater advantages and/or barriers, what these advantages and barriers are and what type of green wall system could be suitable for a particular situation. A cost-benefit analysis would however be a helpful decision making tool with regards to the implementation of a certain green wall system.

Table 1: Advantages and barriers of green wall systems

	Direct green facades	Indirect green facades	Indirect green façade with planter box	Indirect green façade as double skin	Continuous living walls	Modular living walls
Advantages						
Increased albedo	*	*	*	*	**	**
Insulating layer	*	*	*	*	**	**
Shading	*	*	*	*	*	*
Evapotranspiration	*	*	*	*	*	*
Energy savings	*	*	*	*	**	**
Carbon Sequestration	*	*	*	*	*	*
Removal of pollutants	*	*	*	*	*	*
Sound absorption	*	*	*	*	**	**
Biodiversity	*	*	*	*	**	**
xerothermophilous	Cliff	Cliff	Cliff	Cliff	Vegetated waterfall	Vegetated waterfall
Biophilic design	*	*	*	*	*	*
Reduction of stormwater runoff	*	*	*	*	**	**
Barriers						
Installation cost	*	**	***	***	****	****
Published costs for guidelines	-	-	-	-	-	-
Maintenance	*	**	**	**	****	****
Water usage	*	*	*	*	****	****
Climate	*	*	*	*	*	*
Light	*	*	*	*	*	*
Expertise	*	**	**	**	***	***

behaviour. The following research is recommended: standardising of metrics of quantification of green walls; expected costs of the various types of green walls; detailed comparative studies on the various benefits and barriers of the different types of green walls; sustainable water usage for living walls in drought sensitive countries; the level of knowledge of professionals in the construction industry regarding green walls; level of awareness of green walls in developing countries; and cost-benefit analysis for the various types of green wall systems.

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Laws, standards and regulations governing the industry, are primarily designed to ensure safe working environment and delivery of sound structures of high integrity. Each stage of a project may require some permit or approval or certification of the preceding stage as a prerequisite to embarking on the new phase, or certain specialized skills or standard materials. This becomes a legal requirement, and prudent care and attention must be given to its satisfaction, failure of which may result in liability.

An overview of laws and regulations in the building industry

The Constitution of the Federal Republic of Nigeria CFRN 1999 classifies building/construction standards in the concurrent legislative list- meaning that the standards can be set by both Federal and State governments, but where there is a conflict the federal standard overrides the state standards.

Standard have developed over the years from customs, practices, materials and contracts to deliver structures of high integrity. Best practices in designs, materials, safety, labour, professions, monitoring and management are developed and continually modified in all aspects of building works, from planning to post completion (Onyema, 2017). The standards are called performance standards, and may be codified into laws or simply left as guidelines or enforceable clauses in a contract. Thus there are statutory regulations, which set compulsory minimum compliance standards and non-statutory guidelines, such as the national building code and ethics of the professional bodies- both complementing each other to ensure the integrity of the project, the welfare of workers and optimal health, safety and environmental practices. Federal laws applicable to the industry as elaborated by Onyema, (2017) include. Standard Organization of Nigeria Act (SON Act), the Land Use Act, Factories Act 2004, National building Code (NBC), Labour Act 2004, Industrial training Fund Act 2011 and State laws. All the laws and regulations are targeted towards human and environmental protection, yet its effects in arresting the frequency of building collapse has not been effective and at minimal given the current trend of building failure within the country.

Causes of building collapse in Nigeria

Due to the catastrophic impact and consequences of building collapse in Nigeria, several studies by researchers including Adenuga O.A (2012), Adeyemi E. O (2002), Chendo and Obi (2005) etc have identified numerous factors responsible for the incessant collapse of Buildings in Nigeria. These factors include

- Lack of soil test investigation
- bad design,
- faulty construction,
- non-adherence to approved standards,
- non-enforcement of building codes,
- use of substandard materials,
- engagement of quacks, poorly trained workers,
- unqualified builders and non-professionals,
- poor supervision,
- inadequate soil investigation,
- Lack of maintenance, greed and corruption....

Reasons for the continual collapse of building

Experts and professionals in the building and construction industry believes that non-implementation of existing laws by Town Planning Authorities because of the absence of political will by the different arms of government has been the major contributory factor. This is closely followed by the endemic poor work ethics and attitude among Nigerians as a consequence of the ever increasing demand for more pay in view of the consistently growing cost of living for the average citizen. Other three factors which include– falling standard of education; lack of continuing professional development, bribery and corruption are not viewed as critical as the previously mentioned

The study area

Enugu is a city in south-eastern Nigeria and the capital city of Enugu State. The city, which is dominantly populated by people of the Igbo ethnic group, is a medium-size, but rapidly growing urban centre located on latitude 6° 27‖ 10ǁ North of the Equator and 7° 30‖ 40ǁ East of the Greenwich Meridian. It is sited within the tropical rain forest region of Nigeria with a derived savannah. The city has witnessed immense growth in the size of built-up areas, a number of immigrants, transportation, and commercial activities since it became the capital of the Eastern Region after Nigeria's independence in 1960 and has attracted both foreign investors and private developers; a succession of territorial adjustments in 1967, 1976 and 1991 led to Enugu becoming the capital of what is now Enugu State, therefore whatever practice obtainable in Enugu state is assumed to be the standard in the south east as a whole. The city had a population of 722,664 and ranked 9th most populous state according to the 2006 Nigerian census and many are still trooping into the city. It covers a total area of 215 sq mi (556 km2) with a population Density of 3,400/sq mi (1,300/km2) and situated in the Cross River basin and the Benue trough and has the best developed coal in this area.

Enugu is characterized by administrative occupation due to the presence of colonial administrative headquarters, state government and the local government seat in the city, and this has influenced the real estate investment as the city is believed to be a greener pasture for many rural dweller seeking for a better standard of living, this has encouraged rural-urban movement in favour of the city. More so, this has also stimulated the demand for residential and commercial space leading to an outburst of mass housing construction projects embarked upon by the state government, corporate organization and private individuals. A major type of residential property springing up in Enugu is estate housing to cater for the ever increasing demand for accommodation.

RESEARCH METHODOLOGY

Methodology comprises the theoretical analysis of the body of methods and principle associated with a branch of knowledge. (Berg, Bruce L., 2009). It refers to entire process used in obtaining information and data for a successful study. This study is survey approach which involved gathering and collection of primary data. Primary sources of data was employed and it provided direct or first-hand information about the study. This quantitative research dwelled on obtaining responses from respondents with the use of questionnaires, distributed and collected by hand by the researcher. The population for this study is the 3 Local

3. Evidence of ownership (C of O, deeds of assignment, deed of need)
4. 3 year tax clearance. (if the land is located in a government layout, you obtain clearance from zonal officer in the ministry of lands)
5. Affidavit from court on facts.

When you bring building Plan to the town planning office; they assess the plan and give you bill for fees to be paid. It include;

i. Official fees for town planning
ii. Capital territory fees
iii. Fees for site analysis report and plan (SARP)

What the town planning office vet in drawings before giving approval

After survey and interview with town planners in the various approval offices, their standard and criteria for approval drawing assessment are listed below.

1) They make sure that the rules for setbacks are followed. That is 3m for sides and back of all buildings with 4.5m for the front for residential development and 6m for commercial development.
2) They make sure building project go along with the existing scheme. Whether the area is just for bungalow or maisonette.
3) Check the ventilation standard whether it is cross ventilated.
4) Check the comfortability of the room in terms of the room length and width of not less than 3m and the toilet provision.
5) Height of the building in relation to the density of the area.
6) Zoning and the prevailing land use ordinance of the proposed site.
7) Check the property line to avoid encroachment into any neighbouring site
8) Check the soak away and septic tank detail if it can meet the need of the development.

The whole vetting and approval process takes no longer than 3 months.

Site supervision and monitoring

Table 2; frequency of site visits and check list of local government town planning authority in Enugu metropolis

	Enugu south	Enugu east	Enugu north	Remark
Criteria of inspection	Setbacks. Septic tank and ventilation standard. Check if as built is as approved. Check materials on site.	Check if as built is as approved. Zoning regulation. Setbacks. Check materials on site.	Check if as built is as approved. Check materials on site. Building line and setbacks.	Uniform check list
Frequency of site visit	Often as possible but no regular routine for site visits	As much as possible	Site visits is at will but response faster to conflict sites	No scheduled time for site visit
Staff who visit site	Administrative staff	Administrative staff	Administrative staff	Same Staff

Source; researcher's field work

Table 2 shows the checklist for construction site visit and frequency of visit by Local Government Town Planning Authority in Enugu urban. The survey gathered that staff who undertake this assignment are administrative workers. For the 3 local government under study the checklist for inspection is the same likewise the fact

DISCUSSION

Staff strength

The research conducted, evidently depicts that in our town planning and approval offices, lack of adequate and proper staffing or staff strength exist as seen in table 1. The existing staff strength in Enugu urban is 86 and only 8 staff carry out the responsibility of assessing, scrutinizing, evaluating and approving building document and construction drawing. Of the 8 professional who assess architectural working drawing used for the construction of buildings and grant approval, all are non-architects who have little or no knowledge about architectural designs and buildings. This calls for question.

How can a non – architect vet and approve architectural drawings? More so the planning offices do not have structural, electrical, mechanical and soil engineers. Therefore, who vets engineering designs? How can errors or omissions be identified from the working drawing by the planning and approval office that lack the necessary qualified staff for the job? This reflects a missing link in the government establishments and contributes to the reoccurrence of the menace of building collapse. It invariably indicts the government as the number one culprit of building collapse in Nigeria.

The result of the study pointing to the weakness of government and its agency as a Prime cause of reoccurring building collapse in Nigeria is in line with the research of Fagbenle and Oluwunmi, (2010) who blamed the high rate of building collapse on the very low level of compliance with approval of building plans before construction commencement, ineffective monitoring mechanism put in place by the relevant government agencies and the low level of awareness of the existing Building/Planning Regulations by clients/contractors.

Despite the fact that building collapse is flourishing in Nigeria, studies of Oyedele (2018) has shown that the rampant collapses are not due to the fact that control measures to avert building collapse are not in place. Both institutional and legal frameworks to obviate incessant building collapse exist in Nigeria. The building regulations has enough provisions to ensure that the developers and/or their agents on site do not try to cut corners but the supervisors from the government ministry are not adequate, lack logistics to efficiently monitor construction works and are corrupt.

Also in 2015, Kunle Awoboduin in his interview concluded that Low staff strength, bureaucracy, experience, poor methodology, sentiments, cowardliness, compromise, corruption and lack of enforcement are the major bane of physical planning and building control operations across Nigeria.

Folagbade, 2001 and Badejo, 2009 affirms that in Nigeria, the common causes of building collapse have been traced to lack of proper supervision, ineffective enforcement of building codes by the relevant Town Planning Authorities, lack of proper maintenance. Adeyemi E. (2002) believed that non-enforcement of building codes, non-professionals, unqualified builders and poor supervision from government agency among many other factors he listed contributes to building collapse in Nigeria. His studies further reveals that bad design is a cause of building collapse in Nigeria. This generates a very pertinent question. Where are the

The view of Ayinuola et al, (2004) is more general, pointing accusing finger to all parties in the building industry, clients, architects, engineers, town planners in the local authorities and contractors stating that they have contributed to building failures in various dimensions.

Site supervision and monitoring

Table 2 present a uniform check list for building construction project within the local government areas. The Frequency of construction site visit was not specified, drawing to a conclusion that site monitoring and supervision is done arbitrary depending on when it is deemed fit to undertake the assignment. Their regular/attendance to site during construction is relatively low or poor as revealed by table 3 as 20 out of 30 site contractor interviewed reported that no staff of the local government town planning authority visited for inspection and monitoring after paying approval, sundry and or material testing fees. All these levies and fees put together was referred to by some contractor as “settlement fee”.

Even if we pretend and turn blind eye to the inadequate staff strength to match up with the enormous task of development control and poor attendance to construction site for monitoring and supervision, the argument here is, what is the qualification and technical disposition or knowhow of the field workers that inspect construction works? If the foundation for drawing approval is faulty right from the government agencies then there are bound to be countless re-occurrence of this menace, building collapse. The result presented here will not be far different from most states in Nigeria because this is a government establishment that exists in all local government of the Federation.

The conclusions of government weakness in supervision and enforcement of right building practice as the fuel for continuous building collapse strongly support the assertion of Oyewande 1992 who said that almost all the tragic incidents recorded in Nigeria have been blamed on either the government agencies whose duty is to ensure compliance or the developers for failure to comply with building regulation or consultants instruction.

Studies by Akindoyeni (2002), Chinwokwu (2000), Dare (2000) and Ogunsemi (2002) on building collapse in Nigeria confirms that poor quality of materials and workmanship have a very large and positive causal effect on building collapse i.e. there is a very high causal relationship between them. Ogunsemi (2002) asserted that poor quality of materials and workmanship accounted for over 36% of building collapse in Nigeria. (the highest of all the examined factors from his studies) while Chinwokwu (2000) confirmed that failure to investigation the quality of materials and workmanship in Nigeria building industry will certainly continue to result into building collapse. These views above centers on the supervisory and inspection role government planning and development authorities and agencies have failed to execute and implement effectively.

RECOMMENDATION

Humans could also address environmental problems by using biomimicry — examining nature‘s solutions and applying them to building designs. (Okeke et al., 2017). Despite that, the government through the Town Planning Authorities in

be a shame that such occurrence continues to happen unchecked. Governments should rise to the responsibility of ensuring the safety of lives and property, if nothing is done to regulate the business of building and diligently prosecute defaulters as well as revoke the ownership of the property in question, then we should expect more of this national shame and embarrassment.

Limitation of studies

Secrecy: Most contractor interviewed were reluctant to give out information due to fear of the unknown. Also the Local Government Town Planning Authority dislike and dodge question or enquiries that appears trying to probe them. Information that otherwise should be made for public consumption is considered secret.

Further studies

The Study has highlighted the failure of Government and its regulatory agency as hoisting the flag of reoccurring causes of building collapse in Nigeria. Recommendations have been proposed. However, different aspects of this line of research have not been considered. I suggested further detailed studies on Government intervention as it regards to reducing the incidence of building collapse as is been rarely reported. Also Research on new building technology that will reduce building costs as needed to address the issue of poor funding as a result of client cutting corners.

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harmonizes the three aspects of environmental, social and economic concerns (Boyd & Kimmet, 2005; Shen, Hao, Tam, & Yao, 2007; Morelli, 2011; Bal, Bryde, Fearon, & Ochieng, 2013; Hussin, Rahman, & Memon, 2013). Therefore, a building is classified as green when it is developed taking into consideration environmental, social and economic concerns. Despite the many benefits of green building development, the construction industry in Nigeria is yet to embrace the principle of sustainable development (Windapo and Rotimi, 2012; Nduka & Ogunsanmi, 2015).

Ejohwomu and Oshodi (2014), reviewing research in construction economics and management, observed that over a 29year period (1984-2012) there was no research work carried out on sustainable building at PhD level. Not much has been done to improve education for green building development in Nigeria compared to other countries like Malaysia (Onuoha et al., 2017). Lack of training and tools was identified as barriers to sustainable facility development in Nigeria (Oladokun, 2010). The study reported that though the professionals under the study were graduates of universities and polytechnics, no formal training was received either from the educational or professional institutions. This underscores the wide gap that exists in the level of knowledge required for effective implementation of green building development in Nigeria. The construction industry is complex due to the fragmented nature of its activities and requiring inputs from different professionals in the execution of its activities. The fragmented nature has made it imperative for every profession to redefine sustainable development along its professional obligation. This is to ensure that the client gets value for his investment and that the users derive maximum comfort for using the property (Shen et al., 2007; Waniko, 2012; Ejohwomu & Oshodi, 2014). Despite the knowledge gap widely acclaimed, no tangible effort has been made by these studies to assess specifically the knowledge gap among the built industry professionals in relation to green building requirements. Therefore the objective of the study is to identify the level of awareness of the requirement for green building development along professional lines with the aim of .the establishing the variations in the level of awareness among built industry professionals in the Physical Planning Units (PPU) in Federal Tertiary Educational Institutions in South-West Nigeria.

LITERATURE REVIEW

A Green Building refers to a high-performance building designed, built, operated and disposed of in a resource-efficient manner. Green buildings are designed to minimize the overall (negative) impact of the building on the built environment, human health and the natural environment (Kats, 2003; Langdon, 2007). Green building practices refer to design and construction techniques meant to reduce waste, to promote the efficient use of resources and lessen the ecological impact of the built environment. It is an integrated design process which requires that all of the design professionals work cooperatively towards a common goal from the inception of the project. However, lack of awareness has been one of the major challenges to green building development in Nigeria (Dahiru, Dania & Adejoh, 2014; Amasuomo, Atanda & Baird, 2017). In the same vein, Onuoha et al. (2017) observed that efforts towards green building development in Nigeria is still at infancy in comparison with Malaysia. The study also noted that there is lack of professional skill for green building construction in Nigeria. hence this paper seeks

H is statistically significant if it is equal to or larger than the critical value of Chi-Square for the given d.f. Therefore, Ho Rejected if H is greater than the chi-square table value (Dupont, 2009; Cheng et al., 2014). A Post-Hoc test is used as a follow-up if H reports a statistically significant result implying a difference (variation) in the group means. Examples of Post-Hoc tests include Bonferroni Procedure, Dunn's test, Fisher's Least Significant Difference (LSD) among others (Stevens, 1999; Dupont, 2009). The LSD was used to carry out Post-Hoc test on the H value. The LSD calculates the smallest significance between two or more means which allows direct comparisons between two or more means from different individual groups. Any difference larger than the LSD is considered a significant result(Cheng et al., 2014).. The LSD returns t-values and the **formula** for the least significant difference is:

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Where:
t = critical value from the t-distribution table
MSw = mean square within, obtained from the results of ANOVA test
n* = number of scores used to calculate the means

Data collection

The data collection instrument was a well-structured questionnaire adapted from the LEED scoring system. Respondents were requested to score their level of awareness of the requirements for green building development using the LEED v4 project checklist for New Construction and Major Renovation developed by US Green Building Council (U.S. Green Building Council, 2017). The Procedure for Data Collection was by group administration (Hampton and Vilela, 2018). The method is suitable for this study because the population were together in the same unit.

Data analysis

Table 1: Level of awareness of the requirements for green building development among construction industry professionals

S/N	Green Building Requirements	Professional Background (Mean)						
		ARC	BLD	ES&V	ENG	L/SV	QS	TPL
1.	Location and Transportation	3.60	2.81	3.13	2.92	3.13	2.77	2.92
2.	Sustainable Sites	3.90	3.36	3.39	3.66	3.78	3.33	3.42
3.	Water Efficiency	3.15	2.38	2.25	3.18	3.33	2.40	2.98
4.	Energy and Atmosphere	3.36	2.69	2.71	3.04	3.48	2.61	3.33
5.	Materials and Resources	3.15	3.06	2.93	2.71	3.33	2.93	3.14
6.	Indoor Environmental Quality	3.87	3.50	3.19	3.53	4.07	3.24	3.53
7.	Innovation	2.82	2.33		3.13	3.50	2.54	2.59
8.	Regional Priority	2.67	1.50	2.33	2.47	3.00	2.19	1.89
	Overall Average	3.32	2.70	2.85	3.08	3.45	2.75	2.97

Key: QS- Quantity Surveyors, ARC- Architects, BLD-Builders, TPL-Town Planners, ES&V-Estate surveyor & Valuer, L/SV- Land Surveyors, Eng- Engineer

Table 3: Post-hoc test on the level of awareness of green building requirements among construction industry professionals

(I) Professional	(J) Professional	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Architects	Builders	.6119500*	.2317784	*.011	.146174	1.077726
	Estate Surveyor	.4492250	.2317784	.058	-.016551	.915001
	Engineer	.2359375	.2317784	.314	-.229839	.701714
	Land Surveyors	-.1369750	.2317784	.557	-.602751	.328801
	Quantity Surveyors	.5636625*	.2317784	*.019	.097886	1.029439
	Town Planners	.3408250	.2317784	.148	-.124951	.806601
Builders	Architects	-.6119500*	.2317784	*.011	-1.077726	-.146174
	Estate Surveyor	-.1627250	.2317784	.486	-.628501	.303051
	Engineer	-.3760125	.2317784	.111	-.841789	.089764
	Land Surveyors	-.7489250*	.2317784	*.002	-1.214701	-.283149
	Quantity Surveyors	-.0482875	.2317784	.836	-.514064	.417489
	Town Planners	-.2711250	.2317784	.248	-.736901	.194651
Estate Surveyor & Valuers	Architects	-.4492250	.2317784	.058	-.915001	.016551
	Builders	.1627250	.2317784	.486	-.303051	.628501
	Engineer	-.2132875	.2317784	.362	-.679064	.252489
	Land Surveyors	-.5862000*	.2317784	.*015	-1.051976	-.120424
	Quantity Surveyors	.1144375	.2317784	.624	-.351339	.580214
	Town Planners	-.1084000	.2317784	.642	-.574176	.357376
Engineer	Architects	-.2359375	.2317784	.314	-.701714	.229839
	Builders	.3760125	.2317784	.111	-.089764	.841789
	Estate Surveyor	.2132875	.2317784	.362	-.252489	.679064
	Land Surveyors	-.3729125	.2317784	.114	-.838689	.092864
	Quantity Surveyors	.3277250	.2317784	.164	-.138051	.793501
	Town Planners	.1048875	.2317784	.653	-.360889	.570664
Land Surveyors	Architects	.1369750	.2317784	.557	-.328801	.602751
	Builders	.7489250*	.2317784	*.002	.283149	1.214701
	Estate Surveyor	.5862000*	.2317784	*.015	.120424	1.051976
	Engineer	.3729125	.2317784	.114	-.092864	.838689
	Quantity Surveyors	.7006375*	.2317784	*.004	.234861	1.166414
	Town Planners	.4778000*	.2317784	*.045	.012024	.943576
Quantity Surveyors	Architects	-.5636625*	.2317784	*.019	-1.029439	-.097886
	Builders	.0482875	.2317784	.836	-.417489	.514064
	Estate Surveyor	-.1144375	.2317784	.624	-.580214	.351339
	Engineer	-.3277250	.2317784	.164	-.793501	.138051
	Land Surveyors	-.7006375*	.2317784	*.004	-1.166414	-.234861
	Town Planners	-.2228375	.2317784	.341	-.688614	.242939
Town Planners	Architects	-.3408250	.2317784	.148	-.806601	.124951
	Builders	.2711250	.2317784	.248	-.194651	.736901
	Estate Surveyor	.1084000	.2317784	.642	-.357376	.574176
	Engineer	-.1048875	.2317784	.653	-.570664	.360889
	Land Surveyors	-.4778000*	.2317784	*.045	-.943576	-.012024
	Quantity Surveyors	.2228375	.2317784	.341	-.242939	.688614

RESULT AND DISCUSSIONS

Assessing the level of awareness of the requirement for credits among the construction industry professionals shows the Land Surveyors having the highest

suggestions have been made by earlier studies for the professional bodies to provide education and training for green building development in Nigeria (Seah, 2009; Waniko, 2012).

A significant difference also exists between the Builders and Land Surveyors (0.002). The Estate Surveyor & Valuers and Land Surveyors also exhibit significant difference in the level of awareness (0.015). This will influence the decisions on building development in response to green building requirements. There exists no significant difference in the level of awareness between the Engineers and all other professionals with significant figures above 0.05. The Land Surveyors as earlier discussed exhibits a significant level of difference with all the other professionals except Architects and Engineers having 0.557 and 0.114 respectively. The Quantity Surveyors is at ends with the Architects (0.019) and the Land Surveyors (0.004). The import is that if this level of divergence in knowledge exists, the two cannot work together to deliver value to the client for green building development. Lastly the Town Planners exhibits a significance difference only with the Land Surveyors at 0.045.

The summary is that there is so much divergence in the level of awareness from one professional to the other. This high level of divergence in the awareness is in line with Issa, Rankin, and Christian (2010) report on the level of awareness about cost of green building. The report observed the need to improve the knowledge and skill of designers and engineers as this will in turn affect the cost of the green building project. Developing a green building requires an integrated design and construction processes with contributions from various professionals. To ensure an integrated Design Process, (Cole and Pearl, 2007) recommends the need to blur boundaries among the design professional specifically Land Surveyors (Physical environment), Architects (Building) and Engineers. The high significant difference is an indication that there is dearth of coordinated education and training for green building development for the professionals. Hence, it is obvious that Nigeria cannot be moving towards implementing green requirements into the building development processes especially in the tertiary educational institutions.

CONCLUSION AND RECOMMENDATION

Having carefully analyzed and discussed the findings of this study, the conclusion is that there is a statistically significant difference in the level of awareness of the requirements among professionals. From the analysis it is concluded that the Architects, Estate surveyor & Valuers, Engineers and the Quantity Surveyors are more aware of requirements for Sustainable Sites while the Builders, Land Surveyors and Town Planners are more aware of indoor environmental qualities. However, in the overall, the Architects have the highest level of awareness followed by Land Surveyors with the Builders having the least awareness of the requirements.

This high level of divergence in the level of awareness will be a great hindrance to the development of green buildings in Tertiary Educational Institutions in Nigeria. The study therefore recommends that there is need to propagate the requirements for green building development among the construction industry professionals in Nigeria. There is need for each professional institution to develop professional

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cohesionless soils, as they perform better than the conventional methods. Kolay et al. (2008) made use of ANN programming in predicting the compressibility characteristics of soft soil settlement in Sarawak, Malaysia. Benali et al. (2013) used ANNs for principal component analysis and predicting the pile capacity based on SPT results. ANNs was used by Salahudeen et al. (2018) to predict the optimum moisture content and maximum dry density of Nigerian black cotton soil. All these literatures are source of hope for the beneficial use of ANNs in geotechnical applications.

Artificial neural networks (ANNs) are the most widely used pattern recognition procedures. These black-box models have the ability to operate on large quantities of data and learn complex model functions from examples, i.e., by training on sets of input and corresponding output data. The employed philosophy for model generation is similar to the one used for developing conventional statistical models. However, the greatest advantage of ANNs over traditional modelling techniques is their ability to capture nonlinear and complex interactions between variables of a system without having to assume the form of the relationship between input and output variables. Despite the use of geotechnical data for ANNs predictions, similar data set to those used herein have not been reported in the literatures, most especially in relation to CBR. This is a knowledge gap discussed in this study. Therefore, this study is aimed at applying the ANNs to predict the CBR values of Nigerian black clay modified with CKD using multilayer perceptrons (MLPs) artificial neural networks (ANNs) that are trained with the feed forward back-propagation algorithm based on eight input and two output data set in MATLAB R2014.

MATERIALS AND METHODS

Materials

The black clay samples used for this study was obtained from Dadinkowa, Gombe State, Nigeria. The Cement Kiln Dust (CKD) was obtained from Sokoto Cement Factory, Sokoto, the capital of Sokoto State, Nigeria.

Methods

Laboratory Tests

Laboratory tests were performed on the natural soil samples in accordance with BS 1377 (1990) and on the cement kiln dust treated black clay in accordance with BS 1924 (1990). The tests conducted include, particle size distribution, specific gravity, linear shrinkage, Atterberg limits, compaction characteristics test to determine the OMC and MDD and California bearing ratio test. All tests were first carried out on the natural soil then on the CKD-modified soils in steps of 0, 2, 4, 6, 8 and 10% CKD content by dry weight of the soil. Three compactive energies used in this study are the British Standard light (BSL), West African Standard (WAS) and the British Standard heavy (BSH) energies.

Artificial Neural Networks Model Development

The types of neural networks used in this study are multilayer perceptrons (MLPs) that are trained with the feed forward back-propagation algorithm. The typical MLP consists of a number of processing elements (neurons) that are arranged in layers: an input layer, an output layer, and two hidden layers. Each processing element in

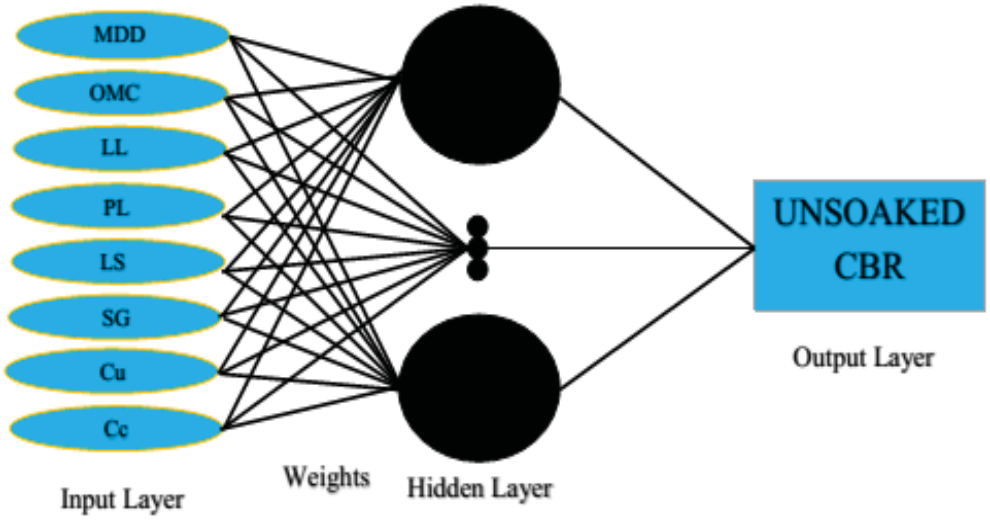

Figure 2: Multilayer perceptron architecture of network used for ANN model development for unsoaked CBR

Data Division and Processing in Artificial Neural Network

In developing the ANN model, the available data (a total of 72 data set) were divided into their subsets. In this work, the data were randomly divided into three sets: a training set for model calibration, a testing set and an independent validation set for model verification. In total, 70% of the total data set were used for model training, 15% were used for model testing and the remaining 15% were used for model validation. Once available data are divided into their subsets, the input and output variables were pre-processed, in this step the variables were normalized between -1.0 and 1.0.

Model Performance Evaluation

The performance of the developed ANNs model was evaluated to ensure that the model has the ability to generalize its performance within the limits set by the training data rather than been peculiar to the input – output relationships contained in the training data. The conventional approach is to test the model performance on an independent validation set of data that was not used in the training process. In the literatures, the common measures often used are statistical measures which include the correlation coefficient (R), the mean absolute error (MAE) and the root mean square error (RMSE). The formulas used for these measures are:

$$R = \frac{\sum_{i=1}^{n}(O_i - \bar{O})(P_i - \bar{P})}{\sqrt{\sum_{i=1}^{n}(O_i - \bar{O})^2 \cdot \sum_{i=1}^{n}(P_i - \bar{P})^2}} \qquad (5)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(P_i - O_i)^2}{n}} \qquad (6)$$

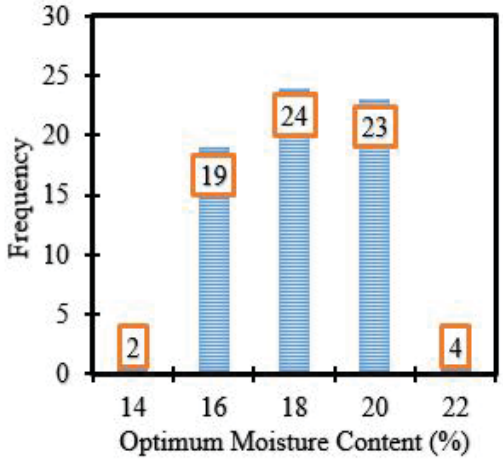

Figure 9: Frequency of OMC

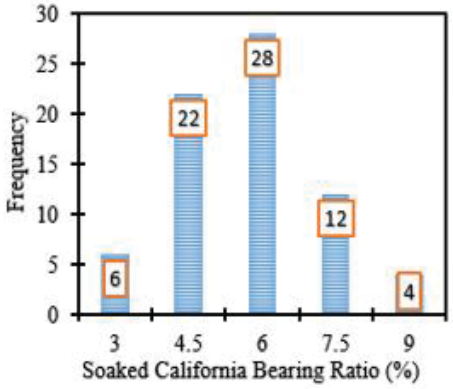

Figure 11: Frequency of soaked CBR

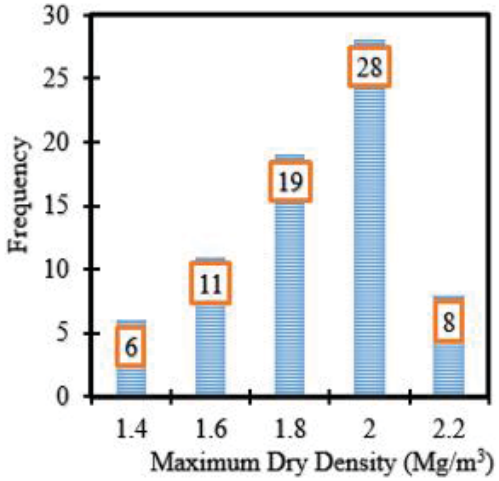

Figure 10: Frequency of MDD

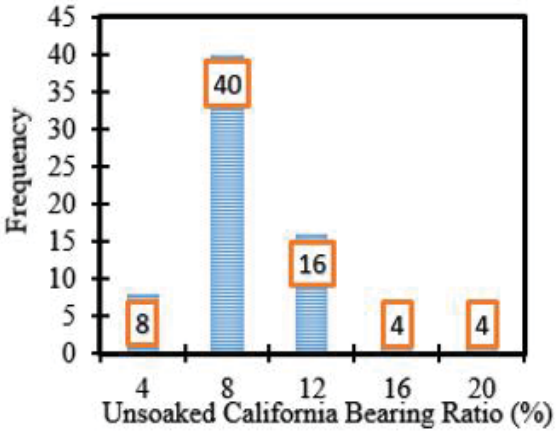

Figure 12: Frequency of unsoaked CBR

The descriptive statistics of the experimental data as obtained from various laboratory tests used for the ANN model development are presented in Table 1.

Table 1: Descriptive statistics of experimental data used for ANN model development

Soil parameter	Minimum	Maximum	Mean	Standard deviation	Coefficient of variation
SG	2.03	2.63	2.403	0.207	0.086142
LS (%)	15.26	20.19	17.4	1.2612	0.072483
C_u	2.83	8.96	6.61	1.6201	0.245098
C_c	0.02	1.04	0.48	0.2489	0.518542
LL (%)	45.5	55.94	49.43	2.8494	0.057645
PL (%)	26.9	39.74	33.41	3.32	0.099371
OMC (%)	13.7	21.3	17.3	1.9195	0.110954
MDD (Mg/m^3)	1.325	2.111	1.75	0.214	0.122286
Soaked CBR (%)	2.5	8.4	4.94	1.4642	0.296397
Unsoaked CBR (%)	3.36	19.2	7.71	3.9585	0.513424

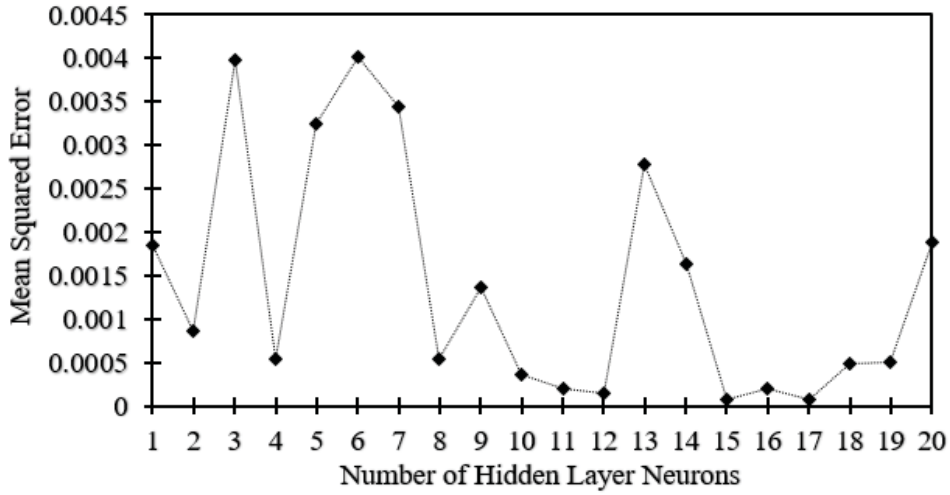

Figure 14: Variation of mean squared error with number of hidden layer neurons for unsoaked CBR

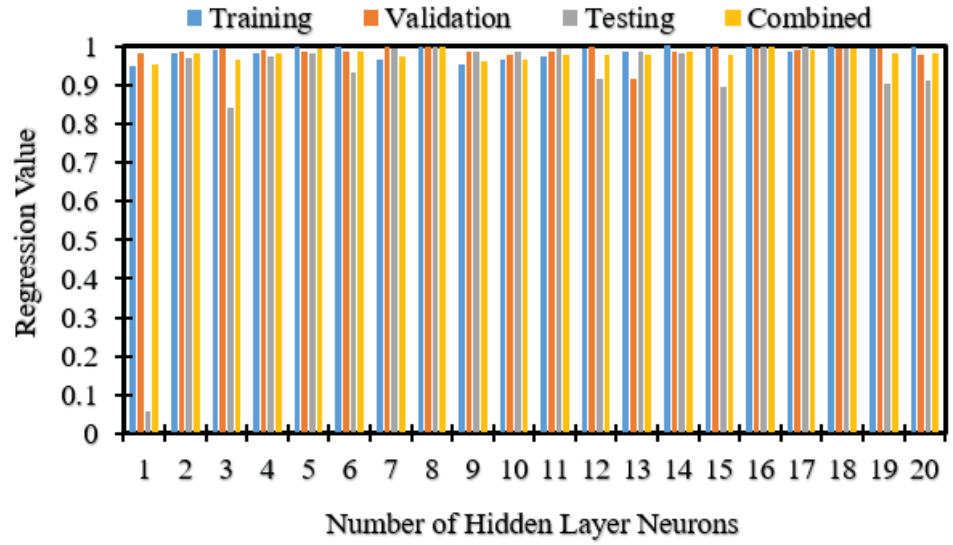

Figure 15: R-values for ANN performance with number of hidden layer neurons for soaked CBR

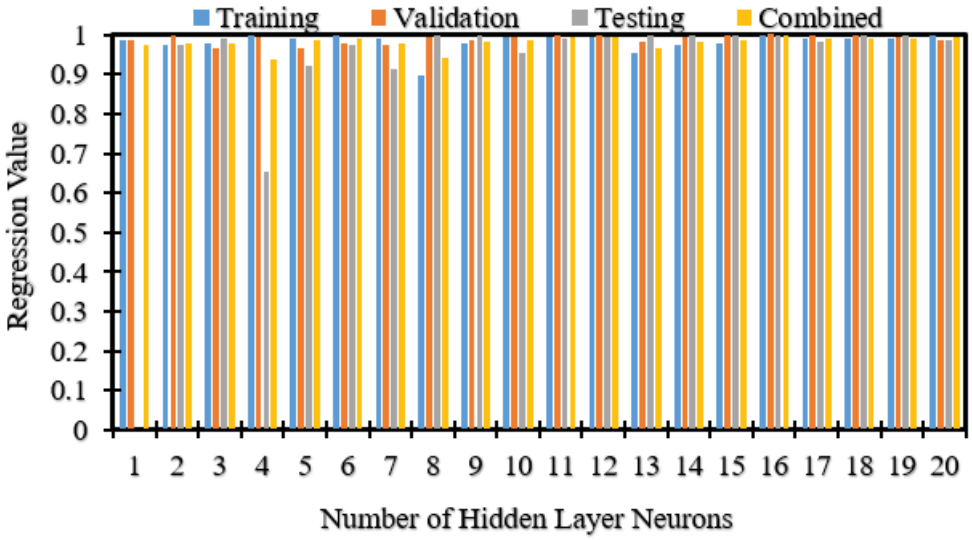

Figure 16: R-values for ANN performance with number of hidden layer neurons for unsoaked CBR

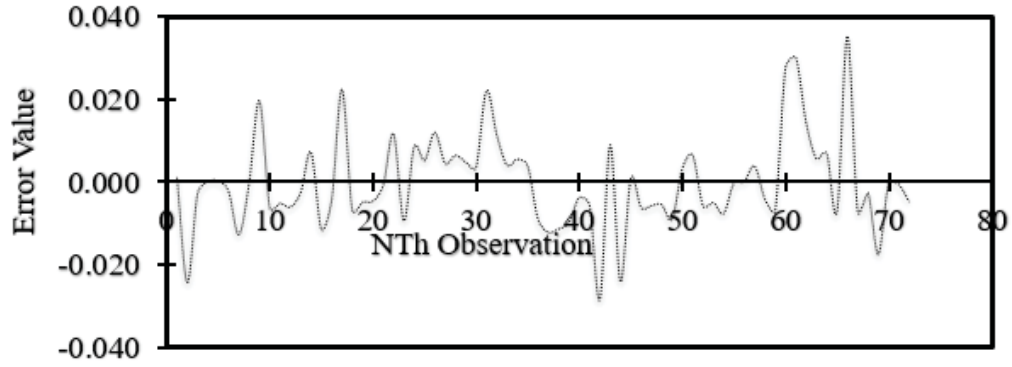

Figure 18: Variation of error values with number of observation for soaked CBR

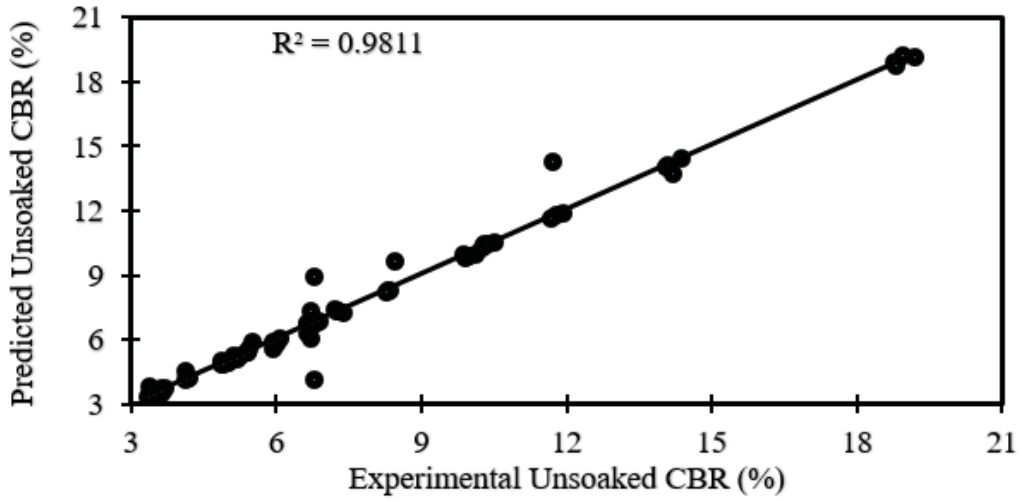

Figure 19: Variation of experimental and ANN predicted unsoaked CBR values

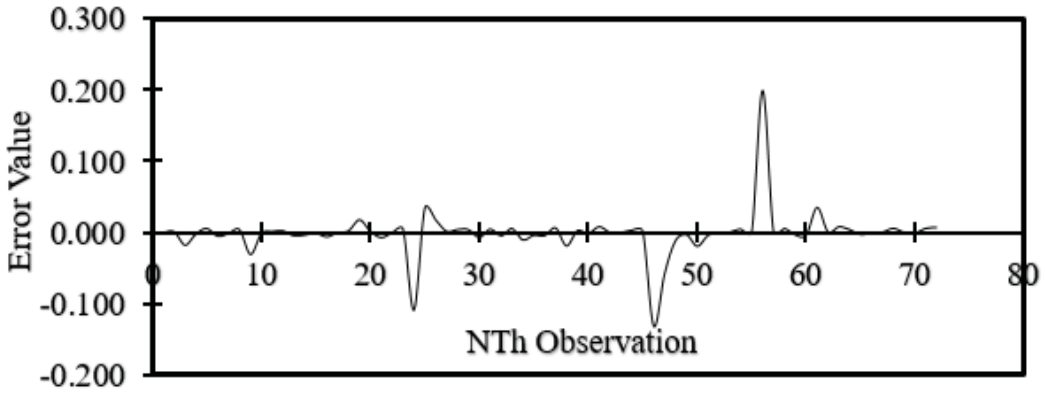

Figure 20: Variation of error values with number of observation for unsoaked CBR

Model Validation

The coefficient of correlation (R) is a measure used to evaluate the relative correlation and the goodness-of-fit between the predicted and the observed data. Smith (1986) suggested that a strong correlation exist between any two set of variables if the R value is greater than 0.8. However, Das and Sivakugan (2010) are of the opinion that the use of R value alone can be misleading arguing that higher

CONCLUSION

Artificial neural networks (ANNs) was used in this study to develop a predictive optimized models for soaked and unsoaked CBR of a cement kiln dust-modified black clay. Based on the results of the developed ANN models, the following conclusions were made:

1. The multilayer perceptrons (MLPs) ANN used for the simulation of soaked and unsoaked CBR of CKD-modified black clay performed satisfactorily.
2. The mean absolute error (MAE), root mean square error (RMSE) and R-value were used as yardstick and criterions. In the neural network development, NN 8-7-1 and NN 8-17-1 respectively for soaked and unsoaked CBR that gave the lowest MSE value and the highest R-value were used in the hidden layer of the networks architecture and performed satisfactorily.
3. For the normalized data used in training, testing and validating the neural network, the performance of the simulated network was very good having R values of 0.9986 and 0.991 for the soaked and unsoaked CBR respectively. These values met the minimum criteria of 0.8 conventionally recommended for strong correlation condition.
4. All the obtained simulation results are satisfactory and a strong correlation was observed between the experimental soaked and unsoaked CBR values as obtained by laboratory tests and the predicted values using ANN.
5. A similar study is recommended for unconfined compressive strength test for flexible pavement construction.

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manufacturing to enhance housing delivery. Aladeloba et al. (2015) laid emphasis on characteristics, barriers as well as prospects of IBS in the production of building. Rahimian, Goulding, Akintoye & Kolo (2017) presented a roadmap focusing on benefits, barriers and action for the adoption of IBS to advance housing delivery. It is evident that there is a paucity of literature on IBS research within the context of Nigeria building construction. Notwithstanding, studies from other parts of the globe largely formed the pivot for this study. It would be expedient to know if those challenging factors deter the actualization of IBS in building production within our locality.

On this note, the study investigates the level of influence of diverse factors impeding the adoption and applicability of the IBS construction method and profound measures for enhancing its implementation within the context of the Nigerian building industry. Hypotheses are further postulated to determine if the challenging factors would be similarly perceived by the respondents and to determine the relationship between the ranking of factors among the respondents

LITERATURE REVIEW

Challenges of Industrialized Building System

Aside, the numerous benefits amassed to IBS, there are some hindrances subject to its implementation and actualization. These include high initial capital costs of construction of factories, acquisition of support machinery, immediate payment for components delivery on site and low manufacturer's capacity to provide IBS products. Often times, there is the unwillingness of construction companies to adopting an industrialized building system (Thanoon, 2003 cited in Jabar, Ismail & Abdul Aziz, 2018) due to the high cost of setting up a prefabrication yard, costs of manufacturing and on-site assembling of components. Use of new construction method for projects is likely to create difficulty for the contractors and construction companies (Nawi, Azman, Osman, Radzuan & Yaakob, 2016; Mohammad, Musa, Abdul Shukor, Ahmad & Din, 2018). Reasons being that using specialized materials and importing high technology based are obviously more expensive in the construction industry especially for developing countries. Often times, migrating from traditional methods of construction to IBS construction could require high cost of training, sophisticated plant and equipment cost as well as high coordination (Kamar, 2011, Jabar, Ismail & Abdul Aziz, 2018).

According to Musa et al. (2018) and Tamrin, Nawi & Nifa (2017) issue of readiness, awareness and acceptance of industrialized building method of construction are critical. Lack of experience and technical knowledge of professionals, lack of research and development, low IT adoption, lack of scientific information and lack of technology are obstacles to adapting and developing industrialized building system (Rahim & Qureshi, 2018). Further, IBS has failed to develop due to the lack of adequate machine-oriented skills like integrating or assembling system and innovative knowledge of IBS, project delivery and supply chain issues, escalated construction costs, paucity perception of stakeholders on the flexibility of the system and the lack of incentives (Hamid, Kama, Zain, Ghani & Rahim, 2008; Amin et al., 2017). It is evidenced that technical difficulties such as site planning, cost of importation of special material and high cost or possibly lack of technology, off-site practice with low performance and fragmented structure of supply chain

RESEARCH METHODS

A survey research design and non-probability sampling were adopted. The collection of data was achieved through the use of questionnaire instruments (Mohamad et al., 2009; Ismail et al., 2012; Kassim, Abdullah & Udin, 2015; Gan, Shen, Chen, Tam, Tan & Lankoon, 2017). Challenges and measures variables were being identified through a comprehensive literature review. This list of variables was summarized and simplified for the study. Absence of list comprising registration of IBS contractors/ firms (sample frame) afford researcher to rely on participant referrals to recruit new participant and this prompted the use of referral sampling also known as a snowball (Wikipedia (n.d)). Snowball sampling could be used for qualitative and quantitative studies, and the use of a questionnaire for collecting data could be appropriate (Gaal, 2016; Showkat & Parveen, 2017). The sample size (385) was estimated using a sample size estimation formula known as Cochran's formula. This considers standard normal deviate at 95% confidence level, likely sample proportion at 50% and precision at 5% (Isreal, 2013; Ali, 2014). The targeted respondents have been involved in the practice of IBS in building production within Lagos metropolis and they were sixty-one (61) in number obtained by referral. This becomes the exact sample, though, this is fairly low compared to the estimated sample size. Copies of the structured questionnaire were used for obtaining responses from the sixty-one referred respondents on their background, level of influence of factors impeding the practice of industrialized building system (IBS) and level of importance of measures enhancing implementation of IBS in Lagos metropolis. Data collected for the study were analyzed using the Statistical Package for Social Sciences (Version 23). The statistical methods employed for the study were frequency, percentage, mean scores, Kendall's coefficient of concordance and Kendall's tau_b correlation coefficient (Leard Statistics, 2018).

DATA, ANALYSIS AND DISCUSSION OF RESULTS

Table 1: Demographic profile of respondents

Gender	No	%	Professional Type	No	%	Projects handlec	No	%
Male	56	92%	Builders	25	41%	1-5 projects	0	0%
Female	5	8%	Q/S	17	28%	6-10 projects	45	74%
Total	61	100%	Engineers	19	31%	11-15 projects	16	26%
Educational Qualifications	No	%	Total	61	100%	16-20 projects	0	0%
OND	2	3%	Years of Experience	No	%	20 and above	0	0%
HND	24	40%	1-10 years	31	51%	Total	61%	100%
BSc	20	33%	11-20 years	24	39%			
MSc	13	21%	21-30 years	4	7%			
PhD	2	3%	31-40 years	2	3%			
Total	61	100%	Total	61	100%			

Table 1 shows the demographic information of the respondents. It captured the number of both male and female gender. The ratio of male to female was 11: 1 and this confirmed that the construction industry is highly dominated by the male gender. The table indicates that 43% of the respondents have OND and HND

Table 2 shows the responses of the referred professionals in the building industry. To quantify challenges impeding the practice of industrialized building system (IBS), a graduated scale of 1-5 was used and the mean scores were calculated. The mean values were interpreted using the following scale 1.00 Ó MS < 1.49 means no influence, 1.50 Ó MS < 2.49 means slight influence, 2.50 Ó MS < 3.49 means somewhat influence, 3.50 Ó MS < 4.49 means moderate influence and 4.50 Ó MS Ó 5.00 means extreme influence. Challenging variables were extracted from the literature, summarized and simplified for the study. The questionnaire instrument is a simple 22-item questionnaire. The frequency counts and mean scores of factors impeding the practice of industrialized building system range from 4.66 to 4.15. Results confirmed that the practice of industrialized building system in the Nigeria context seems not to be feasible. The reason is that the results of the study confirmed that all the 22-itemised challenges have some level of influence on actualizing IBS. It was observed that the level of influence of 5-itemised challenges was extremely influential while the remaining challenges were also moderately influential. There was no single challenge found to be none influential. This is evident in Table 2 as challenges with extreme influence on the implementation of IBS range from 4.66 to 4.51. and are highlighted as follows:

Requires large working area for casting and storage space (4.66 mean score; 68.9 percent extreme influence and 27.9 percent moderate influence)

Lack of experience by contractors (4.56 mean score; 65.6 percent extreme influence and 26.2 percent moderate influence)

Lack of component testing facilities (4.56 mean score; 62.3 percent extreme influence and 31.1 percent moderate influence)

Lack of scientific information (4.52 mean score; 59.0 percent extreme influence and 34.4 percent moderate influence)

Unsure economic condition (4.51 mean score; 55.7 percent extreme influence and 39.3 percent moderate influence)

This implies that each of the factors can prominently influence IBS implementation. Based on this study, the first ranked factor, working area for casting and storage space has the utmost impact as affirmed by 68.9% of the respondents that participated in the study. This is evident in many tight construction perimeter spaces in Lagos. This finding is in agreement with Nawi, Riazi, Hasbollah, Ibrahim & Deraman (2017) study reporting how limited construction area poses a challenge on IBS construction in a school building project. This challenge caused the contractor extra money in acquiring a casting yard outside the construction boundaries. This suggests that limitation of space would rather cause extra construction expenses to secure another site for casting components or contractor settled for complete purchase of components from the manufacturer. This would require about 75% capital deposit from contractors before the manufacturer goes into production (Aladeloba et al., 2015; Amin et al., 2017). Where those arrangements are not possible contractors stick to the conventional method of construction that is permissible within limited space. Other noticeable influential factors that are confirmed include component testing facilities (ranked 2nd), contractor's inexperience (ranked 2nd) as well as economic uncertainty (ranked

Table 4: Measures to enhance implementation of IBS

Measures that should be taken by the government	Rate of response										Mean	Rank
	Not at all important		Slightly important		Somewhat important		Very important		Extremely important			
	No	*%*	*No*	*%*	*No*	*%*	*No*	*%*	*No*	*%*		
Establishing legislative support for industrial development	0	0	0	0	1	1.6	23	37.7	37	60.7	4.59	1
Importation of new technologies/ innovation	0	0	0	0	1	1.6	24	39.3	36	59.0	4.57	2
Development of marketing strategy within the sector	0	0	1	1.6	0	0	24	39.3	36	59.0	4.56	3
Designing according to IBS specifications	0	0	0	0	2	3.3	25	41.0	34	55.7	4.52	4
Provision of necessary equipment and machinery to support the implementation of IBS	0	0	0	0	4	6.6	23	37.7	34	55.7	4.49	5
Adoption and implementation of IBS projects by government agencies	0	0	0	0	2	3.3	29	47.5	30	49.2	4.46	6
Training course for professionals in the built environment	0	0	1	1.6	2	3.3	26	42.6	32	52.5	4.46	6
Training and skill development for construction workers	0	0	1	1.6	1	1.6	30	49.2	29	47.5	4.43	8
Extensive construction planning and scheduling	0	0	1	1.6	3	4.9	26	42.6	31	50.8	4.43	8
Adequate quality monitoring mechanism during the component production process	0	0	0	0	6	9.8	26	42.6	29	47.5	4.38	10
Development of research centers	0	0	0	0	5	8.2	30	49.2	26	42.6	4.34	11
New rules and regulations to support IBS	0	0	1	1.6	5	8.2	29	47.5	26	42.6	4.31	12
Availability of scientific information	0	0	2	3.3	7	11.5	24	39.3	28	45.9	4.28	13
Low interest rate on construction materials and equipment	0	0	0	0	8	13.1	30	49.2	23	37.7	4.25	14
Human capital development	0	0	0	0	8	13.1	30	49.2	23	37.7	4.25	14
Policy and logistic support to support implementation of IBS	0	0	2	3.3	6	9.8	29	47.5	24	39.3	4.23	16
Coherent structure of planning and control from start to end of project	0	0	3	4.9	6	9.8	27	44.3	25	41.0	4.21	17
Effective communication channels and team member involvement during design stage	0	0	0	0	9	14.8	30	49.2	22	36.1	4.21	17
Low cost of importation of components	0	0	1	1.6	9	14.8	28	45.9	23	37.7	4.20	19
New innovation and alternative designs	0	0	4	6.6	3	4.9	33	54.1	21	34.4	4.16	20
Workshop for skilled and unskilled personnel	0	0	2	3.3	11	18.0	25	41.0	23	37.7	4.13	21
Stable economic condition	0	0	3	4.9	9	14.8	27	44.3	22	36.1	4.11	22
Availability of IBS skilled labor	0	0	5	8.2	8	13.1	28	45.9	20	32.8	4.03	23

Table 3 shows the responses of referred professionals to measures for implementing IBS. To quantify the measures for enhancing the implementation of industrialized building system (IBS), a graduated scale of 1-5 was used and the mean scores were calculated. The mean values were interpreted using the

contractors and concerned stakeholders. This study gathers and brings on page barriers in actualizing and measures for improving the industrialized building system. Topmost recommended measures include; legislative support for IBS, exploring IBS innovation and technology, and strategizing the market for the uptake of IBS. The study further advocates for the extermination of barriers by providing supportive facilities for IBS practice with support from the Government as well as the building industry.

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H1 : There is agreement between quantity surveyors in consultancy firms and academia

If p-value is greater than 0.05, then accept H0 and reject H1.

The opposite is true in both alternatives (i.e reject Ho and accept H1 if p-value is less than 0.05).

DATA ANALYSIS AND DISCUSSION

Description of Respondents' Demographic Information

11% of the respondents are HND holders, 57% are BSc holders, 26% are MSc/MBA holders while 06% are PhD holders. 86% of the respondents are fully registered members with their professional associations. The respondents comprise of 52.6% working in the academia while 47.4% in consulting firm. 75% of the respondents have over ten years' experience in consultancy and the academia. This shows that the information supplied by the respondents can be considered appropriate and adequate for the study.

Table 2 presents the ranking of the scores of respondents. Inadequate funding is the greatest challenge facing quantity surveying students in Nigeria. This is evident in the conditions of our lecture rooms, allowances of the lecturers, basic amenities and learning environment in our institutions. Lack of practical class for the students is another major challenge facing quantity surveying students in Nigeria.

Table 2: Challenges facing quantity surveying discipline in Nigeria tertiary institutions

Challenges	N	MS Consultant	Rank	MS Academia	Rank	Overall Rank
Inadequate funding	80	4.71	1st	4.66	2nd	1st
Lack of practical class	80	4.59	2nd	4.68	1st	2nd
Lack of provision of field trips	80	4.57	3rd	4.54	3rd	3rd
Lack of exposure to new technology	80	4.48	4th	4.52	4th	4th
Lack of adequate facilities	80	4.48	4th	4.46	5th	5th
Ineffective and rigid curriculum	80	4.36	6th	4.40	6th	6th
Poor teaching methods	80	3.95	7th	3.97	7th	7th
Less experienced lecturers	80	3.83	8th	3.89	8th	8th
Poor library facilities	80	3.40	9th	3.76	9th	9th

Other challenges are lack of provision for field trips for quantity surveyors in consultancy firms 4.57 and for quantity surveyors in the academia 4.54. This is followed by lack of exposure to new technology with mean score of 4.48 for quantity surveyors in consultancy firms and 4.52 for quantity surveyors in the academia. Other factors are rated high except poor library facilities. This result agrees with the studies of Tella (2011) posited that lack of exposure to new technology affects performance of quantity surveyors as rated by the respondents. Developing countries like Nigeria have not fared well in their quest to apply information and communication technology in their work. Similarly, inadequate

A Mann-Whitney U Test revealed no significant difference in the rating levels of the factors between consultant quantity surveyors and those in academics. The z value is -1.86 with a significance level p = 0.16. Since the probability value (p) is greater than .05, we fail to reject the null hypothesis (Pallant, 2010; SPSS, 2013). There is no statistically significant difference in the ranking scores of consultant quantity surveyors and those in academics at 95% level of confidence. This implies that those factors pose serious threat to the achievement of human capital development in the field of quantity surveying.

Implications for practice

The implication of this study is in two parts. Firstly, the identification of 9 factors that are challenges to quantity surveying education is a starting point for the stakeholders to understand the problems in the sector. It will serve as a guide for them. The need to start from the scratch to conduct research in this area is no longer needed. Secondly, the study has established factors that are challenges to quantity surveying education in Nigeria. This will serve as a guide for the stakeholders in the industry. They are better informed now on the areas to channel their efforts to address these challenges so that the quantity surveyors that would be produced in the nearest future will have the requisite knowledge and proficiency that is required of them. This will surely benefit the profession and the construction industry at large.

CONCLUSION

The required training for quantity surveyors can be said to be inadequate due to the empirical results above. The inferential statistics also indicated the agreement of the quantity surveyors in consultancy firms and the academia. Hence, the need to work on these challenges in our tertiary institutions in Nigeria is crucial and must be taken seriously to give adequate knowledge to our aspiring quantity surveyors. This will enhance their performance and give clients the benefits of engaging proficient quantity surveyors. This will also reduce the incursion of expatriates into our labour market.

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knowledge as is the case with studies in the Ghanaian construction management space. This study sought to investigate the range of students' conceptions of sustainable development and investigate the principles of sustainability highlighted in students' conceptions and is explicit on the type of knowledge assessed. At the end of the study it was found that conceptions of sustainability among post graduate MSc students of KNUST ranged from conceptions that revealed a lack understanding/knowledge of the concept to clearly articulated descriptions of concrete and/or abstract examples of the concept. However, the absence of high level understanding which should be present in a sample of this nature who serve as consultants to clients in the construction industry is worrying. These results highlight the need for teaching methods and learning environment that is suited to allowing students with differing knowledge gaps to develop deeper understanding and applications of the concepts of sustainable development. It is important to also develop content that emphasises sustainability principles that are especially absent in students conceptions. Although the sample is not representative enough to allow for generalisations to the larger construction industry and other construction related students, it highlights the need for such studies that clearly interrogate and examine the nature of the gaps in sustainability knowledge both amongst students and with professionals in the construction industry in Ghana. Further research is therefore need to investigate understanding within different population and also studies that employ interviews to allow for richer data. Assessment should also include other subcomponents of declarative and procedural knowledge and other assessment methods such as concept mapping.

Ghana's efforts towards sustainability has been slow compared with other developed countries; but universities such as KNUST have the potential to serve as a vehicle for change and considerably influence the direction and speed of change towards sustainability through integrated sustainability education that is based an appreciation of the gaps in knowledge and understanding of the students.

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is still a prevailing perception that construction cost in Nigeria ranked among the highest in the world. Against this background, it is imperative to explore the existing scenario in Nigeria and possibly recommend implementable solutions to overcoming perceived causative factors contributing to relatively high construction cost of projects in Nigeria. This study investigated and evaluated determinants of construction cost in Nigeria in other to impact positively on the economy. It appears from the foregoing that, there is need to explore further on this area of concern since most submissions are based supposition than in-depth research. Beyond the cost of construction in Nigeria, there is need to evaluate construction cost determinants in other to establish their contributions and suggest ways to ameliorate on the existing scenario. This is the focus of the study.

This study covered government sponsored building and infrastructural projects in Nigeria.

Statement of the research problem

World Bank (2017) posited that construction is often refers to as driver of economy. Nigerian as a developing country has construction sector as key economy sector second to oil and gas sector. In the event that a nation construction industry is in a perilous state, then such a nation experience difficulty in steady growth. Findings of previous studies disclosed that the cost of construction of roads in Nigeria is alarming in comparison with other nations. Abuja Centre of Social Justice, ACSJ (2018) based on previous study conducted by World Bank (2000) reported that, constructing a kilometres of road in Nigeria cost between 400 million and over N 1 billion naira. This submission was based on specific comparison between the roads with same grade constructed in Nigeria and some African countries. The report referred to the award of 127 kilometres Lagos-Ibadan expressway at 167 billion by Federal Government of Nigeria in 2013 and similar contract of 1,028 kilometres awarded in same year between 167 billion and 240 billion by Economic Community of West African Countries (ECOWAS) as link roads between Lagos, Nigeria; Cotonou, Benin Republic; Togo; Accra, Ghana and Abidjan, Cote D'Ivoire. In essence, the number of kilometres that was covered by ECOWAS project was eight times higher than that of Lagos-Ibadan expressway and the cost per kilometres far lower than that of Nigeria. Mathematically, the maximum cost of ECOWAS road was 234 million naira, whereas that of Nigeria awarded by Federal Government was 1.3 billion naira per kilometres. What this could connote is that for every kilometres of road constructed in Nigeria at the time of this report, cost of eight kilometres could have been lost. If this trend continues, Nigeria may continue in the cycle of developing nation for many years to come instead of attaining the status of a developed country. From pre to post independence, many capital intensive projects have been constructed and many more going and still very many yet to be constructed. These projects have been tagged to be too high in term of cost and the most popular opinion is that cost of construction in Nigeria is perceived to be the highest among its contemporary in Africa and beyond (Samuel, et al, 2016). This study, therefore, tends to investigate this assertion, evaluate contributing factors and recommend ways to overcome this challenge.

Research questions

In response to the statement of the research problem, it is pertinent to raise and find answers to these questions:

not interested in seeking a redress in court to sustain relationship. Daniel et al (2016) further observed that shoddy practices, kickback syndrome and professional negligence are also predominant causes construction cost escalation. Previous report by ACSJ (2018) disclosed that deliberate inflating Government financed projects as become hallmark in the Nigeria procurement system. Idoro (2013) posited that due to observed irregularities and cost escalation of cost of construction in Nigeria concluded Nigeria has the highest construction cost in the world. This submission appears to differ from the opinion of Ajanlekoko (2017). This study tends to feel this gap by establishing a reliable research position on the actual scenario of cost of construction in Nigeria. Aside from contributing to body of knowledge, the output of this research work would be a reference point on the true nature of construction cost in Nigeria and suggestive ways of ameliorating the existing situation.

RESEARCH DESIGN AND METHOD

The study investigated and evaluated determinants of construction cost in Nigeria. Research design adopted for the study was triangulation method. Both stratified and random probabilistic sampling technique was adopted. Nigerian Quantity Surveyors were divided into stratum according to their professional qualifications namely; Fellow, Member and Probationer. Each had an equal chance in filling the questionnaire which formed the primary data. According to Nigerian Institutes of Quantity Surveyors, NIQS (2019) directory of members, these cost experts are referred to as Quantity Surveyors. The research is limited to this category of professionals because they are the custodian of construction cost. Relevant extant literature formed the sources of secondary data. Well-structured questionnaire that address the objectives of the study was randomly distributed to 100 registered Fellows, Members and Probationers of the NIQS but was only able to retrieve 54 copies. The first objective, comparative cost analysis of construction projects in Nigeria with that of some selected African countries was achieved through cost per square meter (cost/m2) analysis of various projects across 12 countries considering their capital cities. This information was sourced from African Property and Construction Cost Guide, AECOM (2018). The study puts into consideration the peculiarity of each country considered in term currency and official exchange rate using dollar as a uniform basis for comparison. Due to lack of adequate published information on comparison of cost of construction across countries, a further step was taking to validate the analysis provided by AECOM, respondents were asked through structure questionnaire to evaluate the cost of construction in Nigeria in terms of Likert's scale of (1-5) using: 5- Very high, 4- High, 3-Uncertain 2- Low, 1- Extremely low and the results were further subjected to analysis using relative importance index (RII) and results were ranked and a comparison of the assertion obtained from AECOM and other related reliable extant literature were compared and conclusion was drawn. To further authenticate the conclusion drawn, respondents where further asked to indicate the basis for their position. This was necessary in other to authenticate the data obtained. The second and objective, evaluation of construction cost matrix was accomplished through reviewed of extant literature and analysis of data obtained from respondents through questionnaire. Beyond the construction cost indicators obtained from extant literature, respondents where ask to indicate additional factors that influence

The combination of academic, professional qualifications and years of experience of the categories of the sample reinforces the reliability of the data collected and analyzed. Among the Quantity Surveyors, 28 of them which is more that 50% of the entire sample had more than 1st degree as they constituted the majority with practical experience above 10years. Fellow and members of the Nigerian Institute of Quantity Surveyors (NIQS) combined, formed 80% of the respondents. Against this background, the results of this research are factual and reliable in conjunction with reliable extant literature.

Cost of construction projects in Nigeria and some selected African countries

Table 1.2: cost of construction in Nigeria – the Nigerian quantity surveyors' perception

	Categories of Respondents				
Quantity Surveyors' Responses	(Fellows)	(Members)	(Probationers)	R	NR
High	3	18	4	1st	25
Very High	3	12	4	2nd	19
Moderate	0	2	2	3rd	4
Low	0	0	0	4th	0
Extremely low	0	0	0	4th	0

Source: Field Survey
Key: RII=Relative Importance Index, R=Ranking, NR=Number of Respondents

Table 1.3: Nigerian quantity surveyors' basis for submission of cost of construction in Nigeria

Quantity Surveyors' Responses	(NR)	(Percentage)	Ranking
Practice	41	82	1st
Published Research article	4	8	2nd
Newspaper article	2	6	3rd
Personal opinion	2	4	4th

Source: Field Survey
Key: NR=Number of Respondents

Table 1.4: Cost of Construction Projects in Nigeria and other African Countries Compared

	Overall Average Cost of Construction/Square Meter in US Dollars	
African Countries	(Total Average)	(Ranking)
Nigeria (Lagos)	2,629	1st
Angola (Luanda)	2,625	2nd
Senegal (Dakar)	1,772	3rd
Ghana (Accra)	1,650	4th
Rwanda (Kigali)	1,500	5th
Botswana (Gaborone)	1,372	6th
Mozambique (Maputo)	1,319	7th
Uganda (Kampala)	1,190	8th
Zambia (Lusaka)	1,183	9th
Kenya (Nairobi)	1,053	10th
Tanzania (Dar es Salaam)	997	11th
South Africa (Johannesburg)	971	12th

Source: African Property & Construction Cost Guide (2018)

Tables 1.2, 1.3 and 1.4 show the view of Nigerian Quantity Surveyors on the cost of construction projects in Nigeria and the basis for their various submissions and the

construction cost in Nigeria under check is a possibility that is attainable as indicated in factors 4 – 6 on table 1.5.

Probable synergies to address issues pertaining to construction cost in Nigeria

Table 1.5: Probable construction cost escalator arresters in Nigeria

Construction Cost Escalator Arresters	SA (5)	A (4)	U (3)	D (2)	SD (1)	RII	R	NR
Engage only certified and qualified cost experts	33	14	3	0	0	0.92	1st	50
Elimination of monopolistic market	29	17	3	1	0	0.9	2nd	50
Government should form omnibus entity	29	16	5	0	0	0.9	2nd	50
Government should formulate working policies	28	19	3	0	0	0.9	2nd	50
Eliminate delays in execution of projects	27	21	2	0	0	0.9	2nd	50
Loan should be easy to access	27	17	5	1	0	0.88	6th	50
Government should establish factories	28	15	3	3	1	0.86	7th	50

Source: Field Survey
Key: SA=Strongly Agree, A=Agree, U=Uncertain D=Disagree, SD=Strongly Disagree, RII=Relative Importance Index, R=Ranking, NR=Number of Respondents

Engaging only certified and qualified cost experts was identified by the Quantity Surveyors as the most important of all remedies to curb skyrocketing cost of construction projects in Nigeria. It is fundamental to note that erroneous estimation is a product of quackery misleading the clients. It is a common established perception that correct and reliable estimate at pre, construction and post construction stages is a tool for accurate cost forecasting. Elimination of monopolistic market was rated 2nd with government should form omnibus entity, Government should formulate working policies and eliminate delays in execution of projects.

DISCUSSION OF FINDINGS

Cost of construction projects in Nigeria

The findings of the research indicate that the common position of the Nigerian cost experts is that cost of construction project in Nigeria is high as indicated in table 1.3. This inference is in consonant with previous submissions of Ajanlekoko (2017) and Oyediran et al (ND) both asserted that cost of construction in Nigeria are relatively high, though acknowledged that there is inadequate research works to substantiate this popular perception. The findings of this work differ from the submission of Idoro (2013) that opined that cost of construction in Nigeria is the highest in the world. The results of this study add to knowledge in this area of concern and could provide remedies to curb escalating cost of construction in Nigeria. The findings of this study provided the intuition for the researcher to compare the construction cost/m2 in Nigeria with that of some African countries, the factors that significantly influence cost of construction in Nigeria and how the situation can be put under check through some control measures.

government and private investors could address high cost of construction in Nigeria. The findings of this study agree with the submission of Ajanlekoko (2017).

CONCLUSION AND RECOMMENDATION

Conclusion

The study therefore concludes that the construction cost of projects in Nigeria is high in comparison with contemporary African countries. Significant factors responsible for this are: High cost of construction materials, Inflation, Monopolistic market for construction materials, deliberate inflation of contract sum, Kick back syndrome, Shoddy practice, Difficulty in accessing loan by contractor, delay in execution of construction projects, Over dependent of imported materials, Professional Negligence, unwarranted upward review of contract sum and construction method. To curb this menace, the study submits that only certified and qualified cost experts, elimination of monopolistic market, formation of omnibus entity, formulation of working policies and elimination of delays in execution of projects by government by removal of bottle neck in process in payments of contractors.

Recommendations

The study recommends that:

i. Cost of construction can be minimized in Nigeria by eliminating monopoly in the manufacturing industry thereby encouraging many investors to invest and promote healthy competition like telecommunication industry
ii. Formation of Omnibus government entity to regulate the activities of construction activities is long overdue. The existing Bureau of public procurement seems not to be enough to address high cost of construction in Nigeria and
iii. All stakeholders in the Nigerian construction industry should learn and adopt the ways of other nations whose cost of construction are relatively low.

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victimization. Victimization rates rose in 2011 with Ebonyi state having a record 95%. Ten other states including Benue had victimization rates above 50%.

Generally, crime control measures are physical manifestations of the principles of Crime Prevention through Environmental Design (CPTED) such as territoriality, access control, target hardening and surveillance. Fences, walls and gates could be territoriality, target hardening or access control measures while lighting, Closed Circuit Television (CCTV) cameras, mixed land uses and doors or windows overlooking the streets provide opportunities for surveillance. Farrington and Welsh (2002) conducted a systematic review of literature on the effects of improved street lighting on crime from studies on American and British cities. The results showed that in four American studies, street lighting was effective in reducing crime while four others reported otherwise. From the British studies, five reported a decrease in crime with improved street lighting. The conclusion from the review was that even though street lighting had an effect in reducing crime, it apparently increased community pride more than it increased surveillance. A study of lighting improvements in two English cities, Dudley and Stoke-on-Trent showed that it reduced crime by forty-one percent in Dudley and forty-three percent in Stoke-on-Trent and heightened perceived public safety (Painter and Farrington, 1999). It has been observed that street lighting is particularly effective at night as it improves night time visibility and enhances surveillance within urban areas; thereby resulting in reduced opportunities for crime (Jacobs, 1961; Welsh and Farrington, 2008).

Ratcliffe et al (2009) also found that the introduction of CCTV cameras in Philadelphia was associated with a thirteen percent reduction in crime. They observed that CCTV cameras were more effective in some locations than in others. Piza (2018) also investigated the effect of CCTV cameras on three crime categories - auto theft, theft from automobile and violent crime in Newark, New Jersey. The results indicate that CCTV cameras were effective in deterring auto theft but ineffective on other crime types. This lends support to the report by Welsh and Farrington (2009) that CCTV cameras were more effective in car parks. Thus, Piza (2018) concludes that CCTV cameras could be a viable option in areas where the target is auto theft. A survey of twelve former burglars showed that the most effective deterrents for home burglaries were CCTV cameras and a barking dog while for car theft, CCTV cameras and car alarms were the most effective (Smithers, 2017).

In South Africa, increasing reliance on private security companies has led to a surge in their numbers. Private security employees outnumbered the Police by 2015/2016. Berg and Howell's (2017) analysis of the situation in South Africa shows that by 2015/2016, there were two hundred and seventy-six Police Officers for one hundred thousand people while there were eight hundred and eighty-nine private security guards for the same population. From the literature, it is not clear if these private security personnel have contributed to crime reduction in South Africa. On the basis of a summary of evaluations of previous research findings from the United States of America, the United Kingdom, The Netherlands and Canada, Welsh and Farrington (2009) reported that a combination of measures including security guards were highly effective in reducing crime at a car park in Basingstoke. In this case, it was not possible to isolate the effects of specific measures on the reduction of crime in the area.

structured questionnaire to elicit information from the residents of Makurdi on the types of crime and the formal and informal measures used in crime prevention and control.

Data collection

Specifically, data was needed on the types of crime that are prevalent in the study area, target hardening or territoriality measures like fences, window grills, electric fences, razor wire; and surveillance strategies such as security guards, vigilante groups or any form of collaborations with Law enforcement agencies. The measures used by residents were identified from the responses obtained. A multi-stage sampling design was adopted for data collection. Makurdi town was first divided into fifty-five spatial units according to the building densities. There were seventeen high density spatial units, thirty-three medium density spatial units and seven low density spatial units. Some of the low density areas include New G.R.A I, Owner Occupier I and Ajaba community; medium density areas include HUDCO North Bank, Low Cost Naka Road, Ankpa Ward I, II and III and Judges' Quarters while high density areas are Logo I & II, Low Level. Wadata and Modern Market Area. A proportionate sampling size was adopted in the ratio 50: 30: 20 (%) for high, medium and low building density areas respectively. The target respondents were household heads. A total of eight hundred and ninety-nine respondents were randomly sampled for the study but only eight hundred and sixty responses were collated.

Data analysis

To determine the effectiveness of the crime control measures adopted by residents of Makurdi town, the multiple regression analysis was used. The percentages recorded against each of the five dominant crime control measures were regressed against the level of victimization and the five types of crime identified in the study area. Statistical Package for the Social Sciences (SPSS) version 15 was used in conducting the analysis. In interpreting the results of the regression analysis, if the p-value is less than 0.05, then the correlation is considered to be statistically significant. This implies that at 95% confidence interval, the relationship between the variables is not due to chance but that the predictor variables (crime control measures) have a significant effect on the dependent variable (crime and victimization). In interpreting the results, coefficients of determination values that were between seventy to one hundred percent meant that the particular crime measure had a strong effect on the occurrence of crime; forty to sixty-nine percent connoted a moderate effect on crime while one to thirty-nine percent indicated a weak effect on crime reduction. A positive relationship indicates that crime will increase when certain measures are deployed while a negative (inverse) relationship suggests that crime will decrease with the application of particular interventions. The unstandardized coefficients (B) provided clarification on the direction of the relationship between the dependent and independent variables.

ANALYSIS AND DISCUSSION OF RESULTS

The average percentage of residents that had experienced crime in Makurdi was 42.1. An average of 14.3% had experienced assault; 4.4% had experienced rape; 26.8% had been victims of burglary; 32.4% had experienced armed robbery while 31.8% had experienced thefts. From the analysis, theft and armed robbery were the

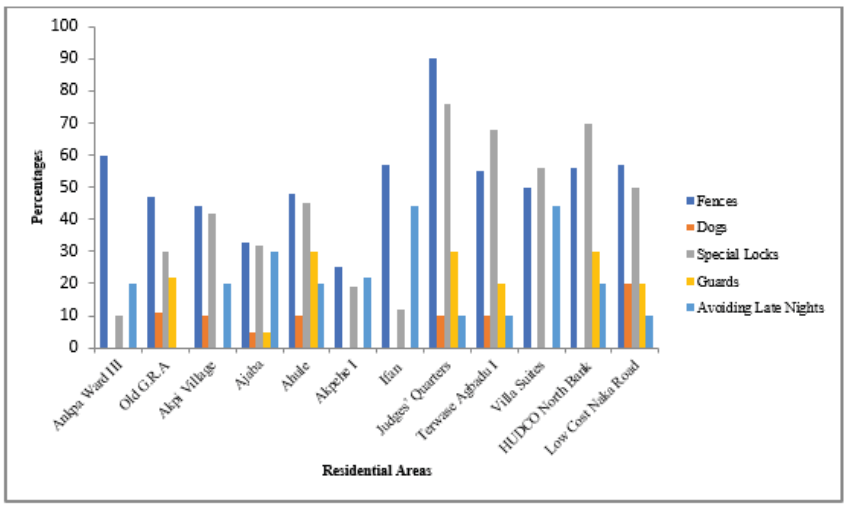

Figure 2C: Percentage of Residents using Different Crime Control Measures

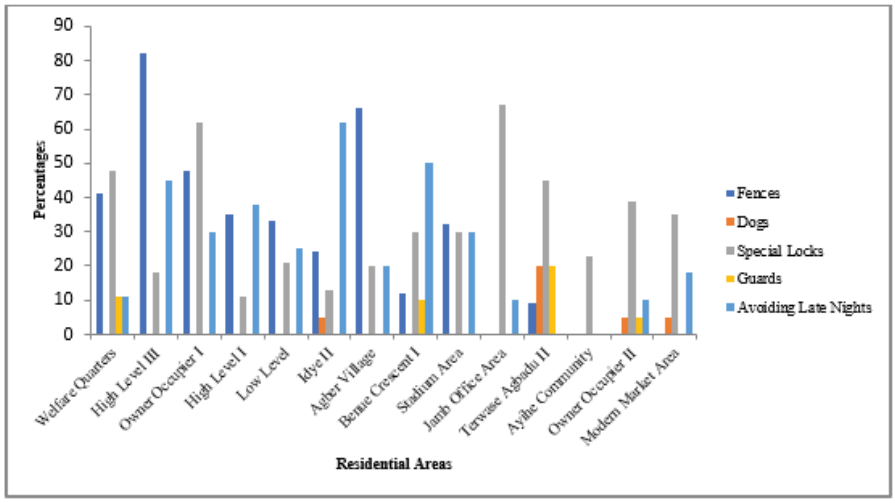

Figure 2D: Percentage of Residents using Different Crime Control Measures

The capacity of these measures to reduce the opportunities for victimization was determined through the application of multiple regression analysis. The results of the analysis (Table 1) indicate the effect each of the measures has on crime reduction.

Table 1: Regression results on the effectiveness of crime control measures

Measures/Type of Crime	Level of Victimization	Theft	Armed Robbery	Burglary	Assault	Rape
Fences	0.03 (0.26)	0.06	0.001 (0.49)	0.79	0.18	0.05 (-0.09)
Special Locks	0.90	0.02 (-0.40)	0.009 (0.42)	0.50	0.19	0.35
Dogs	0.24	0.18	0.043 (1.20)	0.35	0.11	0.25
Guards	0.14	0.07	0.001 (1.40)	0.47	0.07	0.57
Avoiding Late Nights	0.82	0.09	0.014 (-0.46)	0.58	0.01 (0.35)	0.32

Source: Author's Analysis (2015)
Bold figures indicate significant relationship ($p < 0.05$) between the crime control measure and the type of crime
Beta figures (B) showing the direction of the relationship between crime control measures and crime in parenthesis

The effectiveness of special locks and additional reinforcements

Special locks and additional reinforcements are target hardening measures because they increase the effort required by offenders to gain access to their targets. The use of special locks on doors and reinforced burglar proofs were widely reported in Federal Housing Estate North Bank, New G.R.A, Owner Occupier I, Low Cost Naka Road, Judges' Quarters and HUDCO North Bank.

From the results of the analysis, there were statistically significant relationships between the use of special locks and additional reinforcements and the incidences of crimes like armed robbery and theft (Table 1). Special locks and additional reinforcements accounted for 12% and 9% of the variations in the incidences of armed robbery and theft respectively. This implies that special locks and additional reinforcements have a weak (minimal) capacity (12% and 9%) to influence the occurrence of armed robbery and theft in residential areas in Makurdi town. The relationship between special locks and armed robbery was positive while that of theft was negative. The positive relationship suggests that the incidences of armed robbery are still likely to increase even with the use of special locks and additional reinforcements. This can be seen in residential areas such as Judges' Quarters, HUDCO Quarters and Low Cost Estate Naka Road which had the highest number of houses with special locks and additional reinforcement but also had relatively high reported incidences of armed robbery. Thus, special locks and additional reinforcements are not effective in curbing the incidences of armed robbery in Makurdi town.

On the other hand, the negative relationship between special locks and theft suggests that special locks have a limited capability to reduce the occurrence of theft in some residential areas in Makurdi. The least incidences of theft were found in the residential areas which had the highest percentage of residences with special locks and additional reinforcements. However, Owner Occupier I had a high percentage (62%) of residents that had adopted special locks and additional reinforcements, but the area also recorded significantly high incidences of theft. The possible explanation for this variation is the earlier assertion that previous evaluations of crime control measures seem to suggest that location is fundamental to the effectiveness of a particular measure. Though Budd (1999) found that security measures such as deadlocks and window locks or grilles were effective in preventing burglary in Britain, the study in Makurdi did not find any relationship between special locks and additional reinforcements and the occurrence of burglary.

The effectiveness of dogs in crime control

Dogs were used by residents to keep watch over their homes and scare away intruders or potential offenders. For this reason, dogs can be classified as surveillance measures. The use of dogs in crime prevention and control was the least adopted measure in the residential areas of Makurdi town. Residential areas such as Sule Settlement, Low Cost Naka Road, Lobi Quarters and Terwase Agbadu II had the highest percentages of houses with dogs. Only armed robbery had a statistically significant relationship with the presence of dogs. The relationship was weak (7%) and positive (Table 1). This implies that dogs are not an effective measure in the control of incidences of armed robbery. The residential areas which had the highest percentage of residences with dogs also experienced high

Angwan-Jukun, parts of Wadata, North Bank, Idye and Ankpa-Ward and Akpehe. The analysis suggests that majority of the residents that avoid late nights are either pedestrians or those that depend on public commercial means of transportation. From the information obtained during the fieldwork, pedestrians and commuters on public transportation (particularly motorcycles) were more exposed to street crimes.

On average thirty percent of the residents of Makurdi town were concerned about their safety on the streets at night. This is probably because there were high incidences of night-time crime reported during the survey. This crime control measure had a statistically significant relationship with the incidences of armed robbery and assault (Table 1). The relationship between avoiding late nights and armed robbery was negative while it had a positive relationship with assault. In both cases, avoiding late nights accounted for eleven percent of the variation in the incidences of armed robbery and assault respectively. This implies that avoiding late nights had very little positive and negative effect on the occurrence of armed robbery and assault in residential areas.

The negative association with armed robbery suggests that avoiding late nights could have a minimal (11%) effect in reducing the incidences of armed robbery. This finding is supported by the distribution of incidences of armed robbery within Makurdi town. The areas with the highest percentage of residents who avoided late nights coincided with the areas with either none or lower incidences of armed robbery. Such residential areas were Low Cost Estate North Bank, Idye, Akpehe II and Sule settlement. Ankpa-Ward II was the exception in this case; as it recorded high incidences of armed robbery even with a significant percentage of the residents avoiding late nights. Avoiding late nights appears to have the potential to reduce armed robbery because armed robbery was identified as a night-time street crime. Thus, avoiding late nights reduced the presence of attractive targets (people and valuable objects) on the streets at night and increased the chances of a minimal decrease in the incidences of armed robbery.

The implication of the positive relationship is that avoiding late nights can possibly increase the opportunities for assault to occur within residential areas of the town. A probable explanation is that less activity on the streets leaves the streets deserted and unguarded. Therefore, potential victims are exposed to greater risks of assault. Some of the residential areas with the highest percentage of respondents who avoided late nights also recorded relatively higher incidences of assault. These residential areas include North Bank II, Akpehe II and Idye II. Low Cost Estate North Bank, Ankpa-Ward II, Wadata IV and Sule settlement had high percentages of residents that avoided late nights as a safety measure but had no reported incidences of assault. This is possibly an indicator that other triggers of assault such as the presence of young adults (motivated offenders) are absent in these residential areas. From another perspective, one would think that avoiding late nights might contribute to a reduction of crimes that take place within the homes like theft and burglary. But there was no evidence from the analysis to support this assumption.

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Sigsgaard & Verbeek, 2013). A thorough review of these studies revealed some research gaps. Most of the studies conducted are vastly in the residential sector and sparsely in the commercial sector. Efforts are concentrated on methodologies for assessment, symptoms and effect rather than mitigating the effects. Consequently, more than fifty percent of the studies are localised and lastly studies on dampness and moisture penetration in Nigeria are sparse (Ogbu, 2017; Olanrewaju & Anifowose, 2015; Mijinyawa, Adesogan & Ogunkoya, 2007). More importantly, this study is necessitated by the growing trends of dampness and the degree to which damage is done on halls of residence in tertiary institutions, in terms of value and utility. This study is set out to fill some of these gaps.

This is part of a larger study on defects and deterioration in educational institutions' halls of residence in Nigeria, whose purpose is to develop a framework on thorough understanding of defects associated with dampness, the factors responsible and the consequences with a view to providing a data base that may inform decisions by key stakeholders, more so that the need for sustainable/near-zero energy buildings are clamoured globally. Two objectives are set for the purpose of this study. The first objective is to determine the prevalent sources of dampness and the frequency of occurrence in halls of residence within the study area. The second objective is to assess the halls of residence with the highest symptoms of dampness. The benefits of dampness control and mitigation include increased building value, occupants' comfort/or improved health, low maintenance cost and longevity. The assessment of the various types of defects, their sources and consequences will be a good take off to generating data on university buildings and this will be instrumental in formulating policies that will help put Nigerian universities and students' performance on a good pedestal.

LITERATURE REVIEW

Dampness or moisture in buildings

Most of the materials used in the construction of buildings are porous in nature. Thus, an appreciable quantity of water, also known as moisture, will be present in a relatively 'dry building'. A building element or component that retains this amount of water is said to be damp. Different qualitative terms used to denote the presence of excess water or moisture in buildings include dampness, condensation, damp patches, damp spots, water collection and moisture problem. Agyekum and Ayarkwa, (2014) define dampness as the wetting of structural elements through moisture rise by capillary action. Dampness signifies a wide array of signs (also known as dampness indicators / symptoms / characteristics) of moisture damage of variable spatial extent and severity (Ahmad & Abdul-Rahman, 2010).

A building will be described as 'damp', when the effect of the amount of water present as a result of current or prior moisture movement becomes visible through wetting of building components, salts forming on masonry, tidemarks. discolouration/stains of plaster/paintwork, removal of finishes, mould/algal/fungal growth, efflorescence, peeling/bulging of paint, water drips, uplift of tiles, rotting of skirting, peeling of wall papers, misty smell and a sensation of humid interior (ICOMOS, 2016; Agyekum & Ayarkwa, 2014). Dampness and moisture problems result in physical, biological or chemical deterioration of a building or its materials.

Condensation

Condensation is the release of water that occurs internally when air comes into contact with colder building components. Curtis (2007) posits that condensation occurs where water in the air inside a building condenses on a cooler surface due to cold spots or cold bridges. Condensation commonly affects rooms where a large amount of moisture is produced, such as kitchens, bathrooms and bedrooms (Burns, 2010). These are areas with a poor-ventilation tendency and short intense heating cycles which do not allow the walls to fully warm up (Curtis, 2007). Other areas where condensation can be prominent include stair-halls/lobbies, stores wardrobes/cupboards built against external walls and behind furniture or pictures. Excessive condensation frequently results in severe mould growth which can in turn create health hazards. Damp patches can appear on plaster walls in odd places, particularly on outside walls and sometimes, ceiling, appearing and disappearing on a regular basis (Mahdavinejad, Javanroodi & Hashemi, 2013; Ryan, 2002; Bornehag,et. al. 2001). Condensation on surfaces or structures is an indicator of dampness and microbial growth.

Rising Damp

Burkinshaw and Parrett (2004) submit that rising damp occur when water rises upwards, from the ground, through the pores of masonries, cracks in buildings, or the floors of buildings. The process is known as capillary suction or capillarity. Capillary suction becomes stronger as the pore size gets smaller; if the pore size is fine enough damp may rise many metres in a wall, until the upward suction is balanced by the downward pull of gravity. The height to which water will rise in a wall is limited by the rate of evaporation of water from the wall surfaces. The evaporation rate for external surfaces is related to the nature of the masonry materials, surface coatings, climate, season and the wall orientation. The presence of salts in building components affected by rising damp is not always feasible to a casual observer, thus a component that shows minor height or symptoms of rising damp initially would increase humidity and cause serious damage after a while. Salt attack usually presents itself as salty brownish-yellow patches after much damage would have been done to materials such as brick or mortar as the salts dissolve or disintegrate. The normal limit for rising dampness ranges from 0.5 m to 1.5 m above ground level (Halim & Halim, 2010; (Muhamad, Azree & Nangkula, 2015; Mahdavinejad, Javanroodi & Hashemi, 2013; Ryan, 2002).

Ground Water and Penetration Dampness

Ground moisture problems relate to the entry of groundwater into a building which may originate from drainages below ground surface or standing water. Moisture may enter via upward movement through the bases of walls or floors. Rising damp differs from ground water in the sense that rising damp rises through capillary action while ground water does not depend on capillarity (Burkinshaw &Parrett, 2003; Trotman & Harrison,2004; Trotman,et. al.,2010).Water penetration through a building enclosure depends on the simultaneous occurrence of three things: the presence of water; an opening through which water can enter and a physical force to move the water (Beall, 2000). This is however influenced by gravity, air currents, capillary suction, surface tension, kinetic energy, air pressure and hydrostatic pressure (Beall, 2000). Penetration dampness takes place when the forces enumerated re-direct moisture inform of drips from air conditioning, overflows from overhead tanks, rain water, pipe leakages, or water from other sources in

tested in the laboratory, the fourth stage is a bit higher in the sense that destructive tests and examinations that require opening up building parts are conducted. Here, greater emphasis is placed on the sampling which aims at confirming moisture conditions (within walls and floors) by drilling out masonry samples. The decision on where samples are drilled and how they are drilled depend on the kind of investigation undertaken and the prevailing site conditions (Halim, et. al, 2012).

The first two stages of the procedure for dampness investigation were adopted for this study. By utilising these two methods, the sources and the causes of dampness can be identified through a careful observation of the symptoms. Generally, the observation is carried out by looking at specific symptoms that are peculiar to each of the sources of dampness, tracing the causes, that is, what led to the symptoms and getting the most re-curing sources and causes of dampness. The moisture meter was used to take objective readings on the walls that appeared to be severely affected in order to get the actual moisture content that will be used for further investigations.

RESEARCH METHODOLOGY

This study aimed at investigating the prevalent sources of dampness and the frequency of occurrence as well as the evaluation of the halls that have the highest effect of dampness in halls of residence in University of Lagos using the first two stages of the 4-tier dampness diagnosis assessment method. Eleven out of the thirteen halls of residence in the University was chosen. Two of the halls were not chosen because they were newly remodeled.

Stage one-visual observation: The first stage involved visual observation of the halls. This was done to reveal the prevalent sources of dampness based on the mean score of the indicators. To achieve this, a checklist of a minimum of 2 dampness indicators and maximum of 5 was developed for each source of dampness; namely condensation, ground water, penetration damp, pipe leakage and rising damp. These gave a total indicator of 19 for the 11 halls of residence which were graded on a scale of ‘1-3’ranging from ‘1’ for nil to ‘2’ for moderate and ‘3’ for severe based on a minimum area of 200mm by 200mm. Four (4) trained research assistants inspected the halls. The indexes for the halls were then computed using Excel sheet. The scale used for the indexes is 0-0.9 for indicators that were not visible/present, 1.0-1.99 for moderate indicators while 2.0-2.99 is for severe indicators. The computation was done based on an average score of 1.50 which is the mid-way of the Likert scale adopted corresponding with ‘moderate’ symptom. The frequency was computed using percentages.

A second checklist was prepared to assess the halls with the highest effect of dampness on 6 building elements and components namely; walls, floors, roof, finishing, doors/windows and timber fittings/furniture, each with an indicator ranging from 3 to 6 items. The severity indexes for the 6 components for each hall were computed using Excel sheets. The hall with the highest value, signifying the highest severity index, has the highest effect of dampness. The checklist is as shown in Appendix I, with the records of some of the effects of dampness on the halls- by photographs, in Appendix II.

dampness are more pronounced. All the 5 dampness sources have percentages ranging from 17 to 24. This range is close to the percentages obtained from the study of HaverinenΖShaughnessy, et al., (2012) in three countries. This is an indication that all the 5 sources of dampness namely; condensation, ground water, penetration damp, pipe leakage and rising damp contribute to moisture problems in the halls. The most frequently experienced moisture problems however are majorly from pipe leakages, followed by condensation.

Table 1:Sources of dampness and frequency of occurrence in halls of residence in Lagos

Dampness Sources	Mean	Sum	1(Nil)	2(Mod)	3(Sev)
Penetration Dampness (17)					
Wetness of wall based on the direction of water	1.55	17	5	6	0
Water from horizontal direction	1.55	17	7	2	2
Ground Water (19)					
Pools from washing areas/ damaged or blocked drain	1.55	17	6	4	1
Ever present pool even without rain	1.91	21	3	6	2
Rising Damp (20)					
Pronounced defect at plinth level	1.91	21	2	8	1
uneven horizontal line/brown patches/tidal mark	1.55	17	6	4	1
Water rising above one foot with surrounding pool of water	1.55	17	5	6	0
Falling off /deterioration of skirting, tiles, wallpaper close to plinth level	1.55	17	6	4	1
Deterioration to plaster from ground level	2.45	27	1	4	6
Condensation (21)					
Presence of cold surfaces to external walls	1.82	20	5	3	3
Water vapour/Mist/condensation drips at window	2.36	26	0	7	4
Moisture/mist at floor-to-floor junction	1.82	20	4	5	2
Wet spot behind furniture	1.91	21	3	6	2
Misty odour in building space	1.55	17	6	4	1
Plumbing (24)					
Pool of water/Constant flooding	1.91	21	2	8	1
Localised stains	1.45	16	7	3	1
Stand-alone patches around ducts, pipes/air-conditioners	2.18	24	1	7	3
Uplifting of components	2.55	28	0	5	6
Loosening of tiles in bathrooms, kitchen and laundry	2.82	31	0	2	9

NB:0-0.9=indicators not visible, 1.0-1.99= indicators moderate and 2.0 -2.99= indicators severe.

Effect of dampness on halls of residence

The prevalence of the effects of the dampness on the halls was assessed based on the severity of the dampness on 6 building elements and components. The severity index for each component per hall was then computed. The result is presented in Table 2.

The severity indexes of the effect of dampness indicators on floors, walls, roofs, furniture and fittings, doors and windows as well as finishing are as presented in Table 2. The results showed that Hall 1, which is one of the oldest male hostels, located North-West of the university has the highest effect of dampness. This is followed by halls 2 and 5 in that order. However, there is the need to conduct

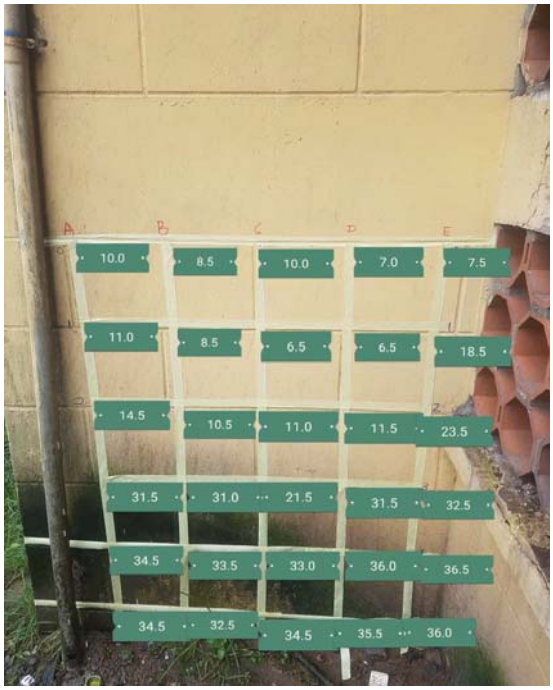

Figure 2: Moisture Meter Readings

DISCUSSION OF FINDINGS

The results of the analysis are hereby discussed based on the objectives.

Prevalent sources of dampness and frequency of occurrence in halls of residence

The findings revealed that most of the indicators of dampness are present in varying degrees in all the halls which inferred that condensation, ground water, penetration dampness, pipe leakages and rising damp are in existence. Pipe leakages, however took the lead based on the degrees of the indicators such as constant pool of water/flooding in the wash areas, localised stains on walls closed to the toilets and bathrooms, stand-alone patches around air-conditioners, long-continuous and pronounced patches traceable to air-conditioner ducts and drips from taps and wash basins as well as uplifting/loosening of floor tiles and wall tiles where pipes are installed. The second most prevalent dampness source is condensation. This was evident from the presence of cold surfaces on window panes close to external walls during the early hours of the day, water vapour/misty droplets on the soffit of upper floors, wet spots behind lockers/cupboards/wardrobes and beds that are placed close to walls. The implication of these results is that all the 5 sources of dampness are prevalent with pipe leakages and condensation having the highest frequency of occurrence.

Evaluation of the halls of residence with the severe perceived effect of dampness

A further scrutiny on some building elements and components namely; walls, floors, roof, finishing, doors/windows and timber fittings/furniture showed the extent of the perceived moisture damage on the halls of residence. The indexes for each of the halls based on the 6 components observed revealed that 2 out of the 11 halls have severity indexes of over five out of a total of six point. The inference here is that the effect of dampness varies from one hall to the other based

water and the collection of debris, the sources of the pool of water and the debris should be attended to with immediate effect. In other words, inspections should be carried out in the halls and attention given to the necessary repair and maintenance works as at when due.

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APPENDIXES

Appendix 1:Specific dampness indicators

Effect of Dampness on Halls of Residence

DAMPNESS INDICATORS/EFFECT	1	2	3	4	5	6	7	8	9	10	11
ROOFING											
Leaking roof											
Rotting of roof members											
Decaying roof/ceiling members											
WALLS											
Blistering , Flaking and peeling											
Bleaching											
Mould growth											
Discolouration /stains/unaesthetic patches											
Efflorescence											
FLOORS											
Ingress of water through floors											
Uneven floor due to previous and excessive water intrusion											
Deterioration of flooring materials/coverings											
PLASTER AND/OR FINISHING											
Cracking/spalling/ softening/crumbling of plaster											
Loosened wall paper											
Deterioration of floor covering											
Falling of /lifting/chipping of tiles											
Appearance of wetness/staining in tiles											
METAL DOORS, WINDOWS, BALUSTRADES 3											
Discoloration of metals											
Corrosion/Decay of metals											
Blistering of protective coating											
TIMBER FITTINGS AND FURNITURE											
Warping of doors/rot/decay											
Fungal growth											
Crumbing of timber fixtures e.g. cabinets											
removal/damages to skirtings											
Swelling of timber fittings											
Unaesthetics pathes/odour behind fittings											

Appendix II : Pictorial representation of dampness observed at hall No. 1

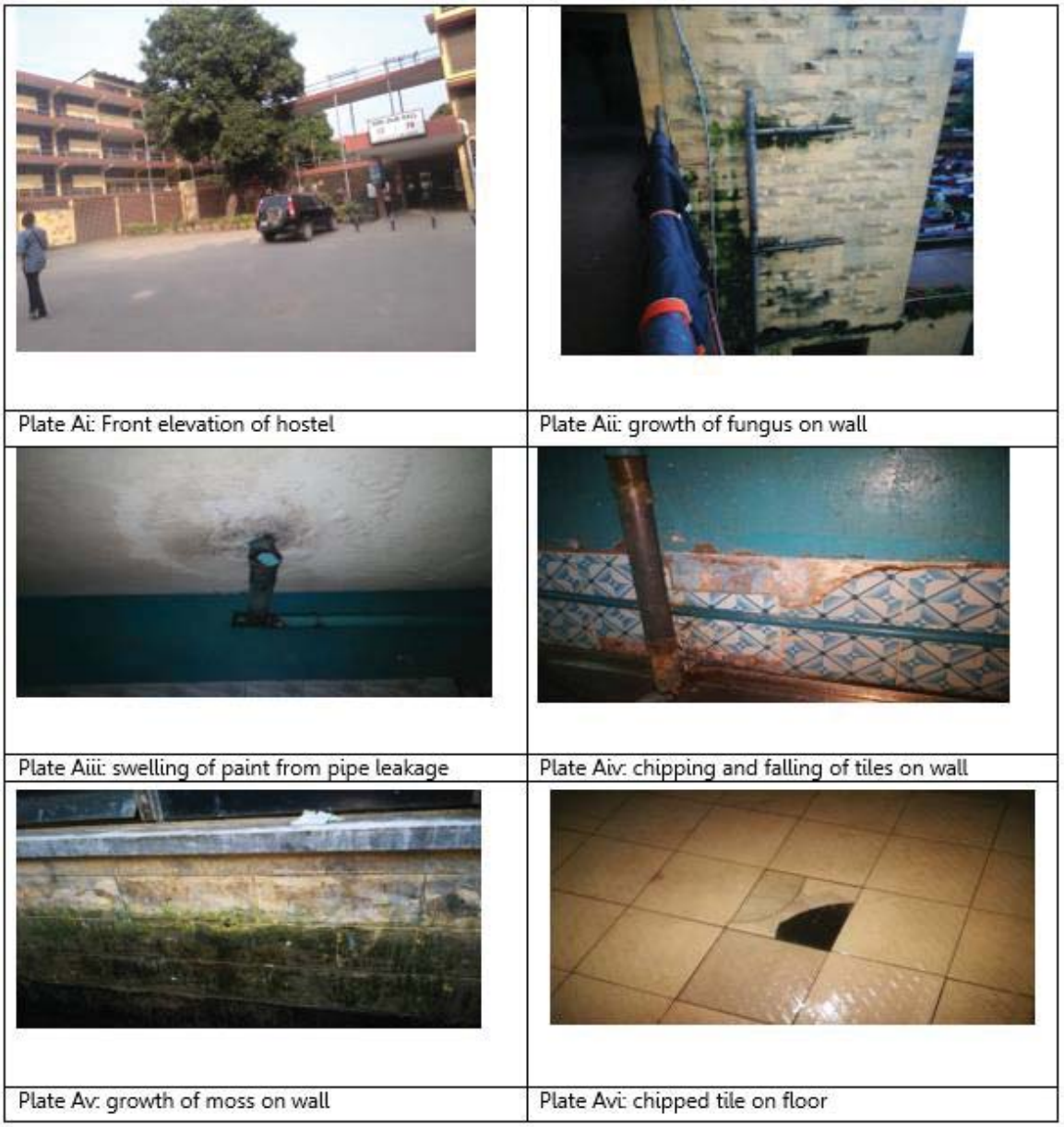


Plate Ai: Front elevation of hostel

Plate Aii: growth of fungus on wall

Plate Aiii: swelling of paint from pipe leakage

Plate Aiv: chipping and falling of tiles on wall

Plate Av: growth of moss on wall

Plate Avi: chipped tile on floor

Dampness problem observed at hall of residence No.1.

Observed in this hall of residence are pipe leakages, tile chipping, discolouration, mould and fungal growth, spalling of structural members as shown in plates i-vi..

Appendix III: Moisture Meter Plates

Appendix IV to VI :Gridlines

Plate A::The grids being marked out on the wall

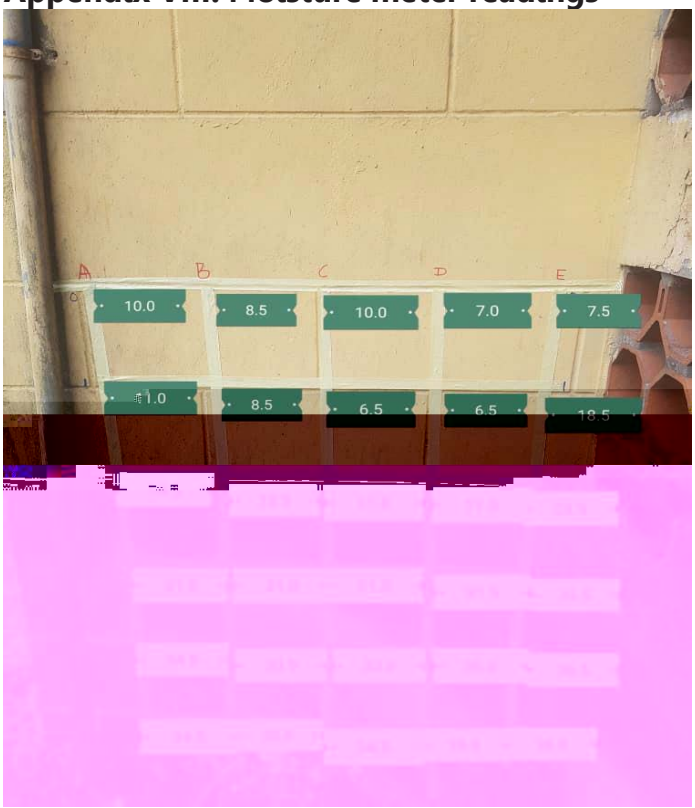
Plate B: The grids completely marked out and numbered.

Plate C: Taking readings at the base of the wall

Plate D: The identified wall showing symptoms of rising damp

Appendix VII: The condensation test result indicating condensation from the inner side (face of the wall) of the foil paper

Appendix VIII: Moisture meter readings



coherence on the level of presence of CCCs in Africa and influence of the firm- and country-specific advantages of the SOEs and POEs on their operations in Africa. The literature review type used is scoping review. Unlike the systematic review, a scoping review is distinguished by its quest to address a wider topic to gauge the quality of the studies reviewed (Peterson et al., 2017). A scoping review is best-suited for an exploratory research question intended to map the key conceptions and verifications to methodically expose evidence gaps (Colquhoun et al., 2014). The five-stage methodological framework advanced by Arksey and O'Malley (2005), which Levac, Colquhoun and O'Brien (2010) later developed into six stages, is used as discussed in detail later on under the section on methodology.

Conceptual framework and theoretical framework

Influenced by the need to establish inter-textual coherence, the conceptual framework used in this study is consensus building. Innes (2004, p.16) has justified the need to distinguish between consensus building that is based on a notion stranded in empirical proof and a grand social theory. The theoretical framework adopted is the Coherence Theory, based on the original intent of epistemic justification derived solely from empirical coherence (Bonjour, 1975, p.281). It should be expected that an epistemic optimal coherence (Amaya, 2011) exists on the level of presence of CCCs and the influence of their firm- and country-advantages on their operations in Africa. As an extension of the literature review, the subsequent section discusses the scoping review of CCCs activities based on a 10-year report (2009-18) by the Centre for Chinese Studies (CCS) (http://www0.sun.ac.za/ccs/).

METHODOLOGY

To establish the level of presence of CCCs in Africa, Levac, Colquhoun and O'Brien's (2010) methodological framework for a scoping review, based on Arksey and O'Malley's (2005) earlier framework, was adopted. Table 1 summarizes the actions taken for the six stages to gather data on the level of presence of CCCs in Africa.

Table 1: Scoping review on CCCs in Africa

Stage	Actions taken
1: Identifying the research question	As discussed towards the conclusion under the introduction section, the research question (RQ) is how significant is the agreement on the presence of CCCs in Africa and the influence of firm-specific and country-specific advantages on the entry and operational strategies of the Chinese SOEs and POEs in Africa? The RQ mode is inter-textual coherence/consistency as discussed at the onset of the literature review section.
2: Identifying relevant studies	There are stages involved: (1) integrative review (IR) and (2) scoping review (SR). The IR established the soaring interests among the existing main and grey studies on the presence and strategies of CCCs in Africa. It flagged the potential impact of a bandwagon effect to posit the need for inter-textual coherence. The SR focuses on representative studies on the presence of CCCs in Africa pre-2009 and tRqty1 T(re39 .02). The3 177.5([(review sectio)5relevan

4: Charting the data	Chen et al. (2007) offers processed data on pre-2009 presence of CCCs in Africa. CCS briefing provides narrative review of the activities of CCCs in Africa. CCS database review focused on building and engineering (including oil & gas), manufacturing, information and communication technology, and services (e.g. banking). The review excluded defence and security, farming, political/peace talks, and relief efforts.
5: Collating, summarizing, and reporting results	The preceding criteria were used during the narrative review for the frequency of the report of CCCs' activities in the African countries from 2009 to 2018. Repetitions were eliminated during numerical analysis while establishing diplomatic ties were not counted as projects. Except where such coincided with an actual project. Due to the page limit constraint in this paper, the detailed result is available upon request.
6: Consultation (optional)	The result was transposed as a proxy for the level of presence of CCCs in different African countries as presented under Figure 1. This was done by adapting Witmer and Singer's (1998, p.231) scale, where 0 = non-existent, 1-2 = not compelling, 3-4 = minimally compelling, 5-6 = moderately compelling, 7-8 = majorly compelling, and 9 and above = very compelling. A Chinese manager validated Figure 1 as "almost 90% accurate".

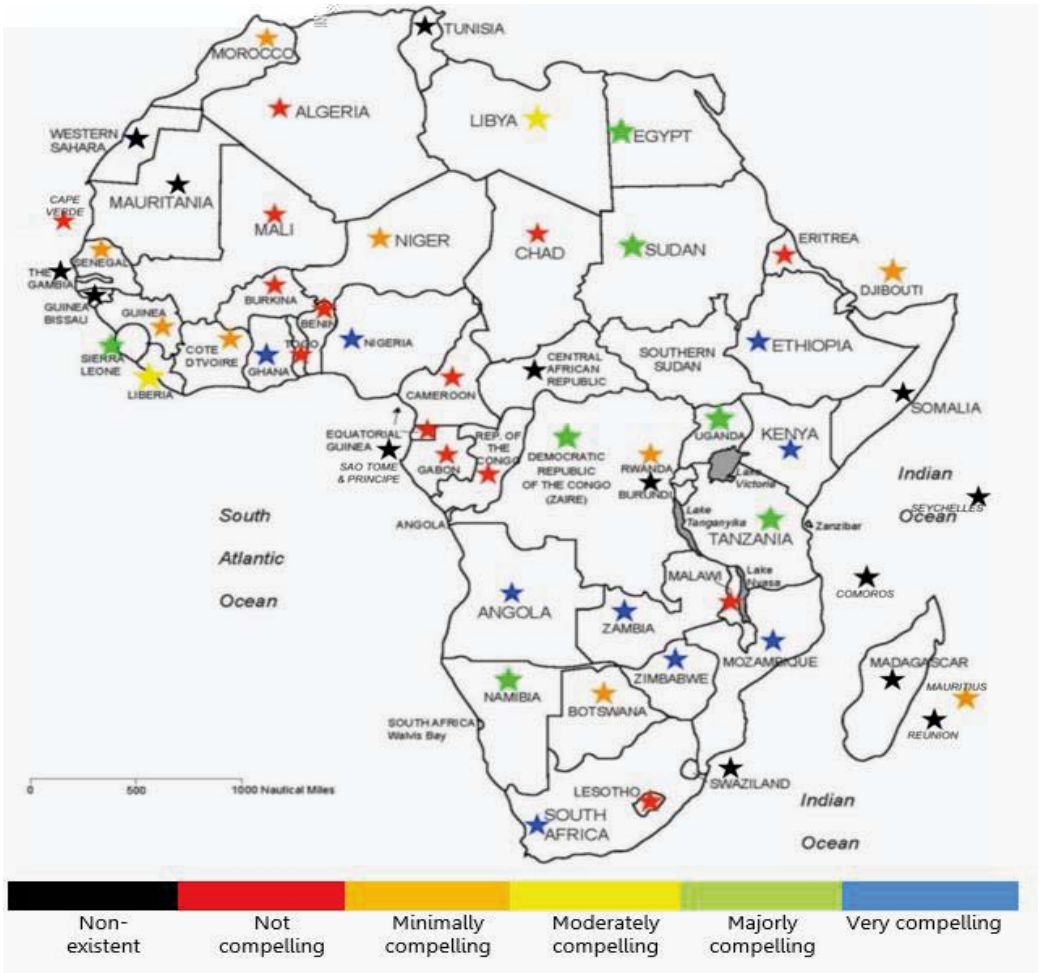


Figure 1: Level of presence of Chinese construction companies in Africa

To establish the level of influence of the advantages of the Chinese SOEs' and POEs' firm- and country-advantages on their strategies in Africa, a field study was conducted. Based on Saunders et al.'s (2016, p.125) onion model, the philosophy,

approach, and methodological choice adopted were, respectively, positivism, deductive, and quantitative.

Research design

A cross-sectional survey design of Chinese managers of CCCs operating in Algeria, Kenya, Nigeria, and South Africa was adopted to cover the four geographic zones in Africa. A cross-sectional study is easier to conduct but prone to non-response from some of the consented parties (Sedgwick 2014).

Research method

A 2-section-web-based structured questionnaire was used for anonymity and flexibility (Newman et al. 2002). The first section focused on the profile of the target population. The second section sought ordinal data on the level of influence of the OLI advantages based on Low and Jiang's (2006) study.

Population and sample

The target population of CCCs operating in Algeria, Kenya, Nigeria, and South Africa was purposively-sampled based on a self-designed sampling frame from previous studies (Babatunde & Low, 2013; Babatunde & Low, 2015). 109 CCCs were e-mailed the questionnaire while 22 questionnaires were returned.

RESULTS AND DISCUSSION

Descriptive analysis of the data obtained via the first section of the questionnaire revealed that the 22 respondents had an average of 8.5 years of working experience and included 13 SOE and 9 POE Chinese managers. Their primary roles included 54.55% management (8 SOEs and 4 POEs), 18.18% technical (2 SOEs and POEs), and 27.27% dual role as management and technical (3 SOEs and POEs). Based on McAdam and Reid's (2001) company categorization using employee size (w.r.t. local operations), the 22 respondents represented 68.18% large firms (10 SOEs and 5 POEs), 9.09% medium firms (2 POEs), and 22.73% small firms (3 SOEs and 2 POEs). Majority of the respondents (63.64%, 7 SOEs and POEs) had offices headquartered in Beijing, followed by the Shandong province (9.09%, 1 SOE and POE), and lastly 1 SOE each from Hangzhou, Guangzhou, Hebei, Gansu, and Guangxi provinces. One and the last POE is headquartered in Nairobi, Kenya. On aggregate, the predominant entry mode appeared to be contracts (11 respondents) followed by direct exports (8 respondents). Six (6) respondents (3 SOEs and POEs) indicated having used a combination of entry modes, mainly contracts and direct exports (4 respondents, 2 SOEs and POEs).

For the quantitative data, Annexure 1 presents the result of the level of influence of the firm- and country-specific OLI advantages on the operations of the SOEs and POEs in Africa. The mean (M) has been used to rank while the standard deviation (SD) has been used as a tie breaker. The coefficient of variation (CV) helps to better interpret the variability that the SD expresses. The z-score is the number of SDs from M, also referred to as the normal deviate (Colan, 2013). Using the non-parametric Mann-Whitney test (Nachar, 2008), Table 2 presents the statistical result on the significance of the difference of the level of influence of the OLI advantages between the SOEs and POEs at the 95% confidence level (α Ó 0.05).

Table 2: Differences in the influence OLI factors of CCCs (SOEs and POEs) in Africa

OLI paradigm	u-value	z-score	p-value	Decision
Ownership advantages (firm-specific)	93			

Table 3: Formulas for computing kappa statistic

Formula	Notation
$K = (P_o – P_e) / 1 – P_e$ where	Formula 1
$P_o = (A + D) / N$	Formula 2
$P_e = (A1/N)(B1/N) + (A2/N)(B2/N)$	Formula 3
$z = K/SE_{k0}$, and	Formula 4
$SE_{k0} = äPe/k(1 – P_e)$	Formula 5

Table 4: Confusion matrix

Author's	Chen et al. (2007)		
	Agree (A)	Disagree (D)	Total
Agree (A)	39	4	43 = B1
Disagree (D)	10	2	12 = B2
Total	49 = A1	6 = A2	55 = N

Table 4 shows that the raters both agreed (A) and disagreed (D) on 39 and 2 countries respectively out of the total of 55 countries (N). Applying Formulas 1 to 5, Table 5 presents the result of the interrater reliability based on Cohen's kappa. Po shows 0.745, which corresponds to a 74.5% agreement to suggest that there is a strong agreement. However, the interrater reliability, K, indicates 0.073, which corresponds to none to slight agreement (McHugh 2012, p.279). Thus, the high percentage agreement provided by Po could have been by chance, attributable to the bandwagon effect or theory discussed earlier. Finally, since the z value is also lower than the critical value, it can also be concluded that the rater agreement is significantly different from what would be achieved by chance.

Table 5: Interrater reliability (Cohen's kappa)

Formula	Value
$P_o = (A + D) / N$	0.745
$P_e = (A1/N)(B1/N) + (A2/N)(B2/N)$	0.725
$K = (P_o – P_e) / 1 – P_e$	0.073
$z = K/SE_{k0}$, where $SE_{k0} = äPe/k(1 – P_e)$	0.219
Critical value at $\alpha = 0.05$, one-tailed	1.960

To sum up, the scope review methodology showed that CCCs have varying presence in the African countries: very compelling in nine (9), major in seven (7), moderate in two (2), minimal in nine (9), not compelling in fourteen (14), and none in fourteen (14). The higher percentage agreement between this present study and Chen et al.'s (2007) on the level of presence is not significant (Tables 4 and 5), which could be due to the bandwagon effect. There is no significant difference on the country-specific OLI advantages between the Chinese SOEs and POEs (Table 2), attributable to the local knowledge home advantage of the host countries' domestic construction companies creating foreign liability for the CCCs. However, there is a significant difference on the level of influence of the firm-specific location

and internalization advantages on the operations of the SOEs and POEs in Africa (Table 2).

CONCLUSIONS

The aim of this study was to establish the level of presence of CCCs in Africa and the difference in the level of influence of the advantages of SOE and POE CCCs on their strategies in Africa. The results of the scope review methodology revealed that CCCs have varying presence in the African countries. This result presents a more graphic representation of the presence of the CCCs in Africa for subsequent practical decision making and future theoretical inclination. For example, an empirical evidence for the factors that account for clustering or spread of CCCs in Africa, which will also have implications for policy makers, investors, and researchers alike to question the taken-

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Annexure 1: Ranking of OLI advantages of Chinese SOEs and POEs in Africa

Criteria		SOEs				POEs			
Paradigm	Description	Mean	SD	CV	Rank	Mean	SD	CV	Rank
Ownership Advantage (Firm Specific)	Size of the firm	4.385	0.961	0.219	1	4.111	0.928	0.226	3.5
	Marketing and project securing capability	4.231	1.166	0.276	2	3.222	1.302	0.404	13
	Product diversification	4.154	0.899	0.216	3	3.889	0.782	0.201	6
	Firm's reputation	4.077	0.954	0.234	4	3.667	0.866	0.236	8
	Accessibility to machinery and material	4.077	1.115	0.274	5	3.667	1.000	0.273	9
	Technological and R&D capacity	3.923	0.760	0.194	6	4.222	0.667	0.158	2
	Management expertise	3.923	1.115	0.284	7	3.556	1.130	0.318	11
	Networking flexibility of headquarter and other affiliated overseas branches	3.846	1.214	0.316	8	3.333	1.323	0.397	12
	Working quality and total quality management capability	3.846	1.281	0.333	9	3.222	1.394	0.433	14
	Experience and knowledge about international market	3.615	0.961	0.266	10	4.111	0.928	0.226	3.5
	Business development capacity	3.538	0.776	0.219	11	4.444	0.726	0.613	1
	Accessibility to technical resources	3.462	1.050	0.303	12	4.000	1.000	0.250	5
	Lower costs in production compared with other international competitors	3.385	1.387	0.410	13	3.667	1.414	0.386	10
	Accessibility to financial resources	3.077	1.038	0.337	14	3.889	0.928	0.239	7
		3.820	**0.366**	**0.096**		**3.790**	**0.376**	**0.099**	
Ownership Advantage (Country Specific)	Home government assistance and incentives on overseas contracting	3.846	0.987	0.257	1	3.556	1.333	0.375	2
	Governmental and historical relationship with developing countries	3.769	1.013	0.269	2	3.444	1.333	0.387	5.5
	Support from other related industries at home for international works	3.692	1.182	0.320	3.5	3.222	1.481	0.460	8

Criteria		SOEs				POEs			
Paradigm	Description	Mean	SD	CV	Rank	Mean	SD	CV	Rank
	Availability of capable sub-contractors from China	3.692	1.182	0.320	3.5	3.556	1.590	0.447	3
	Availability of professionals from China	3.538	1.198	0.339	5	3.111	1.537	0.494	9
	Size and growth of the domestic market in China	3.462	0.660	0.191	6	3.667	1.225	0.334	1
	Availability of low-cost workers from China	3.308	1.251	0.378	7	3.556	1.590	0.447	4
	Support from the financial sector and banking system at home	3.231	1.092	0.338	8	3.444	1.333	0.387	5.5
	Availability of low-cost machinery and material from China	3.077	1.320	0.429	9	3.444	1.590	0.462	7
		3.510	**0.263**	**0.075**		**3.440**	**0.176**	**0.051**	
	Intensive competition in the host country's market	3.769	1.301	0.345	1	3.111			
Location Advantage (Firm Specific)									

Criteria		SOEs				POEs			
Paradigm	Description	Mean	SD	CV	Rank	Mean	SD	CV	Rank
	Large number of other international competitor: in the host countries	2.846	1.281	0.450	9	3.222	1.394	0.433	3
		3.440	**0.280**	**0.081**		**3.050**	**0.503**	**0.165**	
	Local government attitudes, intervention and policies towards international contractors, including regulatory barriers of entry in the host countries	4.308	0.855	0.198	1	3.444	1.236	0.359	8
	Accessibility to local financing resources in the host countries	3.769	1.301	0.345	2	3.333	1.581	0.474	12
	Interference of local unofficial societies in the host countries	3.769	1.363	0.362	3	3.444	1.810	0.526	10
	Availability and costs of local workers in the hos countries	3.615	1.044	0.289	4	3.222	1.563	0.485	15
	Local income and corporate taxation levels in the host countries	3.615	1.193	0.330	5	3.667	1.581	0.431	4.5
Location Advantage (Country Specific)	Currency conditions and policies in the host countries, i.e., exchange rate fluctuation and control on transferring of funds	3.615	1.325	0.367	6.5	3.889	1.616	0.416	2
	Local government bureaucratic system and possible corruption in the host countries	3.615	1.325	0.367	6.5	3.667	1.658	0.452	6
	Local market demand and potential in the host countries	3.538	0.776	0.219	8	4.000	1.118	0.280	1
	Political and historical links between home and host countries	3.462	1.450	0.419	9	3.333	1.871	0.561	13
	Availability and capacity of local subcontractors in the host countries	3.385	0.961	0.284	10	3.556	1.509	0.424	7
	Availability and costs of local machinery and material in the host countries	3.308	1.109	0.335	11	3.222	1.563	0.485	15

Criteria		SOEs				POEs			
Paradigm	Description	Mean	SD	CV	Rank	Mean	SD	CV	Rank
	Local commodity price levels in the host countries	3.308	1.182	0.357	12	3.222	1.563	0.485	15
	Local import and export control and tariff levels for machinery, equipment, and material in the host countries	3.154	1.214	0.385	13	3.667	1.581	0.431	4.5
	Local governmental and regulatory protection for local contractors in the host countries	2.923	0.862	0.295	14	3.444	1.424	0.413	9
	Psychic distance between home and host countries, i.e., language, religion, culture differences, etc	2.923	0.954	0.326	15	3.333	1.500	0.450	11
	Political and social stability in the host countries	2.846	0.899	0.316	16	3.111	1.453	0.467	17
	Availability and costs of local professionals in the host countries	2.769	1.013	0.366	17	3.778	1.563	0.414	3
		3.410	**0.399**	**0.117**		**3.490**	**0.255**	**0.073**	
Internali-zation Advantage (Firm Specific)	To avoid the costs of breach of contracts and ensuing litigation	3.923	1.320	0.337	1	3.444	1.014	0.294	10
	To avoid or reduce information search and business negotiation costs	3.769	0.725	0.192	2	4.111	0.601	0.146	2
	To facilitate the need for alternative investments for the profits earned	3.692	1.437	0.389	3	4.111	1.269	0.309	3
	To better utilize and control resources (material, equipment, technology, human resources etc)	3.615	1.502	0.415	4	4.444	1.333	0.300	1
	To utilize international networking of the firm	3.462	0.877	0.253	5	3.778	0.833	0.221	5.5
	To ensure the quality of product and services provided	3.462	1.198	0.346	6	3.556	1.014	0.285	9
	To facilitate the increasing need for professionals and personnel	3.462	1.330	0.384	7	3.889	1.167	0.300	4
	To protect technological know-how of the firm	3.385	1.193	0.352	8	3.667	1.000	0.273	8

Criteria		SOEs				POEs			
Paradigm	Description	Mean	SD	CV	Rank	Mean	SD	CV	Rank
	To avoid the cost of moral hazard and adverse selection or under-performance of sub-contractors	3.308	1.109	0.335	9	3.778	0.833	0.221	5.5
	To protect the reputation of the firm	3.308	1.182	0.357	10	3.778	0.972	0.257	7
		3.540	**0.205**	**0.058**		**3.860**	**0.296**	**0.077**	
	To meet the host government's policy requirements relating to business operations	4.000	0.913	0.228	1	3.778	0.667	0.176	4
	To better facilitate strategic alliances, partnering and networking with others for the business	3.692	1.032	0.279	2	4.222	0.972	0.230	1
	To overcome price discrimination on projects in host country	3.692	1.377	0.373	3	3.556	1.333	0.375	5.5
Internali-zation Advantage (Country Specific)	To consolidate the market position and to facilitate the future growth and potential of the market	3.615	1.446	0.400	4	3.556	1.333	0.375	5.5
	To avoid client's uncertainty over the nature and value of services being sold and to better facilitate the client's needs	3.462	1.266	0.366	5	4.111	1.167	0.284	2
	To avoid or reduce the host government's intervention (quotas, tariffs, price controls, tax difference, etc)	3.385	1.502	0.444	6.5	4.111	1.364	0.332	3
	To exploit the host government's interventions (quotas, tariffs, price controls, tax difference, etc	3.385	1.502	0.444	6.5	3.222	1.394	0.433	7
		3.600	**0.219**	**0.061**		**3.790**	**0.371**	**0.098**	

			Agreement based on:	
Country	Author's Estimate[1]	Chen et al. (2007)	Nominal scale (i.e., Yes/No)	Ordinal scale (i.e., up to ± 5)
Mauritius	4	4	Agree	Agree
Morocco	3	4	Agree	Agree
Mozambique	10	5	Agree	Agree
Namibia	7	6	Agree	Agree
Niger	3	1	Agree	Agree
Nigeria	10	10	Agree	Agree
Reunion	0	0	Agree	Agree
Rwanda	3	4	Agree	Agree
Sao Tome & Principe	0	0	Agree	Agree
Senegal	4	0	Disagree	Agree
Seychelles	0	2	Disagree	Agree
Sierra Leone	8	0	Disagree	Disagree
Somalia	0	7	Disagree	Disagree
South Africa	10	7	Agree	Agree
Sudan	8	12	Agree	Agree
Swaziland	0	1	Disagree	Agree
Tanzania	8	11	Agree	Agree
Togo	2	3	Agree	Agree
Tunisia	0	1	Disagree	Agree
Uganda	8	7	Agree	Agree
Western Sahara	0	0	Agree	Agree
Zambia	9	6	Agree	Agree
Zimbabwe	10	5	Agree	Agree

INTRODUCTION AND BACKGROUND

Rural travel takes place on community roads and local pathways and these provide necessary gateways to different facilities and areas. The main challenge that the local authorities face is the provision of safe water crossings and this poses a danger especially during the rainy season. There is therefore, need to come up with safe water crossing means like footbridges dotted around villages in rural areas. A number of footbridges in rural areas are open timber footbridges and because timber deteriorates faster when it is exposed to harsh weather conditions, they have a shorter life span. This problem could be solved by combining timber with the concrete deck responsible for safeguarding the timber from rain water thereby increasing durability (Gutkowski et al., 2011; Doehrer and Rautenstrauch, 2006). Composite timber-concrete has been used as a sustainable substitute for rural and municipal use because of its low maintenance need, low construction cost and its higher stiffness and strength (Rodrigues, Providência, and Dias 2010). Use of this composite material results in a substantial improvement of strength and stiffness of the overall structure in comparison with the use of timber and concrete working independently (Doehrer and Rautenstrauch, 2006). The timber is connected to the concrete by means of connectors like nails, stubs, screws and other specially made devices (Steinberg et al., 2003; Kavaliauskas et al., 2005).

Nyanhongo Village is located in Dora which is in the southern parts of Mutare. This Village is surrounded by seven other villages each with different facilities such as schools, clinics and shopping areas. These villages have long been dependent on a single footbridge which was used to cross Sakubva River. This 35m long footbridge was constructed in 1987 and served its purpose until its failure in 2011, which was due to the overturning of the mid-way column. Since 2011 there has not been any safe crossing means for pedestrians and this posed danger especially during the rainy season and just in five years, the three schools have lost a total of seven students during the rainy seasons when the river overflows. Therefore there is need to design a footbridge that is cheap to construct by using locally available materials. The current footbridge is shown in Figure 7 and pupils are seen crossing the dangerous bridge on their way to school.

By using this composite material there will be sustainable utilization of local building materials thereby limiting importation of building materials. The aim of the paper was to design of a composite timber-concrete footbridge across Sakubva River at Nyanhongo Village, Dora, Mutare, Zimbabwe.

The specific objectives for this study are as follows:-

i. To determine the soil and rock parameters of the site area by means of geotechnical investigation.
ii. To investigate the causes of failure of the existing footbridge.
iii. To design the composite timber-concrete footbridge according to the British Standards and other relevant standards.

Cable-Stayed Bridge

This type of a bridge consists of two main towers with cables anchored into them. The major function of the cables and the towers is to carry loads (Tang 2016a). Arch bridges are good for moderate to longer spans. The advantages of a cable-stayed bridge are that it is aesthetically pleasing and can be used for long spans. The disadvantages of a cable-stayed bridge are that it is difficult to construct and require sufficient spacing on the sides of the piers to lower eccentric loading.

Truss Bridge

This type of a bridge make use of members arranged in such a way that the loads are carried mainly by tension and compression members (Dennis, I. T Transport Ltd, and Consultants in Transport for Development 2004). The advantages of a truss bridge are that it is a low cost bridge, easy to erect and it requires minimal construction material. The disadvantage of a truss bridge is that it is aesthetically displeasing.

Construction Materials

Bamboo

In some parts of the world bamboo is available at little or no cost and it is being used in the construction of pedestrian bridges. Due to its hollow structure, it is by far a more effective structural material than timber(Dennis, I. T Transport Ltd, and Consultants in Transport for Development 2004). It has at least double the stiffness to weight and strength to weight ratios of most timber. Bamboo has a short life span because it is susceptible to moisture and termite attack and it is difficult to treat because of its hard skin.

Timber

Use of timber in pedestrian bridges lowers the initial cost of materials. The advantages of sawn timber over timber logs are that it is light, easier to handle, and it produces smart designs. This is because it can be sawn into different shapes and can be treated effectively against biological attack. There are biological and non-biological causes for the deterioration of timber (Margetts, 2016; Leicester et al., 2016). Fungi, marine organisms and termites are the main causes of bio-deterioration while shrinkage, fire and splitting are the causes of non-biological attacks. Depending on the quality of timber used, the design life of the timber logs may only be ten to fifteen years due to complications of treating timber logs (Dennis, I. T Transport Ltd, and Consultants in Transport for Development 2004). Disadvantages of timber floors are that they may suffer from extreme deflection, they are susceptible to vibrations and they have low fire resistance (Yeoh et al. 2011). All timber structures need to be maintained and the most economical maintenance plan for timber involves preventative maintenance activities. The preservation plan should consider the environmental conditions and aesthetic restrictions (Margetts 2016). The simplest practice for protecting timber is waterproofing, as dry timber does not rot. Whenever timber is open to environmental conditions, its moisture content changes depending on its initial moisture content, humidity, its surface area and the type of waterproofing material (Fragiacomo and Schänzlin 2013). When the timber is exposed to environmental conditions such as on bridges and towers, it is important to seal the timber end-grains (Margetts 2016). For bridges a two-coat sealing method is done. This involves the use of a penetrating water-proofer as the main seal, then a bitumen-

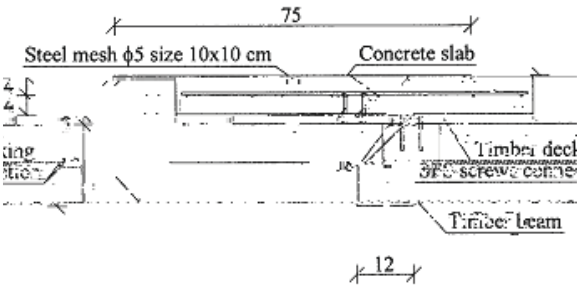

Figure 2: Typical Composite Timber-Concrete slab showing shear connection (Fragiacomo and Ceccotti 2006)

Composite timber-concrete systems proffer advantages as a sustainable substitute for steel reinforced concrete and timber bridges (Gutkowski et al. 2011). The main advantages of this composite material are increased strength towards the timber element, improved stiffness, increased service life, better seismic resistance, improved fire resistance, it is light and cheap compared to steel reinforced concrete because the steel used is produced from a non- renewing production process with high energy demands and high carbon dioxide emission (Fournely et al. 2016).

Basis of Design of Composite Timber-Concrete Systems

The design of composite timber-concrete structures have to comply with both serviceability (SLS) and ultimate limit state (ULS) for long and short term loads (Lukaszewska 2009). Maximum deflection is used to evaluate SLS while the stresses in the materials are used to evaluate the ULS. Figure 3 shows the cross section and stress distribution of a composite timber-concrete beam with shear connectors.

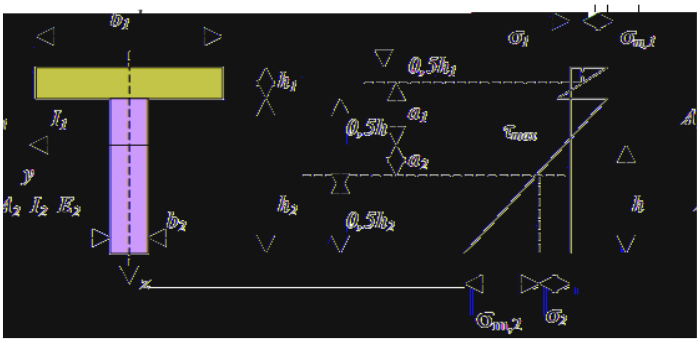

Figure 3: Cross-section and stress distribution of a composite timber-concrete beam with shear connectors (Stojic and Cvetkovic 2001).

There is a basic method for determining these parameters of beams connected mechanically using flexible elastic connectors (Lukaszewska 2009). The following assumptions are made in the analysis.

i. The beams are simply supported with length l.
ii. The individual parts of wood are either made with glued end joints or they are full length.
iii. The concrete and the timber are connected together with shear connectors with slip modulus k.
iv. The spacing between the shear connectors is constant or varies with respect to shear force. It varies between spacing smin and smax where smax Ó smin.

Where, „ﺟﺄﺜ and „ﺋ are stress the flexural component of the stress and the stress at the section centroid in the timber (i=2) and concrete (i=1) and M the bending moment.

Equation 8 and 9 expresses bending moment capacity of concrete and timber respectively. The bending moment capacity must be exceed the design moment.

Ü ﺯﺃﻩ سي ῆ ς ΌΌ ﺓﺙﺙ / ώ Ό Ώ (8)

Ü ﺯﺃ. سي ῆ ς ΌΌ ﺓﺙﺙ / ώ. Ό. Ώ. (9)

Flexural shear strength: - the flexural shear force is resisted by the timber member. The composite timber concrete is designed in such a way that there is no reinforcement in the concrete such that the timber provide the flexural shear strength. This flexural shear strength (Vd) must the greater than the maximum flexural shear force (V) as illustrated by equation 10.

Vd = ῆ ﻏﺮ / ١ (10)

Where ῆ is the shear strength of the timber and ö is the cross-sectional area of the timber member.

Shear strength of the shear connectors: - the shear connectors are assessed where shear force is maximum (Vmax at the supports) and at quarter the span. The shear force in the shear connectors near the supports and at quarter the span is expressed in equation 11 and 12 respectively.

Ũ = - ﺫﻭ ﻭ ﻭ ﺓﻭ ﺥﻜﻔﻜﻴ / ﺅ ﻔﻔﺶ ώ ﺫﺓ (11)

Ũ = - ﺫﻭ ﻭ ﻭ ﺓﻭ ﺥﻜﺸﻔ / ﺅ ﻔﻔﺶ ώ ٢٢ (12)

The defection at mid-span of the composite beam is given in equation 13 (Kavaliauskas, Kvedaras, and Gurksnys 2005). Where δ is the deflection at mid-span of the simply supported beam, q the uniformly distributed load.

δ = ٣ﺤﺅ / ١۶٢ ﺅ ﻔﻔﺶ (13)

Evaluation of Long Term Behavior of Composite System

The design modulus properties of the composite timber-concrete system can be calculated using equation 14 (Kavaliauskas et al., 2005; Stojic and Cvetkovic, 2001).

For timber:

Ό = ﻮ / ٥٨ ﻄﻮﺝﻔﺸﻔ (14)

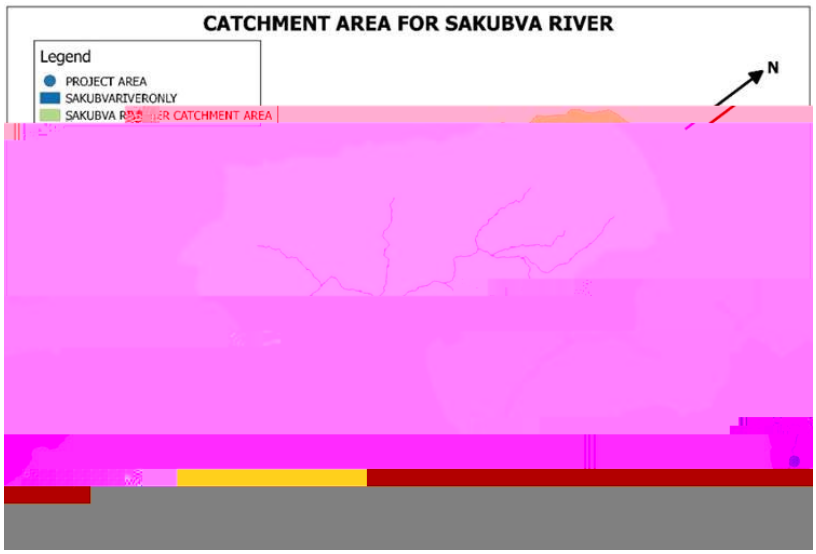

Figure 5: Diagram of Catchment Area for Sakubva River

Geotechnical Investigations

Geotechnical investigations were conducted in order to acquire the safe bearing capacity to be used in the design of the footbridge foundations. Two trial pits were dug at the possible locations of the footbridge abutments. Figure 6 shows the flow chart for the research design.

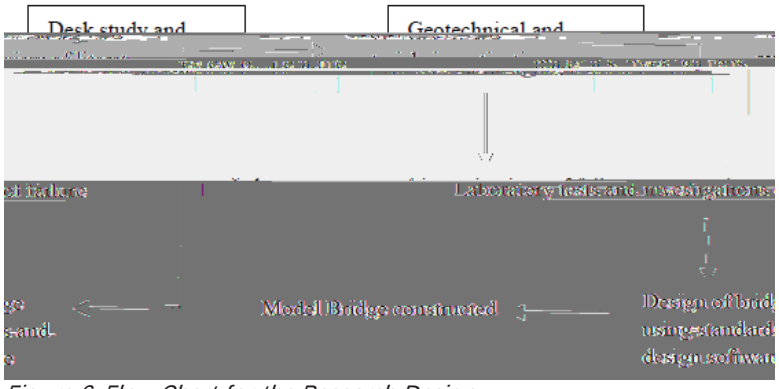

Figure 6: Flow Chart for the Research Design

These trial pits were excavated to a depth of 1.5m below ground level and soil samples were obtained at 0.5 and 1.5m depths in both trial pits. The following test were conducted as per BS-1377-1990 (Part 1, 2 and 7). The results were analysed using NovoLab 2.3.

i. Shear box test
ii. California Bearing Ratio test
iii. Sieve (Particle size analysis) analysis

Investigation into the Causes of Failure of the Current Footbridge

Geotechnical results and visual inspections were used to assess the causes of failure of the current footbridge. Particular attention was paid to the foundations, timber, supporting cables and the activities carried out around the footbridge. Also informal face to face interviews with the locals were carried out to find out more information about the footbridge.

Causes of failure of the Footbridge

According to Mutare Rural District Council the footbridge was constructed in 1987 and it served its purpose until its failure in 2011.

Figure 8: Picture showing the column which collapsed.

Figure 9: Scoured support bases

Figure 10: Grade Zero students crossing the dangerous footbridge

Figure 11: Suspension cable being attacked by corrosion and one of the cables already snapped

This began when the mid-way column overturned as shown Figure 8. This was caused by human interference with the footbridge, inadequate design together with natural reasons. Villagers extracted river sand from the river and this led to riverbed degradation around the mid-way column such that the base was exposed to fast moving water and since the base was not embedded in the solid rock it overturned as shown in Figure 8. Figure 9 shows that footbridge supports there was no considerations for bridge scour when the supports were designed such that soil around the support bases was eroded away weakening the founding material. When the mid-way column over turned the footbridge remained standing as it was being carried by the suspension cables. However due to continued use as shown in Figure 10 and lack of maintenance, one of the suspension cables snapped as it was weakened by corrosion as shown in Figure 11.

Flood Estimation

This was done to determine the design flood so as to get the design level of the bridge from the river bed. TB Mitchell's formula was used to determine the maximum probable flood using the catchment area. The idealized cross section of the River at the point of crossing and catchment area was provided by Mutare Rural District Council and is shown if Figure 17.

$$\ln (MPF + 1) = 1.175[\ln(A + 1)0.755 + 3.133] \quad (17)$$

Table 3: Bridge geometry and loads applied

BRIDGE GEOMETRY		
Clear span	29 meters	
Number of panels	3	
Clear height		
Clear width	1.8 meters	
Handrails height	1.2 meters	
One-way concrete slab	0.1 meters	
Sawn timber	200*300 mm	
Shear connectors	Vertical steel bars	
LOADS APPLIED TO STRUCTURE		
Load Pattern		Weight
Dead load	Concrete	24 kNm^{-3}
Live load	Pedestrian	5.0 kNm^{-2} (BS 5400-2-1978 7.1.1)

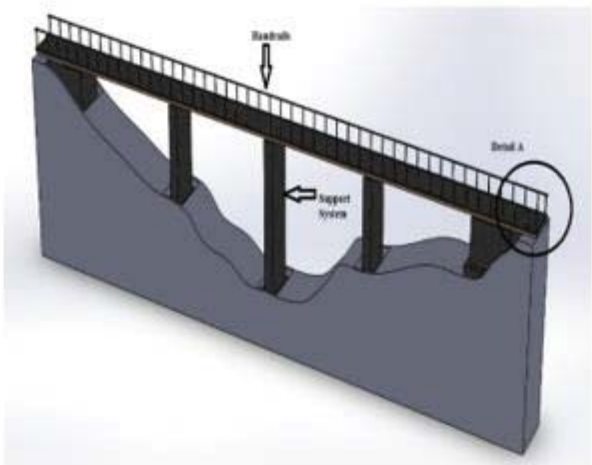

Figure 12: Proposed footbridge modelled with SOLIDWORKS.

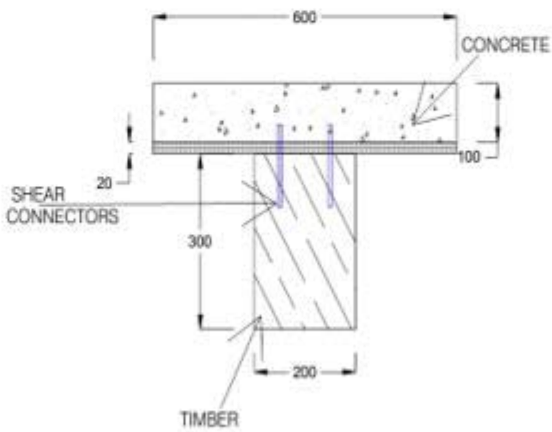

Figure 13: Composite timber-concrete cross section for design purposes.

Calculations for Composite Timber-Concrete System

Adjustment for Long Term Loading (EN95-1-1:2004 Annex B; Kavaliauskas et al., 2005)

Connector Stiffness

Screw stiffness at Serviceability Limit State:

ٹاخ.ؤ ا = أ ىئى / ٥٨ جئىئى ئ ىيرمي = ٤٧ ييي / ٥٨ ئي٤ = 43 125 N/mm2

Screw stiffness at Ultimate Limit State:

ٹاخ.ؤ ا = أ ىئى / ٥٨ گ وجئىئى ئ ىيرمي = ٥٧ ٤يي / ٥٨ ئي١ ئي٤ = 16 610 N/mm2

Concrete and Timber

Modulus of elasticity at Ultimate Limit State:

Effective Bending Stiffness of the composite timber-concrete section at Ultimate Limit State:

(EL) eff_uls =EcIc + yEcIc a2c + EtLt + EtAta 2t

= (14 084*50*106) + (7 712*450*106) + (0.528*14 084*1122*60*103)

+ (7 712*60*103*1082) = 15.2*1012 N/mm2

(EL) eff_sls =EcIc + yEcIc a2c + EtLt + EtAta 2t

= (7 402*50*106) + (5 688*450*106) + (0.853*7 042*1072*60*103)

+ (5 688*60*103*1132) = 11.4*1012 N/mm2

Loading Conditions for the System

Weight of timber = 1.59 KN/m2 (SANS 10163-1)

Weight of concrete = 2.4 KN/m2 (0.1m depth) (BS 8110-1-1985)

Total Dead Load ʹOؤ = 1.59 + 2.4 = 3.99 KN/m2 take 4.00 KN/m2

Total Live Load ӧؤ = 5 KN/m2 (BS 5400-2-1978-7.1.1)

Uniformly Distributed Dead Load (unfactored) = ʹOؤ*spacing of timber beams

= 4.00*0.575 = 2.3 KN/m2

Uniformly Distributed Live Load (unfactored) = ӧؤ*spacing of timber beams

= 5.00*0.575 = 2.9 KN/m2

Factored Total Uniformly Distributed load ώجخ (BS 8110-1-1985-2.4.3.1.1)

ώجخ = 1.4ʺOج + 1.6ӧ̃ج = (1.4*2.3) + (1.6*2.9) = 7.86 KN/m2

Calculation of Design Moment and Shear Force

Maximum Shear Force ώجةذ = $\frac{\text{ب}^z\text{ؤ}}{\cdot}$1000 = $\frac{٥٫٦٤^z٥٫٠٣}{\cdot}$1000 = 28.5*103 N

Moment at mid-span M = $\frac{\text{ب}^z\text{ؤ}}{٦}$10002 = $\frac{٥٫٦٤^z٥٫٠٣}{٦}$10002 = 51.6*106 Nmm

Calculation of Stresses in the Materials (Kavaliauskas et al., 2005)

Maximum Compressive Stress in the concrete „ٮ :

„ٮ سي $\frac{\text{ذ ث ن ة ث}}{\text{ؤ}}$ ӧ = $\frac{٤٫٣٠٦^z٥٢ ٤٦٢^z٥٥٠^z٣٥٫٤^z٥٤}{٥٣٫٠^z٥٤٤}$ = 2.82 MPa

$\frac{\text{ع يج ئن}}{\text{جـ ةذ جـثـجـخـجـ ت تـثـجـتـخـثـحح ةجـجـح د ت ت}} = \frac{\text{٠٥٫ي٣}}{\text{٢ي٫٠٦}}$ = 0.523<1   Satisfactory

Strength Check:

Grade Bending Strength of timber = 11.5 MPa

Maximum Bending Stress in the timber = 3.93 MPa

Ratio $\frac{\text{١٫٧١}}{\text{٥٥٫٣}}$ = 0.342حى ρ   Satisfactory

Grade Tension Strength of timber = 6.7 MPa

Maximum Tension Stress in the timber = 2.83 MPa

Ratio $\frac{\text{٠٫٦١}}{\text{٣٫٥}}$ = 0.422حى ρ   Satisfactory

Combined Stress

0.422 + 0.342 = 0.764حى ρ   Satisfactory

Grade Shear Resistance = 1.6 MPa

Maximum Shear Stress in the timber = 0.434 MPa

Ratio $\frac{\text{ي٫٢١٢}}{\text{٥٫٣}}$ = 0.271حى ρ   Satisfactory

Load Carrying Capacity of shear connectors = 34.4 KN

Maximum Load on shear connectors = 4.64 KN

Ratio $\frac{\text{٢٫٣٢}}{\text{١٢٫٢}}$ = 0.135حى ρ   Satisfactory

Compressive Strength of concrete = 30 MPa

Maximum Compressive stress in the concrete = 2.82 MPa

Maximum Bending stress in the concrete = 2.41 MPa

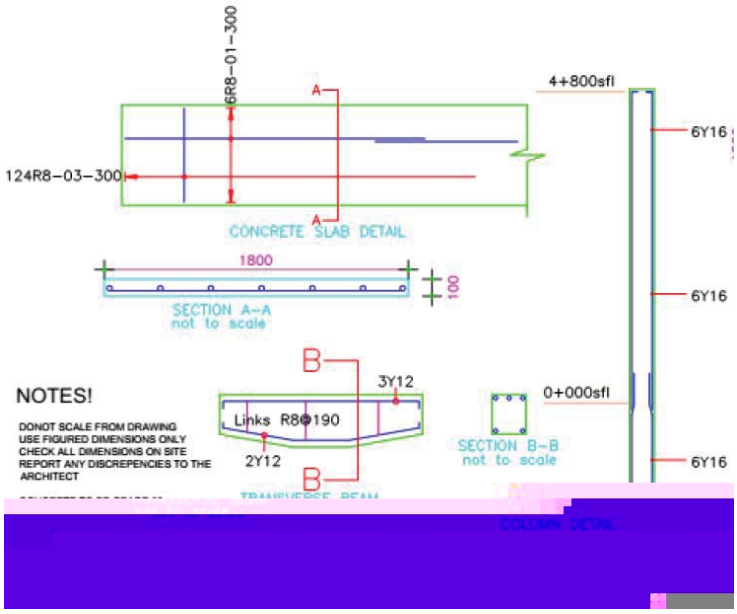

Figure 16: Concrete beam and column detail

Bill of Quantities

The total project cost for the Nyanhongo composite timber-concrete bridge was determined as USD 12,154.20. The breakdown of the costs is given in Table 4.

Table 4: Bills of Quantities for constructing the Composite Timber-Concrete Nyanhongo Bridge

ITEM	ITEM DESCRIPTION	TOTAL AMOUNT($)
A	Earthworks	3,700.00
B	Steel And Reinforcements Works	547.20
C	Concrete	4,023.00
D	Timber Beams	2,790.00
E	Shear Connecters	1,440.00
F.	Hand Rails	156.00
	TOTAL COST	12,154.20

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The total cost of the bridge is USD 12,154.20. Factors such as environmental impacts, constructability, structural integrity, economics, and footbridge accessibility greatly affect the design of the bridge. Composite timber-concrete proved to be a sustainable substitute for use in footbridge decks. From the visual assessment of the current footbridge which was done and it was concluded that bridge scour and poor maintenance were the main causes of failure and from the geotechnical investigation were, a bearing capacity of 250 kPa was obtained at a level 1.6m below ground level. The final design was based on BS8110 and Gamma Method.

Gerber, Christophe, and Keith Crews. 2010. “Development of a Design Procedure for Timber Concrete Composite Floors in Australia and New Zealand.” New Zealand Timber Design Journal 19 (2): 6–15.

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environmental, economic, social and spatial challenges (Civil Society, 2013; Obia et al., 2015; UN-Habitat and Africa Planning Association, 2013; UN-Habitat, 2015). More than half of the world's population reside in urban areas alone and it is projected that 6 out of every 10 people will live in cities by the year 2030. According to UN-Habitat (2015), over 90 per cent of this demographic growth is expected to take place in developing countries alone. In 2010, the urban population of East Africa, West Africa, Southern Africa, North Africa and Central Africa were estimated at 21.7 , 44.95, 48, 51.5 and 58,4 per cent of the total population respectively (UN-DESA, 2015). Research has indicated that the countries in SSA have a population growth rate of 2 percent, the fastest in the world. The rapidly increasing population of urban areas creates greater demand on the economy and constraints economic growth (Mutunga et al., 2012). As a result, many cities in SSA grow spontaneously without the requisite infrastructure, spatial and settlement planning schemes and the resource capacity to manage the growth. SSA recorded the highest proportion of informal settlements than any other part of the world (UNDP, 2012) and these settlements are characterized with inadequate access to basic services, precarious environments and slum conditions (Mutunga et al., 2012; UN-Habitat, 2015).

Ghana, like most developing countries in SSA is not an exception to the unprecedented urban population increase. According to Ghana Statistical Service (2014), the country's urban population constituted 50.9 per cent of the total population of 24,658,823 in the year 2010. Comparatively, the urban population of Ghana recorded a more rapid annual growth rate (4.6 %) than the rural communities. Although the growth of Ghana depicts an urban primacy situation, the monologue by Ghana Statistical Service (2014) on urbanization in the country revealed that the rapid urban growth is fraught with serious developmental challenges. It must be emphasized that these urban challenges are not peculiar to Ghana but evident in most countries in SSA and Africa as a whole (Dave, 2010; Mapuva and Chari, 2010).

According to Mutunga et al. (2012), SSA countries are not able to reap the benefits and prospects of rapid urban growth in contrast to developed countries where urbanization is often accompanied by

to the review process. The data was sourced from internal and external sources. Thus, all journals that focused on development control and urban management of Ghana and SSA countries were selected. The rest were rejected. Out of the 157 journals that were assessed, 40 were found to be relevant to the study.

Step 5- Expanding the Search Using MODES: To avoid missing information and up to date reviews, Onwuegbuzie and Frels (2016) and Williams (2018) posit that relevant media, observations, documents, experts, and secondary data (MODES) should be added to make the review comprehensive. For this study, reviews from UN-Habitat and World Bank groups on urban development, sustainability and resilience on SSA and Africa as a whole were added to the selected journals. Additionally, Research Gate was used to locate experts who have researched in the subject area for inclusion in the list of journals.

Step 6- Results and Discussion: Data obtain from literature were discussed under the following themes; Contraventions of DC strategies for sustainable urban development and Opportunities for achieving sustainable and resilient urban development through building regulations.

Step 7- Presentation to Audience: Onwuegbuzie and Frels (2016) suggested four ways by which a literature review can be presented to an audience using the AVOW method; acting, visualization, oratory, written. Based on the philosophical stance and focus of the research, it was appropriate to present the findings in written format.

THEORETICAL OVERVIEW OF DEVELOPMENT CONTROL

Land has become more scarce and inaccessible for development purposes in cities because they are considered as the centre of all contemporary developments (Aluko, 2011; Jimoh et al., 2017; Ngetich et al., 2014). As a result, there is the convincing need to ration land supply, control and regulate its usage in order to ensure orderliness and avoid the nuisance of conflicting land uses as well as poor quality of infrastructural development (Jimoh et al., 2017;Ogundele, Ayo, Odewumi and Aigbe, 2011). Development control is considered as one of the most important planning instruments for effective management and planning of cities.

To properly grasp the meaning of development control, there is the need to understand the key words “Development” and “Control” in context of planning and management of towns and cities. Development may mean different things in different context but in planning and built environment sense, development as defined by the British Town and Country Planners Act of 1917 “is the carrying out of building operations engineering, mining and other operations in, on, under or over land; or other land”. Keeble (1969) opined that development as defined by the Act should be extended to cover maintenance and alteration works as well as change in use of land or building. Therefore, the Black Law Dictionary as cited by Adeyeye, (2015) defined development as “a human created change to improved or unimproved real estate, including buildings or other structures, mining, dredging, filling, grading, paving, excavating and drilling; and also an activity, action or alteration that changes undeveloped property into developed property”. Meanwhile, control was defined by Ogundele et al. (2011) as the exercise of power

The value of development control to sustainable urban development

To ensure orderly development in the built environment, various countries throughout the world have adopted numerous strategies focused on sustainable urban development. According to Wheeler and Beatley (2014), the concept of sustainable urban development seeks to "create orderly development of cities and towns and improve the long-term health of human and ecological systems". This explanation is an add-on to the initial definition of sustainable development by Butland commission as it seeks to assign equal prominence to both human and ecological systems. In addition to the establishment of a relations between man and his environment, the economic implications of this relationship must be accorded similar if not equal prominence.

In simple terms, Perveen et al. (2017) advanced that the concept of sustainable urban development is a contemporary paradigm that addresses the myriad of challenges in urban centres with the aim of attaining a desirable urban future without draining the natural resources. In the quest to minimize the impact of climate change, ensure equity and the creation of safe, sustainable and resilient built environment, many countries have adopted novel regulation and governance tools to control development in the built environment. Ultimately a sustainable building regulatory regime especially for urban areas will lead to the creation of sustainable cities and communities with minimal negative environmental impact, safe, sustainable, resilient and inclusive communities that offers equal opportunities and services for all in a cost effective and efficient manner (SDG 3 and 11). The sustainable management of urban growth is therefore very topical amongst scholars, urban planners and policy makers throughout the world. It remains relevant irrespective of the scale be it local or global. Wheeler and Beatley (2014) argued that local development patterns ultimately affect the prospects of long-term global survival, hence, there is the need to "think locally" but "act globally". This is because local developments have ramifications on sustenance of the entire world.

As a result, many of the countries, facing rapidly growing urban population all over the world, are developing strategies to achieve urban sustainability especially in the built environment. However, the use and scope of contemporary urban planning and development concepts (including concepts such as the compact city, city cluster development, fringe city, corridor city etc as cited by Perveen et al. (2017)) in developing countries has been restricted to a 'controlling one' due to financial constraints (Johar, 2004). Consequently, it has been established in literature that the introduction of the element of 'control' is very critical in meeting sustainable urban development goals in the built environment of developing countries (Laubscher, 2011; Twum-Darko and Mazibuko, 2015). Although the control and management of growth in urban areas may vary in form, it essentially involves actions that guides the location, quality and timing of developments.

Generally, development controls are carried out to ensure efficient and effective land use that promotes wellbeing and safeguards public interest. Thomas (1997) classified the role of development control into two iterative purposes; "people purpose" and the "property purpose". The people purpose is concerned with the satisfaction of the social and economic aspirations of the citizenry through land use in contrast to the property purpose which is focused on the coordination of

that ensures that developments provided meets minimum standards such as daylighting, ventilation, setbacks, parking etc.

Despite the differences in the degree of success, there is the general consensus that land use and building regulation are the most widely used, efficient and effective contemporary tools for the management of cities and urban areas by both developed and developing countries (Baffour-Awuah et al., 2014; Matey, 2017; UN-Habitat and Africa Planning Association, 2013; World Bank, 2016). Thus, for countries in SSA and other developing economies, land use and building regulation remains the most effective and widely used tools for regulating developments in the physical environment.

As the most commonly used strategy, zoning seeks to regulate the use of land by specifying permitted and prohibited use of land. In simple terms, land use zoning answers the question of "what is to be built?". Despite the expansive use of land use zoning to achieve the objectives of urban planning, it has also been the subject of intensive criticism and analysis. Zoning has long been criticized for been used as a tool for exclusion, interfering with private property, driving housing cost and most recently as a tool for economic inequality and a setback for economic growth (Been et al., 2012). The lack of compliance by developers and the sloppy application of zoning regulations by planning authorities in SSA countries has been identified as a major limitation for its usage for sustainable and resilient development. Consequently, restrictive covenants, nuisance rules and fines have been proposed long ago as alternatives to zoning regulations (Owusu-Ansah and Atta-Boateng, 2016). That notwithstanding, land use and spatial planning laws are continually regarded as an effective means for control of development. However, a study on the state of planning in Africa revealed that most of these policies are yet to be approved by the legislature and in instances where they have been approved, actual implementation remains low (Goodfellow, 2013; UN-Habitat and Africa Planning Association, 2013; UN-Habitat, 2015).

The British Town and Country Planning Ordinance (TCPO) as inherited is still in place in a significant number of SSA countries. For instance, the TCPO of 1945 (CAP 84) and TCPO (1946) for Ghana and Nigeria respectively were modeled after the British planning principles (Owusu-Ansah and Atta-Boateng, 2016a). According to UN-Habitat and Africa Planning Association (2013), the use of these dated approaches and delay in approving newly formulated spatial planning and land use policies demonstrates the shortcomings of SSA countries in responding appropriately to new realities and complex nature of emerging urban challenges. Although some countries in SSA have recently introduced new and forward looking legislation for land use and spatial planning, the British planning systems and approaches forms the legal basis for most of them (UN-Habitat and Africa Planning Association, 2013; Owusu-Ansah and Atta-Boateng, 2016a). These approaches, however, have been criticized for not achieving the desired results especially in developing countries (Goodfellow, 2013; Owusu-Ansah and Atta-Boateng, 2016). In Kenya for instance, the Land Planning Act Cap 134 of 1948 was repealed in 1996 through the enactment of the Physical Planning Act to address the deficiencies inherent in the colonial statues (Ngetich et al., 2016)

minimum acceptable standards that regulates the planning, design, construction, operation and maintenance of buildings with the overarching aim of providing a reasonable level of safety, public health and welfare to occupants in a building.

Taking the discussion further, the granting of development permit, a major provision in building regulations and codes promotes consitent spatial development and structural integrity of new construction and extentions, alteration or redevelopment of buildings(Owusu-Ansah and Atta-Boateng, 2016). Although development permists are used to control building coverage ratio, desnsities, material selection, setbacks, easements, parking etc, the mere granting of these permits without enforcement is no guarantee to safe and sutainble buildings (see Amadu, 2014; Botchway et al.,2014; Ogundele et al., 2011; Tasantab, 2016). The incomplete monitoring and enforcement of building regulations and codes hinder sustainable and resilient development in SSA countries (Daye et al., 2018).

Contrary to the significant progress made by developing countries in achieving sustainable and resilient developments through matured building regulatory regimes, middle and lower income countries are saddled with numerous challenges (UN-Habitat, 2015; World Bank, 2016). Studies by various authors (Ametepey et al., 2015; Botchway et al., 2014; Casa Associati, 2012; Jimoh et al., 2017; Ngetich et al., 2016; Ogundele et al., 2011) reveal widespread violation of building regulations in SSA countries. Although these contraventions are not immune to developed countries, their prevalence in SSA affects the functionality of society (Jimoh et al., 2017) thereby threathening the creation of sustainable cities (African Institute for Development Policy, 2012; World Bank, 2016).

RESULTS AND DISCUSSIONS

This section focusses on the results and discussion on the major weaknesses identified in literature that hinders the use of the two main strategies (land use and building regulations) that are commonly deployed in SSA and their potential usage for sustainable development in SSA.

Contraventions of DC strategies for sustainable urban development.

Although a significant number of SSA countries have formulated planning laws and have building regulations in place, their implementation is very poor (UN-Habitat and Africa Planning Association, 2013; UN-DESA, 2015; World Bank, 2016). Comparatively, land use and building regulations has been implemented with little degree of success in SSA countries as against developed economies. The implementation of development control strategies in urban areas in SSA is fraught with numerous challenges with far reaching socio-economic and spatial implications such as poor housing, squalid environmental conditions, incompatible use, congestion, exposure to chronic risk and increased impact of disasters (Aribigbola, 2018; Owusu-Ansah and Atta-Boateng, 2016; World Bank, 2016).

Many researchers have identified several reasons why development control has not made the expected impact in SSA countries. In most instances, the factors are location specific and differ slightly from country to country. For instance, Alabi (2010) combined Ahp and Delphi techniques to prioritized ten (10) factors that had resulted in the failure of urban development control in Nigeria. Although all ten

major setback in SSA countries (Aribigbola 2018; Owusu-Ansah and Atta-Boateng, 2016b). That said, poorly formulated and poorly communicated building regulations compromises both the enforcement by authorities and compliance by developers.

Inordinate delays and bureaucracies

In addition, inordinate delays and bureaucracies were identified as one of the major setbacks to DC in SSA countries. It was established that DC regulations in SSA countries are cumbersome and complicated (Alabi, 2010). As a result, developers ignore the many unsuitable organizational structure and procedures to build without the necessary approval. The unnecessarily complex, costly and time consuming procedures to obtain land titles, development permit and habitation permits is a hindrance to code compliance (World Bank, 2016).

Lack of capacity of planning authorities to enforce land use and building regulations

From literature, land use and building regulations in SSA cities are ineffective as a result of weak implementation and enforcement regimes. Although a survey by Commonwealth Association of Architects (2018) and World Bank (2016) suggest that the regulations in general may seem comprehensive and at least fit for purpose, the absence of sufficient frameworks for enforcement of these regulations renders them ineffective. From Figure 1 although respondents agree that at least their regulations are about 70% fit for purpose, the effectiveness of the regulations in terms of implementation was 40 – 43 %.

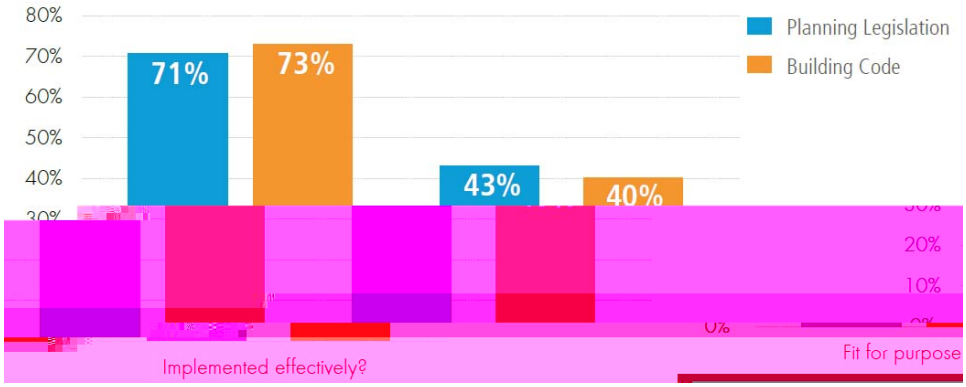

Figure 1: Effectiveness of Planning Legislation and Building Codes
Source: CAA (2018)

According to Daye et al. (2018), municipal authorities in developing economies operate under tight financial budgets and limited resources that makes it difficult for them to enforce their regulations. The failure to mobilize private sector resources undermines the capacity of SSA countries for effective implementation of DC regulations as they are saddled with severe backlogs in planning, development permitting and inspections(World Bank, 2016). Studies on SSA (Ametepey et al., 2015; Aribigbola , 2018; Botchway et al., 2014; Duah, 2013; Ngetich et al., 2016) highlighted the inadequacy of qualified personnel for DC code administration in SSA countries. According to World Bank (2016), the sole reliance on inefficient public resources in developed countries deprives them of the benefits of collaboration with private built environment professionals who could offer more

reducing risk in the built environment. The framework makes ample reference to the use of land use and building regulations for sustainable and resilient urban development. It has been established earlier that these tools are the main strategies used by SSA countries for development control. According to the World Bank (2016), these regulations when deployed efficiently and effectively would reduce large and rapid-onset risk like earthquakes, cyclones etc. as well as more contained but deadly risks such as fires and spontaneous collapse of buildings.

Compared to land use planning, building regulations have received little attention in regulatory, urban planning and management literature (Visscher et al., 2010; Van der Heidjen and Jong, 2013; Twum-Darko and Mazibuko, 2015; World Bank, 2016). Despite the gap in success for developed economies with more advanced and matured regulatory regimes, developing countries have also made incremental improvement in sustainable development, risk reduction and hazard adaptation through building regulatory systems. It is no fluke that there is a broad consensus by many countries on the crucial role of building regulatory governance in reducing underlying risk of developments before their management if disaster occurs.

Governments throughout the world have the ultimate responsibility for the effective leadership and oversight of building regulatory governance (OECD, 2010). Van der Heijden (2014) identified three major governance problems that hamper meaningful urban sustainability and resilience. He first highlighted on the slow reaction from government to sustainability and resilience challenges. This is attributed to the inordinate delay and bureaucracies in the implementation of regulations. Secondly, new regulations introduced by government are mostly inconsequential in that cities especially in developing countries develop faster for new legislations to become meaningful. Thirdly several “wicked” market barriers such as cost, conflicting interest and accountability competes with the benefits of resilient and sustainable regulations by government.

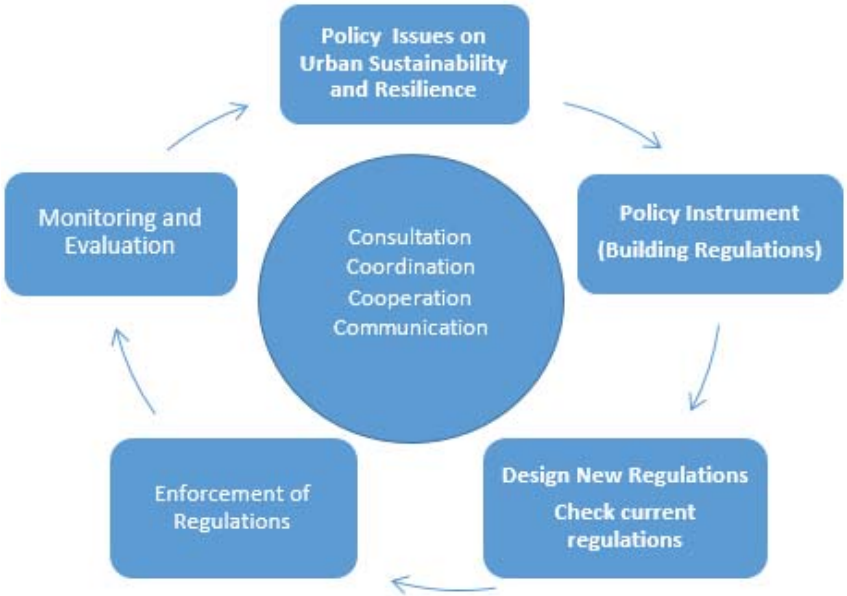

Figure 2: Achieving effective regulatory governance
Source: Adapted from OECD (2010)

Review of regulatory mechanisms to meet contemporary trends and technology remains very crucial to the meeting specific regulatory goals such as sustainability and climate change adaptation. UN-Habitat and Africa Planning Association (2013) has emphasized that the adoption of new systems for managing urban growth and development must be in consonance with available local resources, capacity, context and prevailing trends.

From the ongoing discussion and the challenges that have been identified as barriers to the use of building regulations for sustainable urban development, this paper proposes smart regulation for use by Ghana and countries in SSA. Smart regulation is a more flexible, imaginative and innovative forms of regulatory governance which apart from integrating new policies to meet contemporary demands, seeks to harness not just governments but also business and third parties for effective and efficient implementation of building regulation (Gunningham and Sinclair, 2017).

CONCLUSION

The purpose of this paper was to understand why development control strategies have not been effectively deployed for sustainable and resilient urban development in SSA. From the review of literature, it has been established that land use planning and building regulations are the most effective strategies that could be leveraged for achieving sustainability and resilience goals in SSA. In particular, the paper emphasized the crucial role of building regulation or code implementation which hitherto had not received adequate attention in regulatory literature in providing safe and sustainable buildings. Again, the paper agrees to the unique role of building regulatory systems in shifting focus from disaster management to disaster risk reduction.

Seven major barriers were identified in literature as contraventions that could limit land use and building regulatory systems for achieving regulatory goals. They include lack of awareness, inadequate and poor funding of planning authorities, poorly formulated regulations, inordinate delays and bureaucracies, lack of capacity of planning authorities, corruption and low uptake of ICT systems. It is proposed that smart building regulatory system which embraces innovative, flexible and imaginative approaches that maximizes the use of private sector and third parties as surrogate regulators in the implementation of regulations for sustainable and resilient urban development.

Practically, governments in SSA countries must put measures in place to rectify the ineffectiveness and inefficiency in their building regulatory regimes. There is the need to prioritize urban sustainability in order to ensure the safety and well-being of the urban populace. Strict adherence to building and land use regulations and an efficient enforcement regime for the building industry will be very beneficial to many countries in SSA. Theoretically, having in mind that there are no perfect systems and the existence of difficulties in extrapolating findings from developed to developing economies due to differences in context, future research should focus on how smart regulations could be harnessed to achieve sustainable and resilient urban development in Ghana and SSA countries.

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organizations and the nation (Faragher et al., 2005). Employee job satisfaction is major among several factors that determine the effectiveness of an organization (Idiegbeyan-Ose et al., 2019). Employee satisfaction can lead to greater support of employees in achieving goals of the organization and creating a wider and larger market of products and services and higher profits (Urošević et al., 2016).

Job satisfaction is the result of staffs' perceptions about how their job provides the things they care about (Gholizade et al., 2014). Uddin et al. (2016) captured that several definitions by different authors have described job satisfaction as feelings of workers about their jobs and several job functions. Job satisfaction entails the employee's satisfaction with the general work characteristics, and how it affects the morale of workers. It also refers to the extent to which people like their jobs in relation to what they expect or value most. The strategic and fundamental position of job satisfaction is dependent on employees' attitude to work and is therefore cardinal in any setting or study (Idiegbeyan-Ose et al., 2019).

Past studies have identified a significant cross-pollination between the concept of job satisfaction and motivation. Hence, it is difficult to separate job satisfaction and motivation (Mccormick and Tiffin, 1974). The loss of motivation at work influences employee satisfaction and have a negative impact on employee performance (Octaviannand et al., 2017). Studies in the concept of job satisfaction cannot be effectively done if motivation is not considered. Essentially, it is key to explore further into motivation and its relationship with job satisfaction as these two concepts are mostly related (Singh and Tiwari, 2012).

One of the most prominent theories of motivation which provides the basis for this study is that propounded by Herzberg et al. (1959) and variously called "Two-Factor," "Dual" or Motivation-Hygiene theory. Frederick Herzberg and his research team gathered data through the critical incident recall interview method with over 200 Pittsburgh accountants and engineers. The interviewees were asked to recall situations when they felt "exceptionally good" or "exceptionally bad" about a job, either their present job or any other they had held. A content analysis of the critical incidents was done, and the results produced two set of factors which Frederick Herzberg and his team called satisfiers and dissatisfiers.

According to Herzberg et al. (1959), the satisfiers, which are also known as motivators, intrinsic and job content factors were related to the actual content of the job. The dissatisfiers, which are also known as hygiene, extrinsic and job context factors were related to the context in which an individual performed a job. They further suggested that the factors in a job situation which make people happy are not the same factors which make them unhappy.

Herzberg et al. (1959) asserted that rather than being opposing on a single continuum of satisfaction, they are two independent dimensions – that of satisfaction and dissatisfaction. The presence of the following motivators; achievement, recognition, work itself, responsibility, and advancement can lead to job satisfaction while their absence does not lead to dissatisfaction. Dissatisfaction tended to be associated with the following hygiene factors: company policy and administration, supervision, working conditions, interpersonal relations salary. Based on these findings the motivation-hygiene theory was established. One common survey instrument which subsumes these factors is that of Wood (1974) "Faculty Satisfaction/Dissatisfaction Scale.

Suggesting the need to consider the uncertainty and vagueness of acquired information from individuals (Aliev, 2013). Inaccuracy in measurement of satisfaction perceptions is much certain when questionnaire surveys are involved. Relevant to this discussion, job satisfaction evaluations, which are mostly assessed using questionnaire surveys are conducted based on subjective evaluations and substantially dependent on human interpretations (Rasmani and Shahari, 2007). This premise is further exacerbated when different groups of workers from various departments in an organization are surveyed. Implying different perceptions formed by or presented to construction professionals concerning their motivations and satisfaction needs towards their job. To this end, the onus of this premise is to identify an overall decision which satisfies all the participants involved (Akter and Simonovic, 2002). In providing an antidote to this chaos, the fuzzy set has been suggested as an excellent framework that deals with these challenges as well as the imprecise meaning of preferences and their subjective nature (Abiyev et al., 2016). Essentially, the fuzzy set can address decision-making with conflicting goals (Wang and Liang, 2004).

Considering these promising capabilities of the fuzzy set, a number of studies have been conducted in diverse fields as well as within the arena of job satisfaction. Using fuzzy set, Abiyev et al. (2016) measured job satisfaction of hotel employees in Turkey. Crocetta and Delvecchio (2007) employed the fuzzy set approach to measure the degree of satisfaction of graduates on the suitability of university education for working purposes in Italy. De Battisti et al. (2013) applied the fuzzy set to measure satisfaction concerning employees of a public administration in Italy. Rajareegamand and Doss (2013) used the fuzzy set evaluate the job satisfaction of teachers in engineering colleges in India. Hatipoğlu et al. (2013) adopted the fuzzy set to measure job satisfaction of shift workers in different manufacturing companies in Turkey. Li et al. (2013) used the fuzzy approach to evaluate stakeholder satisfaction during public participation in major construction projects in Hong Kong.

It is apparent that fuzzy set studies on measuring job satisfaction have mostly focused on Asian and European countries. This infers that, despite the pool of job satisfaction studies, little research has been conducted within Africa, and their construction industries (Yirenkyi-Fianko and Chileshe, 2012). As a result, the literature remains unclear about the extent to which job satisfaction features facilitate the improvement of construction professionals' well-being in Africa. This has led to an inferior understanding of how specific job satisfaction dimensions operate within the sub-Saharan Africa region. In effect, little is known about how to effectively measure job satisfaction of construction professionals and which job satisfaction feature is sensitive to significantly influence the well-being of construction professionals in the region. Using Ghana as a case study, this research aims to develop an index to quantify the level of job satisfaction among construction professionals using the fuzzy synthetic evaluation approach of the fuzzy set family. It can also be reasoned that construction organizations in Ghana are likely to share similar features with their counterparts in developing countries (Kheni et al., 2010). Arguably, the findings of this study are of relevance to other developing countries, particularly in the sub-Saharan Africa region.

organization (2) must be in middle management (3) must be project manager, quantity surveyor, architect, or engineer and (4) must obtain at least Higher National Diploma (HND). The selected respondents were invited to answer the questions online and some questionnaires given by hand. Sixty-three (63) responses were valid for analyzes. This sample is close to Patel and Jha (2016) sample of 64 used in developing a project safety hazard index while employing the fuzzy set, hence adequate in the developing the JSI in this study. Besides, the sample size was deemed adequate because it further satisfied the recommendations of numerous researchers that a sample size of 30 for any group could be considered representative (Sproull, 2002).

A majority (54%) of the respondents were quantity surveyors, 28.6% were project/construction managers, and 11.1% were engineers. A group of respondents who indicated belonging to others comprised 6.3%. In terms of length of service, most of the respondents (66.7%) had been with their current company for less than 5 years. Around 23.8% had been with their current company for 5 – 10 years. Whereas 4.8% and 3.2% of the respondents had worked with their current company for 11 – 15 years and 16 – 20 years, respectively. Very few (1.6%) had more than 20-years' length of service with their current company. Regarding working experience in the construction industry, 41.3% had 5 – 10 years' experience, 31.7% had less than 5 years' experience, and 11.1% had 11-15 years' experience. 7.9% of the respondents had 16 – 20 years' experience while additional 7.9% had more than 20 years' experience. Measuring the satisfaction of a single group is not necessary very complicated (Rogers et al., 2013). However, difficulties arise when the number of groups involved in the evaluation process increases, as the objectives of each group in the project can be diverse and are often conflicting (Akter and Simonovic, 2002). As evident in the respondents' demographics, the diversity in relation to respondents' profession, length of service, and working experience clearly reinforces the need to employ the FSE approach by further echoing Akter and Simonovic (2002) assertion concerning the demand to satisfy the collective needs of all while incorporating individuals' views.

Mean score analysis, normalization, reliability analysis, and FSE analysis were performed to develop the job satisfaction index. Prior to developing the job satisfaction index, reliability analysis was performed to check the internal consistency of the 58 items under the 10 dimensions of job satisfaction index. Internal consistency was computed using the Cronbach alpha (Oyedele, 2012). The FSE modeling approach5 is given as follows (Xu et al., 2010):

1. Establish a basic set of criteria. $U = \{u_1, u_2, \ldots, u_n\}$ where n is the number of criteria.

2. Label the set of grade alternatives as $V = \{v_1, v_2, \ldots, v_n\}$. The set of grade categories are the scale measurement. Eg. 1=very dissatisfied.

3. Set the weightings for each factor component. The weighting (W) is determined from the survey using the equation: $W_i = \frac{M_i}{\sum M_i}$, $0 < W_i < 1$, $\sum W_i = 1$.

[5] For more fundamental details of FSE and fuzzy set, interested readers should refer to Sadiq and Rodriguez (2004).

Table 1 Continued: List of Job satisfaction dimensions and their attributes

The extent to which you are informed about matters affecting you, x_{62}	
The procedures for promoting workers to higher positions of responsibility in the company (e.g. Director of commercial unit, Director of Estimating, Technical Director), x_{63}	
The procedures for selecting workers for further education and training, x_{64}	
The administrative procedures used to carry out transfers of workers, x_{65}	
The administrative procedures for carrying out appraisal of workers, x_{66}	
The extent to which administrative policies and procedures are followed, x_{67}	
The extent to which the policies meet workers' needs, x_{68}	
Supervision: x_7 (Herzberg et al., 1959; Hagedorn, 2000; Wood, 1974; Oberman, 2005)	0.908
On-the-job supervision given by your superior, x_{71}	
Competence of your superior to give leadership, x_{72}	
The willingness of your superior to delegate authority, x_{73}	
Counsel and guidance given by your superiors, x_{74}	
The fairness of our superiors, x_{75}	
The sensitivity of your superiors to your needs, x_{76}	
Salary: x_8 (Herzberg et al., 1959; Hagedorn, 2000; Wood, 1974; Oberman, 2005)	0.929
The method used to determine your salary, x_{81}	
The range of salary paid to project managers/engineers, x_{82}	
The top salary available to project managers/engineers compared with other companies, x_{83}	
Your salary compared to that of people with similar training in other professions, x_{84}	
The amount of your salary, x_{85}	
The adequacy of other benefits (retirement, illness, vacation etc.), x_{86}	
Interpersonal relations: x_9 (Herzberg et al., 1959; Hagedorn, 2000; Wood, 1974; Oberman, 2005)	0.831
Your relationship with top management, x_{91}	
Your relationship with your colleagues in the company (other managers, engineers, quantity surveyors etc.), x_{92}	
Cooperation from project team members, x_{93}	
Friendliness of project team members, x_{94}	
Your relationship with the site workers, x_{95}	
Working conditions: x_{10} (Herzberg et al., 1959; Hagedorn, 2000; Wood, 1974; Oberman, 2005)	0.830
Number of hours spent each week on construction activities, x_{101}	
Your office facilities (e.g. computers, telephone etc.), x_{102}	
Adequacy of facilities for your duties, x_{103}	
Adequacy of support from top management for your work, x_{104}	
Your work schedule compared with other project managers, x_{105}	

Mean score analysis was used to rank the job satisfaction attributes in Table 2. Further, to determine the critical attributes of job satisfaction among the list, normalization was used. Normalized attributes greater than or equal to 0.50 are retained. This selection mechanism has been used by many previous studies to establish the most significant factors (Osei-Kyei and Chan, 2017). With this criterion, 39 attributes were deemed critical as presented in Table 2.

Table 2: Ranking of job satisfaction attributes

	Mean	Ranking	Normalization		Mean	Ranking	Normalization
x_{92}	5.11	1	1.00	x_{71}	4.40	30	0.65
x_{95}	5.02	2	0.95	x_{105}	4.40	31	0.64
x_{34}	5.02	3	0.95	x_{101}	4.35	33	0.62
x_{33}	4.98	4	0.94	x_{91}	4.35	32	0.62
x_{72}	4.92	5	0.90	x_{74}	4.35	34	0.62
x_{93}	4.90	6	0.89	x_{52}	4.32	35	0.60
x_{94}	4.89	7	0.89	x_{102}	4.29	36	0.59
x_{42}	4.89	8	0.89	x_{53}	4.25	37	0.57
x_{41}	4.89	9	0.89	x_{75}	4.22	38	0.55
x_{43}	4.87	10	0.88	x_{104}	4.18	39	0.53
x_{24}	4.86	11	0.87	x_{103}	4.06	40	0.48
x_{12}	4.86	12	0.87	x_{55}	4.05	41	0.47
x_{31}	4.83	13	0.86	x_{62}	3.94	42	0.41

Table 3 Continued : Weightings for JSAs and JSGs for construction professionals

x_{31}	4.83	0.246		
x_{32}	4.76	0.243		
x_{33}	4.98	0.254		
x_{34}	5.02	0.256		
The work itself			19.59	0.108
x_{41}	4.89	0.147		
x_{42}	4.89	0.147		
x_{43}	4.87	0.146		
x_{44}	4.54	0.136		
x_{45}	4.82	0.145		
x_{46}	4.71	0.141		
x_{47}	4.60	0.138		
Responsibility			33.32	0.183
x_{51}	4.62	0.350		
x_{52}	4.32	0.327		
x_{53}	4.25	0.323		
Advancement/growth			13.19	0.073
x_{71}	4.40	0.196		
x_{72}	4.92	0.219		
x_{73}	4.59	0.204		
x_{74}	4.35	0.193		
x_{75}	4.22	0.188		
Supervision			22.47	0.124
x_{91}	4.35	0.179		
x_{92}	5.11	0.211		
x_{93}	4.90	0.202		
x_{94}	4.89	0.202		
x_{95}	5.02	0.207		
Interpersonal relations			24.26	0.133
x_{101}	4.35	0.253		
x_{102}	4.29	0.249		
x_{104}	4.18	0.243		
x_{105}	4.40	0.255		
Working conditions			17.21	0.095
Total mean values of JSDs			181.82	

Define the membership functions for each level

The membership functions (MFs) are computed to determine the JSI for construction professionals. The membership functions of the second level (JSAs) are derived to facilitate the calculation of the first level (JSGs). Recall the six-point rating scale where 1=very dissatisfied, 2=moderately dissatisfied, 3=slightly dissatisfied, 4=slightly satisfied, 5=satisfied, and 6=very satisfied were used grade alternatives for evaluating the JSAs. The MF for each JSA is calculated using sample Eq. (2). Using 'your actual achievement of company goals and objectives, x11' for illustrate purposes, the survey results indicated that the respondents rate its satisfaction level as follows: 0% as 'very dissatisfied'; 4.8% as 'moderately dissatisfied'; 4.8% as slightly dissatisfied; 28.6% as 'slightly satisfied'; as 36.5% as 'satisfied'; and 25.4% as 'very satisfied'. Hence, the MF for x11 is derived as:

$$\mu_{x_{11}} = \frac{0.000}{\text{very dissatisfied}} + \frac{0.048}{\text{moderately dissatisfied}} + \frac{0.048}{\text{slightly dissatisfied}} + \frac{0.286}{\text{slightly satisfied}} + \frac{0.365}{\text{satisfied}} + \frac{0.254}{\text{very satisfied}} \quad (2)$$

Table 4 Continued: Membership functions for JSAs and JSGs

Responsibility			
x_{41}	0.147	(0.000, 0.016, 0.079, 0.222, 0.365, 0.317)	(0.002, 0.016, 0.083, 0.233, 0.444, 0.221)
x_{42}	0.147	(0.000, 0.000, 0.063, 0.222, 0.476, 0.238)	
x_{43}	0.146	(0.000, 0.016, 0.048, 0.254, 0.413, 0.270)	
x_{44}	0.136	(0.000, 0.000, 0.127, 0.286, 0.508, 0.079)	
x_{45}	0.145	(0.000, 0.032, 0.032, 0.206, 0.540, 0.190)	
x_{46}	0.141	(0.016, 0.016, 0.095, 0.238, 0.381, 0.254)	
x_{47}	0.138	(0.000, 0.032, 0.143, 0.206, 0.429, 0.190)	
Advancement/growth			
x_{51}	0.350	(0.016, 0.016, 0.143, 0.190, 0.429, 0.206)	(0.032, 0.057, 0.132, 0.227, 0.361, 0.191)
x_{52}	0.327	(0.048, 0.095, 0.048, 0.302, 0.317, 0.190)	
x_{53}	0.323	(0.032, 0.063, 0.206, 0.190, 0.333, 0.175)	
Supervision			
x_{71}	0.196	(0.016, 0.063, 0.111, 0.270, 0.397, 0.143)	(0.026, 0.003, 0.018, 0.162, 0.519, 0.343)
x_{72}	0.219	(0.016, 0.032, 0.016, 0.206, 0.413, 0.317)	
x_{73}	0.204	(0.048, 0.000, 0.048, 0.333, 0.349, 0.222)	
x_{74}	0.193	(0.016, 0.032, 0.175, 0.334, 0.270, 0.175)	
x_{75}	0.188	(0.032, 0.032, 0.143, 0.381, 0.317, 0.095)	
Interpersonal relations			
x_{91}	0.179	(0.000, 0.032, 0.111, 0.460, 0.270, 0.127)	(0.000, 0.012, 0.046, 0.248, 0.448, 0.245)
x_{92}	0.211	(0.000, 0.000, 0.016, 0.190, 0.460, 0.333)	
x_{93}	0.202	(0.000, 0.016, 0.048, 0.206, 0.476, 0.254)	
x_{94}	0.202	(0.000, 0.016, 0.032, 0.190, 0.571, 0.190)	
x_{95}	0.207	(0.000, 0.000, 0.032, 0.222, 0.444, 0.302)	
Working conditions			
x_{101}	0.253	(0.016, 0.016, 0.190, 0.286, 0.365, 0.127)	(0.043, 0.020, 0.147, 0.317, 0.327, 0.146)
x_{102}	0.249	(0.063, 0.016, 0.190, 0.270, 0.222, 0.238)	
x_{104}	0.243	(0.063, 0.032, 0.095, 0.413, 0.270, 0.127)	
x_{105}	0.255	(0.032, 0.016, 0.111, 0.302, 0.444, 0.095)	

Afterwards, the MFs in level one are substituted into Eq. (5) to calculate the JSI for each category.

$$JSI = \sum_{i=1}^{6} m_i \times g_i \qquad (5)$$

Where g_i is the adopted grade alternatives (i.e. 1=very dissatisfied to 6=very satisfied). Using 'achievement' for example, the JSI for x1 is calculated as:

$$JSI_{x1} = 0.000 \times 1 + 0.037 \times 2 + 0.077 \times 3 + 0.217 \times 4 + 0.447 \times 5 + 0.222 \times 6 = 4.743$$

With same procedure, the index for each group is calculated and presented in Table 5. In Table 5, supervision ranked first suggesting its importance to employee job satisfaction. Followed by the work itself. Interpersonal relations ranked third, then responsibility at fourth. Achievement and recognition ranked fifth and sixth respectively. Whereas advancement and working conditions ranked seventh and eighth respectively. The second goal of this study was to determine which job satisfaction group is sensitive to significantly influence the well-being of construction professionals. The finding of this goal is discussed in this regard. The role supervision plays in job satisfaction influences both organizational performance and employee retention. Consistent with earlier study by Schroffel (1999) within the clinical field, workers were generally satisfied with their jobs when they were more satisfied with their supervision. These workers were much more satisfied when an ideal supervisory environment was exhibited. This suggests that the most important factor to consider when management/clients want to increase the satisfaction level of construction professionals is a supportive supervisory

professionals must rate the extent to which the critical 39-job satisfaction attributes under their corresponding dimensions of job satisfaction are crucial within a certain time period, project, or organization on the six-point rating system. The mean coefficients for individual JSG should be computed and substituted in the JSI model (Eq. 6) to determine the level of employee job satisfaction. Compilation of scores over diverse projects involving the organizations employees could be used for benchmarking purposes to foster initiatives in HRM. For academia, this study offers a dais in employing FSE to yield weightings that can be employed to formulate equations for evaluating job satisfaction of employees. Developed countries could adopt the FSE methodology used in this paper to develop job satisfaction assessment tools, implement performance evaluation mechanisms to benchmark, and compare with other already existing assessment tools. Further studies could consider larger participant samples from all the regions.

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monetary gain and career scope. Morgeson and Humphrey (2006) task characteristics are autonomy, task variety, task significance, task identity and feedback from job. The previous studies did not examined task characteristics from the perspective of site supervisors. In studying the task characteristics of site supervisors, Ijaola et al. (2017) identifies the nature of site supervisor's task as skill variety, task identity, task significance, autonomy, feedback, task difficulty, task analyzability, task routineness, task complexity and task structuredness. The study therefore adopts Ijaola et al. (2017) site supervisor's task characteristics as variables for task characteristics.

Training of Site Supervisors

Site supervisors are important human resource in the production stage in construction industry. According to Serpell and Ferrada (2006), site supervisors are personnel on construction site that coordinate and direct the execution of the construction process. They serve as mediator between the site manager and workers on site and they are also professionals that coordinate and monitor the construction works on site. Their tasks include; deciding on when to commence and suspend construction process (Hackman et al., 2015); ensuring compliance with health and safety practice on site (Serpell and Ferrada, 2006; Hackman, et al. 2015); communicating project objectives to workers on site (Serpell and Ferrada, 2006).

Since site supervisors are required to monitor the construction production stage, sustainable training as it relates to the nature of their task is important for improve performance. Serpell and Ferrada (2006) noted that there is lack of formal training to qualify site supervisor for taking on supervisory responsibilities. This lack of training increases construction cost due to inability of site supervisors to effectively carry out their supervisory role. Furthermore, Dzasu and Ayegba (2010) discovered that few construction firms in Nigeria carry out supervisory training yearly. Thus, it is expedient that construction firms train their site supervisors.

Loosemore et al. (2003) identify five procedures of training in the construction sector as training policy definition, training needs identification, training programme, training delivery and training evaluation while Mathis and Jackson (2011) identify four training procedures as training needs assessment, training design, training delivery and training evaluation. A broader classification by Huang (2001) considers training procedures as training needs identification, annual training design, training objectives, training delivery, training implementation, training evaluation and training records. From the training procedures cited above, none of the authors considered training transfer. The study therefore conceptualise training procedures as training needs assessment, training delivery, training evaluation and training transfer

PROBLEM STATEMENT/ RESEARCH QUESTION

From the literature review, ten task characteristics which formed the independent variable were identified and four training procedures which formed the dependent variable were also identified. Previous studies examined the relationship between task characteristics and task performance (Kassem and Sarhan, 2013; Evelyne et al. 2018) and between training and task performance (Onukwube and Iyagba, 2011;

degree to which site supervisors have substantial freedom to make decisions when executing their task. It was measured with 3 variables, for example “My task gives me the chance to use my personal initiative or judgment in carrying out the task”. Feedback described the degree to which a site supervisor receives clear information about his/her performance after executing the task. It was measured with 3 observable variables such as “My supervisor frequently discusses matters related to my job performance”. Task analyzability which described the extent to which site supervisor’s task has a clearly defined sequence of steps was measured with 2 observable variables such as “My tasks involve a clearly defined sequence of steps”. Task difficulty which explained the degree to which site supervisor’s task requires great effort to accomplish was measured with 2 observable variables. For example, “My tasks require great physical effort to accomplish it”. Task routineness described the degree to which a site supervisor requires habitual method of carrying out his/her task. This was measured with 2 observable variables, for example “My tasks involve a habitual method of carrying it out”. Task complexity is the degree to which site supervisor’s task is made up of interconnected or related structures. It was measured with 2 observable variables such as “The nature of my task is complex in structure”. The last latent variable on task characteristics ‘task structuredness’ was measured with 2 observable variables and it described the degree to which site supervisor’s tasks have a definite and highly organised structure. For example “My tasks involve the application of a limited number of rules and principles with well-defined parameter for convergent”.

Training procedure consists of four major variables namely; training needs assessment, training delivery, training evaluation and training transfer. Questions were asked to determine the frequency of training site supervisors in construction firms. Training needs assessment which described the indicators for training site supervisors was measured as a latent variable and consists of 15 observable variables in statement form, such as, “the frequency at which my training needs are determined by the company through personal face to face interview with managers and supervisor is…..”. The second training procedure variable named ‘training delivery’ was also measured as latent variable and comprised 22 statements explaining areas of training and methods of delivering training. For example, “the frequency at which the company sponsors me to workshops, seminars or conferences is….” . Training evaluation explained ways of assessing training received by site supervisors. It was also measured as a latent variable and consisted of 8 observable variables stated in statement form. For example, “the frequency at which the company asks the trainees’ managers or supervisor for their assessment of my learning is……. The fourth training procedure ‘training transfer’ emphasised the transfer of what was gained during training to present job. It comprised of 5 statements such as “the company assigns me duties related to the training I received to a …….” .

To check for reliability of the scale of the instruments, Cronbach Alpha Coefficient for task characteristics and training were found to be 0.98 and 0.86, which are above the recommended level of 0.7 (Field, 2009). This shows that the research instruments are highly reliable.

The population of the study comprised site supervisors in construction firms in Lagos and Abuja. This is to ensure uniformity in the nature of their task and the

variables of training namely training needs assessment, training delivery, training evaluation and training transfer. The p value for task difficulty and training needs assessment is lesser than 0.05 and greate

DISCUSSION OF RESULTS

The result from the hypothesis shows that there is a significant relationship between nine task characteristics variables and four training procedures. This means that the higher the prevalence of task characteristics namely: skill variety, task identity, task significance, autonomy, feedback, task analyzability, task routineness, task complexity and task structuredness in construction professionals' task, the higher the systematic procedures for carrying out training namely: training needs assessment, training delivery, training evaluation and training transfer in construction firms. This emphasises the importance of understanding the nature of site supervisor's task before conducting training. Morgeson and Humphrey (2006) have a contrary view; the duo discovered that there is no relationship between task characteristics and training. Differences in the task characteristics and training variables could contribute to the differences in the findings of this study and that of Morgeson and Humphrey. For example, comparison between the task characteristics variables in this study and that of Morgeson and Humphrey shows differences. Morgeson and Humphery conceptualized task characteristics as autonomy, task variety, task significance, task identity and feedback from job in. Furthermore, autonomy was subdivided into 3 latent variables of work scheduling autonomy, decision making autonomy and work methods autonomy. Furthermore, differences in the industry where the research was undertaken could be a major reason for the contrary view. This study is carried out in the construction industry with site supervisors has respondent while Morgeson and Humphery focused on job incumbent.

Another major finding was that task characteristics variables (skill variety, task significance, feedback, task routineness) were found to be predictors of training; however, task significance and routineness show a negative influence. The finding supports Rausch (2018) study where task characteristics were found to be predictors of learning. Although, the variab

Ijaola, I. A., Onukwube, H. N. and Idoro, G. I. (2017), “Characteristics of site supervision task of professionals in Nigerian const

through, within and around a space, involves not just directional but cognitive and route mapping skills that have overall effect on user's performance within a space (Golledge, 1999). Navigation involves finding routes between pairs of locations, traveling and receiving continuous real-time guidance while on a chosen route. The basic objective of the average user in a space is to navigate within and around the space to a desired destination. Despite these unique features, this paper references wayfinding and navigation as they were defined previously; other times they are employed interchangeably. Being such a complex process, navigation is difficult in large built environments such as the health care facilities (Huisman, Morales, Van & Kort, 2012). These facilities provide a level of health care services within one a large organic system. They typically are large, complex and evolving spaces, which are regularly reconfigured and extended as operational needs shift and change, often resulting in a confusing, non-systematic layout (Li, Brown, Pinchin & Blakey, 2015). Ido, Heylighen and Pintelon (2016) report that patients, who are likely to be under stress, have to navigate their way to multiple locations in the course of a single visit resulting in a problem. Architectural solutions to navigation problems in complex environments are mostly based on the principles of spatial cognition, circulation planning and signage. In order to enhance the ease of navigation especially around auxiliary facilities within the building, signage is usually employed in the common language (Ufuk, 2000). Each country or state has a common language employed. In Nigeria the formal language used is English. Despite this, States in Northern Nigeria for many years have lagged behind in English literacy, according to data on literacy index recently published by the National Bureau of Statistics (NBS) (Ajibola, 2017). Additionally, signage in hospital environments are often presented in medical expressions in English not commonly known or understood by people who do not have experience with medical terminology and who are not conversant with the written English language.

Despite massive funding over decades, literacy level remains very low in Northern States of Nigeria. Kaduna State in particular has a literacy level of 47.31% (Ajibola, 2017). According to Maina and Dauda (2017), there is a deviation in the order of effectiveness of these architectural solutions to navigation problems in low literate zones in comparison with the research conducted in the higher literate zones in foreign countries. In spite of these findings, no research has been conducted to objectively evaluate the extent and impact of this deviation due to the literate ability of the users in the study area. In light of this, this study will first identify and understand navigational issues literacy causes for users of hospital spaces and then to examine its relative significance and impact (Gibson, 2017). These results will in turn provide a user driven, evidence base upon which to improve existing navigational aids and/or inform new forms of adaptive, locative guidance (Jerrod, 2017). The overall aim is for such improvements to significantly reduce everyday navigational inefficiencies and improve the overall 'user experience' for patients, visitors and staff alike. As the study entails an objective evaluation on literacy as an influencing factor on way finders' navigation in tertiary health care facilities in Northern Nigeria, Ahmadu Bello University Teaching Hospital Shika, Zaria Kaduna State (ABUTH) was chosen as an example of a tertiary health care facility in Northern Nigeria.

difficult to assess and measure reliably. Due to this, experimental research on cognition of both indoor and outdoor navigation increased greatly following the work done by Passini in the 1970s. Thorndyke and Hayes-Roth (1982) established a fundamental principle that spatial information acquired from maps was fundamentally different from spatial knowledge acquired from walking through indoor spaces. This early work provided the field with many of the techniques still used today (Karimi, 2015). Based on the basic concepts of way finding as reviewed by many scholars it is assumed that the basic goal during any way finding process is to navigate through, within and around a built environment and subsequently arrive at a destination. Some scholars such as Hirtle et al. (2011) argue that even though textual signage is as useful as graphical signage for assisting navigation, complex buildings are difficult to navigate regardless of signage. Typically, tertiary health care facilities require sophisticated technology, multiple specialists, sub specialists, a diagnostic support group, and intensive care facilities (Farlex, 2007), and are known to be a converging point for people from a wide range of backgrounds; from the upper class and highly exposed to the lower class and unexposed who are all seeking medical attention within a single facility.

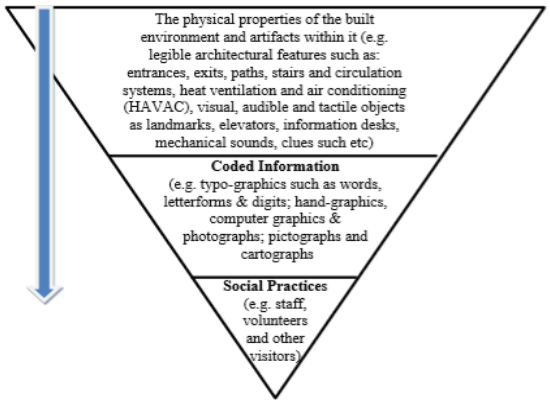

Figure 1: Prescriptive framework for addressing way finding problems. Source: Rooke (2012).

Moreover, medical language may be inconsistent from facility to facility. Signage is not always clear and does not accommodate those who are unable to read English or those who cannot read at all (Cooper, 2010). In order to objectively understand navigational behaviours within a built environment one must look at the way finding concept as a whole and the variables that influence it, in addition to basic principles that are solutions to its difficulties. In light of this some scholars have developed strategies providing solutions to way finding problems. A prominent example is the work of Rooke (2010) comprising a framework providing a prescriptive review to the standard strategies and solutions of way finding problems. Figure 1 illustrates the order of importance of strategies that coded information (usually involving words, letterforms, photographs etc.) is given a greater priority than the vocal strategies involving social practices (e.g. staff, volunteers, other visitors etc).

Based on the prescriptive framework, some would critique that in situations where way finding solutions using coded information designed to aid effective navigation fail due to users being unable to comprehend the signs, symbols and written instructions provided to ease navigation. In that case, the nature of the prescriptive framework (figure 2) would change as posited by Maina & Dauda (2017).

- I can usually recall a new route after I have walked it once.
- I can easily find the shortest route to a known destination.
- I am good at giving descriptions of routes I've passed before.
- When giving route descriptions I describe based on features I remember.

- Spatial orientation

Spatial abilities are used to manipulate geometric information to determine location related to the environment (Rudolph & Barry, 2014). Spatial orientation also involves the ability to coordinate and re-orientate movement within a space. The most important aspect of spatial orientation is self-location, the ability to relate where you are in the real world to the corresponding spot on a map or in your memory (Maxwell, 2013). The WQ evaluates this by assessing user's responses through the following close ended questions:

- When I enter the facility for the first time, I can easily point to the main entrance.
- I can orient myself quickly and correctly when I enter an unknown environment.
- I always try to orient myself in a new environment.
- In an effort to orient myself I panic.
- When I get lost I get nervous.
- When I get lost I try to re-orient myself.

- Basic navigation steps for known and new routes.

The basic objective of the average user is to arrive at a set destination (Rudolph & Barry, 2014). Basic navigation steps vary depending on whether the user is taking a known or new route, which are largely dependent on the user's route navigation and spatial abilities. Successful wayfinding occurs when the navigator can make correct navigation decisions that take him from his present location to a destination that fulfils his larger purpose (Golledge, 1999). The steps are evaluated by the following statements in the WQ:

- When trying to find my way I pay attention to landmarks.
- When trying to find my way I rely on instinct and follow the flow of movement.
- When trying to find my way I try to find a help desk or staff to talk to.
- When trying to find my way I try to understand the area and read the signs around.
- When taking new routes I rely on instinct.
- When taking new routes I openly observe signs and symbols.
- When taking new routes I openly ask for help from people around.

- Route perception

Route perception is a process through which humans and other organisms become aware of the relative positions of their own bodies and objects around them along a specified path (Reginal, Roberta & Jack, 1996). Route perception provides cues, such as depth and distance, that are important for movement and orientation along

Plate 1: Corridor as a physical feature within

Plate 5: Help desk in the entrance lobby, an example of social practices. August 2018

MATERIALS AND METHODS

Data from WQ responses were obtained from patients, staff and visitors. The study population comprised of a random selection of people within the hospital environment; ranging from patients, staff to visitors, of the “Adult” age as defined for the National Literacy Survey (2010) to be persons aged 15 years and above by the time of the survey, and who were available at the time of the distribution of the questionnaires and were willing to participate. According to the records gotten from the Statistics department within the hospital, an average of 650 patients are attended to per day. Sample size was determined from Yomens (2000) using the formulae:

The frequency distribution for literacy reveals approximately 65% of respondents are literate (Table 2), compared to approximately 35% who were not.

Table 2: Literacy Category among users

	Frequency	%
Adult Illiterate	74	34.7
Adult Literate	139	65.3
Total	213	100.0

Notably all respondents were analyzed without disparity, and distribution across genders and ethnicities was neutral and random. Subsequently analysis and results were conducted without any provisions being made for gender or ethnical based differences.

Results addressing the first research aim reveal significant differences in responses between literate and illiterate respondents, with the notable exception of basic navigation steps for known routes (p=0.387, Table 3). In essence, both literate and illiterate respondents did not significantly differ in their ratings of Basic navigation steps for known routes related to the use of signs, symbols and reliance on instinct. The highest degree of difference occurred for basic navigation steps for new routes (p=0.001) which involve the use of verbal communication, use of landmarks as well as following the flow of movement. Interestingly, mean ratings for basic navigation steps for new routes are higher for literate users than for illiterate users, implying that literate users in the study area rely on asking for verbal instructions even when they can read and understand signs and symbols as opposed to illiterate users of healthcare facilities. Illiterate respondents recorded higher mean values for route mapping and perception (Table 3).

Table 3: Differences of ratings for literate and illiterate users

Categories of Navigation Behaviors	M All	M Literate	M. Illiterate	U	p value
Route Mapping	4.77	4.63	5.05	3,935	0.005*
Basic Navigation steps in a known route	4.38	4.40	4.34	5,511	0.387
Basic Navigation steps in a new route	4.35	4.47	4.11	6,528.50	0.001*
Spatial Orientation	3.69	3.78	3.52	6,170.50	0.016**
Route Perception	3.50	3.40	3.68	4,215.50	0.029**

**Sig. at 0.01, **Sig. at 0.05*

In response to the second research aim, results reveal that overall, literate and illiterate users employ route mapping behaviors related to memory recall, use of shortcuts and verbal descriptions more than other categories. Results presented in Table 4 reveal that all but three navigation behaviors record mean values below 3 and RAI less than 0.5 which relate to panic situations in route navigation and spatial orientation. A possible reason for this may have been the negative phrasing of the statements, the meaning of which may have been misconstrued during the process of translation.

RM=Route Mapping, BNSii=Basic Navigational steps in a new route, SO=Spatial Orientation, BNSi=Basic Navigation steps in a known route, RP=Route Perception

DISCUSSION

The results from Table 4 suggest greater reliance on independent navigation and wayfinding behavior than a dependence on asking for verbal instructions. This is an unexpected finding due to the fact that this trend is expected of literate users, not illiterate respondents. It appears that illiterate users have a tendency to rely on individual and independent route mapping abilities, implying a greater dependence on architectural features of the environment for navigational tasks. This means that users would tend to pay more attention to physical cues around them, to aid self-orientation during a navigational task. Architectural and environmental features could enhance route mapping and route memory retention through landmarks and other features which help aid more self-reliant respondents.

Also evident even in the situation of the literate user, was the reliance on social practices, due to the fact that the practice of asking verbal instructions is entrenched within the socio-cultural milieu of Nigerians even within highly educated environments (Maina & Umar 2015; Maina & Dauda, 2017). In this situation such users tend to ignore environmental cues and landmarks and rely on signage as well. This generates a need for improved signage systems, preferable pictorial and graphic signage that does not rely on a particular language but is universally interpreted. Consequently, these social practices could be enhanced to enable a greater ease of interaction within the built environment.

A large percentage of illiterate users show greater reliance solely on individual abilities and independent social practices. This was an unexpected finding as visual observation illustrates illiterates are likely to ask for directions and not be independent in finding their way around new or complex environments. Some illiterate users interviewed however explained this conundrum: reliance on individual abilities was done to avoid being labelled inexperienced or naïve due to their inability to read and write in the English language employed for hospital signage.

CONCLUSION AND RECOMMENDATIONS

A close analysis of the results reveals an impact on effectiveness in the use of architectural differentiation and environmental cues in the study area. This being true due to the socio-cultural attitude of the people in the study area as well as the ineffectiveness of signage and coded information employed in the facility, due to their inability to read and comprehend the written language. Passini, Proulax and Rainville (1990) emphasise the physical environment has a major role in compensating for deficiencies in signage and coded information, thus architectural design of the physical environment is paramount. Marquardt (2011) also stresses that while cues such as signage and distinctive features can support wayfinding, they cannot compensate for a poor plan layout. Thus, in order to cater to all users, these considerations need to be made during and after the design process:

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key impediment to the success of many CMSMEs (Kuratko, Covin and Hornsby, 2014: 648; Arundel, Bloch and Ferguson, 2019: 789). Complexity renders the evaluation and quantification of innovation in CMSMEs and construction difficult, as innovations developed through interaction between construction companies, consultants and clients are often not picked up (Orstavik, Dainty and Abbott, 2015:3). Although innovative capabilities are considered the pivot on which the companies' business stands, their contributions to CMSMEs' survival are poorly understood (Yan, 2015:6). Aouad et al. (2010: 1) confirm that there is a gap in the body of knowledge of different types of innovation and their relationship to the success of CMSMEs.

Innovation may take place in CMSMEs externally and/or internally. External innovation entails developing new products and/or services. Internal innovation may encompass new processes, organisational structures and culture (Li, Salguti, Siddiqi & Sideridis, 2009: 293). More than 95% of enterprises in the world can be categorised as MSMEs (Heslina et al., 2016: 41). In 2013, Nigeria had about 36,994,578 micro, small and medium enterprises (MSMEs), with 731,303 CMSMEs - about 1.99% of the total number of MSMEs in the country (Small and Medium Enterprises Development Agency of Nigeria; National Bureau of Statistics, 2013: 26). However, 50% of CMSMEs in Nigeria become extinct within their first five years of existence, consequently, only about 10% of Nigerian CMSMEs survive, thrive, and grow to maturity. Enterprises failing within so short a time portend a huge problem surrounding innovation (Oduyoye, Adebola & Binuyo, 2013: 33). A survey result further indicates that over 70% of CMSMEs are not creative. This suggests further innovation challenges (Small and Medium Enterprises Development Agency of Nigeria; National Bureau of Statistics, 2013: 6). The challenges and development of CMSMEs can be overcome and achieved through innovation (Kennedy & Moore 2003: 2). CMSMEs need to engage in innovative activities as a competitive strategy and to undertake innovation as an important part of organisational competitiveness, survival and growth (Yoon, Lee & Schniederjans, 2016: 4). The large number of CMSMEs in most economies provides a basis for reviewing various aspects of their operations and growth (Janeska-Iliev & Debarliev, 2015: 3). While the construction industry is mostly dominated by CMSMEs and are considered the engine of economic growth; they promote equitable development in Nigeria through the main advantage of the sector - its employment potential at low capital cost (Ayanda & Laraba, 2011: 201).In addition, it it is hard to overstate the importance of construction to the economy. Construction is one of the largest employers of labour in many countries.. Innovation is as vital for the continued prosperity of this industry (Goodland, Lindberg & Shorthouse, 2015: 1). The research question therefore is, what are the predominant types of innovations and their impact amongs surviving and successful CMSMEs in Nigeria. The aim of this paper is to explore the predominant types of innovations among surviving and successful construction micro, small, and medium enterprises in northern Nigeria, with the view of recommending those to failing CMSMEs.

A major argument supporting CMSMEs innovation is that more innovation generates more growth which promotes job creation. Whereas innovation is a means by which knowledge is transformed into economic growth. A common position is that CMSMEs and a nation that innovates, leads to growth and development (Colombelli, Haned and Le, 2013: 14). An excellent example of this is

Nigeria (Small and Medium Enterprises Development Agency of Nigeria; National Bureau of Statistics, 2013: 7)

Innovation

The working definition of innovation in this study: innovation is the use, application, or commercialisation of inventions, discoveries, creativities, new ideas, processes, products, or procedures that benefit individuals, groups, organisations, or societies (Cefis & Marsili, 2006: 7; Janeska-Iliev & Debarliev, 2015: 5). Moreover, innovation can be classified at, international, national, regional, firm or project levels (Aouad, Ozorhon & Abbott, 2010: 374). The innovative ability of CMSMEs is tested during the turbulence periods of new entry to and exit from the market, or turbulence in the market and the economy (Cefis & Marsili, 2006:8; Janeska-Iliev & Debarliev, 2015: 6). During the last thirty years, innovation has become a synonym for the development of nations, technological progress, and drivers of business success. Innovation is not simply the "creation of something new" but it is also a potential veritable panacea to CMSME problems, since problems points to lack of innovative solution or the need for creative responses (Kotsemir &Abroskin, 2013: 3). Hence, The benefits of innovation are realised by fully understanding the components of the whole innovation process, based on knowledge acquisition, transformation, and diffusion (Aouad, Ozorhon and Abbott, 2010: 389). Hence, the development of CMSMEs in each country should be pursued with efforts to improve the innovative capability and capacity of CMSMEs and to eliminate or reduce their constraints (Shakantu, 2012:265).

Success

There is no specific meaning or definition of a surviving and successful or growth-oriented business. However, percentage increases in revenue or the market share are considered as success (Doub, Edgcomb & Circle, 2005: 12). Success is often equated with the achievement of clearly defined and measurable goals and objectives in a business, firm or all sectors of human life (Komppula, 2004: 2). Similarly, business growth or success is defined as increases in business revenue or sales (Doub, Edgcomb & Circle, 2005: 11). Firm success is defined as the growth and financial performance of a firm measured in volume growth, relative change in net turnover value growth and relative change in equity. As a side condition, profit margins must be positive for a company to be classified as successful (Lingegård &Sandström, 1990: 3). Generally business success is said to be continued viability or longevity (Rogoff, Lee & Suh, 2004: 365).

METHODOLOGY

Two stage non-probabilistic sampling was adopted, comprising judgemental and snowballing sampling for stage one and two respectively. In stage one, participants were drawn by the researcher judgementally based on their innovation(s) and as indicated by the research working definition and in stage two, the sample size was expanded, using a snowballing sampling technique where the participants in stage one suggested other participants who had also been innovative. The data used for the research is basically qualitative primary data, collected from innovative CMSMEs through recorded interviews with structured open-ended questions, from 17 CMSMEs spanning 14 of the 19 states of the north. Data such as interviewees' profiles, firm profiles, and types of innovation were determined and developed

Interpretation of results

This section gives constructive meaning to the data analysed above in respect of the aim of this research as stated. The following interpretations can be reasoned from the data:

CMSMEs' Innovation

Data analysed presents Product Innovation as the most dominant type of innovation among the CMSMEs in northern Nigeria with a 32% occurrence. It is therefore inferred that Product innovation as part of and the most dominant type of CMSME innovation is consequentially the likely cause of logistic innovation and service innovation. While management innovation, process innovation, and technological application innovation are innovation outcomes that are associated with product innovation. This means that product innovation is not just dominant but the driver of all other forms of innovation in the CMSMEs in northern Nigeria. It is therefore safe to induce that innovations within the northern Nigeria CMSMEs are product-focused and product-driven. It therefore follows that CMSME activities and success are hinged on how innovatively they provide the product they offer their customers. Hence, failing CMSMEs that redirect their attention to product innovation are most likely to survive and succeed.

Discussion of findings

Findings from the analysed research data reveal the following types of innovations as predominant within the innovative CMSMEs studied located in the Northern part of Nigeria. The CMSMEs studied have their ages ranging from 3 to 41 years.

Product Innovation

Product innovation is a successfully developed, introduced, diffused and used product (Egmond, 2012: 188). The results from the analysed data reveal product innovation as the most dominant type of innovation within the studied CMSMEs located in the Northern part of Nigeria. This result is consistent with a study conducted by Haugbolle, Forman & Bougrain that draws data from five case studies from three different countries: Denmark, Sweden and France. From the cases studied, the research found the existence of product innovations in an industrial housing concept development firm and at Rockwool (Haugbolle, Forman & Bougrain, 2015: 128). Similarly, a research study in Finland by Koukkari & Orstavik found that product innovations were evident in all the ten construction companies studied (Koukkari & Orstavik, 2015: 192-194).

It has been postulated that construction production and production processes have a great deal to do with product innovation as it creates values (innovative products) along the processes of its production (Orstavik, 2015: 18). Hence, the quest for more efficient products and services and the pursuit of competitive advantages through novelty and innovation have shaped most construction businesses (Orstavik, Dainty & Abbott, 2015: 1). Consequently, product innovation (production) is typically carried out in enterprises whose survival depends on offering products for which alternatives may be available from a range of other competitors (Orstavik, Dainty & Abbott, 2015: 1). As a result, product innovation, characterised by innovatively creating novel values through waste and price reduction, becomes essential within competitive environments for enterprises to survive and flourish. (Orstavik, Dainty & Abbott, 2015: 1). In addition, product

(Wamelink & Heintz, 2015: 154). Hence, in a project, the client is a major driving force behind innovation and sometimes co-Innovation (Egmond, 2012: 202)

Process innovation

Process innovation is a successfully developed, introduced, diffused and used process (Egmond, 2012: 188). In the current study, process innovation was found to be among the low occurring types of innovation within the studied CMSMEs in northern Nigeria. This research outcome is consistent with the findings of Haugbolle, Forman & Bougrain who draw data from five case studies from three different countries: Denmark, Sweden and France. They found the existence of process innovations in a kitchen solutions' firm from among the construction firm cases studied (Haugbolle, Forman & Bougrain, 2015: 128). Process innovation was also identified by Fransen in his research (Fransen, 2013: 17)

CONCLUSION

This study has reached the conclusion that the predominant type of innovations within CMSMEs in the northern part of Nigeria are product innovations, management innovations and service innovations. These innovations are responsible for the CMSME success periods, sources of success and have made a significant contribution to their success over the years. This finding, therefore, implies that failing (closing shop) CMSMEs could focus on product innovativeness, management innovativeness and service innovativeness to boost their chances of survival and eventual success. Furthermore, product innovation is considered the likely trigger of other forms of innovations within CMSMEs, since other types of innovations are necessitated by product innovation as revealed by the study.

However, the researcher acknowledges any variation in the research design, research method, sampling technique, scope of data, source of data, data collection instrument and method of data analysis could result in altering the findings and the application of the findings in this research and hence, limit the research. Furthermore, the study is delimited to only the identification of types of innovations and not the characteristics and nature of the individual innovations. Hence, its limitation.

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opine that the development of business strategies is based on the firm's perception of the environment. In line with this perception, the contingency theory proposes that there is no single best approach to business success but that firms should develop strategies based on the unique situation in their organizations, in other words, their business strategies should be contingent on the environment (Tunji-Olayeni et al., 2014). The Resource-Based View (RBV) theory, however, focuses on firm's resources and capabilities to understand business strategy and to provide direction to strategy formulation premised on the assumption that sustainable competitive advantage is achieved by developing superior capabilities and resources from the internal distinctive resources of the firm (Yan & Chew, 2011; Barney, 1991).

Findings from previous studies suggest that SMCEs adopt the three strategies (Betts & Ofori, 1992) while Langford and Male (2001) opine that focus strategy may provide SMCEs some potentials for creating competitive advantage and achieving superior performance. Yan & Chew (2011) however differ and conclude that focus strategy does not enhance SMCEs performance. Based on RBV theory, Eniola & Ektebang (2014) focused on SMEs' performance and categorized competitive advantage determinants as financial-related, owner-related and technical-related. Ogbu (2016) focused on survival practices and categorized them as owner, firm, project and client- related determinants. Procurement and client-related determinants are adopted from Love, (2002) and Ogunsanmi, (2015). Odediran, Babalola, and Adebiyi (2002) focussed on business development strategies, Uchegbulam, Akinyele, and Ibidunni (2015) focussed on comparative advantage and performance while Tunji-Olayeni et al (2014) hinged on strategic management practices of construction SMEs. Glaringly, the business strategy domain as an intervening variable has not been well researched. This study will attempt to fill this gap. The objectives of the study are to evaluate and compare the effect of the internal environment and project-related determinants on business strategies of SMCEs in Nigeria with a view to promoting the adoption of appropriate strategies for their growth and ultimate survival. The hypothesis of the study states that the difference in the effect of the business strategy determinant groups is not statistically significant.

LITERATURE REVIEW

The construction business environment is characterized by increased intensity in competition and instability which is attributable to external influences, internal competition between firms in the same sector and vertical integration by manufacturers of construction materials (Tan, Shen, & Langston, 2012; Kale & Arditi, 2003). This competition is however more intense with small and medium enterprises because of their peculiar challenges (Basil, 2005). Deriving from the National policy on MSMEs (2003), small and medium construction enterprises (SMCEs) can be defined as firms with an asset base (excluding land) of between 5 million Naira and 500 million Naira, and labour force of between 11 and 300 in their employment (Ajose, 2010). The challenges facing the SMCEs are even more pronounced as a result of the peculiar nature of the construction industry and it is, therefore, crucial for the SMCEs to adapt to the changing environment by strategic positioning. Strategic management has been identified as an important determinant of business success (Tunji-Olayeni et al., 2014). Andendorff, Appels,

and focus strategies) while Chinese construction companies prefer differentiation and marker diversification strategies (Cheah, Kang, & Chew, 2007); Tunji-Olayeni et al., 2014). Betts and Ofori (1992) also confirm that all three strategies have application in the construction industry. Low mark-up, which is a strategy employed by most SMCEs to remain competitive in their final bid is a type of cost leadership strategy while design and build, private-public partnership (PPP) and project specialization are types of differentiation strategy. Executing projects in a fixed geographical location, operating in a specific project such as mass housing construction are examples of focus strategy in construction (Naismith, 2007). However, Yan and Chew (2011) contend that focus strategy does not enhance SMCE's performance because the instability of the market coupled with the narrow market makes the SMCEs more vulnerable to local market fluctuations.

Determinants of business strategies

The choice or preference of a strategy over the other is influenced mainly by the degree of uncertainty of the environment which consists of both external and internal environments. According to Bamber et al. (2004), firms develop their business strategies based on their perception of the environment. External environment refers to the macro and micro-economic realities surrounding a firm. The macro-environment consists of socio-cultural, political, economic, demographic and technological factors which are within the purview of government control, they influence the firm but outside of the firm's control (Jalila et al., 2011). Proponents of the contingency theory believe that there is no single best approach to business success, firms should, therefore, develop strategies contingent on the uniqueness of their organizational situations (Tunji-Olayeni et al., 2014).

The macro-economic environment, however, is the atmosphere in which the individual firm operates and consists of the forces that affect the firm's ability to work (Uc & Kaja, 2013). The variables of the micro-environment of a construction firm consist of local competitors, infrastructure, capital resources, local suppliers, customers' demand among others. These variables influence firm-level decisions (Ogbu, 2016). According to Babatunde and Olaniran (2009), firms' internal environment is tailored to adjust to the dynamism of the micro-environment. Organizations perceive their environments in different ways, thus adopting different strategies. The strategic choice approach is very relevant to SMCEs because strategies enable them to offset their resource limitations. The Resource-Based View focuses on the firm's resources and capabilities to understand business strategy and to provide direction to strategy formulation (Yan & Chew, 2011). The RBV proponents argue that a firm's competitive advantage comes from resources and capabilities that satisfy the VRIN criteria, that is, those that are valuable, rare, imperfectly imitable and non-substitutable (Barney, 1991). RBV proposes that if a firm possesses and deploys these resources which are regarded as core competencies, it has a competitive advantage and can formulate its business strategy based on the advantage (Eniola & Ektebang, 2014).

Firm's internal environment

Business strategies are based on competitive advantage. The essence of business strategy is to do something distinctive, hence construction firms need distinctive individuals, distinctive capacities and distinctive market positions to prosper in the

RESEARCH METHODOLOGY

Research Approach

In order to achieve the objectives of this study, a cross sectional survey was adopted.

Study population and sample size

A pilot study was carried out prior to the actual field survey because the population of construction firms was not readily available. The pilot study identified 100 construction firms in the SME category that have been consistently involved in construction project execution in the past 5 years (2013-2017). This condition is premised on the fact that the study is part of a larger study that needs quantitative data on projects executed within the stated period of time. A sample frame was developed from the list of registered contractors with Lagos State procurement office, registers of the Federation of construction industry (FOCI), Nigerian Institute of Building (NIOB) and Council of registered builders of Nigeria (CORBON). The sample size was calculated using Yamane (1967) formula for calculating sample proportion. A sample of 80 construction firms was obtained from the calculation.

Sampling techniques

A multistage sampling approach comprising simple random sampling and purposive sampling was used for the study. The simple random sampling technique was used for selecting the 80 firms from the population of the study. Using the Microsoft Excel worksheet random numbers function, 80 random numbers ranging from 1 to 100 were generated. Each of the construction firms on the sampling frame had an equal and independent chance of being selected. Furthermore, a purposive sampling technique was used to get the respondents from each of the randomly selected firms. The targeted respondents were either the owners of the firms or their professional representatives.

Survey instrument

A structured questionnaire was developed and used for collecting data for the study. A total of 80 questionnaires were delivered by hand to the respondents through the help of trained research assistants. Six (6) research assistants were trained and engaged in collecting the data for the study. They were trained to guide the respondents where necessary, on how to fill the questionnaires. Three sections of the questionnaire are relevant to this study; section A solicits background information on the respondent, section B on the firm characteristics and section C on the effect of selected determinants on business strategies.

Seventy (70) questionnaires were retrieved. The retrieved questionnaires were checked for completeness and accuracy. It was found out that twenty (20) of them were poorly completed and unusable for the study and thus discarded. A total of 50 questionnaires were therefore used for the study representing 62.5% response rate. Baruch and Holtom (2008) opine that an average of 52.7 percent is acceptable. In view of this, a 62.5% response was considered adequate for analysis.

Thirty-four (34) determinants of business strategies identified from previous studies were used for the study. These determinants were categorized into seven determinant groups namely: Owner-related, Firm-related, Client-related, Technical-related, Project-related, Financial-related, and Procurement-related

Table 1. Mean score of effect of selected determinants on business strategies of SMCEs

Business strategy determinants	N	1	2	3	4	5	TS	MS	Rk
Project specification	50	0	2	7	31	10	215	4.30	1
Project Type	50	0	1	9	18	22	211	4.22	2
Construction management	50	6	2	6	19	17	209	4.18	3
Employee's work experience	50	0	2	2	31	15	209	4.18	3
Project management	50	0	2	6	25	17	207	4.14	5
Project duration	50	0	2	11	18	19	204	4.08	6
Owner's technical experience	50	0	2	5	31	12	203	4.06	7
Management contracting	50	0	2	3	37	8	201	4.02	8
Firm experience	50	0	2	9	26	13	200	4.00	9
Req. skill and qualification	50	0	2	3	38	7	200	4.00	9
Project specialization	50	1	0	8	15	26	199	3.98	11
Firm size	50	0	2	7	32	9	198	3.96	12
Project size	50	0	4	9	22	15	198	3.96	12
Adaptation to new tech	50	2	1	10	24	13	195	3.90	14
Firm age	50	0	1	16	25	8	190	3.80	15
Client financial standing	50	0	4	8	32	6	190	3.80	15
Advance payment	50	0	6	4	35	5	189	3.78	17
Design and build	50	7	0	12	29	7	189	3.78	17
Use of technology (ICT)	50	1	4	15	16	14	188	3.76	19
Client financial credibility	50	2	0	15	27	6	185	3.70	20
Access to loan from banks	50	1	1	17	24	7	185	3.70	20
Owners prof. qualification	50	0	2	18	27	3	181	3.62	22
Access to credit from suppliers	50	0	4	19	25	2	175	3.50	23
Clients involvement	50	0	7	16	23	4	174	3.48	24
Owner's educational qualification	50	0	6	22	19	3	169	3.38	25
Traditional procurement system	50	0	2	30	17	1	167	3.34	26
Project location	50	6	0	27	14	3	164	3.28	27
Use of own capital	50	2	5	32	7	4	156	3.12	28
Age of owner	50	1	9	25	14	1	155	3.10	29
Firm location	50	2	13	25	9	1	144	3.88	30
Altitudes to correction	50	8	20	11	6	5	130	3.60	31
Client's social standing	50	6	15	25	3	1	128	2.56	32
Gender	50	14	26	7	1	2	101	2.02	33
Marital status	50	17	22	8	3	0	97	1.94	34

N=Number of respondents, TS=Total score, MS=Mean score, Rk=Rank, SMCEs= Small and Medium Construction Enterprises

Relative effect of selected determinants of SMCEs business strategy based on classification

To investigate the effect of the determinants within each group, the 34 determinants were classified into seven (7) groups as follows: Project-related group consists of five determinants, procurement-related group has five determinants, firm-related group consists of six determinants, technical-related group has four determinants, financial-related group consists of five determinants, client-related group consists of three determinants while owner-related group consists of six determinants. The groups and their mean scores are presented in Table 2

Table 2 shows that project specification, project type, and project duration are the top three determinants within the project-related group while construction management, project management and management contracting are the top three determinants in the procurement-related group. Firm experience, project specialization and firm size constitute the top three determinants in the firm-related group. Adequate work experience, possession of required skill and qualification and adoption of new technology constitute the top three

determinant groups come fourth, fifth and sixth respectively. The owner-related determinant group has the least but moderate effect on the business strategy of the SMCEs.

Difference between effects of SMCEs business strategy determinant groups. The study also investigates the difference in the overall effect of the seven business strategy determinant groups. To achieve this, a research hypothesis was postulated. The hypothesis states that the difference in the effect of the business strategy determinant groups is not significant. The hypothesis was tested using t-test at p Ó 0.05. The decision rule for the rejection of the hypothesis is that when the p-value is > 0.05, the test fails to reject the hypothesis (LaMorte, 2017). However; when the p-value is Ó 0.05, the test rejects the hypothesis. The mean scores of the business strategy determinant groups were used to test the hypothesis. The results are presented in Table 3.

Table 3: Results of paired t-test of difference between the effects of business strategy determinant groups

Variables paired	N	Mean	t-value	Df	p-value	Sig
Project	50	3.97				
Procurement	50	3.89	0.935	49	0.354	NS
Firm	50	3.73	2.576	49	0.013	S
Technical	50	3.67	2.607	49	0.012	S
Financial	50	3.56	5.279	49	0.001	S
Client	50	3.28	5.878	49	0.001	S
Owner	50	3.02	8.190	49	0.001	S
Procurement	50	3.89				
Firm	50	3.73	1.621	49	0.111	NS
Technical	50	3.67	2.730	49	0.009	NS
Financial	50	3.56	4.215	49	0.001	S
Client	50	3.28	5.709	49	0.001	S
Owner	50	3.02	7.669	49	0.001	S
Firm	50	3.73			.	
Technical	50	3.67	0.560	49	0.578	NS
Financial	50	3.56	1.982	49	0.053	NS
Client	50	3.28	4.051	49	0.001	S
Owner	50	3.02	8.112	49	0.001	S
Technical	50	3.67				
Financial	50	3.56	1.281	49	0.206	NS
Client	50	3.28	4.551	49	0.001	S
Owner	50	3.02	6.006	49	0.001	S
Financial	50	3.56				
Client	50	3.28	2.980	49	0.004	S
Owner	50	3.02	5.619	49	0.001	S
Client	50	3.28				
Owner	50	3.02	2.422	49	0.019	S

N=Number of respondents, df =Degree of freedom, S=Significant, NS=Not significant

Table 3 shows that the difference between the effect of project-related and procurement-related determinant groups is insignificant. The result indicates that the effect of these two determinant groups on the business strategies of SMCEs is the same. However, the difference between the effects of project-related group and firm-related, technical-related, financial-related, client-related and owner-related determinant groups are significant. The results indicate that the effects of these six determinant groups on business strategy of SMCEs are not the same and that the effect of project-related determinant group is significantly higher than that

is a differentiation strategy. The study also discovers that four of the project-related determinants namely: project specification, project type, project duration, and project size have a high effect and rank among the top ten determinants of SMCEs as indicated in Table 1. This finding suggests that only four factors constitute the main determinants of the business strategy of SMCEs. This finding agrees with the finding of Srivannaboon (2009) that project conditions help to improve the formation and execution of business strategy.

The study also discovers that procurement-related determinants of business strategy have the second highest effect. It is also discovered that the effect of procurement-related determinants is significantly the same with project-related determinants. The finding implies that the business strategy adopted by SMCEs is also based on procurement-related factors. The quality level desired in a project is the main consideration in procurement method selection (Ghadamsi & Braimah, 2012). Since quality enhancement is a feature of differentiation strategy, the finding tends to suggest that the business strategy adopted by SMCEs is a differentiation strategy.

The study further discovers that four of the five procurement-related determinants namely: construction management, project management, management contracting, and design and build have a high effect on the business strategy of SMCEs while three of the four high effect procurement-related determinants rank among the top ten determinants of SMCEs business strategy. The finding suggests that only the four procurement-related factors play a major role in determining the business strategy adopted by SMCEs.

The result of the study reveals that owner and client-related determinants have the least effect and that the effects of the other five determinants are significantly higher than their effects. The finding implies that owner and client-related factors are the least determinants of SMCEs business strategy. They indicate competitive parity and not a competitive advantage. They are not indicative of cost reduction, enhancement of quality or creating a niche market, hence they do not indicate a strategic position of the SMCEs. The finding supports the finding of Barney (1991) that resources for competitive advantage must satisfy the VRIN criteria. The results of the study have also revealed that the top ten determinants of business strategy are drawn from five business determinant groups namely: project, procurement, technical, financial and owner-related determinants. The finding implies that although the drivers of the business strategy of SMCEs are concentrated in the project and procurement-related determinants, SMCEs do not neglect some other factors in the selection of the business strategy adopted.

CONCLUSION AND RECOMMENDATION

It is established from the study that the top ten determinants of SMCEs' business strategy are project specification, project type, employee work experience, construction management, project management, project duration, technical experience, management contracting, firm experience, and required skill and qualification. It further discovered that project specification has the highest effect on the business strategy of SMCEs. It further established that the respondents' perceptions of the effect of project-related and procurement-related determinant

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INTRODUCTION

The construction industry is very strategic to the national economy providing infrastructure and shelter for other economic activities to take place (Chigara & Moyo, 2014). The construction industry is complex in its nature because it comprises large number of parties such as owners (client), contractors, consultants, government agencies/regulators. Despite this complexity, the industry plays a major role in the development and achievement of society's goals (Enshassi, Mohammed, & Abushaban, 2009). In Nigeria, the industry when viewed from the perspective of its dynamism has the capacity to generate employment and absorb semi-skilled, skilled and unskilled artisans as operatives for the various trades in the sector. The productivity of this type of workers whose abilities and socio-cultural backgrounds vary in a wide spectrum is naturally affected by many factors, Raza, Muhammad and Saqib (2015), resulting in some of the chronic problems of poor performance leading to failure in achieving effective time and cost performance of projects (Olawale and Sun, 2010) In most developing countries, construction workforce is available at very cheap rate. And this fact has affected the level of efforts which must be done by the upper management in order to meet the expectations of the workforce to keep them motivated in order to achieve good productivity output.

The top level management of organizations that are operating in most developing countries are reluctant to acquire knowledge of core factors which keep the workforce motivated. Human resource management is of strategic importance when it comes to industries like construction industry. The effective management of human resource is the key towards achieving the higher construction workforce productivity thus accomplishing the construction projects within their predefined limits. This accounts for why the respondents in this study are the industry professionals who understand that people employed in the sector should perform optimally towards the realization of organizational goal. There are number of factors that directly affect the productivity of labour, one of those factors is lack of motivation. Therefore this research is aimed at investigating the effects of motivation of operatives on productivity in the Nigeria construction industry. The objectives are to examine the factors which motivate operatives towards improved productivity and to ascertain the effect of motivation of operative's on productivity in the Nigeria construction industry. Thus, this study answered the question, what factors motivate operatives towards improved productivity and how to ascertain the effect of motivation of operative's on productivity in Lekki, Eti-osa, L.G.A, Lagos, the Nigeria. At the micro level, if productivity is improved, ultimately it reduces or decreases the unit cost of project and gives overall best performance of project (Attar, Gupta, & Desai, n.d.). The motivation of employees depends on the strength of their motives. Motives are need, wants, desire, or impulses within the individual and these determine human behaviour. Therefore, motivation is the process of arousing behaviour, sustaining behaviour progress, and channeling behaviour into a specific curse of action. Thus, motives (needs, desire) induce employees to act. Motivation therefore is the inner state that energies people, channels and sustains human behaviour (Maduka & Okafor, 2014). Productivity is defined as a ratio between an output value and an input used to produce the output (Thomas and Sudhakumar, 2014).. Output consists of products or services and input consists of

contributor to maximizing workers' productivity. In particular, motivation plays an important role in workers' generally defined as a composition of powers and mechanisms which help to direct human behaviour in a desired manner, or with a more specific context. It is described as the all convincing and encouraging actions which help workers fulfill their tasks willingly and to come closer to project objectives. Motivation of the labour force is of paramount importance because the quality of human performance at the workplace depends largely upon motivation (Kazaz, Manisali, & Serdar, 2008). That is, higher motivation brings higher productivity. Even the smallest action that is positive or negative can have an effect on workers' attitude and motivation. The motivation, especially monetary rather than moral, has proven its influence on the productivity of workers, and the methods of motivating personnel to promote productivity through applications of different human relations theories of motivation. Research on the relationship between motivation and productivity in the construction industry has been conducted over the last 40 years. There are three most commonly used theories in this research area (Kazaz, Manisali, and Serdar, 2008).

Maslow's need theory

Maslow (1970) argued that human beings strive to satisfy the following needs basically classified in ascending order: physiological needs, safety needs, social or belonging needs, self-esteem needs, and the need for selfactualization

Herzberg's motivation-hygiene theory

Herzberg (1968) labelled his two factor theory as satisfaction or motivation and dissatisfaction or hygiene factors. He further insisted that these two factors independently exist, one running from satisfied to neutral and the other from dissatisfied to neutral.

Expectancy theory of motivation

This theory argues that the motivational force to perform or expend effort is a multiplicative function of the expectancies that individuals have concerning future outcomes and the value they place on those outcomes

Productivity is defined as a ratio between an output value and an input used to produce the output (Thomas and Sudhakumar, 2014). Productivity is reaching the highest level of performance with the least of expenditure of resources. One of the ways to measure productivity in the construction industry is the partial factor productivity (PFP), which is expressed as the ratio of the outputs to a single or selected set of inputs. One of the most commonly used PFP measures in construction is labour productivity, which is defined as the ratio of output to labour input; the output is measured in terms of the quantities installed, and labour input is measured as work-hours. Thus, labour productivity is expressed as follows:

$$\text{Labour productivity} = \frac{\text{Output quantity}}{\text{Labour hours}}$$

Productivity, ultimately, is the ability to produce. (Usman, Inuwa, Iro, & Dantong, 2012). A good manager must identify the particular factor that will appropriately solve his productivity purpose, (Olaitan, 2013). Frederick Herzberg's two-factor theory developed also called hygiene-motivator. One set of the theory defines factors that lead to job satisfaction; like salary, job security, working condition,

received. The other was to calculate a relative importance index (RII). For this purpose, a rating scale of 1 to 5 was adopted with 1 representing the lowest level of effect and 5 representing the highest level. The RII was evaluated by the following expression (1):

$$RII = \frac{\sum_{i-1}^{5} W_i X_i, (1 \le RII \le 5)}{\sum_{i-1}^{5} \emptyset X_i}$$

Wi, is the rating given to each factor by the respondents ranging from 1 to 5, with 1 representing 'not significant' and 5 representing 'extremely significant'; Xi – the percentage of respondents scoring; and i – the order number of respondents. The numerical values calculated by the above formula were then differently classified, because a single point or number changing from 1 to 5 in questions no longer symbolizes each verbal scaling expression in the evaluation phase. Namely, since the results are obtained as decimal numbers instead of integer numbers, a specific scale should be established. Thus, 5 expressions are defined by the intervals of 0.8. In addition to calculating the relative index scale, the percentages of respondents scoring 2 or fewer, 3, and 4 or more, on the significance scale were also evaluated for each factor. These were used to rank the factors in which relative importance indices were the same

Data Collection

To obtain the data required for the study, a questionnaire comprising 58 detailed questions under 6 subject headings, such as demographic features of firms, experience levels of respondents, or factor groups, was first prepared ((Ulubeyli 2004). Then, Lagos Chamber of Commerce and Industry (LCCI), which has registered construction firms in operating Lagos, were contacted for the names of those operating within Lekki. Although there are 73 construction companies in total, 43 firms were interviewed. In the application stage of the questionnaire, face-to-face (one-to-one) interview technique was utilized in order to assure the validity and reliability of the survey. The telephone interviews, explaining the content of this study, were to be conducted with the Managing directors of these 43 firms, but 20 of them (45.85 %) responded positively. This relatively high approval rate can conveniently represent the sampling whole of the survey. The category of the construction firms in terms of economic scaling was determined by means of their average annual incomes In addition, a great portion of the companies (41.74 %) has an experience of over 20 years in the sector, which is an indicator of possessing adequate experience.

ANALYSIS AND RESULTS

Table 1, above shows the number of questionnaire distributed to the respondents, 120 copies of questionnaire were distributed to the respondents, 103(86%) were returned while 17(14%) were not returned. This implies that the researcher recorded 103 questionnaires for data analysis.

experience of the respondents indicates that 42.71% of respondents have been working for less than 10 years. 34.95% have been working for 11-20 years, 17.47% for 21-30years while 4.85% have over 30 years working experience.

Also, the nature of the business of the respondents firm as shown on the table indicates that 44.66% of respondents work for contracting firm, 31.06% for consultancy firm, while 24.27% works for client origination. The age of firm/company of respondents' reveals that 23.30% of respondents were working for company that is less than 10 years old, 34.95% for 11-20 years, 18.44% were working for company that is 21-30 years old and 23.30% over 30 years old

The table 2 above also reveals that 43.68% of respondents were working in a Private Liability Company (Ltd) while 15.55% were working in Partnership, 15.55% in Public Liability Company (PLC) and 17.46% in Public Sector (Government Agencies) and 7.76% were working as sole proprietorship.

Table 3: Relative Importance Indices (RII) and ranking of motivational factors

S/N	Motivational Factors	Types of factors	5	4	3	2	1	RII	Rank
1	The work itself	Intrinsic	10	21	15	3	0	4.80	1
2	Increase in salary	Extrinsic	24	17	6	3	0	4.24	2
3	Promotion	Extrinsic	22	18	10	0	0	4.24	3
4	Interest on the job	Intrinsic	22	19	6	2	1	4.18	4
5	Compensation	Extrinsic	19	17	11	1	2	4.00	5
6	Health .care services	Extrinsic	14	18	15	2	1	3.84	6
7	Potential for personal growth	Intrinsic	10	26	10	3	1	3.82	7
8	Achievement	Intrinsic	14	18	14	2	2	3.80	8
9	Provision of transportation	Extrinsic	10	22	14	2	2	3.72	9
10	A sense of job security	intrinsic	10	21	14	5	0	3.72	10
11	New experience	Intrinsic	10	20	17	2	1	3.72	11
12	Company policy	Extrinsic	9	20	18	3	0	3.70	12
13	Working condition	Extrinsic	12	17	15	5	1	3.68	13
14	Relation with co-worker (union)	Intrinsic	10	17	20	2	1	3.66	14
15	Responsibility	Intrinsic	12	15	16	4	3	3.58	15
16	Holiday abroad with pay	Extrinsic	13	16	9	7	5	3.50	16
17	Fairness of reward	Extrinsic	6	19	19	4	2	3.46	17
18	Worker evaluation of equity	Extrinsic	6	17	22	3	2	3.44	18
19	Fringe benefits	Extrinsic	4	22	18	4	2	3.44	19
20	Sharing profit	Extrinsic	9	17	14	6	4	3.42	20
21	Opportunity for advancement	Intrinsic	4	20	18	7	1	3.38	21
22	Recognition	Intrinsic	4	19	19	7	1	3.36	22
23	Individual importance	Intrinsic	7	15	16	12	0	3.34	23
24	Telephone services	Extrinsic	7	10	17	11	7	3.06	24

Source: Field Survey, 2018

Table 3, shows the relative importance indices (RII) and ranking of the first twenty four factors which motivate operatives towards improved productivity. In the overall ranking of the types of motivation, the work itself which is an intrinsic motivational factor came first as the most important factors which motivate

Table 5. Relative importance indices (RII) and Ranking of effects of motivation

S/N	Effects	5	4	3	2	1	RII	Rank
1	Lead to higher performance and productivity	29	12	7	0	2	4.32	1
2	Help organization to meet up with current dynamic rate of the business trends	17	22	9	2	0	4.08	2
3	Increase the moral of the workers towards productivity and performance	14	21	11	4	0	4.04	3
4	Perform their functions with all sense of responsibility, humility and efficiency	12	28	8	2	0	4.00	4
5	Lead to high level of creativity from the operatives	14	23	9	4	0	3.94	5
6	Lead to high quality performance	16	18	12	4	0	3.92	6
7	Lead to high morale	14	21	13	1	1	3.92	7
8	Lead to high level of initiative from the operatives	14	21	11	4	0	3.90	8
9	Improve general conduct	16	17	12	5	0	3.88	9
10	Lead to high level of cooperation at work	14	15	16	3	2	`3.72	10
11	Willingness to perform additional tasks	12	14	22	2	0	3.72	11
12	Lead to high level of comradeship	13	14	19	2	2	3.68	12
13	Helps operatives to think constructively about how the organization they work for could be improved upon	12	15	18	5	0	3.68	13
14	Effort to perform creditably well in their function	9	16	16	8	1	3.48	14

Source: Field Survey, 2018

Table 5, Shows the relative importance indices (RII) and ranking of the effects of motivation of operatives on productivity in construction, industry of Nigeria. The most important effect is that it leads to higher performance and productivity with a mean item score of 4.32. The second effect is that it helps organisation to meet up with the current dynamic rate of business trends with a mean score of 4.08. Increase the moral of the workers towards productivity and performance was ranked the third most important effect with a mean score of 4.04,

DISCUSSION OF RESULTS

The study has revealed that the work-itself is the most important motivational factors as far as operatives are concerned. The reason for this is that, in this present day of entrepreneurship, operatives are motivated with the work they do so that they can learn the work and be able to set up their own business and become employer of labour. According to Aiyetan and Olotuah 2006, as far as the operatives are concerned, the motivation they preferred most is holiday abroad with pay. The likely reason that could be adduced for this is that, workers will be exposed to more experience in their field of work, to the latest available tools and equipment, better construction techniques/methods, which makes them become experts in their field and hence production will be faster and with higher quality. The likely reason for the difference between this study and the previous one could be as a result of the economic situation of the country as at the time of the findings. Based on the overall average mean of the two types of motivational factors, it has been observed that intrinsic factors is more important than extrinsic factors and this can be confirmed in Table 4.5 as the work itself which is an intrinsic motivational factor was ranked first with a mean item score of 4.80. The result of analysis revealed that the most important effect of motivation of operatives on productivity is that it leads to higher performance and productivity as it was ranked first on Table 4.7. This validates Osabiya (2015) that if employees are highly motivated it will lead to high level of performance and productivity. This study did

This study was limited to Lekki in Eti-osa L.G.A., of Lagos State, Nigeria in the South west geopolitical zone of the Country due to its high concentration of ongoing building projects, further studies can be carried out on other areas of the country.

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created maintenance concerns also presents a challenge that need to be addressed. The paper seeks to address these performance enhancing issues arising from conceptual design, and develop limits on the component mixture selection to enhance better performance of laterite-cement bricks in order to avert the ugly trends.

LITERATURE REVIEW

Conceptual approach to design of laterite-cement brick walls

Safe and efficient load bearing and non-load bearing walls can be built using laterite-cement bricks as compressive strength achievable can be as much as four (4) times in excess of the minimum strength of the conventional sandcrete blocks, (NIS, 2004; Hydraform, 2014; Alao and Jimoh, 2017) at just 8% cement content. Compressive strength achievable can be as much as 8N/mm2. This has also made it possible to use the material to construct buildings up to 2-storey without structural frames (Hydraform, 2014). Blockwall design procedure are similarly well established using the mathematically derived procedure of structural mechanics and are as well documented in several codes of practice for design of walls such as BS 5628: Part I (2005). The principle of conceptual design would translate (Fraser, 1981; Hsu and Liu, 2000; Mola, Mola and Pellegrini, 2011) to: Intuitive reasoning to allocate and maximize space for functionality, aesthetics and efficiency of a building. Details that would also impede durability concerns should normally be taken into consideration such as avoiding water retention on walls thereby causing dark patches.

i) Permit development of adequate resistance to lateral forces in certain or foreseeable directions exposed to strong wind loads. This is particularly evident at vulnerable gable ends and therefore, a code of practice should not be a substitute for care and vigilance.
ii) Avoid torsional effects and therefore avoiding undesirable stress distributions to ensure robustness of the building.
iii) Redirecting load paths for optimal structural efficiency.

Laterite-cement brick walls design process should therefore be guided by both theoretical and practical considerations. In essence, it has to satisfy the limit state principles of ultimate and serviceability, remembering that a wall is a slender member which must both satisfy strength and stability requirements. Similarly, it must also avoid constructability problems and conceptual design flaws which could pose durability concerns. This would produce a balanced design. The main aim of a design ultimately is to function throughout the intended life without excessive deflection, cracking as well as without eventual collapse.

When brickwork is loaded in uniform compression, failure occurs by development of tension cracks parallel to the axis of loading (Ejeh and Adedeji, 1998; Hendry et al, 1987). It is also good to note that the strength of brickwork is usually smaller than the compressive strength of individual brick approximately, it is equal to the square of the nominal brick crushing strength for which it was built, (Hendry et al, 1987).

is particularly unique to produce mixtures at maximum compacted absolute volume equal to unity. In this case, laterite, cement and water. It can enable an empirical model to be fitted for each response of interest, particularly strength. Further refinements of the empirical models can be carried out by modifying a model after removing all insignificant terms in a model. A resulting final model now forms the response prediction equation. This should satisfy the condition that at least 95 percent of the results are expected to fall within the normal distribution curve. This could then form a basis for a quality control procedure and acceptance criteria process.

This methodology of fitting a polynomial can be used to define an experimental region or domain. The vertices of the triangle as shown in Figure 1 represent numerically, the three actual variable component mixtures (Montgomery, 2001). The vertices represent P1 equal 8%, P2 equal 14% and P3 equal 20% cement contents respectively or more precisely, ratio 1:12.5, 1:7.14 and 1:5 representing the ratio of cement to laterite mix. The first part represents the component part, water, the second part represents cement while the third part represents laterite. Similarly, the pseudo components at the vertices are represented by P1 equal (1, 0, 0), P2 equal (0, 1, 0) and P3 equal (0, 0, 1)

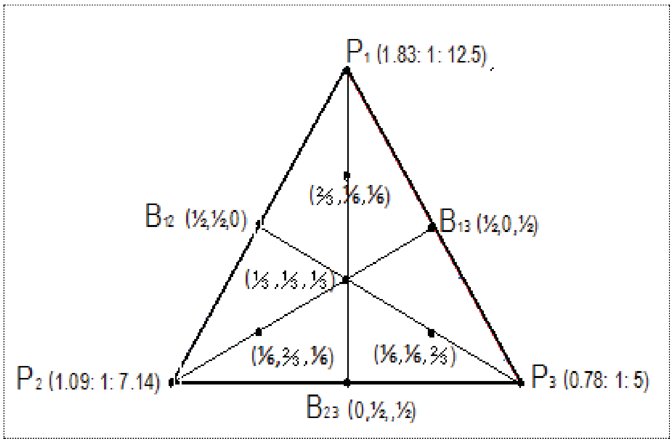

Figure 1: An augmented [3, 2] Simplex lattice

In order to satisfy the requirement of this Scheffe's mixture approach, the component materials are estimated in absolute volume using equation (1) which is fixed and constrained to be summed equal to unity.

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This represents a pre-condition for using this method of solution procedure (Simons et al, 1999; Montgomery, 2001). The components materials in this particular case are water, cement and laterite. The equality constraint of equation (1) estimated in absolute volume is therefore represented in equation (2), (Montgomery, 2001) as:

million naira projects. This scenario, which has become a case of sanctions, liabilities and litigations as at the time of this survey. Table 1 shows the methodology adopted to enhance the performance of laterite cement brick walls

Table 1: The survey method

Develop component materials selection process	Determine suitability of laterite deposit
	Develop component selection procedure for development of specifications writing
	Develop limits or bounds to mitigate against poor mixture combinations
Identifying conceptual design flaws	Identify defects and its diagnosis arising from conceptual design flaws
	Suggest remedial measures

Geotechnical and mineralogical properties of samples

The physical, geotechnical and mineralogical properties of the laterite sample were obtained and tested in accordance with BS 1377 (2016). These properties include: Liquid limit (LL), 49%; Plastic limit (PL), 30.6%; Plasticity Index (PI), 18.4%. Other properties include: Specific gravity of (SG), 2.64; Linear shrinkage (LS), 10.1% and Maximum dry density (MDD) of the deposit was 1821kg/m3. Soil classification: A-2-7. The mineralogical properties include Fe2O3, 18.01% and Sesquioxide content of 42.21%. These indices showed that the properties conform with requirement for moulding laterite-cement bricks since PI Ó 20% and SLÓ 15%.

Properties of brick samples

The factored brick samples were produced, cured and tested at 7 and 28 days to obtain compressive strengths and other mechanical properties using a Testometric Universal Testing Machine Model FS300CT. The testing plan described by ASTM C 170-90 was used. The cement type used here can be termed as Portland Limestone Cement Table 2 shows the design matrix considered for this investigation.

The augmented [3,2] simplex in Figure 1 was used to produce the design matrix in Table 2 for developing specifications writing, specific for the laterite deposit used for the housing scheme. It consists of a 3-component mixture. Additional design points were also selected within the interior of the simplex which enables the possibility of detecting curvatures, (Simon et al., 1999; Montgomery, 2000). In a similar manner, the centre point was replicated in order to obtain statistical significance for model fitting for predicting responses of interest.

building constraints on the lowest and upper bounds on the proportions to yield 1m3 of compacted volume. The limits are represented in absolute volumes and by dividing the proportions of the quantities by their respective unit weight for lowest and upper limits of water (1000 kg/m3) which gives 0.261 and 0.266. Likewise for cement, by dividing the proportions by the unit weight of cement (3150 kg/m3) gives 0.046 and 0.106 and for laterite, by dividing the proportions by the unit weight of laterite (2640 kg/m3) gives 0.633 and 0.688. This is summarized and represented in equation (4).

$$\begin{aligned} 0.261 &\le x_1 \le 0.266 \\ 0.046 &\le x_2 \le 0.106 \\ 0.633 &\le x_3 \le 0.688 \end{aligned} \qquad (4)$$

This domain of mixture proportioning would invariably prevent a reversal of stabilization associated with moisture intrusion within the stabilized laterite-cement bricks, although blending of laterite with silica sand would reduce this effect (Heathcote, 2002). Selection of constituent materials represents what is appropriate for production of bricks for these housing units.

The response prediction yields an inverse relationship for strength at 28-day, 7-day respectively as depicted in equations (5) and (6)

$$\frac{1}{f_{28}} = -3.54724 \times x_1 - 0.10341 \times x_2 - 1.53865 \times x_3 \qquad (5)$$

$$\frac{1}{f_{7}} = -4.13545 \times x_1 - 0.21151 \times x_2 - 1.79349 \times x_3 \qquad (6)$$

Where x_1 = Water, x_2 = Cement, x_3 = Laterite

In each case, the minimum compressive strength ranges between 8 and 18N/mm2 within the domain selected. The test results are shown in Appendix C. The compressive strength values are well above the minimum requirement of 2.8N/mm2 in accordance with NIS (2004), SANS (2008) for load bearing brickwork design. The limits shown in Equation (4) will also produce durable bricks (Guetalla et al., 2006). In likewise manner, a perfect linear relationship for response prediction for quantity of laterite based on ratio of laterite:cement can be obtained using a simple regression analysis at 95% confidence interval. The response in column (11) against cement, the variable in column (10) of Table 1 can be carried out. The merit of this method is that component mixtures can be estimated at 1m3. The resulting predictive response for laterite quantity is presented in equation (7).

$$\text{Laterite quantity} = 1927 - 0.77767 \times x_2 \qquad (7)$$

Where x_2 = Cement

Stability concerns of the main load carrying member

The building survey report carried out has shown that the main load carrying structural member, which is the wall, has failed completely. When a structure cannot perform its main functional requirement, then it is deemed to have failed. Contrary, the conceptual design flaws which can be avoided to enhance the

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APPENDIX B: FAILURE ARISING FROM CONCEPTUAL DESIGN

B.1(a): The gable end shown with a pointer collapsed and re-built by introducing vertical pier in the walls

B.1(b): The vertical wall shown with a pointer has dark patches as a result of undrained water from the cladding

The study area was selected based on careful physical inspection of the structure. the structure was justifiably discovered to have started undergoing some changes on the physical structure and the need to save lives and properties. therefore study of this nature is pertinent to examine whether the building is at risk of collapsing or not, if yes what rate? and probably make some projections.

Table 1: Examples of Building Collapse in Nigeria

S/No	Structure	Location	Year	Number Killed	Number Injured
1.	Multi-Storey building under construction	Makola/Ibadan	Oct. 1974	27	-
2.	School Building	Kaduna	June 1977	16	Many
3.	Housing Estate	Barnawa Kaduna	Aug. 1977	28	many
4.	Residence of Idusagbe Lane	Idumola Lagos	Sept. 1987	17	Many
5.	Segue Primary and Secondary School	Port Harcourt	June 1990	50	Many
6.	Three- Storey building under construction	Enugu	June 1997	20	many
7	Four-Storey office building	Port Harcourt	June 2005	30	many
8.	Five-Storey office building	Port Harcourt	July 2005	-	Many
9.	Three-Storey building	Lagos	July 2005	30	many
10.	Four -Storey block of flats	Lagos	July 2006	25	Many
11.	Block of 36 flats Rent house and shops	Ebute metta Lagos	July 2006	57	50
12.	Four-Storey Building	Lagos	Aug. 2006	50	many
13.	Four-storey shopping center under construction	Utako District Abuja	July 2008	70	30
14.	Two-storey building	Iddo, Lagos	June, 2009	7	30
15.	Classroom block	Collage of education Argungu	Oct. 2009	2	Many
16.	Four-Storey building	Garki 2, Abuja	Aug. 2010	21	many
17	Three-Storey building	Idumota, Lagos	July, 2011	18	many
18	Two-Storey building under construction	Kano universty of science and technology, Wudil Kano	2018	20	many

Source: Fakere, (2005); Nigeria Daily Newspapers (2000-2003); Ogunsemi, (2002); Oke. (2009). Adewale (2018)

Table 2: Examples of Building Collapse in the world

S/NO	Structure	Location	Year	No. Killed	No. Injured
1.	Tellement building	New Delhi, India	2010	67	150
2.	20-Storey building	Rio deJanairo, Brazil	2012	17	many
3.	Building under construction	Mumbai, India	2013	45	56
4.	Gament Factory	Dhalia, Bangladesh	2013	1,100	2500
5.	Bridge	Genoa, Italy	2018	38	many

Source: Fakere, 0 (2005); Nigeria Daily Newspapers (2000-2003); Ogunsemi, (2002); Oke, (2009); Adewale (2018)

Aim and objective of the research

The aim of this research is to establish reliable survey control networks for future deformation monitoring. which will be achieved by the following specific objectives:

terrestrial measurement techniques or space based positioning techniques and/or combination of both techniques.

Conventional ground-based geodetic techniques have been used for deformation monitoring of structures and landslides. Two basic methods for the design of a deformation survey can be used; A horizontal or vertical control network is established in the area under investigation with control points located in the deforming region and Total station instruments are also used to measure angles and distances to target-prisms located on the moving mass. In both cases the aim is for the computation of targetpoint coordinates and/or heights for each measurement epoch. From the comparison of these coordinates/heights, after all proper statistical and reliability tests, the horizontal and/or vertical displacement vectors of each control point can be determined. (Savvaidis, 2003)

According to Anonym, (2002); Global Positioning System offers advantages over conventional terrestrial methods. Inter visibility between stations is not strictly necessary, allowing greater flexibility in the selection of station locations than for terrestrial geodetic surveys. Measurements can be carried out during night or day, under varying weather conditions, which makes GPS measurements economical, especially when multiple receivers can be deployed on the structure during the survey. With the recent developed rapid static positioning techniques, the time for the measurements at each station is reduced to a few minutes.

Photogrammetry techniques can also be used. For instance if an object is photographed from two or more survey points of known relative positions (known coordinates) with a known relative orientation of the camera(s), relative positions of any identifiable object points can be determined from the geometrical relationship between the intersecting optical rays which connect the image and object points. The main advantages of using photogrammetry is to reduced time of field work; simultaneous three dimensional coordinates; and in principle an unlimited number of points can be monitored (Anonym, 2002).

Tilt and inclination measurements techniques; The measurement of tilt is usually understood as the determination of a deviation from the horizontal plane, while inclination is interpreted as a deviation from the vertical. The same instrument that measures tilt at a point can be called either a tiltmeter or an inclinometer depending on the interpretation of the results (Anonym, 2002).

Other techniques found in (Erol et al, not dated) includes;

Insar technique; Elevations can be determined from Synthetic Aperture Radar (SAR) images by interferometric methods,

Pseudolite technique GPS-based deformation monitoring systems, the accuracy, availability, reliability and integrity of the positioning solutions is heavily dependent on the number, and geometric distribution, of the satellites being tracked.

Laser Scanning technique; Ground-based laser scanning is a new technology that allows rapid, remote measurement of millions of points, thus providing an unprecedented amount of spatial information. This in turn permits more accurate

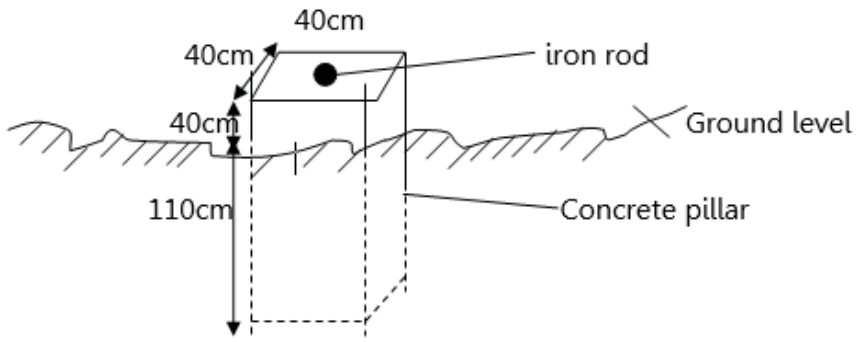

Fig:2.1. Standard control points

In-situ check

The accuracy of project cannot be better than the quality of the ground control upon which its production is based, therefore there is need to confirm whether the control pillars to be used were still intact and in good condition. Therefore, angular and linear checks were carried out on these control beacons. The angular measurements begin from previously established controls before any survey operation. A set of three (3) existing horizontal controls were identified on the ground as WUFP B/K 016, WUFP B/K 017 and WUFP B/K 019 (Table 4), the criteria for selection of the three (3) controls were based on inter-visibility to one another and proximity to the study area

From Fig. 4, a Total station was set up at station WUFP017, all the temporary adjustment was carried out on the instrument, observation made to stations WUFP016 and WUFP019 on several zeros, mean values of both observed angles and distance obtained as indicated in table 4

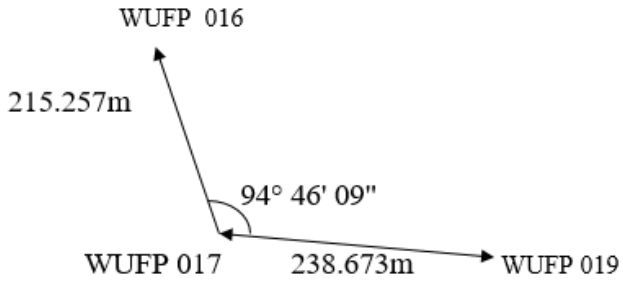

Fig.4 Position of Three Existing Control Points

From fig. 2.2, Observed angle at WUFP017=Foresight (WUFP019) - Back sight (WUFP016)

Observed angle=94˚46'09ǿ-

Table: 4, List of existing controls/Computed angle and distance

Station	Bearing	Dist.(m)	çN(m)	çE(m)	Northing(m)	Easting(m)	Station To
					1378267.480	633303.059	WUFP016
WUFP016	229°13′ 42″	215.257	38.926	-6.182	1378408.053	633468.077	WUFP017
WUFP017	323°59′ 50″	238.673	29.344	50.660	1378601.136	633327.779	WUFP019

From table 4, Computed angle = Forward bearing(line WUFP019) – Back bearing (line WUFP016)

= 323° 59′ 50″ Ĭ 229° 13′ 42″= 94° 46′ 08″

Plate 2a: Flat Plate

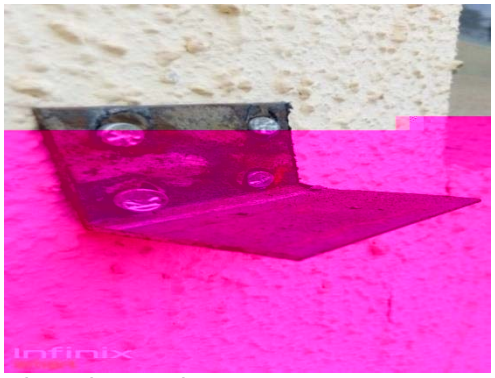

Plate 2b: Angular Hanger

The operation also covered the observation of some cross beams in the building with the aid of inverted staff. Observations were computed, using rise and fall method of level computation. Table 6: presents the reduced levels baseline data for vertical movement monitoring

Table 6: Reduced levels For vertical movement monitoring

Position	Reduce level	Remark	Position	Reduce level	Remark
V1	246.593		V14	247.125	
V2	246.511		V15	247.061	
V3	247.088		V16	247.025	
V4	246.480		V17	247.109	
V5	246.340		V18	245.860	On structural base
V6	247.093		V19	247.016	
V7	246.514		V20	246.968	
V8	246.556		V21`	246.996	
V9	246.104	Structural base	V22	247.101	
V10	247.181		V23	246.097	
V11	247.241		V24	247.166	
V12	247.283		A1	248.819	Cross beam, staff inverted
V13	246.087	Structural base	A2	249.078	Cross beam, staff inverted

Source: Field Survey, 2018

The table 6 above presents the first level of observations as the baseline data for the height determination of the structural beacons of the building.

Horizontal movement control

The horizontal observation on the building was observed with the aid of a horizontal targets see plate 3, fixed on the top most part of the structure and ground reference point, the observation was carried out on both faces of the instrument (NIKON NPL-322+ Total Station). as shown in Table:7 .

extend over a long period of time scale starting from initial fixation at the pre-construction stage and through construction phase and continued into the post construction period of the project. Complete history of the reference datum is as important as that of the points under observation which are located on the structures. Table 8 presents the coordinates of the ground controls.

Table 8. coordinates of new ground control points

Pillar No.	Eastern	Northern	Reduced level of the points
WP001	633481.881	1378377.200	245.788
WP002	633844.047	1378288.503	246.077
WP003	633544.513	1378282.816	245.760
WP004	633609.369	1378321.622	245.417
WP005	633556.467	1378367.862	245.536
WP006	633527.152	1378367.862	246.041
WP007	633547.070	1378325.089	245.965

Source: field survey 2018

RESULTS AND ANALYSIS

Results

Processing of data captured from the field involves the manipulation of raw data into a more useful format through the use of appropriate and desirable method. Data processing includes numerical calculation, classification of data and the transmission of these data from one format to another. In this study, the final data obtained is classified as X,Y, θ and Z. Coordinates of new control points (x,y), Reduced Horizontal Angles (θ as H1, H2, H3.....H24) on the walls and reduced levels for vertical movement monitoring(Z as V1, V2, V3.....V24), see table 3.3, 3.2 and 3.1 respectively

Discussion on horizontal movement control;

A control network is composed by the datum points and deformation points, ground-based geodetic techniques have traditionally been used mainly for determining the absolute displacements of selected points on the surface of the object with respect to some reference points that are assumed to be stable. (Anonym, 2002). The main aim of this study is to establish reliable survey control networks for future deformation monitoring. Therefore, ground-based geodetic techniques in monitoring deformations of engineering structures was considered to be most appropriate in establishing absolute baseline data for deformation study in future.

Table 6, is the reduced horizontal angles obtained from ground-based geodetic techniques between ground control points and selected deformation points. The baseline data was established by relating the reference point and the structural deformation point to determine the internal angle between the two reference stations. The angles obtained left in absolute form without further transformation into coordinates to reduce the effect of rounding errors.

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Breabăn 2018). Ji et al. (2016) compared seven different models of evaluating Water Quality Index and found out that Nemerow-Sumitomo Water Quality Index (NWQI), though robust, cannot effectively judge surface water quality when the water quality is worse than class 5. He further stated that the SFPI approach can easily provide water quality classification for the assessed water quality indexes. However, it uses the worst water quality classification of the assessed water quality indexes as the final water quality classification and gives biased results as a result.

The Weighted arithmetic index method was used in this research as it categorizes water quality according to the level of purity by using the commonly assessed water quality parameters. This method has been widely used by the various analysts (Chauhan and Singh 2010; Balan et al. 2012; and Hector et al. 2012).

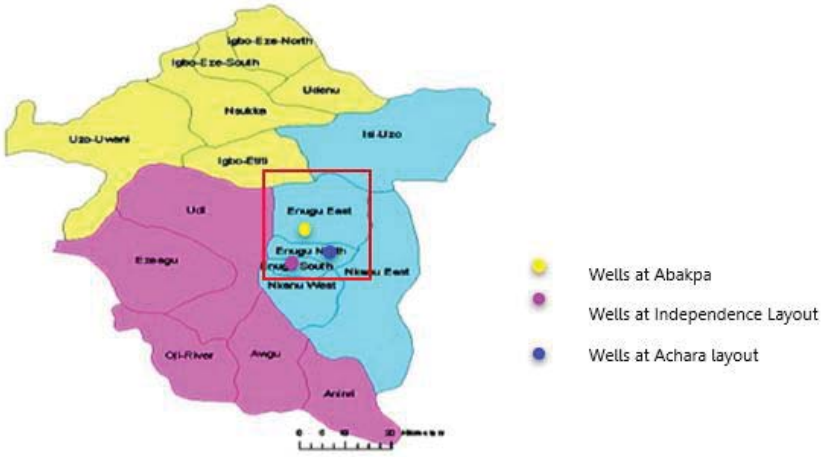

Fig. 1.0: Map of Enugu State, showing Study Area (Enugu Urban).

RESEARCH DESIGN & METHODS

Description of study area:

The Study Area is in Enugu urban which is the capital of Enugu State in South-Eastern Nigeria. It lies at latitude 6021' to 6030'N and longitude 70 26' to 7037'E of the equator. The climate of Enugu Urban is warm and humid with its humidity varying from 55-85% but reaches its peak at 75% between March and November. (Source: NIMET, 2017). The mean daily temperature used to be 26°C (80.1°F), but with current climate change phenomena it is now put 270C - 370C (NIMET, 2017). The rainy season lasts approximately from April till August and is accompanied by heavy humidity and heavy rain falls. Heaviest rainfall occurs between June and July, with around 360 mm in July. The annual rainfall in Enugu State is between 1500mm and 2000mm. (Source: NIMET, 2017). The survey of the selected areas at Achara Layout, Independence Layout, and Abakpa was conducted to identify sites for the sample collection.

Sampling and Sample Collection

The samples were collected from 4 sample points each in Achara layout, Independence Layout and Abakpa respectively. They samples were collected at monthly intervals for 12 months. Samples were collected 2 times; first week and last week of every month. The rainy season samples were collected from April 2018

Sulphate (SO42-) was determined using Turbidimetric Method (AOAC, 1990 and Lenore et al., 1999). Total Hardness was determined using EDTA (Ethylenediaminetetraacetic acid) Titrimetric Method (AOAC, 1990 and Lenore et al., 1999). Electrical Conductivity was determined in accordance with IS 3025 (Part 14) test procedure. (Lenore et al., 1999). Potassium (K) and Sodium (Na) was determined by Flame photometric Method (APHA 3500-K Band APHA 3500-Na B standard methods respectively) (Lenore et al., 1999). Iron (Fe), Lead (Pb) and Zinc (Zn) were determined in accordance with standard procedure (AOAC, 1990 and Lenore et al., 1999):

Data analysis

Data were recorded, organized and summarized in simple descriptive statistics methods using SPSS-PC Statistical Package for Social Scientists (SPSS 20 for windows version).

Table 2: Results (Mean ± SD) and range of the concentrations for rainy season and dry season

S/N	Parameter	Seasons	Samples											
			W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12
1	Temp	DS	30.8	31.8	31.3	30.	30.1	30.7	29.7	29.6	28.9	30.1	31.0	30.0
	(C)	WS	29.1	30.1	31.8	30.1	29.9	30.9	30.9	29.98	28.0	29.97	31.05	30.3
2	E.C.	DS	23.33	20.0	40.00	60.00	16.67	66.7	130.0	190.0	180.0	170.0	200.0	240.0
	(8µS/cm)	WS	63.33	23.3	123.3	236.7	20.00	236.7	305.4	202.7	201.6	200.9	244.6	300.6
3	pH	DS	5.01	5.01	4.90	5.3	5.2	5.4	6.9	6.6	7.2	7.1	7.2	7.5
		WS	4.63	5.01	5.17	4.1	4.9	4.8	4.7	6.0	5.0	5.2	5.8	6.3
4	TDS	DS	10.00	0.00	10.00	20.0	0.00	20.00	60.0	110.0	210.0	90.0	100.0	120.0
	(mg/L)	WS	93.33	3.3	43.3	53.33	6.66	220.0	200.0	111.8	216.7	100.0	183.3	135.0
5	TSS	DS	250.0	120.0	190.0	150.0	70.00	130.0	190.0	250.0	160.0	70.00	120.0	270.0
	(mg/L)	WS	256.7	130.0	200.0	173.3	103.3	140.0	247.2	260.0	166.7	153.3	130.0	273.3
6	TS	DS	260.0	120.0	200.0	170.0	70.0	150.0	250.0	360.0	370.0	160.0	220.0	390
	(mg/L)	WS	350.0	133.3	343.3	226.7	110.0	360.0	447.9	371.8	383.3	256.0	313.3	408.3
7	T/Ac	DS	0.357	0.153	0.237	0.067	0.203	0.327	0.237	0.355	1.233	0.203	0.167	0.603
	(mg/L)	WS	8.447	0.167	0.497	0.103	0.217	0.403	10.37	0.288	1.101	0.247	10.17	0.663
8	T.Al	DS	28.03	40.0	36.08	52.10	47.03	34.03	34.97	28.09	28.11	17.04	37.04	38.81
	(mg/L)	WS	26.03	29.0	30.07	52.03	47.00	28.67	15.37	26.75	28.00	20.03	20.17	25.00
9	SO42-	DS	21.18	20.1	22.13	20.11	22.16	24.18	21.14	21.16	23.20	22.00	20.14	22.40
	(mg/L)	WS	26.23	20.5	24.33	26.27	37.20	82.63	24.54	21.27	33.50	25.73	29.17	29.667
10	BOD	DS	5.07	5.7	5.9	5.607	5.973	4.893	4.6	4.2	4.27	3.14	5.56	5.40
		WS	4.17	5.1	4.1	4.647	5.760	4.037	3.95	3.94	3.79	4.22	4.37	3.67
11	COD	DS	6.883	7.190	9.587	7.380	7.393	8.670	6.4	5.87	6.430	6.617	7.673	7.257
		WS	5.007	6.550	4.937	5.447	7.047	4.947	4.9	4.81	4.847	5.327	5.260	4.567
12	Fe	DS	0.068	0.079	0.280	0.762	0.002	0.456	0.066	0.06	0.096	0.092		
	(mg/L)	WS	0.077	0.023	1.324	1.087	0.000	1.651	0.072	0.04	0.124	0.095		

qi=(Ci/Si) ×100

where q i, = quality rating scale

C i, = concentration of i th parameter

S i = standard value of I th parameter

Relative weight was calculated by wi=1/Si,

where the standard value of the i parameter is inversely proportional to the relative weight.

WQI was calculated according to the following expression:

WQI=Øqi wi/Øwi where:

WQI = water quality index;

Qi = sub index for the i th water quality parameter;

Wi = weight associated with the i th water quality parameter; n = number of water quality parameter.

Table 3: shows the Water Quality Index (WQI) and quality ratings of the 12 well water samples

Source: Author

There was a significant difference between the overall physicochemical water quality index of the study are during dry season and rainy season.

Table 4: Water Quality Index (WQI) range and percentage of different water types

S/N	WQI Range	Type of Water
1	< 50	Excellent water
2	50-100	Good water
3	100-200	Poor water
4	200-300	

fibre-cement plants. The values of TDS obtained in this study were all below the recommended value of 500 mg/L for TDS in potable water set by standard bodies (NIS, 2007; WHO, 2008; WHO, 2006). The range of values for total suspended solid (TSS) during dry season was 70.00-270.0 mg/L with a mean concentration of 164.2±67.62 mg/L. During the rainy season, TSS range was 100.0- 280.0 mg/L with a mean concentration of 186.7±60.03 mg/L. Total Solids (TS) during dry season ranged from 70.00 - 390.0 mg/L and had a mean concentration of 226.7±103.1 mg/L but had a concentration range of 110.0 - 560.0 mg/L and mean of 311.8±120.7 mg/L during rainy season indicating a seasonal increase in TS content. However, the mean value obtained for the TS in this study were below the standard value of 500 mg/L (WHO, 2008; WHO, 2006) recommended by W.H.O. but above the NAFDAC set value of 100 mg/L (WHO, 2008) recommended for drinking water quality.

Turbidity

Turbidity at dry season ranged between 3.450- 50.00 NTU with a mean value of 9.743±12.86. At rainy season the range was 3.800- 56.00 NTU and mean of 10.80±14.37 NTU, indicating a very slight (perhaps due to relative decrease in ground water flow rate) increase in turbidity. The increase in TSS and turbidity may be due to increase in silt and clay carried into groundwater by rainfall runoff on the landscape. The mean turbidity values were higher than the highest desirable level of 5 NTU recommended by standard bodies (NIS, 2007; WHO, 2008; WHO, 2006).

Sulphate (SO42-)

SO42- range between 20.10- 24.34 mg/L at dry season and 0.000- 100.0 mg/L in rainy season. The mean SO42- contents were 21.78±1.267 mg/L and 31.27±16.95 mg/L during dry season and rainy season respectively showing an increase in sulphate concentration. The concentration of sulphate during both seasons was below the recommended value of 200 mg/L (NAFDAC, 1999; WHO, 2008) set by standard regulatory bodies. Studies in other parts of South-east Nigeria and Enugu in the past agree with the similar finding that sulphate content in a borehole water content is below the recommended value (Okoye et al., 2010; Edeonovo, 2010; Onunkwo and Uzoije, 2011).

Total acidity

The range of concentration of total acidity was between 0.060- 1.240 mg/L at dry season and 0.100- 10.50 mg/L at rainy season. There was seasonal variation in total acid contents in the borehole water as the mean acidity concentration increased from 0.347±0.311 mg/L at dry season to 2.739±4.222 mg/L at rainy season. This increase in acidity loading could be due to flushing and percolation of water containing dissolved acidic radicals into the groundwater. The range of total acidity in borehole water in Enugu State, Nigeria as observed by a previous study (Engwa et al., 2015) showed similarities in acid content with the range of total acidity concentrations observed in the dry season result of this study. The mean total acid content of the water samples in this study

mean COD content at dry season may be due to prolong accumulation of seeped organic leachates into the aquifers.

Fe

The levels of Fe in the water samples during dry season and rainy season were in the range between 0.000 - 11.03 mg/L and 0.000 - 12.29 mg/L respectively. The dry season and rainy season Fe mean concentrations were 1.244±2.978 mg/L and 1.499±3.448 mg/L indicating a slight rise in iron content during rainy season; and these were above the recommended guideline value of 0.30 mg/L (NIS, 2007). Similar findings include Nwachukwu et. al (2014) that recorded higher iron concentrations in shallow hand dug wells, lake/ponds and rivers in some rural regions of South-east Nigeria, Uzoije, et al., (2014) recorded high Fe content in shallow aquifers (hand-dug wells and springs of the discharge farmland settlement) and some deep aquifers (boreh

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functions of a product, service or project at the lowest cost (Zhang et al., 2009). Therefore, the justification of value engineering in the construction industry is to come up with innovative ideas and proffer solutions for increased value of construction projects. Value engineering began in the United Kingdom in the early to mid-1960s and to Australia in mid to late 1960s. Whyte and Cammarano (2012) put forward that the construction industry in the UK adapted Lawrence Mile's value analysis and advanced it under the name VM which is synonymous with value engineering. Also, Thiry (1997) advanced that in 1965, VM was introduced in Japan. Since it was recognised that the orientation of value engineering activity was more of management than engineering, the UK Institute of Value Management (IVM) was formed in 1966 (Shen and Yu, 2012). VM afterwards was introduced in Germany, France (1978), South Korea, Kuwait, Denmark, Hungary (Thiry, 1997), China (1978), Saudi Arabia (1981), Malaysia (1986) and Hong Kong (1988). According to Thiry (1997), VM was introduced in South Africa and Taiwan in the eighties, while in 1993, it was introduced in Canada.

Definitions of VM

Shen (1993) defined VM as "an organised function-oriented and systematic team approach, directed at examining the functions and costs of a service, system, equipment, supply, or facility for the aim of improving its value through attaining the required functions indicated by the clients at the least cost, consistent with the requirements for performance". It is a creative and a system approach to validate a certain proposal; and has to undergo a structured and systematic job plan which emphasises on the analysis of functions (Che Mat, 1999). Jaapar et al. (2009) upheld that VM is a "multi-disciplinary, team oriented, structured, analytical process and systematic analysis function, which specifically seeks best value through the design and construction process to meet client's perceived needs". In addition, it is a technique for improving the overall life cycle of projects, products and systems. Odeyinka (2006) defined VM as "a service, which maximise the functional value of a project by managing its development from concept to completion and commissioning through the audit (examination) of all decisions against a value system determined by the client". It is a systematic and multi-disciplinary effort focused on analysing the functions of projempletion

4.

standards, and lack of VM experts. In Malaysia, Lai (2006) identified lack of knowledge about VM, lack of government support, and lack of local VM implementation guideline as main barriers to VM application in the construction industry. Similarly, Jaapar et al. (2009) confirmed that lack of VM knowledge and practice, the resistance to change by the involved parties, and the conflicting objectives of the project among parties are the main difficulties faced during the VM workshop. Jaapar et al. (2012) also found out that one of the challenges of VM application is the VM workshop which could not efficiently be implemented due to insufficient information provided. Also the difficulty of handling different character, background, and values of people was a key barrier faced by VM facilitators. In addition, a study by Ramly et al. (2015) revealed some factors that would promote VM application in the Malaysian construction industry. This include: VM knowledge and experience of participants, multidisciplinary team mix of participants, competency of the facilitator, attitude and discipline of participants, and client support/active participation. Finally, inadequate regulatory frameworks, and poor stakeholder management are also some of the challenges facing the application of VM in the construction industry (Kissi et al., 2015).

RESEARCH DESIGN AND METHODS

The study utilized data obtained from construction professionals based in Abuja, Kaduna, and Jos. Abuja is the federal capital of Nigeria located at the middle of the country. In 2015, Abuja experienced an annual growth rate of 35% (United Nations Report, 2015) with a significant level of construction output. Kaduna and Jos were chosen because of the proximity to Abuja, high construction activities, and population. According to Rowley (2014), “questionnaire is one of the most extensively used means of collecting data, and is typically used in surveys to profile a population”. This study adopts the 5-point Likert scale closed-ended questions for the structured questionnaire based on the methodology, objectives of the research, and the outcome of a pilot survey. The questionnaire was structured into four (4) sections. The third section was made up of questions aimed at identifying the barriers to VM application in the construction industry, and these barriers were identified from literature and pilot survey. The quantitative approach was adopted for this study. This is because sampling, measurement and the use of questionnaires are utilized due to the complexity and fragmentation of the construction industry. The study began with identifying the research challenges and establishing the gap that exists in the application of VM. The research question was developed and the review of past and present studies was conducted to get an in-depth knowledge of the research problem.

The study had 93 variables, 5 responses per variable (i.e. 465) as recommended by most researchers for factor analysis (Pallant, 2005). Self-administered questionnaires were distributed to 465 construction professionals who were chosen from contracting, project management, consulting engineering, quantity surveying, consulting architects, and client organisations. A total of 344 (73.98%) questionnaires were appropriately filled and returned. Normality test was first conducted using skewness and kurtosis to confirm the normality of the data collected. Similarly, Tabish and Jha (2012) pointed out that in order to establish the stability and comprehension of respondents, instrument reliability should be used to adequately measure the variables of a study. Hence, reliability test was

management, and client organisations respectively. This indicates that the respondents are from the core area of study under investigation, and gives credibility to the data used.

Table 1. Demographic characteristics

Demographic Characteristics		(N= 344)	
		f	%
Profession	Architects	90	26
	Quantity Surveyors	108	31
	Builders	68	20
	Civil Engineers	59	17
	Services Engineers	19	6
Working Experience	> 20 years	25	7
	16 – 20 years	38	11
	11 – 15 years	117	34
	6 – 10 years	105	31
	Ó 5 years	59	17
Role of Respondents' Organisations	Contractor	54	16
	Project Manager	38	11
	Consulting Engineer	78	23
	Cost Consultant	108	31 13
	Consulting Architect	46	6
	Client	20	

Instrument reliability test and factor analysis

The reliability test was conducted using the Cronbach's alpha coefficient to confirm the reliability and validity of the data collected. The least Cronbach's alpha coefficient was 0.80 while the highest value was 0.91. The KMO test, which is a measure of sampling adequacy that compares the magnitudes of the partial correlation coefficients of measuring variables, is 0.711, while Barlett's test of sphericity, which tests the correlation matrix is significant since the p-value is less than 0.05 (Table 2).

Table 2. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.711
Bartlett's Test of Sphericity	Approx. Chi-Square	8431.239
Barriers	Df	210
	Sig.	.000

The extraction of the components of VM barriers was based on the total variance explained which indicated eigenvalues of 1 and above. Thus, the four components explain a total variance of 73.21%, while the loading of each of the variables is

Where, ni = number of respondents that chose pi.

pi = 1 to 5 on a Likert scale.

N = total number of questionnaire returned.

The 20 barriers to VM application among construction professionals were identified, selected, and accepted by the respondents at the pilot survey phase of this study. While Tables 5 shows the mean scores of barriers to VM application among construction professionals, Table 6 depicts the ranking of these barriers by the respective respondents within the construction industry. Consequently, Majid and McCaffer (1997) posited that factors can be rated as “very hinder” (3.5 Ó mean < 4.5), or “averagely hinder” (2.5 Ó mean < 3.5) depending on their mean values. Hence, the criticality of the barriers was established.

Table 5. Mean scores of barriers to VM application

Var.		Architects		Q/Survey		Builders		Civil Engr		Serv. Engr		Overall	
		MS	Rk	MS	Rk	MS	Rk	MS	Rk	MS	Rk	MS	Rk
BP	1	4.023	11	4.204	2	4.015	6	4.034	3	4.339	3	4.100	4
	2	3.739	15	3.648	16	3.794	13	3.831	13	4.111	7	3.757	15
	3	4.091	9	3.935	11	3.838	11	3.881	12	4.056	8	3.953	11
	4	4.148	6	4.056	5	3.985	9	3.983	7	4.333	4	4.067	7
	5	3.614	16	3.722	15	3.691	16	3.678	15	4.167	6	3.704	16
	6	3.761	14	3.944	10	3.794	13	3.814	14	4.000	9	3.848	12
	7	3.818	13	3.843	13	3.824	12	3.678	15	3.833	13	3.804	14
BG	1	4.534	1	4.278	1	4.235	1	4.102	2	3.833	13	4.282	1
	2	4.102	8	3.870	12	4.015	6	3.949	8	3.889	11	3.974	10
	3	4.420	2	4.056	5	4.074	4	4.034	3	3.889	11	4.141	3
	4	4.364	3	3.963	8	4.088	3	4.000	5	3.944	10	4.097	5
	5	4.273	4	4.093	4	4.029	5	4.000	5	3.833	13	4.097	5
BE	1	3.966	12	3.796	14	3.750	15	3.949	8	3.556	16	3.845	13
	2	4.216	5	4.148	3	4.176	2	4.136	1	4.556	1	4.191	2
	3	4.136	7	4.037	7	4.015	6	3.949	8	4.278	5	4.056	8
	4	4.034	10	3.963	8	3.941	10	3.932	11	4.389	2	3.994	9
BM	1	2.330	18	2.111	19	2.250	18	2.203	20	2.667	17	2.240	19
	2	2.000	20	2.278	18	2.238	19	2.525	17	2.667	17	2.282	18
	3	2.023	19	1.991	20	2.147	20	2.254	19	2.556	20	2.106	20
	4	2.568	17	2.528	17	2.456	17	2.424	18	2.611	19	2.510	17

From Table 5, the Architect perceives the following five (5) factors as “very hinder” or of major hindrance to VM application in the construction industry. These are: lack of VM experts [BG1]; poor collaboration and working relationship among stakeholders [BG3]; inadequate facilitation skills and training [BG4]; lack of willingness to accept changes and new innovations [BG5], and Lack of awareness among clients [BE2].

In addition, other barriers that are of major hindrance to the application of VM by the Architects include: lack of active involvement of clients and stakeholders [BP4]; absence of local VM guidelines [BE3]; lack of VM knowledge [BG2]; difficulty in the involvement of decision makers/other key partners in VM workshop [BP3]; and lack of encouragement on the part of government [BE4]. However, barriers that are

[BG4], poor collaboration and working relationship among stakeholders [BG3], and lack of willingness to accept changes and new innovations [BG5] as major hindrances to VM application in the construction industry. Afterward, stakeholder's resistance to accept new innovations [BP1], lack of VM knowledge [BG2], absence of local VM guidelines [BE3], lack of active involvement of clients and stakeholders [BP4], and lack of encouragement on the part of government [BE4] are some of the major hindrances to VM application as perceived by the Builders. However, the following barriers were considered to moderately hinder VM application. These are: lack of time to conduct VM studies; incurring additional cost as a result of VM workshop; difficulty in conducting analysis/evaluation of functions; and inappropriateness of procurement strategies to implement VM.

The civil engineer recognises the following five (5) factors as "very hinder" or of major hindrance to VM application in the construction industry. These are: lack of awareness among clients [BE2]; lack of VM experts [BG1]; stakeholder's resistance to accept new innovations [BP1]; poor collaboration and working relationship among stakeholders [BG3]; and inadequate facilitation skills and training [BG4].

In addition, other barriers that are of major hindrance to VM application by the Civil Engineer include: lack of willingness to accept changes and new innovations [BG5]; lack of active involvement of clients and stakeholders [BP4]; lack of VM knowledge [BG2]; lack of legislation which provides VM application in the construction industry [BE1]; and absence of local VM guidelines [BE3]. On the other hand, barriers that are considered "averagely hinder" or of moderate hindrance to the Engineers are: lack of time to conduct VM studies; inappropriateness of procurement strategies to implement VM; difficulty in conducting analysis/evaluation of functions; and incurring additional cost as a result of VM workshop.

And last but not least, the Services Engineer distinguishes lack of awareness among clients [BE2], lack of active involvement of clients and stakeholders [BP4], stakeholder's resistance to accept new innovations [BP1], Lack of active involvement of clients and stakeholders [BP4], and absence of local VM guidelines [BE3] as the major obstacles to VM application in the construction industry. The Services Engineer also sees other barriers as major obstacles to VM application in the construction industry. These take account of: difficulty to establish mutual project objectives by stakeholders [BP5]; lack of commitment to implement VM [BP2]; difficulty in the involvement of decision makers and other key partners in VM workshop [BP3]; self-justifying attitude of the original design team [BP6]; and inadequate facilitation skills and training [BG4]. On the contrary, lack of time to conduct VM studies, difficulty in conducting analysis/evaluation of functions, VM workshop incurs additional cost, and inappropriateness of procurement strategies to implement VM were measured to be of moderate hindrance to VM application in the Nigerian construction industry.

It is essential to note here that the barriers that moderately hinder the application of VM are common to all the construction professionals in this study.

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The four (4) identified groups of barriers to VM application were ranked to reveal the criticality of the groupings. The people-related group ranked 1st with an average MS of 4.12 followed by the government-related group with Av.MS of 4.02. The environment-related and methodology-related groups ranked 3rd (Av.MS= 3.89) and 4th (Av.MS= 2.29) respectively. Figure 1 shows the ranking of the VM barrier components in the Nigerian construction industry.

Figure 1. Barriers to VM Implementation

Measurement and structural models for VM Application

The barriers to VM application were validated using measurement and structural models to determine the leading authenticated barriers hindering the successful application of VM. The first-order measurement model establishe

working relationship among stakeholders; stakeholder's resistance to accept new innovations; lack of willingness to accept new changes in the construction industry; inadequate facilitation skills and training; lack of active involvement of clients and stakeholders in a VM workshop; absence of local VM guidelines; lack of encouragement on the part of government; difficulty in the involvement of decision makers and other key partners in VM workshop. It was discovered that the people-related factor (lack of VM experts, poor collaboration, lack of awareness/knowledge on VM, inadequate facilitation skills) which ranked top by the Nigerian construction professionals is supported by the findings of Li and Ma (2012), Al-Yami (2008), Ojoko et al. (2016), and Kissi et al. (2015); inferring that trained VM experts are essential for the implementation of VM in the Nigerian construction industry in order to optimize the value of construction projects.

Based on the findings of this study, the following recommendations are made:

I. VM experts are needed for the successful implementation of VM in the Nigerian construction industry.
II. There is a dare need to familiarise both public and private clients on the potential and benefits of applying VM in construction projects.
III. Effective communication and co-operation among construction professionals, clients, contractors, government agencies, and other stakeholders would support the actualisation of VM implementation in Nigerian construction projects.
IV. Stakeholders must be ready and willing to welcome and adopt new value-added innovations and ideas so as to promote VM.
V. Construction professionals should be adequately trained in VM.
VI. Active participation of clients and other participants will stimulate successful implementation of VM in the construction industry.
VII. Government and top management play the leading role in terms of policy initiation, strategy development, and the implementation of strategies and policies. Therefore, the implementation of VM guidelines as well as government support are central to VM application.
VIII. The participation and decision making ability of government and other associates in the realm of VM would uphold the implementation of the technique in Nigerian construction projects.

In general, it is vital to note that the "people" and "government" related factors posed a major hindrance to VM application in the Nigerian construction environment. Therefore, the need to remedy the identified barriers should be given high priority so as to improve the value of Nigerian construction projects without sacrificing any performance standard.

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LITERETURE REVIEW

Clay roof tiles

A roof is an essential component of a dwelling and is critical to shelter and privacy. In many developing countries in which Nigeria is not exempted, roofing alone represents about 50% of the total construction cost of low cost houses. As the name implies, most roofs for low cost houses are constructed using low cost and the indigenous materials such as thatch of unfired clay which have poor durability and can be hazardous to both health and safety. Moreover, such materials can be dangerous during fire outbreaks, windstorms, earthquakes and other disasters. To provide more permanent roofing materials, many developing countries have been spending a lot on importation of corrugated Aluminum and asbestos cement roofing sheets. These materials are often too costly for most people in developing countries and hence do not solve the roofing problem, it has also be found that asbestos fibre is dangerous to health because the fibre is cancerous and has led to death of many people in developing countries William, (1981).

The special advantage of using clay roof tiles is the authenticity and the historical longevity and time proven track record. Nothing matches the classic look of real clay tiles. Concrete Roof Tiles are only pretending to look like clay tiles, but often can't match the natural colour blends and style of clay tile roofs, Euro-Tech Construction, (2010).

Previous research on production of roofing tiles using local materials

The study conducted by Khalil (2005) on stabilization of clay using cassava starch as a binder. The study used 2.5%, 5%, 7.5%, 10%, 15%, 20% and also 0% as a control as a percentages of clay with cassava starch by weight. The findings revealed that 15% replacement had the less water absorption of 25% as compared with other percentage replacements. Also, higher values of compressive strength of 1.88N/mm2 is recorded at 15% replacement. This implies that the optimum replacement level of cassava starch as a binder in clay is 15%. Similarly, Oyeleke and Bankole (2000) investigated the use of natural fibres an agricultural residue in the production of roofing tiles. The results revealed that the strength values obtained using these natural fibres had better strength than the roofing tiles produced with conventional construction materials.

Furthermore, Opara (2011) undertook a study for the production of ebonite roofing tiles using rice husk, marble dust pulp, cement and water in appropriate proportions. The study compared the roof tiles produced with these materials with asbestos roofing tile sheets. The research revealed that mean compressive strength of specimens obtained is 13 N/mm2 this value satisfied BS 1191, 6463 Part 4 and ASTM 204 requirement. In addition, Maminat (2001) undertook a study on production of plain concrete roof tiles stabilized natural materials. The finding from the study showed that the average breaking load due to flexure failure at 28 days is 562N which is more than 498N specified by B.S 473:1967:Part 1. Also, the results of water absorption averagely was 10.13% which indicates that the tiles has the tendency to absorb water in moist environment.

in research was obtained from saw mill in Kara Market in Birnin kebbi Local Government Area of Kebbi State, Nigeria.

3. Makuba (Parkia bioglobosa)

The African locust bean tree, Parkia biglobosa is a perenial tree legume which belongs to the sub-family Mimosoideae and family Leguminosae. It grows in the savannah region of West Africa up to the southern edge of the Sahel zone 130N (Campbell-Platt, 1980). These trees are not normally cultivated but can be seen in population of two or more in the savannah region of Nigeria (Schnell, 1957: Hopkins, 1983). The Parkia tree plays vital ecological role in cycling of nutrients from deep soils, by holding the soil particles to prevent soil erosion with the aid of roots. The trees also provide shades for farmers (Campbell-Platt, 1980). Parkia tree is used as timber for making pestles, mortars, bows, hoe handles and seats (Hagos, 1962; Irvine, 1961). The trees of the Parkia species are usually and carefully preserved by the inhabitants of the area where they grow because they are valuable sources of reliable food, especially the seeds which serves as source of useful ingredients for consumption (Campbell- Pratt, 1980). It has been reported that the husks and pods are good food for livestock (Douglass, 1976), Husk of Makuba (Parkia biglobosa) used in this research work was obtained from Zuru, Zuru Local Government area of Kebbi State, the husk was grounded to pounder form. The husk is shown on Plate 1.0

PLATE 1.0: Husk of Makuba

Methods

Preliminary tests such as specific gravity and bulk density test were conducted on clay, sawdust and Makuba. Also, tests like water absorption, abrasion resistance and flexural strength test were equally carried out on the hardened Clay roof tiles.

Preliminary tests conducted on research materials

1. Specific gravity test

The specific gravity of material is defined as the ratio of the weight of a given volume of that material to the weight of an equal volume of water. The specific gravity test was carried out in accordance with ASTM D 2395-83. Five trial samples were tested for clay, sawdust and makuba and average value was obtained for each material. These values were used in calculating the quantity of the materials to use in the production of clay roofing tile.

2. Bulk density test

This test was considered as loose and compacted bulk density. For compated bulk density, measurement involves filling the cylinder in three layers each layer being compacted with a metal rod for twenty five 25 times before adding the next layer.

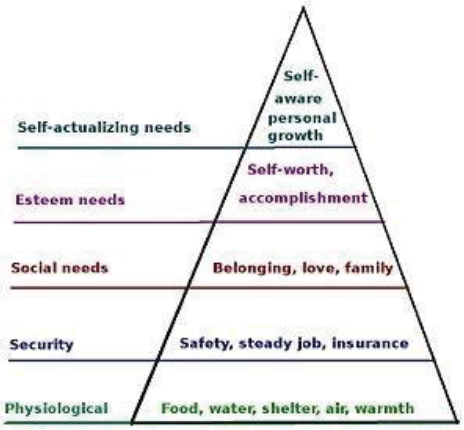

Figure 1: Hierarchy of needs. (Maslow, 1943)

LITERATURE REVIEW

As 17.5% of workers in the NZ construction industry is female (NAWIC NZ, 2016), a review of literature is carried out highlighting various barriers faced by females in the construction industry. These are classified and briefly discussed (Table 1):

Table 7: identified barriers to females in the construction industry by past studies.

Needs	Barriers identified	Key Citations (reduced due to limited page number)
Physiological Needs	Perceived gender roles and expectations; Work-life balance	Arditi et al., (2013); Rosa et al., (2017); Amaratunga et al., 2006; Dainty & Lingard (2006); Arena et al., (2015) Dainty et al., (2004)
Safety Needs	Prevalent working conditions; Risks associated; Coarse language and Harassment;	BRANZ (2017); McClure (2014); Kolade & Kehinde (2013); Aulin & Jingmond (2011) Arditi et al., (2013) Withers (2018); Agapiou (2002); Amaratunga et al., (2006); Chileshe & Haupt (2010); Watts (2009); Anaya et al., (2017)
Social Needs	Perception of influencers	Maringe (2006); Eremie (2015); Naz et al., (2014)
Esteemed Needs	Negative industry image; Less opportunity for career progression	Rameezdeen (2007); Amaratunga et al., (2006), Haupt (2016); Waters (2017); Gurjao (2006); Francis (2017); Chileshe & Haupt (2010); Strachan (2016)
Self-actualisation Needs	Lack of role models and mentors; lack of required information; Biased recruitment processes	Yates (2001); Rosa et al., (2017); NAWIC NZ (2013); Chileshe & Haupt (2010); Fieden et al., (2000); Galea (2017); Kolade & Kehinde (2013); Fielden et al., (2000)

Perceived gender roles and expectations

Although gender roles in modern society have altered significantly, it is generally assumed that a female is characterised by the need to nurture and cater to her dependents (children, elderly). As such, there is an obligation for females to be at home, cook, clean and take care of children (Arditi et al., 2013). Achieving this need provides a sense of fulfilment that is fundamental to the female. Females are often posed with the challenges of fulfilling their domestic roles while working full time, thus; increasing the likelihood of feeling overloaded and stressed (NZ Ministry of Social Development, 2009). Gender stereotyping is embedded in society and is

Professions that have a higher percentage of females in the workforce offer better opportunity for young females to follow.

Negative industry Image

Despite the contributions of the construction industry to the NZ economy, the industry suffers from a negative image. The public tends to equate the industry with physical labour and construction sites and fail to consider sub-sectors such as design, consultancy, manufacturing, and supply (Gurjao, 2006). This image has led to the perception that careers within construction are less prestigious than other competitive industries, such as medicine (Amaratunga et al., 2006). Trades, such as carpenters, plumbers, and electricians, are popularly known career paths within the construction industry. However, their manual labour component has led to their association with a low-status career path (Haupt, 2016).

Less opportunity for career progression

As the culture within the construction industry been consistent for a long time, there is resistance to change, and reluctance to accept suggestions and differing views from females (Agapiou, 2002). Females within the industry have reported that gender unique career opportunities remain within the industry (Ling & Poh, 2004). Some within the industry still believe that females are limited to the traditional female career opportunities of administration, secretary, human resources and communications, while the higher level managerial roles should be filled by males (Francis, 2017). Females who begin their careers on an equal footing as their male counterparts, either gradually fall behind, or are blocked at some point as their career progress (Kolade & Kehinde, 2013). These potential limitations on career opportunities are discouraging females from entering the industry (Chileshe & Haupt, 2010). Females have been noted to leave the construction sector almost 39% faster than their male colleagues (Strachan, 2016).

Lack of role models and mentors

One of the barriers females encounter within the industry is the lack of role models and mentors to guide them through personal and professional development. Role models provide excellent examples of professional conduct and also guide new

interesting however, to observe that security needs (4.56) were identified as more significant than physiological needs (4.52). This heightens the negative image of construction as a risky career path. It

biodegradation, resistance to moisture penetration and availability in a wide range of sizes and densities. Furthermore, EPS is cost effective for thermal and sound insulation (Kageni 2014).

Despite all the merits and advantages of the EPS building system, the application by developers in the Nigerian building industry is very limited. This is confirmed by Ede et al. (2014) where they attribute such to relatively scarce knowledge in the innovative methods of construction and poor access to the material. Furthermore, low lte aEzrf5.44(d-.1 EPS indus).0(-he Eprbut)-4.984EP

Where:

n1, n2, … , nA = number of respondents scoring response stem integers 1 to Amax, respectively.

A = largest integer on the response item (5 for this research)

N= total number of respondents

Additionally to the use of the RII technique in this study, frequencies will also be used to identify the deviations from the median of each factor affecting the use of EPS. The use of the 'median' as a basis for analysis of data consisting of Likert items is stressed by some authors particularly due to the fact of the 'ordinal' nature of the data (refer to Holt, 2014; Joshi, Kale, Chandel, & Pal, 2015; Bishop & Herron, 2015; Carifio & Perla, 2007; and Harpe, 2015).

RESULTS

All 39 questionnaires distributed were not only completely retrieved but all questions were answered. The experience of the respondents in the use of EPS is illustrated in Table 3. While 38.46 percent of the respondents attest to have used EPS in construction only, over 60 percent of the respondents have used EPS in both design and construction.

Table 3: Respondents experience in the use of EPS

Background	Number of respondents	Percentage
Design only	0	0
Construction only	15	38.46
Design and construction	24	61.54
Total	39	100

Eight factors (reported in Table 2) warranting the use of EPS in the construction of building elements of houses were studied. Based on the data fetched from the survey, Table 4 depicts the results of the RII, ranking of the factors and both the scores above and below the median (3).

Table 4: Evaluation of the factors affecting the use of EPS

Factor	Frequency of responses					Scores above median	Scores below median	RII	Rank
	1 VP	2 P	3 A	4 G	5 VG				
Reusability potential	0	0	0	1	38	39	0	0.99	1st
Time savings	0	0	0	10	29	39	0	0.95	2nd
Job opportunity	0	0	0	9	30	39	0	0.95	2nd
Aesthetically pleasing	0	0	0	17	21	38	0	0.91	3rd
Hot weather resistance	0	0	17	21	1	22	0	0.72	4th
Fire resistance	0	1	14	24	0	24	1	0.72	4th
Cold weather resistance	0	0	23	16	0	16	0	0.68	5th
Strength and stability	0	0	28	11	0	11	0	0.66	6th
Resistance to impact of sound	1	0	26	12	0	12	1	0.65	7th

Legend: 1- Very Poor, 2- Poor, 3- Average, 4- Good, 5- Very Good

Based on the results, the use of EPS rank 1st based on its potential for re-usability (RII, 0.99). Also, the use of EPS for its time savings and job opportunity jointly rank

future studies could assess EPS specific to tenants occupying the houses in Citec Mbora Mount Pleasant Estate.

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Appendix A

(Questionnaire)

Kindly select the performance of Expanded Polyesterene (EPS) used in housing construction relative to the following factors	Very Poor (1)	Poor (2)	Average (3)	Good (4)	Very Good (5)
Cold weather resistance					
Hot weather resistance					
Fire resistance					
Resistance to impact of sound					
Aesthetically pleasing					
Strength and stability					
Reusability potential					
Time savings					
Job opportunity					

actual outcomes for several reasons that are sometimes not systematically investigated, documented and understood.

This paper argues that systematic identification and analysis of factors responsible for inefficiency in the procurement and delivery management of infrastructure projects can help to identify problem areas and design ways to enhance performance and outcomes. However, completed projects are not always audited to identify success or failure factors. In some cases, the reason may be due to a lack of access to the relevant data. Here, in this research, a performance audit of two infrastructure projects conducted by the Auditor General of South Africa in 2016 provided a useful opportunity to closely analyse those infrastructure projects and establish a detailed understanding of reasons why there was a failure to achieve the intended outcomes and value for money in the implementation of those projects. As indicated in the literature review, several construction projects in the South African content experience poor outcomes and the findings of this study provides useful insight for more efficient infrastructure planning and execution.

81 construction professionals attending a short course on Infrastructure Procurement and Delivery Management (IPDM) in Johannesburg and Cape Town in 2018 were divided into 14 groups to examine performance audit reports on two infrastructure projects and analyse why the problems encountered in smooth delivery of the two projects arose in the first place. The factors identified by the 81 professionals was the main data analysed in this study to generate some explanations on the factors causing inefficient infrastructure procurement and delivery management in South Africa. Therefore, the aim of this study was to examine factors responsible for inefficiency in infrastructure procurement and delivery management.

LITERATURE REVIEW

The purpose here was to conduct a review of salient literature on key issues constraining efficient and effective procurement and implementation of infrastructure projects particularly in the South African context.

Construction procurement strategy

One key point explained in a research by Laryea and Watermeyer (2014) on innovative construction procurement and contract strategies used in the Wits University capital projects programme was that one of the root causes of projects ending up with a wide deviation between expected and actual outcomes was due to a lack of procurement strategy. The purpose of a construction procurement strategy is to identify the best way to achieve the intended objectives of a project and value for money (OGC, 2007). It was argued by the authors that if this strategic exercise is competently executed by those responsible, the deviation between expected and achieved outcomes should be as small as possible. However, construction clients often experience the problem of delivery outcomes that significantly exceed the planned budget and time specifications.

A key reason for poor infrastructure project outcomes in South Africa may also be due to the traditional approach used for delivering projects. According to Fitzgerald and Hodgson (2010) the established construction procurement methodology is based on a traditional model that separates the design and

(https://www.agsa.co.za/Auditinformation/Performanceauditing.aspx), "performance auditing is an independent auditing process to evaluate the measures instituted by management to ensure that allocated resources are procured economically and utilised efficiently and effectively".

Two infrastructure projects that had a performance audit conducted on them in 2016 were the Urban Renewal Programme at the Gauteng Department of Human Settlements; and provision of water infrastructure at the Department of Water and Sanitation. The water infrastructure audit report reflects on the success of implementation and subsequent performance of the water infrastructure programme that was implemented on behalf of the national Department of Water and Sanitation. This audit was conducted at 7 district municipalities that were supported by the department, covering 6 provinces. The audit of urban renewal programme was limited to 4 projects in Gauteng and was initiated at the request of the provincial Departments of Human Settlements and Cooperative Governance and Traditional Affairs and focused on the extent and quality of delivery of renewal projects compared to the original intentions of this programme. The four key challenges which hampered efficient and effective delivery of services applied to all of them. In all three cases, the AG highlighted the following themes which hampered efficient and effective delivery of services and projects: Leadership and oversight; Funding; Project management and operations; and Intergovernmental coordination.

The studies reviewed in this section including Laryea and Watermeyer (2014); Fitzgerald and Hodgson (2014) and the performance audit reports provided a framework to understand some of the root causes of significant deviations between expected and actual outcomes in projects.

RESEARCH METHOD

The methodology used to conduct the study and used to identify factors responsible for inefficiency in infrastructure procurement and delivery management was a focus group discussion which is a qualitative research technique (summarised in Figure 1). A focus group discussion (FGD) provides a useful way to gather together people from similar backgrounds or experiences to discuss a specific topic of interest (Saunders et al., 2016. A FGD is a structured discussion used to obtain in-depth information from a group of people about a particular topic. The purpose of a focus group is to collect information about people's opinions, beliefs, attitudes, and perceptions, not to come to consensus or make a decision per se (Saunders et al., 2016).

Two separate infrastructure procurement and delivery management (IPDM) courses were delivered by the School of Construction Economics and Management at Wits University in 2017. The first one, held in Johannesburg on 25 August to 1 September 2017, was attended by 61 delegates from various provinces in South Africa. The second one, held in Cape Town on 2-6 October 2017, was attended by 20 officials of the Western Cape Department of Transport and Public Works. Altogether there were 81 participants (see Table 1).

In terms of the data collection for this study, the IPDM course participants were divided into random groups, and each group was tasked to analyse why they think that the problems reported in the 2016 AG performance audit reports arose in the first place. The specific wording of the assignment to the groups was as follows:

> "Performance auditing is an independent auditing process to evaluate the measures instituted by management to ensure that allocated resources are procured economically and utilised efficiently and effectively and, if necessary to report thereon. Performance auditing encourages learning and change within the public sector by providing new information and drawing attention to various challenges. It contributes to improvement and reform in public administration, providing the government with recommendations based on independent analysis.
>
> Performance auditing plays an important role in keeping the legislature well informed about governmental actions and the outcome of its own decisions. It increases public transparency and accountability, providing objective and reliable information on how public service perform.
>
> A number of media releases and performance reports have been published including the following:
>
> - Media release dated 30 November 2016: Auditor-General tables three performance audit reports dealing with the pharmaceuticals, water infrastructure and urban renewal projects
> - https://www.agsa.co.za/Portals/0/Media%20release/2016%20Media%20release/2016%20MEDIA%20RELEASE%20(3%20PA%20REPORTS)%2030%20Nov16.pdf
> - Media release dated 1 June 2016: Auditor-general reports an overall, encouraging five-year improvement in local government audit results
> - https://www.agsa.co.za/Portals/0/MFMA%202014-15/Section%201-9%20MFMA%202014-2015/FINAL%20MEDIA%20RELEASE%20(MFMA%202016)%20FN.pdf
> - Performance audit on water infrastructure at the Department of Water and Sanitation dated November 2016
> - https://www.agsa.co.za/Portals/0/AGSAReports/Water%20Infrastructure%20and%20Public%20Report.pdf
> - Performance audit of the effectiveness of the Urban Renewal Programme of the Gauteng Department of Human Settlements dated November 2016
> - https://www.agsa.co.za/Portals/0/AGSAReports/AGSA%20Performance%20Audit%20Gauteng%20department%20of%20Human%20Settlements%20-%20Part%201.pdf

You are required to produce a written report on your analysis of the performance audits. Analyse why you think that the problems reported in the AG report arose in the first place."

manager, chief architect, chief engineer, and chief quantity surveyor. The participants are considerably experienced infrastructure officials with average work experience of ~15 years.

The 81 participants were divided into random groups for the purpose of undertaking their assignments. Each group spent a minimum of 2 hours reading and analysing the cases with their technical knowledge. It is assumed they approached the group analysis with importance and a good technical understanding of project implementation requirements.

RESULTS

The factors identified by the 14 technical groups were systematically analysed and categorised to enable a meaningful interpretation of their frequency and magnitude. See Table 2. The following categories were developed through a qualitative process of the researcher going through the data and interpreting it qualitatively.

Categorisation and coding of data provided by participants

Each of the 14 groups submitted a written account of their group conversations and the factors they identified to be responsible for the procurement inefficiencies identified by the A-G. The factors identified by each group were categorised qualitatively, coded and presented in Table 2. The following categories or codes were developed by the researcher. The categories were developed through a colour coding process as the researcher read through the factors identified and interpreted the meaning of each one to assign a category or code for the qualitative analysis.

1. Poor project scope definition and management [code: -1-]
2. Funding and financial management problems including payment [code:-2-]
3. Poor governance and leadership role of the client [code: -3-]
4. Poor contract management [code: -4-]
5. Poor planning [code: -5-]
6. Poor Communication [code: -6-]
7. Ineffective stakeholder and community engagement [code: -7-]
8. Lack of skills and technical capacity in the client organisation [code: -8-]
9. Non-compliance with supply chain management (SCM) regulations [code: -9-]
10. Poor information management system (Poor recordkeeping and filing practices [code: -10-]
11. Poor project implementation practices leading to poor performance [code: -11-]

Table 3: Analysis of causes of construction procurement inefficiency in the Urban Renewal Programme

	Codes used to analyse the list of factors presented by the groups										
Technical Groups	-01-	-02-	-03-	-04-	-05-	-06-	-07-	-08-	-09-	-10-	-11-
Group 1	x	x	x			x	x	x	x	x	
Group 2		x	xx	X			x	x		x	
Group 3		xxx	x	X	xx	x		x	x	xx	x
Group 4											
Group 5	xxx	xxx	xxxx	xxx	x		xx	xx			x
Group 6											
Group 7											
Group 8											
Group 9											
Group 10											
Group 11											
Group 12			x								
Group 13											
Group 14											
No of groups	2	4	5	3	2	2	3	4	2	3	2
Frequency o factors identified	4	8	8	5	3	2	4	5	2	4	2

Table 3 Notes
The same 11 categories were used for the data analysis in both projects
Most technical groups identified similar factors to be responsible for the project implementation challenges experienced in the urban renewal programme to be similar to the ones experienced in the water infrastructure project and hence chose not to present repetition of the factors. However, five groups provided a separate analysis for both projects

Some of the key issues identified by the groups in relation to each of the eleven categories codes presented in Tables 2 and 3 are summarized as follows. This presentation is in no order of significance and a ranking of the factors is presented in the discussion section.

Poor project scope definition

A key reason both projects experienced difficulty in implementation was because of poor scope definition by the client's team. A summary of issues identified by the technical groups were as follows:

1) Unclear, needs analysis, deliverables and delivery strategies
2) Use of unconventional methods, disruptive acceleration of projects and inappropriate technologies
3) Mismatched between Growth and infrastructure delivery/ management
4) Poor definition of project scope and objectives, and identification of stakeholder requirements

23) Funding agreements not integrated and incomplete
24) Late payment of contractors
25) Non alignment of funding sources
26) Lack of funding
27) Delay in payment of creditors
28) Funding and Budget issues (Funding not aligned to other project phases)
29) Late payment of emerging contractors
30) Lack of funding (due to inadequate planning and foresight leading to infrastructure failure)

Poor governance and leadership role of the client

Poor governance and leadership role of the client was identified by the technical groups as one of the leading causes of inefficiency in construction procurement. Some specific issues identified by the groups are summarised as follows:

1) Intergovernmental Structures not in place
2) Commitments that were not followed through
3) Roles of the key role players was not clear – no coordination
4) Ineffective Internal control systems
5) Poor monitoring (resulting in stock loss, infrastructure deterioration/increased maintenance costs & poor infrastructure projects quality)
6) No Skills audit was conducted for 15 years
7) Professional in professional (due to lack of mentorship and collaboration programmes)
8) No alignment between strategy and operational plans
9) Lack of integrated planning, communication and coordination of institutional dependencies
10) Lack of accountability (poor leadership & oversight)
11) Lack of leadership, (Lack of accountability from senior leadership, Poor contract management from the client)
12) Lack effective and efficient governance structures (Lack of controls and inadequate use of controls- SPO's)
13) Poor institutional practices (institutional value not upheld)
14) Non-adherence to Principles of governance (included delegations of authority transparency, procurement policies and procedure, with the inclusion of demand management)
15) Lack of strategic and effective leadership
16) Lack of accountability, transparency and due processes in the institutions
17) Non-alignment of Institutional values with project deliverables.
18) Lack of project governance (resulting in the decrease of project success rates)
19) Lack of leadership and oversight (leading to a lack of accountability in terms of the separation of duties)
20) Lack of supportive departmental structures
21) No governance of formal approvals (lack of communication, people working independently – silo mentality, no infrastructure management system, no monitoring policies in place)
22) Lack of clear roles and responsibilities in terms of leadership and proper communication

25) Lack of effective contracts for coordination, operation and maintenance

Poor planning

The key factors relating to poor planning were as follows:

1) Poor planning and monitoring
2) Resources are not used economically
3) Delivery based on pressure rather than plans
4) Poor planning on projects
5) Ineffective HR Plan
6) Poor planning & project management, lack of community needs alignment and infrastructure delivery oversight
7) Unclear Strategies (not clear on how it will be implemented as the business plans were not credible
8) Poor planning (Lack of coordination between role players to ensure timeous service delivery & the ability to effectively fund the project)
9) (Lack of forward planning on O&M roles and responsibilities)
10) Poor project Planning (Insufficient time for the preparation - Ground Water quality tests was not performed before it was distributed to customers)
11) Lack of planning for the delivery of different infrastructure components
12) Lack of infrastructure plan to prioritize projects and align funds
13) Poor project planning (construction programmes)
14) Lack of integrated planning
15) Lack of integrated planning of IDP/budget/SDBIP/sectorial plans
16) Lack of detailed planning & execution
17) Lack of integrated planning of projects
18) Lack of succession planning and a resultant understaffing of the professional workforce

Poor communication

The key factors relating to poor communication practices were as follows:

1) Poor communication-Working in silos
2) Poor communication/integration amongst critical stakeholders (leading to poor budget management, delays in projects and non-compliance to regulations)
3) Lack or poor communication between role-players
4) Late applications
5) Lack of and poor communication internally and with stakeholders
6) Poor communication
7) Poor communication up and down the delivery chain

Poor stakeholder and community engagement

The key factors relating to poor stakeholder and community engagement practices were as follows:

1) Poor stakeholder engagement
2) Lack of stakeholder engagement
3) Lack of collaboration with communities, lack of integrated planning, proper communication and coordination

4) Non-compliance with SCM prescripts
5) Weaknesses in SCM function (caused contractor payment delays resulting in poor contractor performance and service delivery)

Poor recordkeeping, filing practices and information management system
The key factors relating to poor information management systems were as follows:

1) Lack of effective records management system
2) Poor document management.
3) No cost norms nor a database of similar past infrastructure
4) Lack of formal SDA's
5) No written SDA's (leading to no accountability or reaching of objectives)
6) Inadequate document management
7) Lack of documentation (affected maintenance implementation)
8) Lack of documentation (affected maintenance implementation)
9) Poor documentation of system condition assessments (resulting in delays in reaction to plant breakdowns and servicing thus rendering delivery ineffective and resulted in a lack of planned funding for operational and maintenance interventions

Poor project implementation practices
The key factors relating to poor project implementation practices were as follows:

1) The key factors relating to poor planning were as follows:
2) Poor delivery of water to communities
3) Projects either not achieved or not assessed by municipality, poor post-construction maintenance and lack of oversight regarding disposals
4) Poor contract and supplier performance management
5) Poor performing contractors
6) Performance (Time, Cost and Quality- the projects did not achieve the institutional value proposition)
7) Delays (due to adjustments in construction programme to address on-site-related queries and concerns)
8) Project failures in projects abound (Missed deadlines; Late payments; No or late contractual agreements; Accelerated delivery causes no; Weak contractors; Poor planning; Shortage of funds during construction; Community unrest; Poor scope definition; Land & Licensing issues not dealt with; Lack of integration with interdependent Infrastructure)
9) Project delays (Delayed payments to service providers)
10) Inadequate performance by the contractor (Community unrest)
11) Delays in implementing construction program (Appointed contractors lack technical capacity to execute works)
12) Unacceptable additional costs to the project
13) Terminating the services of the non-performing contractors (contracts were terminated because the contractors were unable to deliver the technical quality)
14) Poor contractor performance (lack of supervision by contractor and expertise, no allocation of sufficient resources, no monitoring by department)
15) Poor performance of contractors

Alternatively, the ranking can be done by the number of factors identified in relation to each particular category. Ranking based on either method was done and presented in Tables 4 and 5. The rankings based on either criterion are not far apart in terms of significance (see Tables 4, 5 and 6).

Table 6: Combined Ranking

Causes of inefficiency in IPDM	Ranking		
	WIP	URP	Combined
[-01-] Poor project scope definition and management	7	7	7
[-02-] Funding and financial management problems	1	2	1
[-03-] Poor governance and leadership role of the client	2	1	1
[-04-] Poor contract management	3	4	4
[-05-] Poor planning	5	8	5
[-06-] Poor Communication	9	9	10
[-07-] Ineffective stakeholder and community engagement	9	5	7
[-08-] Lack of client skills and technical capacity	3	3	3
[-09-] Non-compliance with SCM regulations	11	9	11
[-10-] Poor information management systems	8	5	5
[-11-] Poor project implementation practices	6	9	9

Note: Cross referenced to Tables 4 and 5
Legend – WI – Water Infrastructure Project; URP – Urban renewal programme

The combined overall ranking is shown in Table 6. The analysis demonstrates that the major causes of inefficiency in IPDM are issues pertaining to funding and financial management, poor governance and leadership role of the client, lack of client skills and technical capacity, and poor contract management. An article by Watermeyer (2019: 36) on the critical role played by the client in delivering infrastructure project outcomes presents evidence of a case study on the new universities project which was presented to approximately 130 senior government officials involved in infrastructure projects at two separate workshops, sponsored by National Treasury. The participants at both workshops identified procurement strategy, governance, client leadership and a skilled client team as the critical innovations and practices that led to these successful project outcomes. Although these are different projects in different contexts, there is a significant overlap in the factors responsible for success and failure in infrastructure project implementation and outcomes. The key overlapping ones are role of the client and governance.

CONCLUSIONS

The performance audit reports on two infrastructure projects was analysed by 14 groups of built environment professionals. The groups were required to analyse why they think that the problems reported in the AG report arose in the first place. These factors they generated essentially explained the root causes of inefficiency in the procurement and delivery management practices which led to poor project outcomes. The significant causes of inefficiency in infrastructure procurement were identified as funding and financial management challenges, poor governance and leadership role of the client, lack of client skills and technical capacity, and poor

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Watermeyer, R. (2019) The critical role played by the client in delivering infrastructure project outcomes, SAICE Civil Engineering Magazine, January/February 2019 Issue, pp.32-38

acknowledged that ceramic sanitary ware (CSW) products are manufactured with either Vitreous China or Fireclay body usually covered with opacified glaze and appears in a standard white colour or a range of other well-defined colours.

In South West, Nigeria, there are different types of sanitary wares available for use in homes, offices, worship-places, hospitals and other public places but the most commonly see is the CSW. When it comes to choice of sanitary ware utilization, man is an intelligent being whose sense of choice cannot be overemphasised. This study henceforth, examine the factors responsible for user preference of CSWs over other sanitary ware alternatives in South-west, Nigeria, which in turn provides information to guide both local and foreign investors.

LITERATURE REVIEW

Pathak, (1995) revealed that long before the establishment of human abode; people have lived as wanderers and have relieved themselves wherever and whenever they felt like doing so. In prehistoric era people have defecated in open fields, bushes, caves, valleys and river channels without much health consequence. Hence, having considered the population around that period, the researcher is of the opinion that it does not necessarily mean that the prehistoric people were dirty or unhygienic. It was because these settlements were so small and organised in such a way that human waste was so minimal that assaults on nose and health was too small to be a nuisance (Barbara, 2013). As population began to expand, houses were built, small villages began to emerge into towns and cities, the management of human excrement became a major challenge, having to deal with smells and health related issues. This development necessitated the need for environmental sanitation since improper disposal of waste has inextricably linked to health issues which in due course led to the creation of a private secluded place (toilets, lavatories, bathrooms, or latrines) where the body can relieve its waste (World Health Organization, 2012).

Teresi, (2002) claimed that the third millennium BC was the “Age of Cleanliness, when toilet invention began to spring up in several parts of the world, and Mohenjo-Daro circa 2800B.C. had some of the most advanced toilets at that time, with lavatories built into the walls of houses. These were primitive “Western-style” toilets made from bricks with wooden seats on top. They had vertical chutes, through which waste fell into street drains or cesspits. These were only used by the affluent classes. Most people at that time squat over the pots set into the ground or use open pit. Early toilets using flowing water to remove waste according to Lambert, (2001) were also found at Skara Brae in Orkney, Scotland, dating from about 3100B.C. until 2500B.C. Around this period some of the houses there have a drain running directly beneath them, and some of these had a cubicle over the drain; such that flowing water helps to wash their excrement away. As years go by more innovative designs and improved sanitary products were invented using different materials and technologies with the aim of properly managing human excrement all over the world, (Becky, 2012).

As for Nigeria, there is no specific record on sanitary ware historical development. The management of excrement has always been based on the diverse traditional value of the people. Ages before colonization, Nigerians defecate in bushes. Some

è = sample size,
N = population size, and
e = acceptable sampling error limit or level of precision taken as ±10%.

Using a 95% confidence level, i.e. 5% significance level, the sample size of the population was calculated as follows:

Assumed population of 'N' for each state = 100000
è = 100000/[1 + (100000*0.12)] = 100000/[1+ (1000)] = 100
Sample size è for CSW end users was 100 for each state
There are 6 states in the study area
Hence sample size è for the study area was:
Six (6) states x è = 600

Sample size for CSW end-users was 600 for the study area.

A structured questionnaire was designed to obtain data from end-users of CSW. During the distribution of questionnaires 10 extras were added to ensure returned questionnaires falls within the recommended number. This was because it has been established through various studies that returned questionnaires are always lower than number distributed. Thirteen (13) variables were designed in the questionnaire for consumers order to assess the factors influencing the users' preference. The questionnaires were administered and collected over a period of time and the service of well-trained assistants were employed to aid the study. The Likert scale model of eliciting information was adopted in the design of questionnaire. The data collected was analysed using Statistical Package for Social Science (SPSS). And the results were presented using means, percentage and relative importance index in tables.

ANALYSIS AND RESULTS

Demographic data of the respondents

Gender of respondents

Gender distribution is appropriate in research because it helps to highlight sex disparity in the study area and sometimes it helps to check if there are any bias or gender influence. The gender distribution as displayed in Table 1 indicates that the female gender represented 58% of respondents in the study area. This suggests that more female use sanitary ware because of their quest to protect their privacy than the male in south-west, Nigeria.

Table 1: Gender distribution of Respondents

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Female	348	58	58	58.0
Male	252	42	42	100.0
Total	600	100	100	

Source: Author˜s field work, 2017

Age distribution of respondents

Table 2 shows the age distribution of respondents within the study area. The result revealed that the usage of sanitary ware cuts across all ages between less than 21

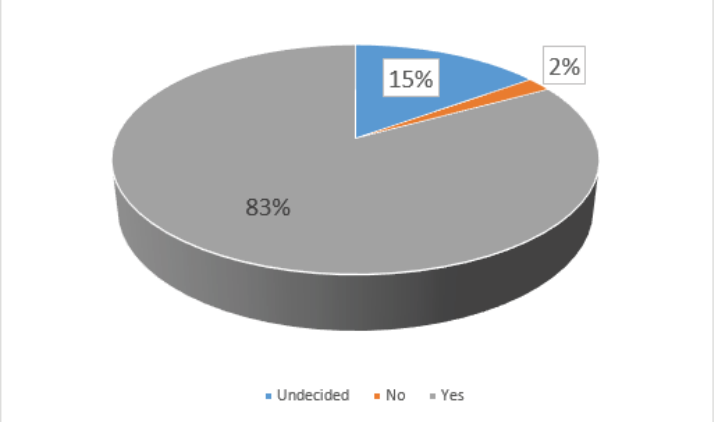

Figure 2: Ownership of ceramics sanitary ware
Source: Author˜s field work, 2017

Comparative use of sanitary ware facilities

The analysis carried out to assess the utilization of sanitary ware facilities as displayed in Table 3 reveal the comparative use of sanitary ware facilities. The result indicated that 91% majority of respondents use CSW flush-toilet. This attested to the fact that toilets furnished with CSWs are the most used and ranked the first in the list of sanitary facilities. CSW flush toilets have the mean score of 4.9 and Relative importance index (RII) of 0.98. RII for other alternative sanitary wares included Pit Latrine (0.63), Open Defecation (0.58) and Bucket latrine (0.29).

Table 3: Use of ceramic sanitary ware fixtures in comparison with other alternatives

S/N	Sanitary facility	MU	U	N	LU	NU	Mean	RII
1	CSW flush-toilets	546 (91%)	36 (6.0%)	-	6 (1.0%)	12 (2.0%)	4.9	0.98
2	Bucket latrines	6 (1.0%)	42 (7.0%)	24 (4.0%)	72 (12.0%)	456 (76.0%)	1.5	0.29
3	Pit Latrines	120 (20.0%)	186 (31.0%)	60 (10.0%)	108 (18.0%)	126 (21.0%)	3.2	0.63
4	Open Defecations	78 (13.0%)	156 (26.0%)	96 (16.0%)	126 (21.0%)	144 (24.0%)	2.9	0.58

Source: Author˜s field work, 2017
Keys: MU = Most Used U = Used N = Neutral LU = Less Used NU = Not Used

Identification of factors responsible for consumer preference for CSW from end users' responds.

It was perceived from the analysis made, that end-users of CSW were attracted based on some qualities that appeals to them. These forces of attraction can also be referred to as factors influencing demand. These factors were investigated using relative importance index (RII) and judging from the results shown in Table 4. The results shows that 92% choice was very important, 7% important and 1% undecided. This ranked the Ease of cleaning as the first most important factor end-users consider before buying CSW with RII of 0.98 (Mean = 4.9).

The table also categorized other priorities in the following order of RII; functionality (0.97), durability (0.97), comfort (0.96), price (0.96) and availability of products in the market (0.92). These were the factors most sort after by end-users before purchasing a CSW. Other important factors include size (0.88), colour (0.86), elegance (0.85), surface texture (0.83), uniqueness (0.83) and Glaze type (0.76). While choice based on origin of CSWs remains undecided and has RII of 0.67.

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INTRODUCTION

The issue of technology gaps that exist between the construction sectors of developed and developing countries is well-known (Abbott, 1985; Osabutey, Williams and Debrah, 2014). These differences are not solely limited to the use of physical components of technology; it extends to the development and use of non-tangible components (e.g. skills and knowledge) associated with exploiting and modifying the tangible parts to suit contextual needs (cf. Oti-Sarpong & Leiringer, 2018). However, attempts to narrow these gaps are mainly about technology and knowledge (T&K) transfers through arrangements requiring foreign participation. To this end, countries seeking to improve their construction sectors and advance technology in this sector have focused on increasing Foreign Direct Investment (FDI) inflows from developed countries.

FDI is widely recognized as a major means through which firms can participate in different economic sectors of other countries through technical or financial support under specific contractual arrangements such as subsidiary formation, or foreign-local alliancing/partnering/mergers (UNCTAD, 2014). In the construction sector, a recommended approach by the World Bank (2015) for FDI projects is the use of voluntary international joint ventures (IJVs) as vehicles because they allow for close collaboration and cross-party learning to support T&K transfers (cf. Muller & Schnitzer, 2006). IJVs have thus become the preferred medium for T&K transfers under FDI arrangements in developing countries (Osabutey et al., 2014). Thus, inflows typically serve as a key metric for 'how much' foreign T&K is being and by that an indication of technological advancement in a sector (cf. Lumbila, 2005). Furthermore,, for developing countries (DCs), FDI provides a key source of 'debt-free' concessions-based financing for infrastructure projects (World Bank, 2015); contributes to employment creation in recipient countries (Boakye-Gyasi & Li, 2015), and creates access to foreign markets and capital (Okudzeto et al., 2014).

Although FDI is considered to be a means by which T&K transfer and technological improvement occurs, practice in DCs reveals how reliance on such a metric has its shortfalls. Here, it is worth noting that the economic perspectives underpinning studies that establish such claims fail to discuss the processual nature of technological advancement – particularly in the construction sector – beyond the short-term impacts of FDI inflows and what that could suggest (cf. Liu, 2008). Despite FDI inflows into DCs in Africa being the highest globally in the past years (World Bank, 2015), it is difficult to clearly establish how that has contributed to technological improvement in the construction sectors of such countries. Concurring with the foregoing, Potterie & Lichtenberg (2001) and Siaini & Meyer (2004) argue that it is misleading to infer and generally conclude that an increase in FDI into a country is commensurate with an inflow of T&K into a country's economic sectors. With the construction sectors of DCs trailing those of advanced countries in terms of technological capabilities (cf. Ofori, 2012) despite increasing FDI inflows in the past decade (World Bank, 2015), we critically examine the case of a developing country in West African to present evidence for how the preceding prevails.

This paper takes as a point of departure the assertion that FDI is a measure of T&K transfer and an indicator for technological advancement in the construction sector

With FDI being a favoured approach to 'fast-track' economic development, it therefore becomes common to find governments in DCs conveniently relying on such records to infer that T&K transfer and in consequence technological advancements is taking place in various economic sectors. This reliance is reflected in government policies, and reports touting technological advancements based on FDI records and focusing on aspects of ownership structures, employment creation, value of investments and foreign participation (cf. Osabutey & Jin, 2016; Osabutey & Croucher, 2018). Whilst such metrics are potentially useful indicators of foreign engagement (technically or financially), they neglect certain critical nuances about T&K transfers and technological advancement, particularly in the construction sector. These include the notoriously slow-paced nature of new technology uptake in construction, context-specific nature of technology and knowledge adoption, and the transience of project teams. This paper expands on these issues by focusing on Ghana's FDI trends and the state of its construction sector.

FDI in Ghana: an overview

Ghana has in the last three decades experienced steady FDI inflows to key economic sectors including manufacturing, services, tourism, building and construction, trade and agriculture (Okudzeto et al., 2014). Data from Osabutey & Debrah (2012), Osabutey et al. (2014) and records from the Ghana Investment Promotion Centre (GIPC) – the government agency charged with facilitating foreign investment and monitoring a healthy investment climate in Ghana – show that the country has recorded growth in foreign investments in terms of number and value of FDI projects since 1994. Figure 1 shows the trend.

In Ghana, most FDI projects have technology transfer components incorporated and are consequently registered with the GIPC as technology transfer agreements (TTAs) under the provisions of Act 865 (2013) and the Technology Transfer (TT) Regulations, Legislative Instrument (L.I) 1547 (1992). Briefly, TTAs registered as part of FDI projects, are expected to – over time – contribute to the technological advancement of the specific local economic sectors through T&K transfers. Using these TTAs, the GIPC uses FDI inflow records in evaluating T&K transfers and technological advancement. In so doing, technology and its attendant knowledge are largely limited to explicit or tangible elements such as machines, devices, and imported codified knowledge. This approach neglects a comprehensive assessment of the unique nature of the building and construction sector, in particular, where such 'metrics' fail to capture the occurrence of any 'real' technological advancement. Consequently, this lapse in perspective creates an illusion about technological advancement and contributes to sustaining the technological lag in the Ghanaian construction sector. Invariably it bolsters reliance on foreign firms to execute essential projects at the national level.

Technological lags in the Ghanaian construction sector

Technology-related lags existing between developed and developing countries is well researched from different theoretical perspectives (Reisman, 2005; Noh & Lee, 2017). In the area of construction, studies report that the latter are behind the former in terms of using new technologies to execute projects (Osabutey & Croucher, 2018; Iyer & Banerjee, 2018). Players in the construction sectors of DCs lack the capabilities to use advanced technology to deliver projects that are

minerals and mining (Act 2006, Act 703 and LI 2173, 2012). Despite the existence of these regulations aimed at technological advancement, it is difficult to establish tangible improvements in the Ghanaian construction sector in terms of technological capabilities (cf. IMANI, 2018).

A reason for the preceding has to do with the temporality of construction project delivery. TT agreements 'die' when a project is handed-over and foreign parties disband to pursue other endeavours in different locations. This situation puts the construction sector (at the project level) in a unique spot that the current laws and regulations fail to address comprehensively in assessing for 'real' technological advancement following FDI projects with built-in T&K obligations. Another aspect of existing laws that do not capture tangible technological improvements in the construction sector is in Section 43 of Act 865 and Regulation 9 of LI 1547. It prescribes that a TTA that is required to be registered with the GIPC must not have a duration of less than eighteen (18) months and not more than ten (10) years. The agreement may be renewed – subject to review and approval by the GIPC – for a period not exceeding five (5) years. This provision outlines the kind of TTAs that legally fall under the oversight of the GIPC – and projects that do not fall within this range may not necessarily be registered with the Centre. This is where construction projects fall off the grid. If crucial infrastructure projects arranged with TT goals are delivered in less than 18 months, there will only be project-level accountability about the fulfilment of transfer obligations by foreign parties that will not fall under the radar of the Centre.

The lack of clear evidence to suggest technological advancement across key economic sectors including construction is reportedly a consequence of the absence of clear policy directions and strategic implementation guidelines (Osabutey & Jin, 2016; Osabutey & Croucher, 2018). Examining the Singapore and China economies, Ofori (2000) and Liu (2008) respectively highlight the importance of these two elements for achieving deliberate technological advancement in the construction sector via FDI projects. In Singapore, Ofori (2000) identified that strategic implementation guidelines helped ensure that through FDI projects, local construction firms could improve technologically over time. The government created project opportunities allowing local firms to use newly acquired technological capabilities after completing FDI projects with foreign firms. In China, Liu (2008) and Chen & Landry (2018) highlight that the government's clear strategic vision underpinned the successful transformation of their construction industry into one that is presently advanced technologically. However, in developing countries in Africa, studies (e.g. Osabutey & Croucher, 2018; Osabutey & Jin, 2016) identify a lack of both components, sustaining (and possibly widening) the technological gaps between their construction firms and foreign counterparts. Ghana is not an exception here.

The reliance on FID data by Ghana to infer T&K transfer and technological advancement has occurred is also problematic. Sinani & Meyer (2004) in their study of Estonia, for instance, suggest that whilst technology and knowledge 'spill overs' may occur via FDI projects, it is narrow and potentially misleading to rely on FDI inflows data to conclude there is T&K transfer and technological improvement in an economic sector. This study advances the preceding viewpoint by examining the case of Ghana's construction sector. Without annulling the impact of 'spill

structure of FDI projects (number IJVs and values of percentages foreign or locally owned). The second part focused on data about the number and value of FDI projects registered under construction, ownership structures and the number of consequent (foreign and local) jobs created.

ANALYSIS AND DISCUSSION

FDI inflows and the prevailing situation in the Ghanaian construction sector: A critical view

From the data captured in Figure 1, it is evident that Ghana is enjoying a steadily increasing trend of FDI inflows. The GIPC touts such trends as indicative of T&K transfer into economic sectors of the country, suggesting growth in the economy. Whilst this may hold true from an economic perspective, the fundamental assumption that such trends suggest technological advancement in the construction sector remains flawed as there are aspects of such developments that the figures do not show. Thus, relying on FDI to suggest such improvements remains misleading, making the fixation of the government and the monitoring body on such an assessment measure problematic. Here, we draw on current examples and past studies about the state of the construction sector (and players) in Ghana to argue why the FDI records – at best, provide partial indications that – fall short in accurately providing evidence for T&K transfer and consequently technological advancement. We discuss these lapses in two main parts. First, FDI inflows and technological advancement for construction sector development, and second, ownership structures, local employment and T&K transfer.

FDI inflows and technological advancement for construction sector development

Overall, the trends (in Figures 3 and 4) indicate a steady growth in FDI inflows into Ghanaian construction sector. Specifically, the cumulative number of FDI construction sector projects and Ghana-Foreign IJV projects shows a positive (increasing) trend (Figure 5). This suggests that, to an extent, there is consistent foreign involvement in the construction sector. Concomitantly there is the introduction of foreign knowledge and physical components of a technology to parties via FDI construction projects (cf. Saad et al., 2002). This trend however does not suggest that the presence of such elements impacts local parties in the ways that governments and supervising bodies envisage (cf. Ofori, 2000). The presence of foreign elements does not necessarily mean recipient parties are obtaining their technology and knowledge as there are issues of absorptive capacity, learning and inter-party issues of trust and willingness to share, all influenced by the kind of (favourable or restrictive) environment of operations (Osabutey et al., 2014; Fu, 2008; Siani & Meyer, 2004).

The construction sector is generally regarded as ‘slow paced’ in technological advancements. Low absorptive capacities in technology about the actors in the sector in developing counties reportedly exacerbate this situation (Osabutey et al., 2014). The prevailing scenario in the Ghanaian construction sector shows the presence of many foreign construction firms (including from China, Brazil and Israel) undertaking a variety of complex and technologically-demanding projects for education, public housing, transport and commercial purposes (cf. Construction

technological advancement of their construction sectors. Technological advancement thus does not take place over one project. It involves learning, trialling, adaptation, modification and further localisation for parties to develop the level of capabilities needed to proficiently use the technology (Manimala & Thomas, 2013).

FDI vehicle (IJV) ownership structures, local employment and T&K transfer

The positive trend of local-foreign IJVs recorded over the period under review is unsurprising for a burgeoning economy like that of Ghana (Okudzeto et al., 2014) where foreign investment is projected to grow (cf. World Bank, 2015). IJVs serve strategic and competitive intentions of foreign and local firms in the short, medium or long terms (Osabutey et al., 2014; Osabutey & Jin, 2016). However, IJVs are also known for embedded structural limitations they pose to T&K transfer especially between parties from developed and developing countries (Devapriya & Ganesan, 2002). At best, the positive trend observed in Figures 6 and 7 for the number of Ghanaian-Foreign IJV projects, local employment creation and construction sector jobs suggest consistent exposure of local parties to foreign technology and related knowledge. Real technological advancement, however, is yet to be realized as the prevailing situation depicts. Typically, foreign parties reportedly subscribe to non-voluntary IJVs as a means to penetrate new or promising markets as part of strategic business moves (cf. Ofori, 2000; Osabutey & Debrah, 2012). The burgeoning construction market in Ghana is reason for many foreign firms to seek participation. Local firms on the other hand see this as an opportunity to increase their competitiveness by forming IJVs with foreign parties for short- or medium-term gains (see: Obeng-Odoom, 2015). It follows therefore, that local-foreign involvement in IJVs may not necessarily be in the interest of T&K transfers for tangible technological advancement in the construction sector. After over a decade of having an oil and gas sector, IMANI (2018) reports that there is no local firm in Ghana with the capacity to execute projects (and deliver products) to support upstream oil and gas operations. This is in spite of the LI 2204 which is meant to help develop local capacity in the sector through prescribed obligations for foreign involvement with locals in IJV formation.

Similar to the number of local employment created through FDI in general, the number of construction sector jobs created for Ghanaians has seen steady increment from 2007 to 2018 (see Figure 6). From the positive it is evident that over the years, more Ghanaians have been exposed to some levels of foreign T&K by means of association on construction sector FDI projects through IJVs (cf. Tang & Gyasi, 2012; Boakye-Gyasi & Li, 2015). Notwithstanding the preceding, capabilities to use and improve on foreign technologies are lacking locally (Osabutey et al., 2014). It is observed that even when local parties are employed in IJVs with foreign parties, they are more often than not recruited to fill low-ranking positions where they have little to no involvement in key decisions regarding new technology and their use on projects (cf. Ofori, 2000, 2007). Local actors are likely to be directed to use components of a technology without necessarily having an understanding of how it could be localised and exploited in the future. Consequently, when foreign parties depart after completing an FDI project aimed to transfer T&K, there are machines or tools left behind, and local workers who know the 'how', but lack the required knowledge to adapt or modify them for future use. This phenomenon has also been reported in Iran and Egypt (cf. Saad et al., 2002), and is evidenced in the

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the needs of the beneficiaries. Inclusiveness in governance provides opportunity for voices of the most vulnerable to be heard at all levels of decision-making. This approach is participatory, consensus oriented, accountable, transparent, responsive, effective, efficient, and equitable (UN Research Institute for Social Development, 2014). It is also recognised as a pro-poor approach that equally values and incorporates the contributions of all stakeholders, including marginalized groups, in addressing development issues (Gupta, Cornellissen, and Ros-Tonen 2015). Lack of stakeholder participation in decision making, equates to absence of inclusiveness. This has been identified by the United Nations (UN, 2018) as a clear manifestation of poverty, which Sustainable Development Goal (SDG) 1 (one) addresses. Expectedly, in seeking to attain the Sustainable Development Goals, ending poverty and inequality must go hand-in-hand with strategies that promote inclusive development and participatory decision-making (Gupta and Nilsson, 2017). Future interventions in border communities must therefore explore inclusiveness as a sustainable infrastructure development strategy. This strategy which is based on a thorough knowledge of the complex dynamics of development in border communities, has a high likelihood of restoring communities' confidence in the state.

Problem Statement

Nigeria is presently faced with challenges of international terrorism, human trafficking, and smuggling of contraband among others. All these are aided by cross-border challenges. These challenges are varied, and include porous borders which make it easier for transnational criminals to thrive. Also, the absence of any real structure of a vibrant, economically viable settlement in these border areas, help reinforce the ease with which border crimes are perpetrated. Border crimes in the long run, deprive the nation of much needed revenue, while also contributing to social and sometimes environmental problems. Nigeria's ranking among the countries with the longest land borders in the world, makes border management of prime importance in national planning.

To reduce challenges in border management, border communities should operate as regular mainstream communities, in terms of social, economic and infrastructural development. The peripheral location of border communities, is however a problem, as it puts them at a structural disadvantage in terms of infrastructure planning and social mobilisation efforts (Asiwaju, 1993, cited in Mailabari & Hamidu, 2015). The resulting consequence is that these border communities are neglected in the mainstream of national development, and therefore remain hotbeds of unrest and insecurity in the country. The thrust of this research in approaching this problem is that adequate infrastructural development in border communities, can situate them as vibrant and functional settlements, where dwellers are free to undertake legitimate businesses in a conducive environment. By so doing, a society that would not need to thrive on illegality would emerge, with the residents themselves feeling obligated to the peace and security of the country. This could possibly reduce security breaches, as the social dynamics of the communities would change.

Aim and Objectives of the study

The aim of this study is to evolve an appropriate framework for sustainable development of border communities in Nigeria. The major objectives are to

historical and kinship ties between the people separated by political boundary, which identity is rekindled and reinforced through regular border movements and economic exchanges across borders. These identities are not static nor rigid, but interchangeable based on situation and importance. This suggests that to redirect allegiance to the sovereign state, conscious efforts must be made through governance, to draw border communities into the mainstream of national development. The sense of national belonging has a tendency to be fluid, particularly when the center of power is distant from the border, and development programs and interventions for border communities are not forthcoming. This means that there must be dedicated efforts through governance to elicit patriotism towards the sovereign state, as such actions have implications for border security, transnational crimes, and accrued revenue to the government. Where this is the case, residents of border communities may see the greater gain in belonging to their nation state, than in engaging in activities likely to jeopardize the peace and security of the country. Of course, cultural affinity between communities across border lines can never really be obliterated, but cross-border relations can be fostered in a manner legally beneficial to all countries concerned.

The livelihoods of border communities are affected by the prevailing socioeconomic factors in their settlement areas. Livelihood as adapted from the definition by Chambers and Conway (1992), comprises the capabilities, assets, material and social resources, and activities required for a means of living. These activities are carried out repeatedly, such that they become a way of life, and employ the use of one's human and material endowments to generate adequate resources for meeting the requirements of self and household (Ellis, 2000; UNDP, 2004). The concept of livelihood strategy has become central to development policies, programmes and practices in recent years throughout the world. Livelihood strategy as defined by Walker, Mitchell and Misner (2001) is an organized set of lifestyle choices, goals, values, and activities influenced by biophysical, political, legal, economic, social, cultural, and psychological components . The term livelihood strategies according to the UK Department for International Development (DFID, 2001), denotes the range and combination of activities and choices that people make in order to achieve their livelihood goals. They believe that an intrinsic attribute of many livelihood strategies, is the exploitation of multiple assets and sources of revenue. The government of Nigeria is also involved in such livelihood promotion efforts to enhance the living conditions of its people. The Border Communities Development Agency (BDCA) was set up by the government in 2003 to implement various infrastructural development programmes in border communities, and by so doing, improve their livelihoods.

For development to make an impact on the people and foster the desired structural shift, it must not only be sustained over a long period, but also adequately address the critical needs of the benefiting communities. There must necessarily be that sense of ownership on the part of the natives, which can only happen if the projects are truly impactful. To achieve this, the livelihood strategies adopted must be sustainable. Sustainable livelihood as a strategy, puts people at the center of development and by so doing, increases the effectiveness of development assistance (DFID, 2001). According to Rahut et al. (2014), the success and security of livelihood projects is dependent upon a number of activities and strategies

Development Bank, 2018). Investments in infrastructure are crucial to achieving sustainable development (UN, 2018). Infrastructure projects are sustainable, when they are planned, designed, constructed, operated, and decommissioned in a manner to ensure economic, financial, social, environmental, and institutional sustainability over the entire life cycle of the projects (Mercer and Inter-American Development Bank, 2017). As opined by Gupta & Baud (2015), infrastructure appears both as an explicit goal and an implicit means to implement and achieve other SDGs as it provides the services that enable society to function and the economy to thrive.

From the reviewed literature, border communities have been identified as hotbeds of transnational crimes and insecurity, largely as a result of neglect in sustainable socioeconomic and infrastructural development. This neglect is not unconnected to their peripheral locations near the nation's boundary line. To curb this phenomenon, concerted efforts must be made by government to bring development directly to the communities. This is considered crucial in fostering improved livelihoods for border community residents, and possibly eliciting their patriotism. This must however be sustained, if a structural shift in attitudes must occur.

Study area

The study was conducted in Akamkpa local government area of Cross River State, Nigeria. The local government area has a land mass of 4,300 square kilometers. In 2006, the population of Akamkpa LGA was 200,100 persons with a density of 40 persons per square kilometer (National Bureau of Statistics, 2011). Akamkpa local government area is made up of seven autonomous communities, two of which are at the Nigerian border with Cameroon. The seven autonomous communities in Akamkpa local government area are Akpai, Mfamosing, Ndapbachot, Achan, Abung, Owom, and Nyeji. The study was conducted in Achan and Abung, being the two communities closest to the border. In Achan, two border villages namely Old Ndebiji and Ekang were studied. In Abung, two villages were also selected as a result of their location at the Nigeria-Cameroon border. The villages are Abung and Ojok.

RESEARCH DESIGN AND METHODS

This research analysed the structure and functioning of infrastructural development programmes put in place in the border communities of Akamkpa local government area, to assess how far they have enhanced the livelihoods of the communities. Descriptive research design was used in the study. This is an effective research strategy in establishing existing phenomena, which in this case, is the current status of development in the border communities of Akamkpa local government area.

Selection of communities to study was by purposive sampling. There are four border villages in Akamkpa local government area, located in two autonomous communities. These four villages were purposively chosen because of their location at the border. Selection of survey participants was by simple random sampling. Forty (40) household heads were randomly selected for the study. The main research instrument was a structured questionnaire administered face-face to the heads of households. The contents of the questionnaire were explained to the respondents, and their responses recorded devoid of researcher influence. This

Cumulatively, 86.3% of the residents are under 45 years old, with 51% of the population actively involved in income yielding ventures, and the remaining 49% students. The randomly selected 40 heads of households were of different employment statuses such as government employment 7.5%, private employment 12.5%, farming 35%, fishing 5% crafts 10%, and trading 30%. Housing type is predominantly owner-occupier single-dwelling bungalows, devoid of basic in-house facilities. The main toilet facility is pit latrine, located outside the house and commonly shared by 77% of the population. Main water source is the river or stream. Public power supply is nonexistent and about 60% of the population depend on generators for electricity. Burning of refuse in front of buildings or any available space is a regular feature in the area. Apart from the sub-regional collector road leading to the LGA, all other roads such as the distributor roads are in disrepair while none of the access roads is tarred nor provided with drainage. As a result of these, there is impairment of access to residences and places of socioeconomic activities.

The level of social and economic infrastructure existing in the communities

Questions were asked about the availability and proximity of key facilities like road, health, shopping, educational and recreational facilities, including electricity and clean water. The results show that there are no government hospitals in the communities, no vocational institutions, and no institutions of higher learning also. The only available recreational facilities seen were open play grounds, and community center. No formal sporting arena was found in the study area. The communities were also not connected to the national electricity grid, neither do they have access to pipe-borne water inside their homes. Major source of water is from the stream and river.

Table 2 – Social and Economic infrastructure available to residents

Facility	Description/location	Types available
Road	There are access roads within the community	Untarred with some parts inaccessible to vehicular traffic
Health facilities	Health facilities are located within the community, and are within 0-3km of residents	Chemist shops, Community health centre, Private clinics, and Local health practitioners
Shopping facilities	Shopping facilities are located within the community, and are within 0-3km of residents	Small kiosks, Open market
Educational facilities	Educational facilities are located within the community, and are within 0-3km of residents	Nursery/primary school, Secondary school
Recreational facilities	Recreational facilities are located within the community, and are within 0-3km of residents	Open playground, Community centre
Electricity	There is no public source of electricity supply in the community	Private generators
Drinking water	There is no pipe borne water supplied to individual buildings	River/stream, Hand dug well, Borehole

Extent of government intervention in infrastructure

The infrastructure considered were provision of clean water, good roads, electricity, educational facilities, mass housing, community centres and parks, primary healthcare facilities, articulated and coordinated refuse disposal, adequate security of lives and property, and the establishment of institutional presence within the communities. Respondents were required to rate government intervention in

property, and the establishment of institutional presence. Table 4 is a summary of the result.

Respondents rating of priority areas of infrastructure development was measured on a five point likert scale of very high, high, average, low, and very low. Responses for very high and high were categorized as high priority, while responses for average, low, and very low were categorized as low priority. To calculate cumulative mean scores, numerical values were assigned to the responses as follows: very high = 5, high =4, average = 3, low =2, and very low = 1. The ratings by the heads of households on the priority areas for government intervention with respect to infrastructural development in the study area were subjected to the upper median score of 3.05. The respective scores range from 3.1 to 4.1, significantly above the upper median score of 3.05. This shows that all stated infrastructure are priority areas for the community, for which they require government intervention. However, the results show that priority for the respondents is in the order of; provision of clean water and adequate security of lives and property, followed by provision of electricity, construction of good roads, provision of health care facilities, articulated refuse disposal, government presence, provision of educational facilities, mass housing and community centers and parks.

The role of infrastructure on the livelihood of border communities

Questions were asked to ascertain the importance attached to infrastructure in maintaining a stable environment for people to go about their livelihoods in the community.

Table 5 - The role of infrastructure on the livelihood of border communities

	Agree %	Not sure %	Disagree %	Cumulative mean
Availability of infrastructure (road, water, school etc) is a key factor if peace and stability must be maintained in the community	72.5	0	27.5	3.58
People are more productive in their businesses and are therefore better able to grow their communities if infrastructure is available	90.0	7.5	2.5	4.25
People are less likely to engage in antisocial behaviors if employment opportunities exist in their communities	95.0	5.0	0	4.35
Development in the form of infrastructure, employment opportunities and government presence can help create a sense of patriotism in the community	92.5	7.5	0	4.55
It is of critical importance that government presen is felt in border communities	82.5	12.5	5.0	4.33

The areas of interest were the role availability of infrastructure like road, water, and school can play in maintaining peace and stability in the community, the possibility that people would be more productive in their businesses and therefore better able to grow their communities if adequate infrastructure was available, and the likelihood of reduction of certain anti-social behaviors if employment opportunities existed in the communities. Also in consideration was the possible connection between employment opportunities through government presence, on patriotism. Rating of responses was measured on a five point likert scale of strongly

Since the calculated value of 38.506 is greater than the table value of 13.85, the null hypothesis is rejected. The alternative is therefore accepted, which says that there is a significant effect of sectorial involvement on successful delivery of infrastructure projects in the community.

CONCLUSION

The border communities of Akamkpa LGA are deficient in basic infrastructure and services like good roads, adequate housing, clean water, and other facilities that can position them for improvement in their livelihoods. The impact of the Border Communities Development Agency is as yet not felt in these communities. Absence of much needed infrastructure can connote absence of government, and can lead to weakened state controls, which easily manifest as insecurity, lawlessness, and different acts of criminality. A sustained regime of infrastructure development is a viable strategy for bringing governance to the people. However, as posited by Woodhead (2006), in bringing governance to the people, it is important that the existing organisational system, structures, and processes are integrated into whatever is proposed for the key stakeholders, for the development to be effective. The levels of participation by different stakeholders have to be properly managed and coordinated to achieve desired results. Results of this study show the community's openness to broad based participation by governmental and non governmental sectors in infrastructure development, but with full consideration of community participation. Policy formulation, decision making, funding, implementation, and monitoring are essential activities in the planning and execution of projects. The involvement of various sectors in these activities as confirmed by this study, is connected to enhanced socio-economic well-being and delivery of sustainable projects, which should expectedly elicit full buy-in by the user community.

The strategy of inclusiveness will ensure to a large extent, that the infrastructure provided will be used and ultimately safeguarded by the people who live in the community. Community-driven development strategy in such cases, becomes an important tool in ensuring that the development is sustainable, and ultimately meets the needs of the intended users. Additionally, there is a higher likelihood of collective ownership of the projects, and through the use of local governance structures, the community will ensure that the facilities are preserved. Sustenance of this strategy would expectedly lead to incremental changes, which would positively transform the communities into vibrant and well structured social settings. This strategy is recommended for application in border communities in Nigeria, as it is vital to effective border management and security, and preservation of the nation's territorial integrity.

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these responses, looking for central and extreme tendencies, and their validations (Grisham, 2006). The results are fed back to the input provided by the coordinator (researcher). The experts are then asked to resubmit their opinions, aided by the input provided by the researcher. This process continues until the coordinator sees that a consensus has been formed. The technique removes the bias that is possible when diverse groups of experts meet together. In the Delphi method, the experts do not know who the other experts are in the process. Hence, the Standard-Delphi-Method is a survey which is directed by a coordinator (researcher) as already stated, comprising several rounds with a group of experts, who are anonymous among each other and for whose subjective-intuitive prognoses a consensus is aimed at (Cuhls, 2003) cited in (Aigbavboa and Thwalla, 2012).

After each survey round, a standard feedback about the statistical group judgement which was calculated from median and interquartile range of single projections is given and if possible, the arguments and counter-arguments of the extreme answers are fed back. In the Delphi process, nobody 'loses face' because the study is done anonymously using a questionnaire. Rowe and Wright (1999) and Häder and Häder (1995) informed that it is commonly assumed that the method makes better use of group interaction whereby the questionnaire is used as the medium of interaction. The method is especially useful for long-range forecasting, as expert opinions are the only source of information available (Aigbavboa and Thwalla, 2012).

Over time, the method has gained a favourable popularity across many scientific disciplines as a method of inquiry (Czinkota and Ronkainen, 2002). Czinkota and Ronkainen (2002) identified that Delphi technique has been used as a study instrument in the fields of library and information science (Buckley, 1995), in the medical disciplines (Linstone and Turoff, 1975), and by actuaries to predict economic conditions (SOA, 1999). Czinkota and Ronkainen (2002) further reported that those experienced with the Delphi technique, indicated that the method produces valuable results which are accepted and supported by the majority of the expert community. The above instance proves that the Delphi method in research is an accepted practice. However, it is not entirely appropriate for all research activities. This study therefore sought to assess how the Delphi technique could be used to identify the barriers to total quality management implementation in the construction industry. Consequently, the specific objective was to identify the barriers to total quality management implementation in the construction industry using the Delphi technique.

LITERATURE REVIEW

Some studies in the field of Total Quality Management (TQM) attempt to provide reasons why in such extensive and growing manner, the rate of TQM failure is high (Soltani, 2003; Hamidi and Zamanparvar, 2008) and also attempt to outline factors that are likely to impede the TQM implementation (Whalen and Rahim,1994; Sebastianelli and Tamimi, 2003; Johnson and Kleiner, 2013; Mosadeghrad, 2014). Hamidi and Zamanparvar, 2008), in their study outlined problems and barriers to TQM implementation as lack of senior and middle management commitment. They stressed that without management commitment and creating appropriate and supportive organizational culture, there would be no progress. They added that in

- Contextual barriers: are those difficulties that arise when there are developed a context and a culture appropriate to achieve the highest potential of the deploying of the TQM
- Procedural barriers: mainly are generated by the complexity of the processes, the lack of focus on the client, the lack of partnership with suppliers, the bureaucracy and the lack of a system of evaluation and self-assessment.

Table 2: Categories of barriers to the implementation of TQM

Categories	Example of barriers to TQM implementation
Strategic barriers	✓ Inappropriate TQM program
	✓ Unrealistic expectations
	✓ Deficient leadership
	✓ Poor management
	✓ The lack of top management support
	✓ Poor involvement of managers
	✓ The strength of the middle management
	✓ Inadequate planning
	✓ The lack of consistency of objectives
	✓ Lack of long term vision
	✓ The lack of a vision and a clear directions
	✓ Conflicting objectives and priorities
	✓ The lack of priority of improving the quality
	✓ The previous failures in terms of initiatives of change
	✓ The lack of Government support
	✓ Political uncertainty
Structural barriers	✓ Organizational structure inappropriate
	✓ Lack of organizational flexibility
	✓ Lack of physical resources
	✓ Lack of information systems
	✓ Lack of financial support, the cost of implementation
	✓ Lack of time
Human resources barriers	✓ The lack of interest of employees
	✓ The lack of commitment and involvement of employees
	✓ Employee resistance to change
	✓ A deficient human resources management
	✓ Poor delegation at all hierarchical levels
	✓ Few employees work tasks and increasingly higher
	✓ Lack of training and education of employees
	✓ Lack of motivation and satisfaction of employees
	✓ The lack of recognition and rewarding for success
Contextual barriers	✓ Inadequate organizational culture
	✓ Difficulties in changing organizational culture
	✓ Lack of guidance teams
	✓ Poor communication and ineffective
	✓ Poor coordination
	✓ The lack of confidence of employees in the management
	✓ Cultural issues resolution
	✓ Lack of innovation
	✓ Political behaviour
	✓ The diversity of the workforce
Procedural barriers	✓ Lack of focus
	✓ The lack of an adequate process management
	✓ Lack of concentration on the client
	✓ The lack of involvement of suppliers
	✓ Bureaucracy
	✓ Lack of evaluation and self-evaluation
	✓ The change agent or counsel incompetence in implementing quality
	✓ Ineffective corrective action
	✓ Efforts to improve quality are time consuming

c. Weak consensus - median Ó 6.99, mean Ó5.99 and IQDÔ2.1Ó3 and Ó 59% (5.99).

Data obtained from the Delphi survey was analyzed with Microsoft EXCEL, spreadsheet software. The output from the analysis was a set of descriptive statistics such as means, median, standard deviations and derivatives of these statistics. The results were further presented in Table 4.

Table 3. Impact scale

No impact/influence		Low impact /influence		Medium impact /influence		High impact /influence		Very high impact/influence
1	2	3	4	5	6	7	8	9

DISCUSSION OF RESULTS

Construction Company's inability to implement Total Quality Management (TQM) is due to several factors. Some of which may be beyond control and others out of reach due to limited resources. A set of relevant factors/barriers that affect the implementation of TQM in the construction industry were emphasized in this study through a comprehensive review of literature. The main factors/barriers obtained were based on the level of influence, as categorized in the Delphi questionnaire. The rating was based on an ordinal scale of one to ten with one being low influence or no impact and ten being high influence or very high impact (see Table 3). In all, twenty (20) factors were identified as major barriers to the implementation of TQM in the construction industry. Among these twenty identified barriers, lack of commitment from management was ranked first as most significant factor/barrier, followed by reluctance to change old management technique, lack of interest in the application of TQM, lack of efficient TQM management system, unavailable TQM policy, limited knowledge of TQM, lack of understanding among construction professionals in applying TQM, lack of coordination of TQM implementation policy, inability to train/educate employees on TQM, TQM technique is costly, lack of finance in the management of TQM experts, absent of systematic TQM framework, lack of TQM expert, TQM technique is time consuming, lack of enforcement from the legislative bodies overseeing the implementation of TQM, complex nature of TQM technique, limited access to body responsible for the implementation of TQM policy, lack or limited company resources, inability to employ TQM personnel, and perception that TQM may not yield any better results was ranked last in that order (see Table 4).

By applying the Interquartile Deviation (IQD) to assess whether a factor reached consensus or not, nine (9) out of the twenty (20) identified factors (major barriers) to the implementation of TQM in the construction industry were considered by the experts to have achieved strong consensus with IQD score between 0.00 and 1.00 (see Table 4). Good consensus was also achieved for the remaining eleven (11) factors with an IQD score between 1.1Ó 2 (see Table 4). Hence, all the twenty (20) factors identified were considered by the experts to have reached a good consensus. As explained in the methodology section, for consensus to have been achieved, there has to be a convergence of ideas and reasoning towards a subjective central tendency measure. Hence, consensus was determined to have been reached if the IQD was less than 1.00. Meaning that items with IQD = 0.00

factors have very high influence which affects Construction Company for not implementing TQM.

CONCLUSION AND RECOMMENDATION

This study intended to apply Delphi survey technique for identifying the barriers to Total Quality Management (TQM) implementation in the construction industry. The conclusions of the study are anticipated to fill the gap in the literature on the very important barriers which affect TQM implementation in the construction industry. Through comprehensive analysis, twenty barriers to TQM implementation in the construction industry were identified. The six most significant barriers among the twenty identified barriers in order of ranking are: lack of commitment from management, reluctance to change old management technique, lack of interest in the application of TQM, lack of efficient TQM management system, unavailable TQM policy, and limited knowledge of TQM. All the twenty identified barriers achieved good consensus by the experts and were considered to have high influence on TQM implementation. Hence, understanding these identified factors that are likely to impede the TQM implementation, will enable managers to develop more effective strategies for improving TQM implantation in the construction industry. It is suggested that further research should be carried out by using the empirical fieldwork (questionnaire survey) to determine the importance, similarities and differences of the identified factors/barriers.

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INTRODUCTION

Cities depend on public services to function optimally. Public services are provided in public buildings, and good public buildings make it easier to deliver services to the community. Efficient delivery of public services can improve livability of cities, as they keep the cities running smoothly and effectively (Litman, 2015). The types of services provided in public buildings make it imperative that the buildings be fit for purpose, so as to accommodate large volumes of users and also withstand the expected wear and tear as a result of use. Expectedly, huge budgetary allocations are expended in erecting public buildings, and they should therefore remain in good enough condition for a long period of time, to justify the expenditure.

Public building can be defined in a variety of ways, and definitions differ from country to country. One definition of public building, is a building that provides public services and usually occupied by a governmental body (Department of Culture Media and Sport, 2000). In the United States, public buildings are defined as buildings that are accessible to the public and funded from public sources (VanBaren, 2019). Public buildings are also any buildings consisting of, or containing a theatre, public library, hall or other place of public resort, including schools, educational establishments and places of worship (Uk Building Regulations, 2010). In Nigeria, the National Insurance Act of 2003 (Federal Government of Nigeria, 2003), defined public building as any building that is not wholly used by the owner for residential purposes. This definition is further broadened to include tenement houses, hotels, residential buildings occupied by tenants, and any other building to which members of the public enter and exit for purposes of recreation, education, or medical care. These definitions establish a wide range of characteristics that set public buildings apart from other construction.

Public buildings should typically project the character, ideals, and philosophies of the communities they serve. This is critical, as they define the form and landmarks of towns and cities, and are therefore expected to accurately reflect the beliefs, priorities, and aspirations of the people (Serville, 2001). This suggests that the quality of public buildings in a community have a direct bearing on the quality of life of the people, and stand as valid indicators of the level of growth and advancement of the people. This further highlights their importance as not only economic, but social and cultural investments which should function optimally throughout their life span, with minimal downtimes for repairs, rehabilitation, and maintenance.

Public buildings play host to large numbers of persons daily, and are therefore subjected to substantial wear and tear. They should as a result, be designed to withstand high volumes of traffic, and be maintained regularly, to retain them in good condition. Presently, buildings are not constructed to be completely maintenance free. However, ease and frequency of maintenance are important as they determine not only life cycle costs of a building, but also lifespan, fitness for purpose, and overall quality. It is important therefore that buildings are designed to create the right conditions that permit maintenance within reasonable effort and cost.

building maintainability is the condition of an item or a surface that permits its repair, adjustment or cleaning, with reasonable effort and cost. This suggests that an item or surface can be such that it may not be easy for maintenance activities to be effectively carried out on it, notwithstanding the desire to do so. The character of a surface or item that may permit ease of maintenance would clearly include location and placement of the item, and properties of the surface material, which are all outcomes of design.

Chew and De Silva (2003) see building maintainability as achieving the optimum performance through the building life span within minimum cost. In this case, maintainability is achieved through use of durable components, materials, and construction methods. Lau and Ho (2014) paint a more holistic picture of maintainability, covering both the character of the building and the maintenance strategy adopted in the building. They see building maintainability as features and/or measures that expedite maintenance, leading to improved maintenance efficiency, augmented building performance and best value outcomes. The design component of maintainability is clearly stated in all the discourses. In summary, maintainability is a concept which addresses the need to improve effectiveness and efficiency of maintenance (Rounds, 2018).

Building Maintenance

Maintenance is the combination of all technical, administrative, and managerial actions during the lifecycle of an item intended to retain it in or restore it to a state in which it can perform the required function (BS EN 13306:2010). Building maintenance is necessary to sustain the utility value of a building (Plavina & Geipele, 2013). Maintenance operations in a building can be broadly categorised as routine, preventive and remedial maintenance. Regular cleaning and beautification of building and premises amount to routine maintenance, and are necessary to keep the structure functional and protected from early decay. Preventive maintenance is all activities undertaken to keep the building structure sound and unsusceptible to early damage. Remedial maintenance on the other hand are measures undertaken to correct, remove or repair a damaged part of a building. The frequency and cost layout of these maintenance activities largely depend on the building itself, and the maintenance strategy adopted.

Maintainability of public buildings

Public buildings by their sheer size and function, are prominent fixtures in any urban environment. These buildings do not exist in isolation. They are a part of the whole town or city, and together with physical infrastructure and spaces, define the design of the urban space. It is known that urban design features can enhance the quality of life in the built environment (CABE, 2002). Urban quality of life according to McCrea et al (2005) includes satisfaction at regional, neighbourhood, and housing levels. While regional satisfaction is concerned with services like health, education, cost of living, and urban growth, neighbourhood satisfaction is best predicted by evaluations of social interactions and quality of public facilities. Quality of public facilities is particularly important because it has been shown to have implications for effective administration of public services, with attendant effects on crime, health, safety, and social behaviour (Deniz, 2016; Rastyapina and Korosteleva, 2016). Urban quality of life does not only refer to the quality of life in urban areas as conventionally known, but also to the quality of its built

RESEARCH METHODOLOGY

This research studied the challenges to maintenance of public buildings in Owerri Nigeria, so as to determine how maintainability can be improved in the buildings. Descriptive research design was used. This is effective in studies that seek to establish the current status of existing phenomena without interference. Data collection was through survey.

The survey was conducted using a structured questionnaire administered to any of two categories of users, who were considered qualified to answer the questions. The first category was managerial heads of the buildings studied, who were in a position to know the state of the buildings, report same for maintenance and monitor the maintenance process. These were classified as direct users. The second category was the technical personnel in charge of maintaining the buildings, who could in some cases, be users of the buildings also. These categories of users were considered qualified to answer the questions, as they are directly involved in maintenance of the buildings. Qualitative data were collected through personal observations. This was undertaken, to determine the nature and extent of deterioration common in public buildings in Owerri.

The study area covered the core administrative zone of Owerri capital territory, which comprises sections of Owerri municipal, Owerri west, and Owerri north local government areas. Owerri is the capital city of Imo state in southeast Nigeria. It is also a growing center of entertainment, attracting visitors from neighbouring states to its hotels, bars, restaurants, and night clubs. Good public infrastructure would substantially enhance the status of the city, and support its continued growth. Four broad building types were selected for the survey. They are administrative, educational, banking, and public activity center buildings. These make up the majority of public building typology in Owerri. Fifty copies of questionnaire were administered in fifty separate buildings falling into these four categories. The buildings studied were chosen through purposive sampling. Fifteen (15) buildings each were chosen from education and banking because they are the predominant public building types in the study area. Ten (10) buildings each were selected from administrative and public activity center buildings. Public activity center buildings include libraries, theatres, event centers etc.

Forty two (42) copies of questionnaire were returned, making a return rate of 84%. Simple descriptive statistics were used to analyze the results.

RESULTS AND DISCUSSION

General character of public buildings in Owerri – the buildings studied showed a preponderance of low rise buildings on two floors only; ground and first floors. 59.5% of the buildings surveyed were under 20 years old and could be said to be relatively new, and not yet subject to obsolescence. The predominant material for walls is sandcrete block. Aluminium frames with glass in-fill panels are the preferred choice for windows. These were seen in the form of sliding, projected and casement windows. Doors were mostly made of wood, and a combination of glass and aluminium. Roofs with concrete gutters and parapet walls made up 35.7% of the sample, while pitched roofs with exposed eaves were 50% of all buildings

Levels of deterioration in public buildings in Owerri – Questions were asked to determine the component parts of the buildings where respondents observed defects, and their assessment of the extent of the defects.

Table 2 – Defects in building components in public buildings in Owerri

Description	VM Defects %	MDefects%	Not sure %	MNDefects%	No defects %	
Roofing sheets	4.8	28.6	4.8	52.4	9.5	100
Windows	2.4	15.5	0	59.5	22.6	100
Plumbing	2.4	16.7	7.1	57.1	16.7	100
Handrails, cabinets e	2.4	14.3	7.1	66.7	9.5	100
Doors	3.6	17.9	3.6	59.4	15.5	100
Electrical fittings	3.6	21.4	5.9	53.6	15.5	100
Wall finish	7.1	26.2	3.6	44.0	19.1	100
Ceiling	0	28.6	0	47.6	23.8	100
Wall structure	1.0	16.8	4.8	56.0	21.4	100
Floor finish	2.4	40.4	4.8	31.0	21.4	100
Air conditioning	7.1	26.2	4.8	38.1	23.8	100
Floor structure	0	28.6	4.8	28.6	38.0	100
Roof structure	4.8	7.1	23.8	40.5	23.8	100

A total of 19 items comprising internal and external components and services in a building were rated to determine extent of defects. The rating was done using a five point Likert scale of Very major, Major, Not sure, Minor, and None. Forty two (42) respondents filled out the questionnaire, making a total of 798 possible responses.The items were collapsed into 13, following the merging of components that had external and internal aspects. Frequencies and percentages were calculated for each of the response types. The classification of defects was explained to the respondents as follows:

Very major defect (VMDefects) – defects within the building that result in total failure of a part or whole of a structural component of the building, such that it can no longer perform its designed function eg. blown off roof covering, collapsed roof, collapsed ceiling, eroded foundation etc.

Major defect (MDefects) – defects that affect a major component of the building in such a way that it no longer functions optimally even though it has not failed completely. It also applies to a series of consecutive minor defects in a part of the building occurring at the same time thereby creating a heavier impact eg. cracks in the wall, broken ceiling sheets, leaking roofs, broken fittings and fixtures

Minor defect (MNDefects) – defects that mostly affect aesthetics, cleanliness, and optimal functioning of the building without the need for improvisation eg. broken latches, flaking, chalking, and peeling of paint, dirty surfaces, chipped tiles, burnt out light bulbs etc.

Table 3 – Prevailing category of defect in public buildings in Owerri

	Frequency	Percent	Cumulative Percent
Very major	30	3.8	3.8
Major	162	20.3	24.1
Not sure	35	4.4	28.4
Minor	394	49.4	77.8
None	177	22.2	100.0
Total	798	100.0	

and non-concealed pipe-work hidden behind grills and in ducts. Of these, concealed pipe-work was the predominant method of plumbing pipe-work installation at 59.6% occurrence, followed by exposed pipe-work at 33.3%, cumulatively accounting for 92.9% of plumbing pipe work installation methods in the buildings studied. Table 6 shows analysis of defects in plumbing services, measured against these two frequently occurring installation methods.

Table 6 - Level of defects in plumbing fittings and fixtures

Type of plumbing pipework	Very major defect	Major defec	Not su	Minor defec	No defect	Cumulative Percent
Surface and exposed	7.14	25.58	7.14	57.14	0	100
Concealed in wall cavity	4.0	44.0	8.0	32.0	12.0	100

The results in Table 6 show the two observed pipe installation methods recorded very high occurrences of defects in the plumbing services. In the case of surface and exposed pipe work, minor defects were seen in 57.14% of the times, while major and very major defects accounted cumulatively for 32.72%. For the concealed pipe work, minor defects were observed in 32% of the cases, while major and very major defects cumulatively were seen in 48%. Total defects in all categories for both surface and concealed methods were 89.6% and 80% respectively. These are very high figures for both methods. However, majority of the defects seen in concealed pipe work were major defects unlike in the surface pipe work.

Challenges to effecting maintenance – Questions were asked about the challenges to maintenance in the buildings studied. Maintenance challenges include access for maintenance, properties of materials and finishes to be maintained, design and detailing, and methods and quality of construction. Aspects of these factors were included in the questions asked, and responses were rated based on a five-point Likert scale of strongly disagree (SDA), disagree (DA), neither agree nor disagree (Not sure), agree (A), and strongly agree (SA).

Table 7 – Challenges to effecting maintenance

Description of item	SDA (%)	DA (%)	Not sure %	A (%)	SA(%)	Cumm %
Sometimes components to be maintained are beyond the reach of workmen	2.4	28.6	7.1	54.8	7.1	100
The technology (know-how and equipmer required to effect some levels of maintenance is not available	14.3	35.7	4.8	33.3	11.9	100
Some of the maintenance problems in the building are as a result of the design of th building	0	14.3	14.3	45.2	26.2	100
The quality of construction is a major caus of maintenance problems in the building	2.4	11.9	14.3	40.5	31.0	100
The finishing materials used are such that they require constant maintenance	0	16.7	7.1	57.1	3.79	100

Questions were asked on possible challenges to the technical aspect of maintenance, which is effecting repairs, rehabilitation, or cleaning of parts or components of the buildings studied. The questions were asked in relation to design, quality of construction, and location and quality of materials used for the parts or components. Data collected showed that improper design, poor quality

Durability is essential if public buildings are to be kept in use and in good enough condition for prolonged periods of time, especially while the overall poor maintenance management strategy and attendant poor maintenance culture in public buildings in Owerri subsists. Of course this will not negate the need to eventually strive to improve maintenance management protocols in public buildings in Owerri.

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Industrialized building system or Pre assembled systems also known as prefabricated components in the case of concrete(precast concrete) is one of such alternative construction methods. The extensive programme of rebuilding and reconstruction that followed the end of the Second World War coincided with shortage of traditional building materials and a depleted labor force which was inadequate for the scale of the project work. In this event, a substantial part of the building programmes was met by the use of concrete in the form of precast frames, cladding units and wall frames.

In developed and some developing countries of the world, there has been a tremendous transition in the construction industry from the traditional method to industrialized building System (IBS). Manufacturing and productivity have moved from being project based to product based. No doubt, the implementation of prefabrication in construction industry has enhanced productivity and improved quality as well as several other benefits.

In Nigeria, with the huge defect in housing delivery and unprecedented growth which has put pressure on the existing infrastructure, there is need to breech the gap in infrastructural development by the use of the Industrial Building System (IBS).

Aim

This study is aimed at highlighting the prospects and problems of the Industrial Building System (IBS) in Nigeria with a view to developing strategies on improving the application of the Industrial Building System (IBS) in Nigeria.

Objectives

1. To identify factors inhibiting the development of the Industrial Building System (IBS) in Nigeria.
2. To critically evaluate the prospects and problems of Industrial Building System (IBS) in Nigeria.
3. To appraise the level of IBS in Nigerian construction sector.
4. To identify the role of Government in establishing legislative frame work for Industrial Building System application.

LITERATURE REVIEW

According to Zakari, Abdul Awal, Zakaria, Abdullah and Zakaria Hossain (2017), in Nigeria, organized building practices date back to the 1930's when the very few construction activities of significance were handled by the Public Works Department (P.W.D) and Royal Army Force which was later transformed to the Nigerian Army Engineers. Direct labor was the mode of construction and project delivery at this time. Construction contracting in Nigeria began in the 1940's with few British and Italian companies coming into operation. Nigerian Independence in 1960 brought an upward trend in construction activities and until the late sixties, most of the available construction organizations were over-stressed with contracts. The "oil boom" that followed ten years after independence led to an upsurge in construction and demand for construction services, as the country at that period opened up to foreign and local investments and the obvious need for infrastructure to drive the economy.

With Nigeria's current population of over 186 million and the dire need of housing and other building development, to be able to meet the need of housing for its teeming population, industrialized building production has to be embraced.

In Malaysia, Hong Kong, and Singapore amongst others, the Industrial Building System (IBS) has become a major part of construction technology for production of high volume of houses at affordable cost especially low cost houses.

Development of the industrial building system (IBS) in Nigeria

Initial Cost is one of the factors that inhibit the development of IBS in Nigeria - Many small contractors are reluctant to adopt IBS system and prefer to continue using the conventional method of construction. This is due to the fact that small contractors are already familiar with the conventional system and for them the technology suit well with small scale projects and therefore not willing to switch to mechanized based system. Furthermore small contractors lack financial backup and are not able to set up their own manufacturing plants as it involves very intensive capital investment (Kamarul, Mustafa& Zuhairi, 2009).

Adaptation of standards is another factor that inhibits the development of IBS in Nigeria – The use of Industrial Building System requires standardization of components and spaces; also joints and connection details need to be standardized. This requires tremendous education and training efforts. Warsawski, 1999 observes that modular co-ordination and standardization are among prerequisite characteristics underlining the successful implementation of IBS. It therefore becomes necessary that to accomplish the requirements of modular co-ordination, all components need to be standardized, implying that standard plans and standard component drawings are required, particularly to aid the production process. This is cited as one of the principal hindrances to the use of modular coordination. Otherwise, even partial introduction of IBS components such as lintels or staircases is not looked upon favorably and is therefore rarely used for the construction project due to a lack of standardization of modular coordination.

Government policy and Incentives is another factor – There is no government policy or incentive for use of IBS as against the conventional traditional construction method. For the change to be feasible the government has to put more attractive incentive systems, benefits and create awareness on the advantages of using the Industrial Building System.

Inadequate manufacturing facilities is also a factor inhibiting the development of IBS- Presently the level of manufacturing facilities for IBS is not available because it has not been fully embraced.

Prospects and problems of industrial building system (IBS) in Nigeria

With the world being a global village and sustainable housing being a topical issue which is being provided through modern construction technology like IBS, Nigeria has to embrace this technique. This industrial building system has prospects and problems in the Nigerian society.

The prospects are: Economic benefits through savings in site labor and minimization of construction waste as compared to the conventional methods. Reduction of construction time on site. It will bring about commitment and

cooperation between the public and private sectors. Meet the housing need of Nigeria within the framework of sustainable development. Increase the stock of buildings in supply within the construction sector of the nation's economy. Provision of a more skilled workforce and upgrading of the skills of mass construction workforce.

According to Zakari et.al, (2017), there are problems faced in the implementation of IBS in Nigeria. The construction requires: high initial investment capital purposely for machineries, steel mold, foreign technology, Transportation and the wages of skilled workers for the installation process. Other problems of IBS are: lack of knowledge and expertise in IBS, it requires more skill from the workers when compared to the conventional According to Zakari et.al, (2017), the following barriers were summarized: Research and educational courses on IBS unavailable, not economic for small rise buildings and small projects, unfamiliarity, insufficient manufacturers. Resistance to change from traditional method to other methods, high capital cost, high payment of skilled labor, transportation access, lack of technology reference, construction methods and also requires the education and training of human resource in the construction industry.

Level of industrial building system (IBS) in Nigerian construction sector

Aladeloba,Okesoto and Olawale (2015) opined that the country is one of the most populated in the continent of Africa, suggesting that the country is in dire need of housing and other building development to meet the requirements of its teeming population. The decline in the country's Gross Domestic Product (GDP) through the building sector can only be arrested, if the nation embraces industrialized materials in building production. This will accelerate the growth in the industry and promote rapid growth and development of the building and construction sector.

Currently, the industrial building system in Nigeria has been applied in few projects such as Coca-Cola industry in FCT Abuja, Benue brewery industry in Benue state and Benue Cement Company in Yandev Gboko, Federal Housing Authority Lugbe, Mass Housing Construction FCT Abuja, and residential building in FCT Abuja and Kano state.

Compared to the level of work going on in the construction industry in Nigeria, this is very minimal.

Legislative frame work for industrial building system (IBS) application

The role of Government in establishing legislative frame work for industrial building system (IBS) application cannot be overemphasized. The government has a major role to play. According to Kamarul et.al, (2009) IBS in Malaysia began in early 1960's when Ministry of Housing and Local Government of Malaysia visited several European countries and evaluated their housing development program. After their successful visit in 1964, the government started first project on IBS aimed at speeding up the delivery time and building of affordable and quality houses. The endorsement of IBS Roadmap 2003-2010 in Malaysia by the Malaysian Parliament on 29th October 2003 expressed the importance and urgency of IBS implementation in Malaysia. It is a systematic and coordinated blueprint of total industrialization of construction industry towards achieving total industrialized industry and promoting open system by the year 2010. Malaysia is still grappling

with this building system but has made successful progress because of their government effort.

Nigeria, can establish a legislative framework for the promotion of IBS by studying what obtains in countries like Malaysia, Finland, Sweden, Japan, Germany and Singapore where technologies had eventually modernized and improved the industry.

METHODOLOGY

This paper examined the prospects and problems of the Industrial Building System (IBS) in Nigeria with a view to developing strategies that will help improve the application of IBS in Nigeria. The data for the study was collected in Owerri, Imo State, Nigeria with the aid of a structured questionnaire which was administered to the various professionals in the built environment i.e. Architects, builders, engineers, quantity surveyors, estate valuers working in construction sites; these were selected based on their knowledge and involvement with the topic in question. The questionnaires were administered to 100 randomly selected professionals but 78 were retrieved. The data retrieved was analyzed using the descriptive statistics such as frequency tables and percentages respectively. The respondents were asked to rank the factors that inhibit the development of industrial building system (IBS), prospects of industrial building system (IBS) and barriers and problems of industrial building system (IBS) using 4-point Likert scale of:

1-Strongly Agree
2-Agree
3-Disagree
4- Strongly Disagree

which established a criteria mean of 3.00 and 75% percentage mean was adopted and served as basis of acceptance or rejection of the factors.

FINDINGS AND DISCUSSION

Table 1: Designation of respondents

Respondents	Frequency	Percentage
1. Architects	25	32
2. Urban Planners	10	13
3. Builders	25	32
4. Estate Surveyors	11	14
5. Engineers	7	9
Total	78	100

Source: Field Study 2019

Table 1: Shows the percentage representation of the respondents, 32% for Architects, 13% for urban planners & 32% for builders, 14% for Estate surveyors and finally another 9% for engineers. This result expresses the opinion of the professionals in the study area.

Table 2: Years in practice

Respondent	Frequency	Percentage
Above 5years	10	13
Above 10 years	18	23
Above 15 years	20	26
Above 20 years	30	38
Total	78	100

Source: Field Study 2019

Table 2: Shows the respondents' years of experience as professionals. With average working experience of 10 years, respondents are deemed experienced enough to supply reliable data for this research.

Table 3: Respondents opinion to awareness of Industrial Building System (IBS)

Are you aware of Industrial Building System (IBS)?	Frequency	Percentage
Yes	67	86
No	11	14
	78	100

Source: Field Survey 2019

From Table 3: 86 percent of the respondents were aware of Industrial Building System (IBS) while 14 percent were not aware. The result show that majority of the respondents were aware of IBS.

Table 4: Factors that inhibit the development of Industrial Building System (IBS)

S/No	Do these factors inhibit the development of the IBS in Nigeria?	Mean	Percentage Mean
1	Initial start up cost	3.44	86.2
	Adaptation of standardization of components and spaces, also joints and connection details	3.23	80.7
	Government policy and Incentives	3.11	77.8
	Inadequate manufacturing facilities	3.32	83

Source: Field Study 2019

Table 4: Shows the factors and their mean and percentage mean. It can be observed that all the factors are above 3.00 and 75% which is criteria to accept the factors, so all the respondents agree that these factors inhibit the development of the industrial building system (IBS) in Nigeria.

Table 5: Prospects of the Industrial Building System (IBS) in Nigeria

S/N	Do you Agree that the following are prospects of the industrial building system (IBS) in Nigeria?	Mean	Percentage Mean
	A. Reduction of construction time on site	3.29	82.4
	B. Commitment and cooperation between the public and private sectors.	3.25	81.4
	C. Meet the housing need of Nigeria within the framework of sustainable development	3.38	84.5
	D. Increase the stock of buildings in supply within the construction sector	3.46	86.6
	E. Economic benefits through savings in site labor and minimization of construction waste	3.48	87
	F. Provision of a more skilled workforce	3.44	86

Source: Field Study 2019

Table 5: Shows the Prospects of the industrial building system (IBS) in Nigeria. The responses are above 3.00 and 75% which is criteria to accept the factors, so they all agree that the above are prospects of the industrial building system (IBS) in Nigeria.

Table 6: Barriers and problems of the Industrial Building System (IBS) in Nigeria

S/N	Do you agree that the following are barriers, and problems with IBS?	Mean	Percentage Mean
	A. Not economic for small rise buildings and small projects	3.24	81.0
	B. Research and educational courses on IBS unavailable	2.96	74.0
	C. Unfamiliarity	3.03	75.9
	D.Insufficient manufacturers	3.29	82.3
	E. Resistance to change from traditional method to other methods	3.30	82.6
	F. High capital cost	3.49	87.3
	G. High payment of skilled labor	3.10	77.5
	H. Transportation	3.37	84.2
	I. lack of knowledge	3.42	85.5

Source: Field Study 2019

Table 6: Shows the barriers, and problems with IBS in Nigeria. The response on research and educational courses on IBS unavailable is 2.96 and 74.0 so that factor is not a barrier or problem but all the other factors are above 3.00 and 75% so they are accepted as barriers or problems of the industrial building system (IBS) in Nigeria.

Table 7: Respondents opinion to government establishing legislative frame work to improve the application of Industrial Building System (IBS) in Nigeria

Will Government effort through establishing legislative frame work improve the application of industrial building system (IBS) in Nigeria?	Frequency	Percentage
Yes	20	25.6
No	58	74.4
	78	100

Source: Field Survey 2019

From Table 7: 74.4 percent of the respondents agree to government establishing legislative framework to improve the application of industrial building system (IBS) in Nigeria while 25.5 percent do not agree. The criteria established to accept a factor is 75% and this is 74.4%.

Based on the data which were collected through the administration of questionnaires to the 78 respondents involved in this study: various professionals in the built environment i.e. Architects, builders, engineers, quantity surveyors, estate valuers working in construction sites in Imo State, Nigeria, the followings findings were made;

1. Most of the respondents were aware of Industrial Building System (IBS). See Table 3
2. All the respondents agree that factors that inhibit the development of the industrial building system (IBS) in Nigeria are initial start up cost, inadequate facilities for manufacturing, government policy and adaptation to

standardization of components and spaces, also joints and connection details. As shown in Table 4.

3. All the respondents agree to all factors listed as prospects of the industrial building system (IBS) in Nigeria. See Table 5.
4. All the respondents agree to most factors listed as barriers and problems that try to inhibit the development of the industrial building system (IBS) in Nigeria but disagreed that educational courses on IBS is unavailable. See Table 6.
5. As shown in Table 7, all the respondents do not agree that government establishing legislative framework will improve the application of industrial building system (IBS) in Nigeria.

The above findings agree with the works of most of the authors like Aladeloba et.al (2015) Zakari et.al (2017):Kamarul et.al (2009) and Warsaki (1999) who agree that the country is in dire need of housing and other building development to meet the requirements of its teeming population and that the decline in the country's Gross Domestic Product (GDP) through the building sector can only be arrested, if the nation embraces industrialized materials in building production which will accelerate the growth in the industry and promote rapid growth and development of the building and construction sector.

CONCLUSION/ RECOMMENDATIONS

This paradigm shift from the traditional construction methods to IBS in Nigeria construction environment is inevitable. To encourage the adoption and application of IBS in the Nigerian construction industry, the following are recommended:

i. The construction workforce need to upgrade their skills to be involved in IBS
ii. More informative and awareness programs such as seminar, colloquiums and conferences or collaboration with higher institutions should be organized to enlighten the private as well as public sector on IBS and its benefits.
iii. Government should use IBS in the construction of mass housing and most projects thereby encouraging its adoption and should set up IBS manufacturing plants and also be willing to assist construction firms in the initial startup cost.
iv. Contractors should be encouraged to invest in IBS by setting up their own manufacturing plants.

All these will help to breech the gap in infrastructural development by the use of the Industrial Building System, meet growing demands for affordable housing, and need to be competitive in an increasingly global market also move the nation to a sustainable growth path.

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INFLUENCE OF ORGANIZATIONAL SUB-CULTURE ON TOTAL QUALITY MANAGEMENT PRACTICES IN NIGERIAN CONSTRUCTION FIRMS

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Construction in Nigeria is characterized by lack of adherence to standard and lack of implementation of Quality management practices. Recent study in the field of TQM shows that there is increasing recognition of the influence of organisational culture on the success or failure of TQM implementation. This paper is aimed at examining influence of organisational subculture on Total Quality Management practices in Nigerian construction firms, and establishing the culture type(s) that could be strengthened to support TQM implementation. The survey research method was used for the study. The research was carried out by administering structured questionnaires to managers and heads of departments of construction organisations in Nigeria. A total number of 659 questionnaires were administered and 418 returned giving a response rate of 63%. The research was analysed using Structural Equation Modelling Smart PLS 3. The findings of the study revealed that only the Clan subculture has significant relationships with all the TQM practices. Strengthening the Clan subculture will improve the success of TQM implementation. The study recommends that any efforts that can be made to increase the presence of Clan subculture prior to commencing the formal implementation of TQM would be highly beneficial

Key words: organisational subculture, quality, total quality management

INTRODUCTION

The concept of quality is broad and related to a wide range of human needs (Reid & Sanders, 2012) Total quality management (TQM) can be defined as a management philosophy aimed at achieving customer satisfaction (Baird, Jia &Reeve, 2010; Calabrese & Corbo, 2015). Valmohammadi & Roshamir (2015) describes TQM as a collective interlinked system of quality practices that is associated with the performance of organisations. TQM is aimed at achieving customer satisfaction not only in the production of goods and services that meets

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customers' needs and requirements but also exceeding them through continuous improvement (Prajogo & McDermott, 2011). In an attempt to improve quality and performance, many companies have focused on TQM. However, in spite of these claimed benefits, a closer examination of literature shows that implementing TQM has attained about 30% success, thus it has achieved less than intended results and one of the key barrier is organisational culture (Gambi, Gerolamo, & Carpinetti, 2013). TQM as a management concept has been in existence for over five decades and has been generally accepted by firm, however firms record less than optimal results from its adoption (Jayaram et al., 2010). Recent studies in the field of TQM show that there is increasing recognition of the influence of Organisational Culture on the success or failure of TQM implementation (Green, 2012; Haffar et al., 2013; Jimenez-Jimenez, Martinez-Costa, Martinez-Lorente, & Rabeh, 2014; Rad, 2006). Study of the cultural profile of organisations is vital for successful implementation of TQM (Rad, 2006). The important role of OC in TQM success is often referred to in the literature (Chung et al., 2010; Gimenez-Espin et al., 2013; Green, 2012; Haffar et al., 2013; Prajogo and McDermott, 2005; Rad, 2006; Zu et al., 2010). Organisational Culture is a set of shared meanings that make it possible for members of a group to interpret and act upon their environment (Valmohammadi & Roshami, 2015). Organisational culture depends for its existence on a definable organisation, in the sense of a number of people interacting with each other for the purpose of accomplishing same goal in their defined environment (Mathew, 2007). The success of TQM implementation depends to a large extent on the organisational subculture, this makes it important to take the culture of organisations into consideration before attempting to implement TQM (Zu et al, 2010; Valmohammadi & Roshamir, 2015; Roldan et al, 2015). The impact of organisational culture is felt on the operation of the business and on the performance of the firms (Cadden, Marshall & Cao, 2013). Consequently, Organisational culture and TQM can individually and jointly promote the performance of organisations. This study assessed the influence of organisational subcultures on TQM practices by examining the relationship between each subculture type and TQM practices an also by establishing the right subculture mix for TQM implementation in Nigerian construction firm.

LITERATURE REVIEW

Organizational culture

The culture of organisations can be described as a set of common assumptions that makes it possible for organisational members to act and interpret their environment (Valmohammadi & Roshamir, 2015). The shared assumptions and the understanding lie in level that is conscious for individuals, the assumption is identified through stories, norms and artifacts that emerge from the behavior of individuals (Haffar et al 2013). The culture of an organisation defines the core values, assumptions, interpretation and approaches that characterize and organisation (Cameron & Quinn, 2005). The existence of organisational culture depends on a people i.e. a number of people interacting with each other mainly to achieve set goals in their defined environment (Zu et al, 2010). Within organisations, different subunits exist and each unit can exhibit its own unique culture referred to as subcultures. Organisations can have several departments and each department can exhibit its own culture. For example, the subculture of the

administrative department may differ significantly from the finance department etc. in addition to that, subculture can exist based on hierarchical levels, top management subculture may differ from the lower cadre (Cameron & Quinn, 2005; Prajogo &McDermott, 2005).

This study adopts the competing values framework (CVF) proposed by Cameron & Quinn (2005). The CVF explores the in-depth structure of cultures that relates to compliance, motives, leadership, desion making effectiveness and organisational forms in organisations (Chunget al.,2010; Gimenez-Espin et al., 2013; Haffar et al., 2013). The CVF's basis is on two major dimensions that diagnoses the subcultural profile of organisations base on effectiveness indicators into four clusters (Zu et al, 2010). The CVF evaluates six dimensions of culture (dominant characteristics, leadership, management of employees, organisational glue, strategic emphasis and criteria for success) to assess the subcultural profile of organisations. One dimension of the CVF places emphasis on the focus of the organisation both internal and external, the second-dimension places emphasis on the difference between flexibility on one end and stability on the other end. The two dimensions forms four quadrants with each quadrant representing a subculture type referred to as the Clan, Adhocracy, Marketing and Hierarchical subculture. None of the subculture type is superior over others (Valmohammadi & Roshamir, 2015). The CVF has been adopted in previous studies to assess the influence of organisational cultures on management issues such as TQM (Gimenez-Espin et al., 2013; Haffar et al., 2013; Prajogo and McDermott, 2005; Zu et al., 2010).

	Flexibility and Discretion		
Internal Focus and Integration	**Culture Type: CLAN** **Orientation**: Collaborative **Leader Type**: Facilitator, Mentor Team builder **Value Drivers:** Commitment Communication Development **Theory of Effectiveness:** Human development and participation produce effectiveness. **Quality Strategies**: Empowerment, Team building Employee involvement, Human resource development and Open communication	**Culture Type: ADHOCRACY** **Orientation:** Creative **Leader Type:** Innovator Entrepreneur Visionary **Value Drivers:** Innovative outputs Transformation Agility **Theory of Effectiveness:** Innovativeness, vision, and new resources produce effectiveness **Quality Strategies:** Surprise and delight Creating new standards Anticipating needs Continuous improvement Finding creative solutions	**External Focus and Differentiation**
	Culture Type: HIERARCHY **Orientation:** Controlling **Leader Type:** Coordinator Monitor Organizer **Value Drivers:** Efficiency Timeliness Consistency and uniformity **Theory of Effectiveness**: Control and efficiency with capable processes produce effectiveness **Quality Strategies**: Error detection, Measurement, Process control, Systematic problem solving, Quality tools (fishbone diagrams, Pareto charting, affinity graphing)	**Culture Type: MARKET** **Orientation:** Competing **Leader Type**: Hard driver Competitor Producer **Value Drivers:** Market share Goal achievement Profitability **Theory of Effectiveness:** Aggressively competing and customer focus produce effectiveness **Quality Strategies:** Measuring customer preferences Improving productivity Creating external partnerships Enhancing competitiveness Involving customers and suppliers	
	Stability and Control		

Figure 1.: Competing Values Framework adapted from Valmohammadi & Roshamir, (2015)

These 4 typologies of organisational culture simultaneously exist theoretically in every organisation as the

a. Clan culture
b. Adhocracy culture
c. Marketing culture

d. Hierarchical culture

Clan culture: Clan culture places emphasis on flexibility and internal orientation Cameron & Quinn, 2005). Organisations with emphasis on this culture promote the development of human resources, emphasizing openness, participation, cohesiveness and commitment to membership. Such organisations are typified as a friendly place to work where people share a lot (Zu et al, 2015).

Adhocracy culture: Cameron and Quinn (2005) described adhocracy culture as one that emphasizes flexibility but with more focus on the external environment. The orientation is towards growth, creativity stimulation, resource acquisition, innovation, and continual adaptation to the external environment (Ivana & Matina, 2016).

Marketing culture: According Cameron and Quinn (2005), the marketing culture is also focused on the external environment but is control-oriented. It emphasizes productivity, performance, goal achievement, and one of the primary motivating factors is competition. Such organisation is a results-oriented workplace. Leaders are hard-driving producers, directors, and competitors. They are tough and demanding (Baird et al, 2011).

Hierarchical culture: According Cameron and Quinn (2005), the hierarchical culture is both control and internal oriented. It emphasizes rules and regulations, and standardization to achieve control and stability. Such organisation is characterized as a formalized and structured place to work. Procedures and well-defined processes govern what people do. Effective leaders are good coordinators, organizers, and efficiency experts.

TOTAL QUALITY MANAGEMENT

The advent of TQM spans over three decades ago, it has proven to be one of the most significant innovations that influence management practices of organisations. TQM first appeared in the US in the early eighties in response to the intense challenges and competition facing US organisations from Japanese firms (Liu, Zhang & Shroeder, 2011; Prakash, Barua & Balon, 2015).The generic term “total quality management” is used to mean the vast collection of philosophies, concepts, methods, and tools now being used throughout the world to manage quality (Juran and Godfrey, 1998). Quality management (QM) is defined as an method of achieving and sustaining high quality products and services, TQM practices are the observable side of TQM through which management work to realize improvements in organisations (Valmohammadi & Roshamir, 2015). TQM practices are presented in frameworks used in presenting National Quality awards such as the Malcom Balderige National Quality award (MBNQA). In recent times, quality awards are used as a guide to TQM implementation by a large number of organisations (Zu, Robin & Fredndall, 2010). This study examined six TQM practices (top management support, workforce management, customer focus, strategic planning, process management and measurement analysis) according to the MBNQA to investigate the implementation of TQM in Nigerian Construction firms.

Top management support: Literature places emphasis on the vital role of top management in TQM implementation as a prerequisite for effective and successful implementation (Kantardhieva, 2015; Merih, 2016). This evidence is provided in

previous research projects stressing that the role of leadership in TQM successful implementation. Top management takes the center stage and must show strong evidence of commitment for the initiative to be successful (Isaac, & Thomas, 2018; Valmohammadi & Roshamir, 2015).

Customer focus: Quality is defined by the customer; it is centered around the demands of the customers. Customer focus emphasizes on meeting and exceeding customer satisfaction as one of the most important features of TQM and that is also the focus of TQM definition (Talib, Rahaman & Qures, 2012). In any production process, customer is an important element.

Workforce management: Workforce management can be defined as a systematic and planned activities to enhance an individual's performance. Success of TQM depends on people orientation that can be exhibited through initiatives such as team work, training and development (Sumukadas, 2016). Workforce management involves empowering the workforce to solve problems and make decisions at levels appropriate (Isaac & Thomas, 2016).

Strategic planning:Strategic planning is a necessary foundation in the success of TQM, specifically, strategic plans on quality issues should be based on strength, weakness, opportunity and threats analysis (Hokoma et al, 2010; Talib et al, 2010). Substantial attention has been paid to quality planning that are customer based by quality gurus though the attention they give to strategic planning vary.

Process Management: In any organisation, processes especially those that involve quality initiatives should include all functions and departments as the central focus of production (Albayak &Albyak, 2014). A combination of process understanding and process improvement is the lifeline of any organisation seeking to implement TQM.

Measurement analysis: Measurement analysis is a detailed assessment of a measurement process that include research that is designed to identify variations that occur in the production process (Yasin et al, 2007). similar to the production process that varies, the process of data collection and analysis also varies and can generate wrong results.

Organizational subculture and TQM

Problems associated with TQM implementation has been reported in literature (Gimenez-Espinetal.,2013), among several factors attributed as key to the success of TQM is the organisational culture of the firms . the relationship that exists between the various culture types and TQM have been previously reported (Gimenez-Espinetal.,2013; Haffar et al.,2013; Zu et al., 2010). This study assessed the influence of Organisational subculture and its effect on TQM. This implies that each subculture types and TQM practices will be considered in the analysis. not any of them are superior over the others (Gimenez espin et al., 2013). In addition, few organizations are featured by only one culture type, rather they have a culture profile consisting of different culture types (Zu et al., 2010). To adopt any successful change in an organisation, the culture cannot be over emphasized. Kaluarachchi et al (2010) stated that TQM programmes are likely to succeed if the dominant organisational subculture is compatible with the basic assumptions and value are in agreement with the principles of TQM. The success of TQM depends largely on the subcultural profile of the organization implementing it (Soltani, 2008).

Relationship between Organisational Subculture and TQM practice

Previous researches on TQM and Organisational subculture has established different relationships that exists between both concepts (Zu et al, 2010, Valmohammadi &Roshamir, 2015). A set of four independent variables (clan subculture, adhocracy subculture, marketing subculture and hierarchical subculture) are theoretically related to six dependent variables (Top management support, customer focus, workforce management, strategic planning, process management and measurement analysis). Based theory that defines the hypothesis, the regression paths of all the hypothesis are positive. The implication is that when a score on any of the independent variable goes up i.e. the stronger the subculture the score on the TQM practice goes up i.e. the TQM practice goes up showing a positive relationship. The following theoretical relationships exists between Organisational Subculture and TQM practices:

Clan subculture is positively related with customer focus.
Clan subculture is positively related with workforce management.
Clan subculture is positively related with process management practice.
Adhocracy subculture is positively related with customer focus practice.
Marketing subculture is positively related with customer focus practice.
Marketing subculture is positively related with workforce management practice.
Marketing subculture is positively related with process management practice
Hierarchical subculture is positively related to workforce management practice

Problem Statement/ Research question

Previous researches have looked into the relationships that exist between TQM practices and Organisational Culture, however, they view organisation as having only one culture. Few organisations are featured by only one culture type rather organisations have a profile consisting of subculture (Lok, Rhodes, & Westwood, 2011; Zu et al., 2010), existence of these subcultures bring diversity into the situation as they can work in agreement with TQM practices or work against it. Previous researches have not examined the influence organisational subcultures have on TQM practices (Gimenez-Espin et al., 2013; Green, 2012; Valmohammadi & Roshanzamir, 2015) in order to develop strategies for successful TQM implementation. Thus, this study will investigate the influence of organisational subculture on TQM practices in the Nigerian construction industry. The study will address the following research questions

What is the relationship between each subculture type and TQM Practices?

what is the right subculture mix for TQM implementation in Nigerain construction firms?

RESEARCH DESIGNS AND METHODS

This research reviewed literature that suggests that most researchers have looked into the relationship that exists between TQM and Organisational Sub-Culture and considers the fact that Organisational Sub-Culture precedes TQM implementation. The survey strategy will be adopted for this research. Response to the research questions will help to determine the type of subculture that should be strengthen to support TQM success in the Nigerian Construction Industry. The data collection

process points towards the positivism research philosophy and the deductive research approach, this further points towards the survey strategy since it also allows the collection of large data from the population. The survey method has been applied in research examining aspects of TQM (Akinola, Akinderawo, & Olatunji, 2012), Organisational Culture (Ivana & Martina, 2016; Oney-Yacizi, Gritili, Topcu-Oraz, & Acar, 2007)) and relationship between Organisational Culture and TQM (Haffar, Al-Karaghouli, & Ghoniem, 2013; Valmohammadi & Roshanzamir, 2015).

This study focused on construction organisations registered with the Bureau for public procurement. The target respondents of this survey are Construction Organisations in Nigeria. A comprehensive list consisting of 88,424 contractors was obtained from the BPP database. This constitutes the intended population. The determination of sample size is a common task for many applied researchers. Inappropriate, inadequate or excessive sample sizes could influence the quality and accuracy of any research. An efficient and robust formula for selecting the sample size for a research problem based on a level of significance. Cochran (1977) and Leme-Show (2011) proposed predetermined margin of error. A sample size of 383 is needed to arrive at a sample with a sampling error of at least 5% (Saunders etal,2009, Cohen et al, 2007 & Bertex et al, 2006) .The choice of 384 is consistent with the three tables for a population size of less than 100,000 with 95% confidence level and 5% margin of error.

DATA COLLECTION

To achieve the objectives of this research, it is necessary to collect information on the type of organisational subculture, and the significant TQM practices that exist in the Nigerian construction organisations. An interview was conducted to guide the respondents on the questions raised in the questionnaire. The questionnaire is divided into three sections to provide empirical evidence to answer the research questions. The first section of the questionnaire constitutes questions on personal information of the respondents. The second section of the survey instrument will examine TQM concepts and practices. To identify the practices, extensive literature review was carried out to derive a set of common practices filtered from a list of practices. Respondents were asked to indicate their agreement or disagreement on the existence of the identified TQM practices in their organisations. Likert scale was used to calculate the mean of the practices. The third section of the questionnaire will identify the dominant subculture in the organisations and its characteristics. Specifically, the six key dimensions of organisational culture (Dominant Characteristics, Organisational Leadership, Management of Employees, Organisational Glue, Strategic Emphasis, and Criteria for Success) will be measured using the Competing Value Framework (CVF). The CVF was used for assessing and profiling the dominant cultures in organisations because it helps individuals to identify the underlying cultural factors that exist in their organisations.

ANALYSIS AND RESULTS

Likert scale was used for each item measured 5 Points representing Strongly Agree and 1 point Strongly Disagree. The descriptive analysis of the data collected were analyzed using SPSS version 21 and the partial least square structural equation

modelling (SmartPls 3) for the inferential statistics. Structural equation modelling was developed out to demand to test theories and concepts by estimating the composite relationship between identified variables (Hair et al, 2014). PLS is a variance based PLS path modelling similar to multiple regression analysis in operations and has the benefit of relaxed distributional assumptions, ability to use smaller sample size while still achieving high levels of statistical predictive power (Chin, 2010; Robins, 2012)

Internal consistency: The results of the internal consistency also referred to as composite reliability for the firms is presented in table 1. SmartPls prioritizes the indicators according to their individual reliabilities and thus utilize composite reliability as against the traditional criterion of internal consistency (Cronbach's alpha). It is however interpreted in the same way as Cronbach alpha. All the constructs meet the minimum threshold of 0.70. The scores as presented in table are as follows: measurement analysis 0.812, process management 0.841, top management 0.867, workforce management 0.851, customer focus 0.848, strategic planning 0.853, marketing subculture 0.782, clan subculture 0.832, hierarchical subculture 0.825, adhocracy subculture 0.802.

Convergent validity: A common measure used in establishing the convergent validity of constructs is the Average Variance Extracted (AVE). this is referred to as the grand mean of the squared loadings of the indicator associated with each construct. Table 1 shows the AVE of the model. The findings show that the 10 constructs meet the minimum 0.50 threshold. The hierarchical subculture has the highest AVE of 0.588, adhocracy subculture 0.576, clan subculture 0.557, marketing subculture 0.552, strategic planning 0.538, process management 0.534, measurement analysis 0.523, top management 0.523 and workforce management 0.502.

Coefficient of determination (R2): The most common method utilized by SmartPls to evaluate structural model is the value of the coefficient of determination R2 value. R2 measure the predictive accuracy of the model and it represents the combined effect of the exogeneous latent variables on the endogenous variables. R2 values ranges from 0 to 1. R2 value of 0.75, 0.50 and 0.25 for endogenous latent variables can be interpreted as substantial, moderate or weak respectively.

Table 1: Composite reliability, AVE and R^2

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)	R2	Q2
Adhocracy	0.734	0.802	0.576		
Clan	0.757	0.832	0.557		
Hierarchical	0.737	0.825	0.588		
Marketing	0.798	0.782	0.552		
Customer Focus	0.774	0.848	0.530	0.457	0.273
Measurement Analysis	0.724	0.812	0.523	0.665	0.193
Process Management	0.783	0.841	0.534	0.858	0.219
Strategic Planning	0.785	0.853	0.538	0.865	0.288
Top Management	0.817	0.867	0.523	0.623	0.230
Workforce Management	0.789	0.851	0.502	0.846	0.270

Higher level indicates higher level of predictive accuracy. Table 1 shows the results of the firms. The findings indicate that the four subculture types explain 86.5% of the variance in strategic planning (Substantial), 85.8% of the variance in Process management (Substantial), 84.6% of the variance in workforce management (Substantial), 66.5% of the variance in Measurement analysis (Moderate), 62.3% of the variance in top management (Moderate), and 45.7% of the variance in customer focus (Moderate).

Path Coefficients: Table 2 shows the results of the path coefficients. Results of Path coefficients are always standardized coefficients. They vary from -1 to +1. The closest to 1 reflects the strongest paths (Hair et al, 2012). The results show that the path coefficient between the adhocracy subculture and customer focus is 0.090, with measurement analysis is 0.032, 0.041 with process management, 0.200 with strategic planning, 0.020 with top management and 0.094 with workforce management. The coefficient between the clan subculture and customer focus is 0.467, 0.415 with measurement analysis, 0.312 with process management, 0.237 with strategic planning, 0.355 with Top management and 0.308 with workforce management. The hierarchical subculture has a path coefficient of 0.185 with customer focus, 0.131 with measurement analysis, 0.079 with Process management, 0.148 with strategic planning, 0.223 with top management and 0.186 with workforce management. The marketing subculture has a path coefficient of 0.055 with customer focus, 0.184 with measurement analysis, 0.380 with process management, 0.260 with strategic planning, 0.149 with top management and 0.250 with workforce management. The adhocracy subculture has the strongest relationship with the strategic planning practice and the weakest relationship with the top management construct, the clan subculture has the strongest relationship with the customer focus practice and the weakest relationship with the strategic planning practice, the hierarchical subculture has the strongest relationship with the workforce management practice and the weakest relationship with the process management practice while the marketing subculture has the strongest relationship with the process management practice and the weakest relationship with the customer focus practice. The summary of the findings show that the subcultures have a positive relationship with TQM practices.

Table 2: Path coefficient

	Customer Focus	Measurement Analysis	Process Management	Strategic Planning	Top Management	Workforce Management
Adhocracy	0.090	0.032	0.041	0.200	0.020	0.094
Clan	0.467	0.415	0.312	0.237	0.355	0.308
Hierarchical	0.185	0.131	0.079	0.148	0.223	0.186
Marketing	0.055	0.184	0.380	0.260	0.149	0.250

Effect size F2: In addition to evaluating the predictive relevance of the endogenous constructs, the f2 effect size is also analysed. Table 3 shows the f2 results of the firms. The adhocracy subcultures have effect size of 0.03 on customer focus (small), 0.091 on measurement analysis (small), 0.016 on process management (small), 0.001 on strategic planning (small), 0.081 on top management (small) and 0.393 on workforce management (large). The clan subculture has f2 effect size of 0.023 on customer focus (small), 0.128 on measurement analysis (small), 0.066 on process

management (small), 0.658 on strategic planning (large), 0.124 on top management (small) and 0.050 on workforce management (small). The hierarchical subculture has f2 effect sizes of 0.378 on customer focus (large), 0.007 on measurement analysis (small), 0.309 on process management (medium). 0.455 on strategic planning (large), 0.008 on top management (small) and 0.050 on workforce management (small). The marketing subculture have f2 effect size of 0.001 on customer focus (small), 0.013on measurement analysis (small), 0.500 on process management (large), 0.001 on strategic planning (small), 0.002 on top management (small) and 0.732 on workforce management (large).

Table 3 F^2 Effect size

	Customer Focus	Measurement Analysis	Process Management	Strategic Planning	Top Management	Workforce Management
Adhocracy	0.003	0.091	0.016	0.001	0.081	0.393
Clan	0.023	0.128	0.066	0.658	0.124	0.050
Hierarchical	0.378	0.007	0.309	0.455	0.008	0.050
Marketing	0.001	0.013	0.500	0.001	0.002	0.732

Size and significance of path coefficients: The next step after running the SmartPls algorithm is to obtain estimates for the structural relationship between the constructs, this represents the hypothesized relationships.

Table 4: Mean, STDEV, T-Values, P-Values

	Sample Mean (M	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	sig
Adhocracy -> Customer Focus	0.087	0.061	1.487	0.138	NS
Adhocracy -> Measurement Analysis	0.030	0.059	0.538	0.591	NS
Adhocracy -> Process Management	0.037	0.051	0.794	0.428	NS
Adhocracy -> Strategic Planning	0.199	0.060	3.319	0.001	***
Adhocracy -> Top Management	0.018	0.065	0.315	0.753	NS
Adhocracy -> Workforce Management	0.094	0.067	1.403	0.161	NS
Clan -> Customer Focus	0.472	0.074	6.279	0.000	***
Clan -> Measurement Analysis	0.427	0.070	5.970	0.000	***
Clan -> Process Management	0.319	0.064	4.888	0.000	***
Clan -> Strategic Planning	0.241	0.071	3.344	0.001	***
Clan -> Top Management	0.362	0.072	4.948	0.000	***
Clan -> Workforce Management	0.306	0.067	4.579	0.000	***
Hierarchical -> Customer Focus	0.185	0.066	2.813	0.005	**
Hierarchical -> Measurement Analysis	0.123	0.075	1.745	0.082	*
Hierarchical -> Process Management	0.075	0.064	1.246	0.213	NS
Hierarchical -> Strategic Planning	0.145	0.069	2.133	0.033	NS
Hierarchical -> Top Management	0.220	0.063	3.550	0.000	*
Hierarchical -> Workforce Management	0.183	0.059	3.158	0.002	*
Marketing -> Customer Focus	0.053	0.057	0.963	0.336	NS
Marketing -> Measurement Analysis	0.184	0.064	2.870	0.004	**
Marketing -> Process Management	0.381	0.053	7.179	0.000	***
Marketing -> Strategic Planning	0.260	0.062	4.179	0.000	***
Marketing -> Top Management	0.149	0.060	2.481	0.013	**
Marketing -> Workforce Management	0.255	0.053	4.740	0.000	***

*Source: Field Study (2017) Note: NS = not significant. a. Bootstrap confidence intervals for 10% probability of error (a= 0.10). *p < .10. **p < .05. ***p < .01, NSP= Not supported, SP=Supported*

To determine if a coefficient is significant depends ultimately on its standard errors, this can be obtained by means of bootstrapping.

The bootstrapping standard error allows the T value to be computed. When the t value is larger than the critical value, the coefficient can be interpreted as significant. To test for the statistical significance of SmartPls paths, the bootstrapping technique is used to resample the cases to determine the t statistics value that indicates the level of significance of the paths. table 4 shows the t statistics and p value results associated with each path result for the firms. A total number 24 path relationships exist between the four subculture types and the six TQM practices. A total number of sixteen significant and eight non-significant relationships exists between the exogenous and the endogenous variables. The clan subculture has six significant relationship with measurement analysis, process management, strategic planning, customer focus, workforce management and top management, the adhocracy subculture has one significant relationships with strategic planning, the hierarchical subculture has four significant relationships with customer focus, top management, workforce management and measurement analysis while the marketing subculture has five significant relationships with process management, top management, customer focus, measurement analysis and workforce management practice. The empirical results of the paths significance show that the four subcultural types influence the different TQM Practices however the result of indicates that the clan subculture is significantly related to all six TQM practices and this finding confirms the importance of the clan subculture for TQM implementation in the firms.

Predictive relevance Q2: According to Cohen (1988), Q2 results can be interpreted as 0.02 represents a “small” predictive relevance, .15 represents a “medium” predictive relevance, and .35 represents a “high” predictive relevance. Based on this, table 1 shows that strategic planning has a Q2 value of 0.288 (medium), process management has a Q2 value of 0.219, workforce management has a Q2 value of 0.270 (medium), measurement analysis has a Q2 value of 0.193 (medium), top management has a Q2 value of 0.230 (medium) and customer focus has a Q2 value of 0.273 (medium)

DISCUSSION OF RESULTS

The empirical results of this study show that different subculture types influence different TQM practices. The findings indicate that the clan subculture and the marketing subcultures are the predominant subculture types in Nigerian construction firms, the clan subculture is significantly related with the six TQM practices while the marketing subculture is significantly related with five out of the six TQM practices. The importance of the clan subculture for TQM implementation is reported in of Zu et al (2009), Kairimi et al (2012), Haffar et al (2013),Marofi et al (2012), Naor et al (2008) and the importance of the Marketing subculture for TQM implementation is reported in Willar et al (2016), Igo & Skitmore (2006). The clan subculture is focused on internal relationships and is flexible. market culture is a results-oriented workplace. Leaders are hard-driving producers and competitors. They are tough and demanding. The results presented in table 2 also indicates that construction firms in Nigeria supports all the hypothesized relationships between the subcultures and TQM practices. the findings support the findings of Harinarian, Bornman & Botha (2012), Arditi Nayak & Damsi (2017).

CONCLUSION AND RECOMMENDATIONS

Culture has been recognized in literature as critical for TQM implementation, however previous research view organisations has having one culture type. Previous research has viewed organisations as having one culture type, however, few organisations are featured by only one culture type, rather the profile consists of subculture types. This study has examined the relationship between each subculture type and each TQM practice by using the Structural equation modelling to investigate the possible relationships that exists between organisational subcultures and TQM practices. this study supports the all the theoretical relationships that exist between the clan subculture and customer focus practice, workforce management and process management. The adhocracy subculture also has a positive relationship with customer focus, marketing subculture and customer focus practice, workforce management practice and process management practice. The relationships between the hierarchical subculture and workforce management is also positive thus construction organisations in Nigeria supports all the theoretical relationships between organisational subculture and TQM practices. To successfully implement TQM Construction firms in Nigeria should emphasize the clan and marketing subculture types. The clan subculture has positive significant relationships with all the six TQM practices while the marketing subculture has five significant positive relationships with TQM practices. Effective TQM implementation requires a careful consideration of the subcultural profile of each firm before implementing. Managers need to assess the subcultural values of their firms and develop necessary action policies and plan ahead to create a supportive subcultural environment to ensure successful implementation. The instrument for data collection used in this research is a pre-TQM tool, this should be adopted for periodic/continuous self-assessment

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INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) APPLICATION ON CONSTRUCTION SUPPLY CHAIN MANAGEMENT: EVIDENCE FROM NIGERIA

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With the advent of information and communication technology (ICT) these days, construction supply chain management (CSCM) related activities can be achieved seamlessly via real-time information dissemination and sharing with a view to reducing conflicts and delays. This study therefore, sorts to examine the effects of ICT on CSCM. To achieve the purpose of this study, a quantitative research approach was adopted for the study. Based on the outcome of the literature review, some hypotheses were proposed in relation with ICT and CSCM. Data for the study were collected from practitioners within the Nigerian construction industry via a purposive/convenience sampling technique. A total of 214 questionnaires were distributed based on the Krejcie and Morgan's method, while 203 were retrieved and used for further analysis. Structural equation modeling (SEM) was used to test the hypotheses. The results of the study reveal that ICT had a significant relationship with CSCM. The constructs associated with ICT, viz; deployment of web based & other software and portals, use of internet applications and web based technologies, use of mobile devices & personal digital assistants, and integrating radio frequency & identification (RFID) technology had a significant and positive relationship with CSCM. A better implementation of ICT is the key to enhancing the successful delivery of construction projects to fruition.

Keywords: construction projects, construction supply chain management, information and communication technology, Nigeria, structural equation modelling

INTRODUCTION

The coming into existence of the internet in the early 90s brought with it a new beginning that is hinged on the deployment of information and communication

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technology (ICT) in virtually all human endeavours. Hence, most organisations in other developed climes of the world have to a greater extent deployed ICT in carrying out their various day to day activities with a view to supporting extant inter and intra-firm relationships (Adzroe and Awuzie, 2018; Tserng et al., 2005). The construction industry as opined by (Wang et al., 2007), is extremely complex, this complexity is due to the fact the entire project development process generally consist of several phases requiring a myriad of specialized services as well as the involvement of numerous participants. Hence, to control and coordinate construction project activities effectively becomes extremely difficult owing to the involvement of various participants with diverse backgrounds.

Rivard (2000) opined that the main purpose of ICT is to facilitate the sharing and management of information that posses a lot of potentials that would accrue to the construction industry via information processing (Sarosa and Zowghi, 2003). According to Gaith et al. (2012), the use of ICT in construction is expected to expand given the fact that organizations are beginning to realize the importance and role of ICT in achieving and maintaining a competitive advantage in the industry (Wikforss and Löfgren, 2007). Xue et al. (2007) posited that in time past, there has been an increase in the globalization of markets and as such, the ability of firms to concentrate on their core competencies invariably gave rise to increase in supply chain coordination via supply chain management (SCM).

A myriad of definitions have been offered with respect to SCM, hence, within the context of this paper, SCM could be adduced as “an integrated and collaborated supply chains be it an upstream or downstream, inter or intra organization with the same goals and objectives for long term relationship integration” (Abd Shukor et al., 2011 p.112). While Ribeiro and Lopes (2001), defined supply chain (SC) as consisting of series of individual activities or processes that constitutes in the transformation of raw materials into finished products that could be purchased by a client. They (Ribeiro and Lopes, 2001) further stated that a SC with regards to construction can be inferred to be a process /series of activities that transforms raw materials into finished deliverables like roads or buildings and services for possible use by a client. Akintoye et al.(2000), sees SCM as the process of strategically managing the flow and storage of materials, parts and finished inventories from the suppliers, via the firm and to final consumers. The various definitions that have been proposed by various scholars as opined by Akintoye et al. (2000), virtually indicates that SCM prescribes in clear terms more of an organizational restructuring process that is extended to the entrenchment of a company-wide collaborative culture.

As opined by Tserng et al. (2005), most professionals handling construction projects on site, need access to the site to manage the project because most of the construction projects are operated in the remote areas of the construction sites. Hence, the use of desktops or even notebooks may not be convenient for the construction sites largely due to inconveniences associated with handling. Most on-site practitioners generally handle various types of digitally-related types of information, such as reports, drawings, checklists, and specifications. The use of sheets of paper and/or field notes becomes the order of the day. The resultant effect of this is a gap in time and space between the site and the office, which often leads to low efficiency, delays and other problems that might affect the entire

project. Achimugu et al.(2009) opined that ICT's use has diffused rapidly in other developed climes, but its diffusion has been generally slow in developing climes and as such this has led to a widening gap in ICT viz the digital divide amongst the two climes. The construction industry according to Xue et al. (2007), is characterized with high level of fragmentation, cost and schedule overruns, disputes and conflicts, as well as low level of productivity compared to other industries. They (Xue et al.,2007) further opined that these are the major characteristics and causes of performance-related problems confronting the construction industry. Contractors most times rely more on interactions via telephone or fax when communicating with suppliers, subcontractors and designers. In most cases these transactions are frequently lost or misunderstood between sites and offices, and among all participants, when these facilities are malfunctioning or not existing at all. This often leads to ineffectiveness and inconveniences in the discharge of their job functions (Wang et al., 2007).

Hence, the need for this study to take a look at these aspects. The objectives of this study are to examine and analyze the effects of the deployment of ICT on CSCM. Thus, the following hypotheses were postulated with a view to testing the relationship between the variables.

- Hypothesis H1: Deployment of web based and other software and portals positively affects CSCM.
- Hypothesis H2: Use of internet applications and web based technologies positively affects CSCM.
- Hypothesis H3: Use of mobile devices & personal digital assistants positively affects CSCM.
- Hypothesis H4: Integrating radio frequency & identification (RFID) technology positively affects CSCM.

LITERATURE REVIEW

ICT in construction

ICT to a greater extent has been responsible for driving the entire construction process from information generation through to transmission and interpretation with the intent to enable the realization of a construction project's objective. In a nutshell, it has contributed to transforming individuals and organisations activities (Onyegiri et al., 2011). As stated by Usman and Said (2012), construction firms deploy the use of technological devices in overcoming problems and improve on their construction activities. They (Usman and Said, 2012) further opined that ICT facilities also contribute to providing better communication amongst team members in construction projects. These to a greater extent are some of the benefits and values associated with the use of technology and ICT facilities in curtailing risk, waste of valuable time in a bid to achieve some specific objectives.

The construction industry according to Olalusi and Jesuloluwa (2013), depends to a larger extent on the use of huge amounts of information during the construction and the entire project life-cycle process. In such case, it becomes expedient that information is made readily available to the construction sites in such a way that data integration is enabled, task controlled, and communication amongst the various SC entities like the company and its suppliers, as well as the entire materials

and resources are properly coordinated. This type of information as stated by Olalusi and Jesuloluwa (2013) contributes to the necessary support needed by project participants to carry out the construction phase of the project to fruition within the acceptable cost and schedule limits. Hence, the use of ICT facilities that are capable of improving information dissemination are fundamental in improving decision-making process during construction.

SCM and the construction industry

With the attendant increase in competition and technology enabled activities, most firms are beginning to see the need to adopt SCM as an integral component of their strategic competence, which in essence is believed would lead to achieving a competitive advantage (Othman and Rahman, 2010). SCM according to Amade (2017), is a process that strategically manages the movement, storage of materials, parts as well as finished inventories from the suppliers, via the firm and to the final consumers. The main focus of SCM as stated by Hai et al.(2012) is to maintain a collaborative relationship amongst the SC members with a view to maximizing competitive advantage and achieving a more profitable outcome for the entire SC entity. Vrijhoef and Koskela (2000) reiterated that SCM originated and flourished in the manufacturing industry, and one of the visible signs of SCM was observed from the just-in-time (JIT) delivery system, which is a subset of the Toyota Production System. According to Voordijk and Vrijhoef (2003), SCM has been adjudged as an emerging field of study as well as a potential source of enhancing the performance of the construction industry. Given the specific nature of construction SCs and the attendant industrial and economic context, there's need for the inclusion of particularly, the temporal and fragmented nature of project-based multi-organizational construction SC, compared to the permanent production-based organizations such as that of the manufacturing industries (Voordijk and Vrijhoef, 2003).

The deployment of SCM to the construction industry is a recent phenomenon that is challenging largely due to the nature of the industry and its hectic nature in terms of specialisation of work packages as well as the fragmentation of the entire process amongst the SC partners (Othman and Rahman, 2010). According to Othman and Rahman (2010), when comparing the construction industry with other industries such as manufacturing, the construction industry involves a range of component parts with a unique site or project requirements. Given the immoveable nature, product and size of construction products, it product is usually assembled at a particular point of consumption (Othman and Rahman, 2010). With this development, it is not usually possible to assume a single firm would possess the power or ability to single-handedly coordinate the entire SC, but each member of the SC can influence and be influenced by the entire SC (Othman and Rahman, 2010). The objective of SCM as stated by Robert et al.(1999), is to precipitate cost-effectiveness, efficiency and improve on services, enhance communication among SC components, as well as increase flexibility via improved delivery and response time. They further stated that, it is also necessary and important to achieve SCM in construction for purposes of improving inefficiency, avoid mistakes and delays, poor communication in construction processes.

It is imperative to state that there are a myriad of studies on the deployment of ICT in the construction industry, some of them are studies carried out in Nigeria

(Oladapo, 2006), Malaysia (Mui et al., 2002), Canada (Rivard, 2000; Rivard et al., 2004), New Zealand (Dorherty, 1997), Sweden, Denmark and Finland (Howard and Samuelson, 1998, Howard et al., 1998, Samuelson, 2002); Hong Kong (Futcher and Rowlinson, 1998, Futcher and Rowlinson, 1999); Saudi Arabia (O'Brien and Al-Biqami,1999); Australia (Masqood et al.,2004) amongst others. It also interesting to note that none of the above mentioned studies was conducted with a view to x-raying on the critical ingredients of CSCM on one hand. Secondly, the above mentioned studies did not deploy the use of structural equation modeling (SEM) approach in analyzing their findings. Hence this study intends to fill in this gap by adopting SEM in evaluating the influence of ICT on CSCM. As opined Molenaar et al. (2000), SEM is construed as an extension of a standardized regression model used in resolving problems associated with poorly measured independent variables and is mostly deployed on construction engineering and management related researches. While Byrne (2010) is of the view that SEM is an equivalent of a graphical and mathematical representation of a set of equations namely a dependent variable and a set of explanatory variables (Bollen and Long, 2010; Hair, et al., 1998; Jackson et al., 2005). SEM is more superior to other multivariate techniques like factor analysis, multiple regression and path analysis, hence its use in modern day researches (Ng et al., 2010).

CONCEPTUAL MODEL

Deployment of web based and other software and portals and CSCM-(DWBSP)

According to Viswanadham and Kumar (2006), ICT has altered the way information is stored and transferred from one place to another and the construction sector is no exception to this. Viswanadham and Kumar (2006) further opined that the use of information technology in construction is limited in the areas of accounting, project control, drafting, wireless communications etc. Example of firms that had utilized ICT resources in achieving transformational growth according to Viswanadham and Kumar (2006) include; Wal-Mart, Dell Computers etc. According to Tarantilis et al. (2008), web-based technologies are cost effective, efficient and of recent, have been the target of most development efforts. Web-access has been facilitated by recent advances in telecommunications and network technologies that have given rise to the creation of virtual private network (VPN) structures which connects various enterprise spatial entities. In the construction sector, computer aided design (CAD) has consistently helped in reducing cycle time, productivity and accuracy whenever there is need for a change in design. While other construction firms use productivity and cost reduction software applications like Primavera, CAD design tools, enterprise information portals for multi-project visibility and other costing and scheduling modules. E-business is another tool that is gradually becoming a primary means of trading in the European construction industry (Ribeiro and Lopes, 2009). This according to Ribeiro and Lopes (2009), is demonstrated by the proliferation of portals, such as the e-commerce and e-business sites in the industry.

Use of internet applications and web based technologies, and CSCM- (UIWBT)

ICT has been adjudged as one of the essential ingredients for organizational survival, success and enhancement of SCM activities via the supporting and integration of business processes across the various functional units (Yu, 2015). The importance of ICT according to AbTalib and Hamid (2014) in SCM cannot be underestimated as information has always been the pivot in the efficient management of logistics. With the introduction of personal computers, fiber optic networks, the internet explosion and the world wide web (WWW), the cost and availability of information resources enables easy and fast linkages which eliminates information related schedule delays within any SC (Handfield and Bechtel, 2002). These technologies as stated by Handfield and Bechtel (2002), are SC enablers, this implies that, they can be used in minimizing the level of paper works, improve communication, as well as minimize SC cycle times. While Ribeiro and Lopes (2009) on the other hand, were of the view that internet applications and web based technologies have emerged as the most effective means of achieving SC integration in the realization of construction projects. According to Xue et al.(2007), the construction industry is adjudged to be an information dependant industry given its diversity in terms of information generating procedures that are associated with detailed drawings and photos, cost analysis sheets, budget reports, risk analysis, charts, contract documents, and planning schedules. The internet on the other hand, plays a key role in fostering the integration of construction business processes across the construction SC by way of facilitating information flows necessary for coordinating construction activities. According to De Oliveira et al. (2011), supplier and customer oriented processes have been significantly affected by the advent of ICT. They opined that the consistent use of internet and ICT applications has led to creating a positive impact on information visibility amongst SC partners thus leading to an improvement in SC performance. Other critical benefits includes; the possibility of breaking organizational barriers by disseminating critical information and interacting on a near real-time on line basis across the SCs and the possibility of monitoring processes in order to reduce decision cycle processes thus allowing upstream suppliers and customers respond more abruptly and consistently.

Use of mobile devices, personal digital assistants and CSCM- (UMDPA)

ICT plays a significant role in controlling and managing construction projects successfully, especially in enhancing communication and coordination among SC partners (Tserng et al., 2005). According to Usman and Said (2012), mobile technology refers to a situation where a technology can move around with the user, but may not necessarily be online real-time; hence, users can download a software, send e-mail messages, and access web pages on their personal digital assistants (PDA), laptops, or other mobile devices. Tserng et al.(2005), reiterated that active communication and coordination needs to be sustained with a view to supporting effective sharing of resources and competencies in a construction SC network. Hence, introducing promising ICT facilities such as bar code scanners, PDAs, and data entry mechanisms, can be of outmost importance in improving the effectiveness and convenience of information dissemination in construction SC systems. As stated by Ward et al. (2004), standardized packages exist for use by mobile site workforces who are more often targeted towards pre-determined

inspection and reporting tasks. Unlike what exist in the manufacturing sector, the construction site is more of a reactive environment, where unexpected changes to work regularly occur.

Integrating radio frequency & identification (RFID) technology and CSCM-(RFIDT)

RFID is an automatic device that identifies and captures data and it consist of three elements viz; a tag that is connected to a chip by an antenna; a reader emitting radio signals and receiving responses from tags, and a middleware that connects RFID hardware and enterprise applications (Sarac et al., 2009). According to Usman and Said (2012), RFID technologies makes use of active and passive tags in the form of chips or smart labels that can store unique identifiers and translate such information to electronic readers. The tag consists of a microchip that holds data with the aid of an electronic product code (EPC) and antenna that transmits data to a reader. The reader thereafter uses radio waves to read the tag and sends the EPC to computers in a SC (Usman and Said, 2012). Furthermore, Wang et al. (2007) reiterated that with the introduction of promising technologies like the RFID, and web portals, substantial improvements could be felt via the convenient flow of information in the construction SC control systems. While Sarac et al.(2009) were of the view that RFID technologies could also help in improving SCM activities viz; the reduction of inventory losses, increase in efficiency and speed of processes, while also improving information accuracy. Unlike bar codes, RFID can identify and track products and equipments on line real time without contact or line-of-sight, hence it can withstand harsh, and rugged environments. These advanced identification and communication characteristics of RFID as stated by Sarac et al.(2009), could help in improving product traceability and visibility among SCs. For instance, RFID can improve on accuracy, efficiency and increase the speed of processes. It can also decrease storage, cost of handling and distribution as well as improve on sales by decreasing the number of stockouts. The contribution of RFID to SCM is not only related to increasing the efficiency of the entire system, but also support the reengineering of the systems so that they become more efficient.

Figure 1 shows the 4 proposed research hypotheses alongside the conceptual model of positive impacts.

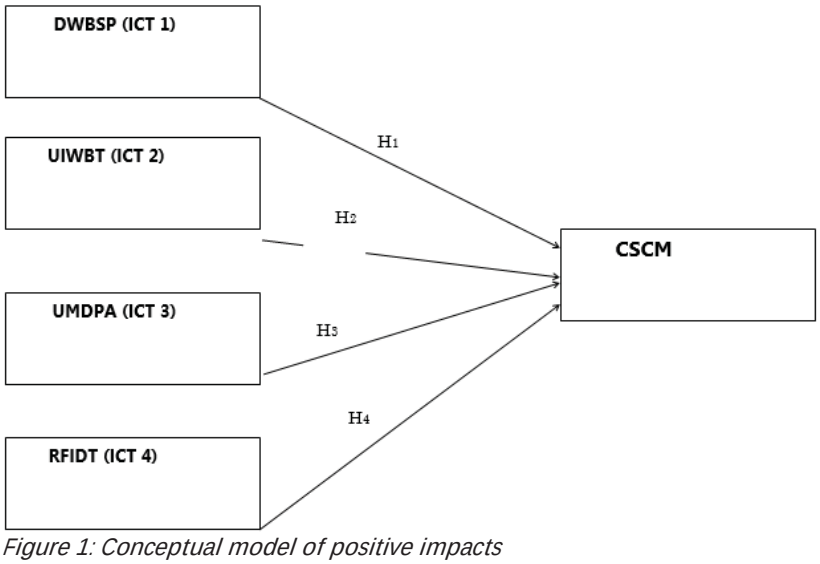

Figure 1: Conceptual model of positive impacts

RESEARCH METHODOLOGY

The study adopted a quantitative approach and specifically, a cross sectional research design method of research. While data was collected from some selected (targeted) construction firms located in Port-Harcourt, Rivers State, Nigeria who by their very nature are involved in construction SC related activities. A self-administered questionnaire was deployed for data collection. A total of 203 useable questionnaires were retrieved for analysis from a sample size of 214 using the Krejcie and Morgan methods of sample size determination (Krejcie and Morgan, 1970). The questionnaire had an introductory section and other demographic information. The questionnaire further included sections about the respondent's ICT and internet usage habits with particular reference to CSCM. To measure the constructs of the study, a five-point labelled Likert-type scale was used in measuring the level of agreement with respect to items measuring perceived use and attitude with regards to ICT and CSCM where 1 indicates 'strongly disagree' and 5 'strongly agree'. Data for the study was collected over a five-week period. Cronbach Alpha values for each of the four constructs were computed to measure the reliability of the items used in the research instrument after a thorough data editing using IBM Statistics SPSS Version 22.0. Exploratory factor analysis (EFA) was also used in discovering the underlying relationships existing between the items in the study's constructs. The results of the EFA gave rise to the different constructs in the study being retained. Statistical techniques such as the Structural Equation Modelling (SEM), the latent variables and the theoretical models that are built with EFA and Confirmatory Factor Analysis (CFA), and the different hypotheses formulated for the study were tested (Su and Yang, 2010).

Analysis and Results

A total of 208 responses were retrieved from the 214 questionnaires distributed amongst which 203 were found to be usable after a thorough data editing, which consist of the exclusion of the unwarranted responses and multivariate outliers. The data analysis process consists of three categories as explained below.

Data Screening

Data screening consists of sorting of data prior to the final data analysis. The stage consists of identifying missing values, outliers, and collinearity. Responses with missing values and outliers were initially excluded via a manual screening process before their collinearity statistics were assessed. According to Hatcher (2005), the extent to which two or more latent variables are correlated with each other is called multicollinearity.

Table 1: VIF value for multicollinearity

Variables	VIF values
DWBSP	2.443
UIWBT	2.675
UMDPA	2.245
RFIDT	2.315

Multicollinearity could lead to a lot of problems, one of which is the complication in interpretation and computation of relationships. Hence, this study chose CSCM as the dependent (observed) variable and the four ICT approaches to CSCM as the independent (latent) variables for multicollinearity via linear regression. From table

1 below, all the computed VIF values are less than 10, which is a clear manifestation that there is no case of a multicollinearity in the data set.

Reliability Analysis

In a bid to obtain high quality statistical data, the need to determine the validity and reliability of the measuring instrument becomes imperative (Bollen and Long, 2010). For the purpose of this study, the process of assessing the internal consistency of the instrument for data collection was conducted using the Cronbach alpha test (Ikediashi et al., 2013; Su and Yang, 2010). As stated by Hatcher (2005), the value of the coefficient (Alpha test) showing greater than 0.70, indicates a good representation of results of the instrument based on the considered population. Given the obtained Cronbach alpha coefficient of internal consistency of the set of questions on the questionnaire, (DWBSP to CSCM), the validity and reliability of the questionnaire on ICT and CSCM has been proven. One can deduce that the results of the research would be reliable.

Table 2: Cronbach's Alpha's Test of Latent variables, composite reliability, and average variance extracted

Constructs	Number of items	Cronbach's α	Composite reliability	Average variance extracted (AVE)
DWBSP	4	0.966	0.775	0.879
UIWBT	3	0.783	0.823	0.593
UMDPA	4	0.889	0.842	0.776
RFIDT	2	0.872	0.836	0.657

Factor Analysis

In applying factor analysis, the testing of the adequacy of the sampling was carried out (Measures of adequacy sampling) using the Kaiser-Meyer-Olkin (KMO) test and Bartlett test of sphericity. As a basis for recommendation, the accepted minimum value for KMO is 0.6, while the level of significance of the Bartlett's test is pÓ0.05 (Bollen and Long, 2010; Hatcher, 2005). In this study, the result of the KMO coefficient is 0.683, an indication that the data collected are convenient for application and use for factor analysis. The Bartlett test of sphericity indicates that ($\chi 2 = 154.22$, $p < 0.000$), indicating that there are correlations among the items within the measurement instrument, thus indicating that the correlation matrix is not an identity matrix (Chai et al.,2015).

Correlation Matrix of the Variables

This aspect of the study examines the correlation existing amongst the 13 items on the questionnaire (variables) and CSCM in the construction firms.

Table 3. Inter-correlations among five ICT and CSCM within proposed model

Coefficients	DWBSP	UIWBT	UMDPA	RFIDT	CSCM
DWBSP	1.00				
UIWBT	0.38	1.00			
UMDPA	0.30	0.22	1.00		
RFIDT	0.01	0.45	0.33	1.00	
CSCM	0.65	0.65	0.00	0.27	1.00

For the purpose of this study sample, the correlation coefficients in the matrix in table 3 fulfill the eligibility level of 0.05. This signifies that a significant correlation exists between the 13 items on the questionnaire, and therefore the application of

factor analysis is justified. The correlation matrix of five factors of ICT and CSCM is shown in table 3.

Exploratory Factor Analysis

An exploratory factor analysis (EFA) was conducted with a view to retrieving the key factors of ICT and CSCM in the selected construction firms. The relationship that exist between the identified variables, is such that on the basis of the identified correlations, the regrouping of the variables into smaller set of variables can be carried out with a view to representing a concise and understandable structure of the variables (Memon et al.,2013). The EFA analysis carried out on the set of 13 variables amongst the proposed groupings were established and the obtained results showing the factor loadings and communalities of the constructs as shown in table 4. Factor loading depicts the correlation coefficient existing between the original variable and the extracted factor. While the communality variable defines the proportion of total variance computed on the basis of common factors (Memon et al.,2013).

Table 4: Results of Exploratory Factor Analysis

Constructs		Factor Loadings	Communalities
ICT 1.1	DWBSP	0.822	0.952
ICT 1.2		0.819	0.951
ICT 1.3		0.792	0.967
ICT 1.4		0.791	0.967
ICT 2.1	UIWBT	0.791	0.879
ICT 2.2		0.733	0.861
ICT 2.3		0.654	0.796
ICT 3.1	UMDPA	0.652	0.684
ICT 3.2		0.625	0.848
ICT 3.3		0.605	0.961
ICT 3.4		0.602	0.972
ICT 4.1	RFIDT	0.587	0.861
ICT 4.2		0.509	0.744

Structural Model Assessment

With the aid of IBM Statistics SPSS version 22.0 software, the Path Model Analysis was carried out with particular reference to the outcome of the conceptual model in figure 1. The outcome of the structural model is shown in figure 2. The figure/value above the arrow indicates the value of the regression coefficients (β-path coefficient). It explains the strength of the relationship existing between the observed and latent variables and as such are related to the effect of DWBSP (ICT 1), UIWBT (ICT 2), UMDPA (ICT 3) and RFIDT (ICT 4) on the dependent variable CSCM. The figures/values appearing below the arrows indicate the values of the t-test. The coefficient of determination (R2), is shown on the symbol of the dependent variable. It shows the inclusion of the explained variance in total, that is, how the variations of the observed variable are explained by the predictor variable. Hence, it can be inferred that all the ICT variables have moderate effects on CSCM. Furthermore, it necessary to check for the significance of these results for the acceptance or rejection of the hypothesis. Table 5 shows the results of the parameter estimates and hypotheses tests. The results so obtained have sufficiently supported the proposed hypotheses as significant. This study determined the hypotheses according to a one-tailed test with a 95% confidence interval. Table 5 shows that DWBSP (ICT 1), UIWBT (ICT 2), UMDPA (ICT 3) and RFIDT (ICT 4) have

positive and significant effects on CSCM, as all t-values are greater than 1.645 and P-values greater than 0.05.

Table 5: Parameter estimates and results of hypotheses

Constructs	ß-value	t-value	Results
DWBSP ⟶ CSCM	0.309	14.057	Supported
UIWBT ⟶ CSCM	0.274	15.287	Supported
UMDPA ⟶ CSCM	0.183	8.910	Supported
RFIDT ⟶ CSCM	0.078	4.571	Supported

Significant at p > 0.05

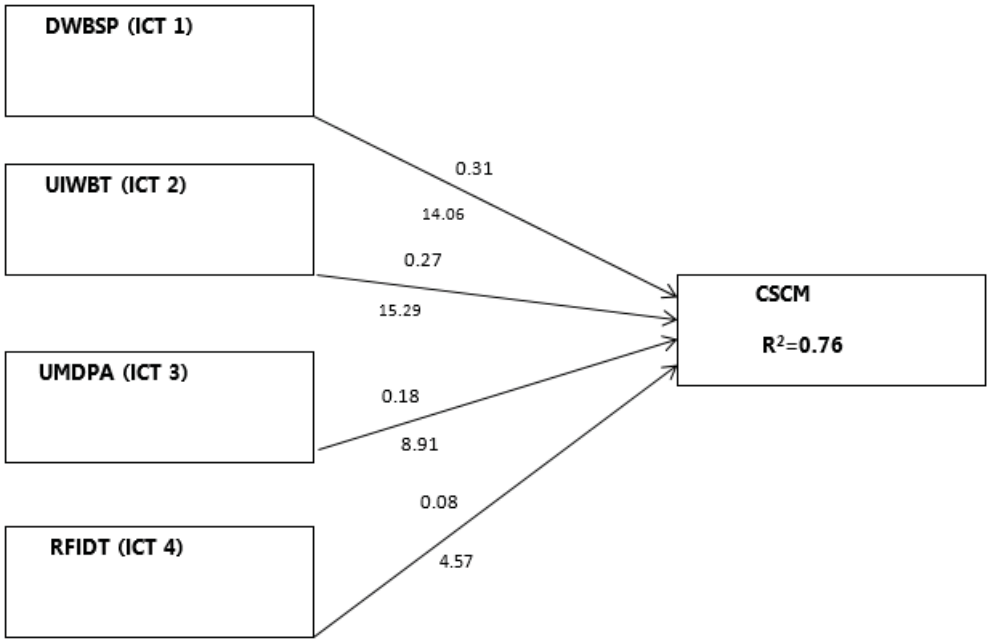

Figure 2: Structural model

Model Fit Measures

A Goodness-of-fit measure of structural models was carried out. Values of the most significant fits are displayed in table 6. Based on the outcome of the results, the values of the fit measures were analyzed based on which of the models satisfactorily or unsatisfactorily fits the initial data by way of comparing the obtained values with recommended values. The Root Mean Square Error of Approximation (RMSE) was obtained based on the approximate error that occurred due to the expected degree of freedom from the studied population. A low value of RMSEA implies a greater correspondence, in other words, the better the fitting of the model to the input data. Hence, the acceptable congruence is below 0.10 (Hatcher, 2005; Su and Yang, 2010).

The Goodness-of-fit index (GFI), determines the extent to which the model is more applicable compared to when the model does not exist. This indicator falls between the range (0-1), where 0 implies a poor and 1 signifies a perfect match. Acceptable values are the ones greater than 0.8 (Hatcher, 2005; Su and Yang, 2010).

The Adjusted Goodness-of-Fit Index (AGFI), CFI (Comparative Fit Index), IFI (Incremental Fit Index), NFI (normed Fit Index), NNFI (Non-normed Fit Index) and RFI (Relative Fit Index) indicates a situation where the considered model depicts a

profound increase in correspondence. Values of AGFI, CFI, IFI, NFI, RFI, NNFI are considered acceptable if they are greater than 0.9 (Eybpoosh et al.,2011).

Parsimony of the proposed model is considered based on the average value of chi-square and degree of freedom (χ2 / d.f.). Fitting of the data is considered satisfactory if the value is greater than 1 and less than 3. Furthermore, the process confirms that the data are a good representative (Aibinu et al., 2010; Zainudin, 2012).

Table 6: Summary of Model Fit Measures

Fit Indicators	Model Estimates	Cut off values
Chi-square (χ2)	154.22	-
Degree of freedom (d.f)	78	-
Relative Chi-square (χ2 /d.f)	1.98	<3.0
Root Mean Square Error of Approximation (RMSEA)	0.087	0.08-0.10
Goodness-of-Fit Index (GFI)	0.92	>0.9
Adjusted Goodness-of-Fit Index (AGFI)	0.93	>0.9
Normed Fit Index (NFI)	0.90	>0.9
Non-Normed Fit Index (NNFI)	0.94	>0.9
Comparative Fit Index (CFI)	0.92	>0.9
Incremental Fit Index (IFI)	0.91	>0.9
Relative Fit Index (RFI)	0.94	>0.9

DISCUSSION OF RESULTS

Based on the outcome of the results, it can be seen that the reliability and validity of the measurement scale was achieved based on the estimates of the interconsistency of the instrument used in collecting data via the Cronbach alpha test. Based on the results shown in table 2, the values of Cronbach alpha coefficients for all 4 groups of questions are greater than the recommended value of 0.7, it can be concluded that there is an internal consistency of all 4 groups of the control model. These findings are in line with similar findings of (Su and Yang, 2010; Ikediashi et al., 2013). In testing the adequacy of sampling with the aid of factor analysis, the KMO and Bartlett test of sphericity was conducted. The value of KMO indicator was 0.683. Bartlett test of sphericity indicates a significance level of ($\chi2 = 152{,}22$ $p < 0.000$), implying that there are important correlation existing amongst the items within the measuring instrument, hence, majority of the correlation values lie between or above 0.50 (See table 3). It is evident that based on the outcome of the indicators, the data are deemed suitable for factor analytical approach. In deploying exploratory factor analysis as shown in table 4, 5 factors were extracted viz; DWBSP, UIWBT, UMDPA, RFIDT and CSCM. These findings illustrate the formation of the conceptual model for this study.

A structural model depicting the outcome of the hypotheses testing is as shown in figure 2. The findings show that the four hypotheses were confirmed, acceptable and statistically significant (H1, H2, H3 and H4). With the outcome of these hypotheses, the regression coefficients had positive values, and as such, the t-test values were higher than the recommended threshold value of 1.96. The underlisted results were obtained for the above mentioned hypotheses viz; H1 ($\beta = 0.309$; $t = 14.057$; $p < 0.05$); H2 ($\beta = 0.274$; $t = 15.287$; $p < 0.05$); H3 ($\beta = 0.183$; $t = 8.910$; $p < 0.05$); and H4 ($\beta = 0.078$; $t = 4.571$; $p < 0.05$). Hypothesis H4 (RFIDT) had the least

β-value, even though that it is statistically significant, its value of t-test was still greater than recommended 1.96 (β = 0.078; t = 4.571; p <0.05).

The first hypothesis was significant; it implies that deployment of wed-based software and portals (DWBSP) positively affects construction SCM. Tarantilis et al. (2008), also reported similar findings in their study. They opined that most web-based technologies are efficient, cost effective and recently has been the most sought out in terms of developmental efforts.

The findings further depicts that the coefficient of determination (R2) indicates that the influences of the latent predictors H1, H2, H3, and H4 on the latent endogenous variable CSCM may be calculated with 76% of the variance. The outcome of this finding is that the demand for ICT in CSCM may not be the same with other advanced climes; hence, there is need for another study to look at the main areas of RFIDT as this aspect of the study turned out a low β-value. As stated by Sarac et al.(2009), the applications of RFID technologies are still limited because the costs associated with it are still expensive. The implications of these results are from the theoretical and practical points of view. From a theoretical point of view, the use of RFIDT is a new variable that should be accorded ample attention in the study of CSCM and ICT application in the Nigeria construction industry. While from a practical point of view, project managers in charge of construction projects should not overlook the influence of RFIDT. This study confirms that RFIDT positively affects CSCM of the construction firms with the least value.

The findings of the structural analysis of the model are as depicted in figure 2 and table 6. The structural model of the Root Mean Square Error of Approximation (RMSEA) has a value of 0.087, implying that based on this value, a favorable congruence exist with the proposed model. The Goodness-of-Fit Index (GFI) value also depicts a good correspondence of the model, giving the resulting value of the indicator as 0.92. Hence, based on the values of RMSE and GFI indicators, it can be deduced that there is an absolute coincidence with the proposed model. The values of the indicators of the structural model are for AGFI = 0.93; NFI = 0.90; NNFI = 0.94; CFI = 0.92; IFI = 0.91 and RFI= 0.94. The values are deemed to be acceptable since they are above 0.90, thus indicating that the models depict a solid increase of concurrency. This finding agrees with that of Zainudin (2012), who opined that a model should at least meet one of the fitness requirements in terms of absolute, incremental and parsimonious fits. Parsimony of the proposed model is measured based on the relative value of chi-square (χ2 / d.f.) which equals 1.98 representing the recommended threshold value of between 1 to 3, which is a confirmation that the initial data are true representatives. Based on the outcome of the indicators of fitting of the structural model, it is imperative to characterize the model as absolutely appropriate. The conclusion in a general term is that all 13 variables can in a reliable and valid manner be described as being responsible for the 5 groups of variables based on the conceptual model shown in figure 1.

CONCLUSION

This study investigated the role of ICT in CSCM among some selected (targeted) construction firms in Port Harcourt, Rivers State, Nigeria. ICT can be used as a strategic tool to enhance CSCM practices, particularly in construction firms. Proper

deployment of ICT has the ability to resolve various issues in the construction industry in Nigeria. ICT is linked to four key elements of CSCM which includes; DWBSP, UIWBT, UMDPA and RFIDT in construction firms which has a positive and seamless relationship with SCM. DWBSP, UIWBT, UMDPA and RFIDT increase the accuracy of ICT activities which ultimately enhances the overall firm's SCM performance particularly in the construction industry. Therefore, the Nigerian construction industry must commence the implementation ICT with a view to boosting up their CSCM. One noticeable limitation with this study is that, there's need to extend part of this study on most recent constructs of ICT as it relates to CSCM which would help in the development and validation of a robust model via a SEM approach.

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INNOVATIVE ARCHITECTURE FOR FLOOD RESILIENCE: A RESPONSE TO SUBMERGED NIGERIAN CITIES

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Prolonged rainfall and overflowing river banks have made flooding a common problem in Nigeria. Recent flood events in 2018 have been described as the worst in 40years. Available records show that more than 825,000 people have been affected across the country while properties worth billions of Naira have been destroyed. Climate change has induced significant impacts on Nigeria such as aggravating urban flooding exacerbated by human activities. In addressing this challenge, a strategic approach is required to enable communities to adapt to the consequences of flooding, create sustainable environments whilst developing technological and innovative solutions. This study utilizes secondary data from the National Emergency Management Agency [NEMA], research papers and newspaper articles to unravel the anthropogenic factors that contribute to the incessant floods. Key lessons were synthesized and the evidence suggests that there is recognition of the need to take action on the impacts of climate change. Going forward, innovative adaptation solutions should be incorporated into development management plans with all efforts geared towards sustaining livelihoods and assets of people. The research takes into account some examples as a tool for the development of innovative knowledge and concludes by recommending sustainable practical suggestions that could reduce the impact of flooding in the Nigerian built environment.

Keywords: climate change, flood, innovative architecture, resilience, sustainability

INTRODUCTION

Flooding is a general condition of dry land being submerged in water [Ward, 1978] which occurs from overflowing tidal waters, heavy rainfall and extreme climatic events. Odufuwa et al, [2012] noted that floods are the most widespread and frequent of natural hazards of the world resulting in fatalities in the region of 20,000 persons annually [UN-Water, 2011] thereby confirming that only very few countries are immune from floods. The growing flood scenarios worldwide have resulted in the loss of human lives, the displacement of persons, loss of property and destruction of the environment. Asides from spells of prolonged heavy rainfall, flooding is attributable to changes in built-up areas. Rapid population growth and migration have led to increased urbanization with 70million people exposed to flooding globally [Peduzzi et al, 2009; Raaijmakers et al, 2008]. In 2016, the UN Habitiat in its World Cities Report projected that by 2030, the urban population of developing countries will double, while the area covered by cities could triple. This

has generated slums and squatter settlements with limited or no access to potable water, electricity, sanitation and waste disposal [Dimuna and Omatsone, 2010]. Urbanization creates a varied set of challenges in communities and these include large areas of ground covering with buildings, roofs, roads and pavements thus creating obstructions to natural water channels [Douglas et al, 2008]. Incidences of destructive flooding in Nigeria is not a recent phenomenon with records dating as far back as 1951 [Agbola et al, 2012]. The National Emergency Management Agency [NEMA] in Nigeria reported that as at October 9, 2018, a total of 103 Local Government Areas [LGAs] across 10 states in the country, were impacted by severe flooding with an estimated 1.9 million people affected. 561,442 people have been internally displaced while 351,236 are in need of immediate humanitarian assistance [Sumaina, 2018; AFP, 2018].

Disasters reveal the links between building design and urban layouts thereby confirming that communities are vulnerable to the impacts of extreme natural events [Geis, 2000; Adeyeye, 2016]. This paper focuses on the aspects of resilience and hazard planning that need to be considered as part of the solutions for resilient innovative architecture based on documented contemporary examples. The integrated approach to flood resilient architecture confirms that there are benefits to be derived from integrating a suite of practical measures that will minimize flood water ingress and destruction into buildings.

METHOD AND DATA

The search process employed in this study was to identify the body of literature relevant to flooding and habitation in Nigeria with a view to addressing the threats and consequences of flood impacts. Mitigation impacts and opportunities that are missed in designing out social, building deficiencies and infrastructural vulnerabilities are also reviewed. Published academic papers and articles provided most of the information used to establish the study. The data that provided the flood updates, affected population and weather forecasts was sourced mainly from the administrative records of NEMA and ACAPS [Assessment Capacities Project – an independent humanitarian information provider]. Flood events recorded in newspaper articles such as This Day, Vanguard, Punch, Tribune, The New York Times, The UK Guardian and the Nigerian Guardian were also utilized.

The study area

Nigeria is a West African country situated in sub-Saharan West Africa. It is north of the equator and covers a land area of 923,768km^2. It is bordered by the republics of Benin, Niger, Chad and Cameroon. The coastline along the Atlantic Ocean ids 853km long with hydrological features that include the rivers Niger and Benue which meet at a confluence in a city called Lokoja. The two rivers then flow southwards past the Niger Delta and empty into the Atlantic Ocean [Nkwunonwo et al, 2015]. Nigeria's population is presently estimated to be more than 170 million people [Obeta, 2014; NPC, 2007].

Figure 1: Map of Nigeria [Inset is Africa showing Nigeria's location]
Source: ACAPS https://www.acaps.org/search?search_query=map+of+nigeria

Flooding in urban areas

Flooding since late August 2018 in Nigeria has affected some 826,000 people in 12 states as reported by NEMA in September 2018. The numbers displaced are as articulated in the NEMA data shown in Table 2. The deluge has displaced thousands of people and claimed 199 lives. Pathetic stories captured by some local and international newspaper articles on flooding in Nigeria are as stated in Table 1 below.

Table 1: Newspaper and article headlines on flooding in 2018

	Date	Author	Article Headline
Punch	11.05.2018	Nnodim	35 states to experience flooding this year - NIHSA
Tribune	15.07.2018	Olukoya	Many feared dead, scores missing as flood wreaks havoc in Ogun
The New York Times	17.09.2018	Searcey	Floods in Nigeria Kill More Than 100, Wiping Out Homes and Farms
Vanguard	18.09.2018	Adekola	100 die in severe flooding in Nigeria
The Guardian [Nig]	27.09.2018	AFP	Death toll climbs in Nigeria flooding

More than 150,000 hectares of farmland have been inundated and 321 roads and bridges destroyed. A state of national disaster has been declared in four states severely affected by flooding. [UN-OCHA, 2018].

Table 2: Flood situation reports by NEMA for 2018

	Date	Affected Population	Internally Displaced Persons	Displaced Persons living with friends and family	States Affected	National Disaster States
Report No. 1	21.09.2018	327,052	77,460	19,155	12	4
Report No. 2	24.09.2018	441,251	141,369	80,642	12	4
Report No. 3	27.09.2018	176,299	176,299	109,820	12	4

Flooding has impacted urban areas of Nigeria. The perception and impacts have been comprehensively studied and reported in academic journals [Ayoade and Akintola, 1980; French et al, 1994; Muoghalu and Okonkwo, 1998; Ologunorisa, 1999]. Land use changes, rainfall characteristics, removal of vegetation have all contributed to the increased frequency, magnitude and duration of flooding in urban areas. This occurrence is commonplace amongst the urban poor and it has

severe consequences [Douglas et al, 2008]. Governments consider the areas inhabited by the urban poor as informal settlements therefore they are regarded as being outside the accepted urban and town planning management systems, thereby neglected and ultimately vulnerable. Case studies of urban flooding have been carried out in numerous Nigerian cities such as Lagos, Port Harcourt and Ibadan. Parts of Lagos are two metres below sea level coupled with the fact that many slum dwellings are built on stilts over wetlands and swamp areas thereby exposing the vulnerability of these poor communities. These low-lying wetlands in Lagos settlements are supposedly natural flood basins. Lokoja was virtually submerged due to rising waters during prolonged rainfall with levels reaching 11m [Adekunle, 2018]. It, therefore, becomes inevitable that increases in rainfall will affect certain dwellings more frequently. These instances require interventions from the relevant agencies.

'The 2003 World Development Report notes the pronounced difficulties the poor face when disaster strikes. Developing countries are particularly vulnerable because they have limited capacity to prevent and absorb the effects [of natural disasters]. People in low-income countries are four times as likely as people in high-income countries to die in a natural disaster.... Poor people and poor communities are frequently the primary victims of natural disasters; in part because they are priced out of the more disaster-proof areas and live in crowded, makeshift houses... poor families are hit particularly hard because injury, disability and loss of life directly affect their main asset, their labour. Disasters also destroy poor households' natural, physical and social assets, and disrupt social assistance programmes.' [World Bank Independent Evaluation Group, 2006: p48].

The perceived causes of flooding

The flooding events in Nigeria are attributable to anthropogenic factors classified under four main themes:

- Hydrological factors;
- Waste management factors;
- Institutional factors; and
- Awareness factors.

Hydrological factors: Water is the key element that underpins the impacts of climate change in human environments albeit the challenges vary from one location to the other [IPCC, 2014]. Prolonged heavy rainfall and overflowing riverbanks are natural phenomena but the damage and associated losses are attributable to the consequences of human activity or the lack of it [Douglas et al, 2009]. Urbanization and rapid growth in Nigeria compelled the urban poor to live on floodplains. Fluvial floods account for the majority of the flood threats experienced in locations along the plains adjoining major rivers in Nigeria, including rivers Niger, Benue and Hadejia. Historically, Lagos state appears to have experienced most of the flooding in the country but the states in Nigeria mostly affected by such floods are Adamawa, Kano, Niger, Jigawa, Kaduna, Cross River and Kebbi [Iloje, 2004]. Lagos flooding has been attributed to its exposure to coastal influence and rapid population growth. Streets become rivers and drainage systems become submerged [Searcey, 2018].

Pluvial floods occur during the rainy season which falls between the months of July and October with the effects seen largely in urban areas of Nigeria. The volume of rainfall in recent times is unprecedented and as a result the drainage systems coupled with the infiltration capacity of the soil are insufficient [Houston et al, 2011]. The infiltration capacity of the soil is largely impeded by attributable to urbanization given that there is an increased presence of impervious surfaces [Kalnay & Cai, 2003]. Strategies required to support urbanization and anthropogenic activities appear to be lacking and the approach to tackling flood rests largely on general knowledge [Nkwunonwo et al, 2015].

Waste management factors: Poor solid waste disposal is a factor in impeding the free flow of water. Dumping of refuse in drainage and river channels is commonplace in urban areas [Onibokun and Kumuyi 1999; Olaseha and Sridhar 2004]. There are no provisions for waste bins and communities either lack the resources to hire private refuse collectors or through lack of cohesion. Waste left in water and drainage channels is made up of leftover food, degradable leaves, clothing items, plastic bottles and cellophane bags with the anticipation that the rains will wash them from the gutters into the streams and rivers. These items eventually accumulate and impede the free flow of water and they in turn act as catalysts for flooding as the drainage channels eventually get blocked with heaps of debris. Douglas et al [2008] reported in their study on urban areas that the residents of the study area in Lagos were reluctant to accept waste dumping as a cause of flooding thereby refusing to recognize personal responsibility for flooding problems.

Institutional factors: These are attributable to government ministries who have the responsibility and role of assessing flooding potentials including mitigation and flood reduction measures for the country. The Federal Ministry of Works and Housing and the Federal Ministry of the Environment are responsible for the two agencies under their supervision who are directly responsible for disaster management, these agencies being the Federal Emergency Management Agency [FEMA] and National Emergency Management Agency [NEMA]. NEMA co-ordinates disaster management in Nigeria at the federal level, ensure relief materials are readily available for distribution to flood disaster victims in the respective states and the general education of the public.

Weak institutional frameworks: The existing frameworks are culpable in the management of the urban environment. Agbola et al [2012] in their study reported that the severe floods that occurred in Ibadan in 2011 were attributable in part to buildings erected on floodplains, indiscriminate refuse disposal and illegal parking of vehicles in unauthorised locations throughout the city. These illegally erected structures obstruct the free flow of water and they are also vulnerable to flooding. Some residents with the illegally built dwellings claimed to have approved building plans but it was evident that most of the properties investigated in the study had violated statutory setback regulations. Efficient policy and environmental management are required to eliminate the ignorance exhibited by property owners who claimed ignorance of the effects of building close to river banks. A lack of official attention to maintaining drainage networks for rapidly growing megacities such as Lagos is a major factor to the causes of flooding [Douglas et al, 2008].

In order to manage the devastating effects of flooding on the built environment, it is imperative that urban development is structured and integrated into a masterplan and development agenda for urban areas in particular or the cities concerned. This requires concerted efforts from all relevant institutions and more importantly built environment professionals to affect policy and its implementation at all levels. From the foregoing, the origins of flooding that results from climate change and urbanization and its resultant effect on buildings, dwellings in particular, require solutions that will assist the locality affected to adapt to the impact. This paper seeks to offer suggestions for urban and architectural resilience that will maximise the ability of built assets to withstand and recover from the impacts of extreme natural occurrences.

Innovative architecture for flood resilience

Adeyeye et al [2016] posit that living with water requires innovative architectural solutions which should incorporate a culture shift by professionals and the larger public. Built environment professionals will need to work with the government and the public to deliver solutions that are sensitive to nature i.e. living with nature, and not against it. Architects should be the catalysts for change on the understanding that architectural solutions presented to a community should be adaptable rather than being generic [Morgan, 2015]. In the same vein, to be innovative, architects must become more responsive to their users and environments [Rahim, 2006]. Aravena, the Chilean starchitect, posits that architects like to build things that are unique, but if something is unique it cannot be repeated, so in terms of it serving many people in many places, the value is close to zero [Chatel, 2018].

Housing design and construction technology have been developed to cope with the challenges of flooding. Designs for resilience are processes and strategies that engage solutions to adapt nature as confirmed by Walker et al [2004:p1], ‘Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks.’ Being resilient in the development sense goes beyond preparing for the inevitable – ‘floods’. There are a degree and expectation that requires a certain level of preparation that takes into consideration the gradually changing conditions, albeit localized, from singular or combined coastal, pluvial or fluvial sources. The way we design and build is the first and foremost method of minimizing human and property losses [Gees, 2000] and in the same vein, the building forms the ‘last line of defence’ of resilience strategies. Building projects should integrate a series of many small measures that are informed by the natural systems support resilient design [Watson and Adams, 2010; Adeyeye and Emmitt, 2017]. Hurricane Katrina devastated large parts of New Orleans in 2005. Significant redevelopment has occurred since then using the same parcels of land but with more resilient innovative architecture. ‘The same type of single, free-standing houses as the residents had before was built but had features such as stilts or floating foundations incorporated into the design. This meant that the effects of future flooding were mitigated without changing significant community functions’ [Morgan, 2015: p41]. Examples of these house types are shown in plates 1 and 2.

Plate 1: Bild Designs homes for the Make It Right Organisation, 2012. https://www.pinterest.co.uk/pin/313844667752817629/ [accessed 15 April 2019]

Plate 2: Shigeru Ban house for the Make It Right Organisation, 2009. https://www.pinterest.co.uk/pin/841680617840690543/ [accessed 15 April 2019]

Floating communities

K. Olthuis in the Netherlands has developed amphibious structures which rest on floating concrete foundations to floating houses and houseboats - some of them are even islands [plate 3]. These developments are also known as 'going with the flow' where the body of water remains intact and the building is made to fit into the existing environment.

Plate 3: Floating Cities and Communities – A floating apartment complex near Naaldwijk, Netherlands by Koen Olthuis, 2015. https://www.waterstudio.nl/the-floating-dutchman/ [accessed 15 April 2019]

Bangladesh experiences annual flooding of varying severity for up to three months annually, from the outflow of the Himalayas. One solution adapted is as shown [in plate 4] where an elevated plinth is used to protect the dwelling.

Plate 4: A house in Bangladesh situated on an elevated 'compacted earth' plinth S.B. Linkon, [2017].

Contemporary flood resilient architecture

A common form of construction is building on stilts that relies principally on being able to predict the highest flood level with the structure creating a natural elevation to avoid the property being submerged. The stilts can be constructed from steel framing or concrete columns [Lisa, 2012].

Plate 5: Sol Duc Cabin – Lisa [2012] https://inhabitat.com/the-prefab-sol-duc-cabin-by-olson-kundig-architects-rests-lightly-on-four-stilts/ [accessed 15 April 2019]

Property Flood Resilience [PFR]: an innovative suite of measures for property flood resilience exist in the UK. They are aimed at minimizing the ingress of water into traditional domestic masonry construction buildings. Beddoes et al [2018] in their study on flood risk reduction recognize the need to demonstrate that properties can be protected externally. These measures include the following:

- door and aperture guards;
- flood doors and external wall treatment;

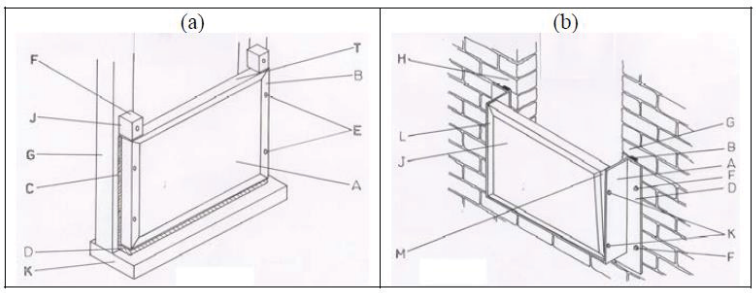

Figure 2: Door guards
Source: Beddoes et al [2018]

ANALYSIS AND DISCUSSION

i. The impact of flooding in Nigeria continues to raise concerns for environmental and solid waste management, urban development and the vulnerability of the general public. The paper highlighted that coastal areas such as Lagos appear to have experienced the most flooding due to urban growth and proximity to wetlands whilst other inland areas in close proximity to rivers such as Niger, Benue and Ogun account for the remainder of areas that experience frequent floods [Figure 3: BBC, 2018]. Certain communities demonstrate an overwhelming level of irresponsibility when faced with the challenges of flooding and these include non-compliance with planning laws, non-adherence to flood alerts and advance

warnings including a lack of perception of flooding issues [Aderogba, 2012]. Efforts need to be concentrated on education and compliance.

ii. The prevailing trend by NEMA and institutions saddled with the responsibility of addressing the threats of flooding appears to be evacuation. 'Best practice' flood risk reduction procedures must be developed to prevent and respond to issues of flooding. Research and development together with the development of appropriate flood reduction measures is required. Flood risk policies that are underpinned by preventative, sustainable and flood-proof measures similar to those that exist in developed countries such as the UK and the Netherlands must be developed [Driessen, 2018; Adedeji, 2012].

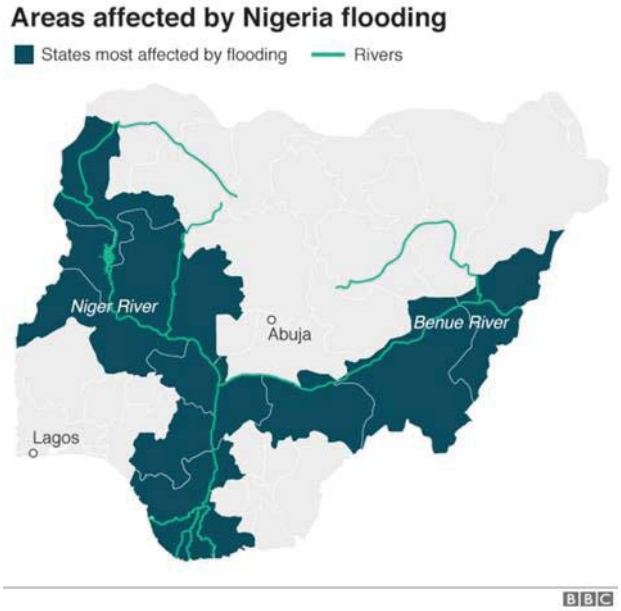

Figure 3: Map of Nigeria showing states most affected by flooding.
Source: BBC News [2018]

Enforcement of environmental laws is required to curtail the effects of climate change and by extension flooding. Indiscriminate car parking, construction along riverbeds, indiscriminate waste disposal and other illegal anthropogenic factors must be made punishable offences.

Capacity building of the population is required to enhance the peoples' abilities to prepare and cope with the hazards of flooding. The paper also proposed the adoption of innovative architectural solutions and technologies that can cope with the challenges of flooding whilst also being sensitive to nature, in order to lower the risk of flooding in urban and low-lying areas. These include building on stilts, raised floor plinths and the use of flood doors.

CONCLUSIONS

The devastations caused by flooding in Nigeria has had severe impacts on people, infrastructure and economic life. This has been linked to climate change and the efforts employed to tackle the impact of flooding appear to be reactive. Flooding is widespread in the country but the awareness and knowledge of the wider population are lacking. The paper presented improvised and practical suggestions

of building designs and building types as solutions in anticipation of flood resilience from examples that have been 'tried and tested'. However, architecture for flood resilience cannot be executed in isolation of urban scale strategies as both are integrated. The scope of this paper was limited to the issues surrounding mitigating damage to individuals lives and properties alongside design solutions that can be adapted on future developments in floodplains. Looking at the scale of the devastations created by climate change in recent months, the government appears ill-prepared and limited in dealing with the consequences of flooding. In view of the fact that the country has one of the fastest growing urban areas and population density in the world, the perceived lack of preparedness and obvious negation of the anthropogenic factors that are associated with flooding leaves a large sector of the urban poor exposed. Help is required at all levels to improve drainage, regulate developments and to provide security of tenure for properties. Weak institutions and regulatory bodies need to take responsibility for ensuring compliance with planning and urban development regulations. Lastly, individuals must be made aware of the consequences of their actions and accept responsibility for inaction or making bad decisions.

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INTERPRETATION OF RISK MANAGEMENT AMONG SMALL CONSTRUCTION ENTERPRISES

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The purpose of this study is to identify the perceptions of risk among small enterprises in the construction sector and explore the possibilities of using artificial intelligence (AI) as an enabler for improving their risk management practice. This paper is a theoretical study. A systematic literature search and an integrated purposive sampling approach were applied to review the relevant literature. The methodology aimed at identifying the level of awareness and competencies for traditional risk management among small enterprises, and their willingness to adopt related technologies as a way to improve their current practices. The focus was narrowed down to risk handling challenges for small enterprises, with a particular focus on business risks, and the concept of artificial intelligence in risk management. The significant limitation of the study is its theoretical nature at this stage. Findings from the review of extant literature demonstrate that small enterprises do not have a strategic way of handling their risks. They struggle with ranking risks that affect their business, thereby failing to mitigate such risks holistically. Nonetheless, the use of AI in business risk planning presents a possible solution to small enterprises. The paramount advantage of AI is the capacity for precision and the enablement for saving costs and time. Implications of findings include the need to establish the benefits of AI in risk management and decision making within the construction context, and to determine effective AI technologies that can be used by such enterprises to develop systematic risk management frameworks that are reliable. The study forms a basis for understanding current risk management practices of small enterprises, and the possibilities for improvements. This study is at its early stage of a more extensive research project and will be used as the foundation for empirical studies.

Keywords: artificial intelligence, business risks, risk management, risk perception, systematic risk management

INTRODUCTION

The economic growth of developing countries greatly relies on small enterprises ability to create jobs, introduce new products in the markets, define innovation practices, and grow the nations GDP (Hyder and Lussier, 2016). The business dynamics of small enterprises have been extensively researched, and, in the African

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markets, their business growth in the unstable economies they operate in studied (Chileshe and Kikwasi, 2014). The instability in economic movements has seen a rise in business risks that inhibit small enterprises from developing to their full capacity (Belás et al., 2015). Sahebjamnia et al., (2015) In their research state that organizations regularly face disruptive events that interfere with their business objectives, such circumstances require a proactive decision framework that will keep incurred financial losses at a minimum. Racher (2015) further highlights that risks will severely affect an enterprise if adequate mitigation measures are not efficiently structured. Any enterprise's development relies on its aptitude for efficient management of risks (Falkner and Hiebl, 2015). Risks identified as having a crippling effect on the success of small enterprises are business and financial risks, and they are known to produce a severe ripple effect where the enterprise does not have a defined orientation or business strategy (Belas et al., 2015: Torabi et al., 2016). Unfortunately, small enterprises struggle with comprehending various risks, and as a result, fail to develop a system for risk handling/mitigation (Ekwere, 2016). Their most significant limitations are their understanding of risk analysis strategies that are qualitative, inadequate knowledge, the practice of risk management, and the absence of trained specialists to perform risk identification (Chileshe and Kikwasi, 2014; Yoon et al., 2015; A et al., 2017).

Existing research stresses the importance of having a systematic strategy for handling risks, suggesting that perhaps the most effective way to implement such strategies in an enterprise is to strike a balance between human intelligence and the use of technology intelligence. Schoemaker and Tetlock (2017) in their research show strong support for technology and describe the trend for "smart" organizations as blending technology-enabled insights with a delicate considerate of human judgment, cognition, and choice. Enterprises that effectively carry through this vision stand a high chance of having a competitive advantage over their contenders (Schoemaker and Tetlock, 2017). Given the competitive nature of the construction industry and its inherent risks (Yoon et al., 2015), this approach has a fair chance of success, particularly with small enterprises where a business risk strategy has not yet been identified. Developing an effective business risk strategy is critical for business stability when an enterprise is small and undeveloped (Lechner and Gudmundsson, 2014). The background thus far emphasizes the need to understand risk management practices and challenges for small enterprises. However, there is scarcity of evidence in the existing literature to describe how small enterprise owners/managers in construction perceive business risks, and their risk management style. There is also a need to explore the impacts of technological enablement such as AI in RM for small enterprises in construction. The pertinent research question is, therefore: What is the nature of risk management in small construction enterprises, and how can they integrate AI in their business risk management strategies to achieve business goals?

LITERATURE REVIEW

The research is primarily grounded on risks and the principles of risk management. The link between risk and risk management is that risk management exists because of risks being present. The study is focused on business risks of small construction enterprises, and as such, it is necessary to establish a link between risks, risk management, and business strategies.

Risk and risk perception

The concept of risk is interesting because risks are subjective and context based. Torabi et al. (2016) explain that there are varying definitions of risk, and it is essential to define what is meant by risks when conducting academic research. In this study, a risk is an event that alters the expected desired outcomes of an enterprise, thus affecting the enterprises business objectives. Culture plays a significant role in how individuals identify risks. A group of people can be presented with the same information and still have different opinions on the implications of such information; some may interpret it as a threat, an opportunity, or neither (Yates and de Oliveira, 2016). This aspect will significantly influence one's perception of risks and how they handle them as a result. Mostly the concept of risk lies in a person's knowledge and valuation of risks, thereby making risk perception a strong factor for risk interpretation and management (van Winsen et al., 2016). Risks do not only have an adverse impact; they can also be an opportunity for an enterprise/company (Cagliano et al., 2015). Common types of risk include credit risk, market risk, project risk, business risk, strategic risks, operational risks, reputational risks, liquidity risks, political risk, employee risk, enterprise risk and financial risk (Griffin, 2018). The current study focuses on business risks.

Business Risks

All enterprises encounter risks; without risks, there is no reward (Truong Quang and Hara, 2018). However, too much risk can result in business failure, and as such, there are numerous methods to identify business risks, and every identifying strategy should comprehend the specific business activities that pose a threat to the company (Hyder and Lussier, 2016). The following diagram gives examples of business risks as identified by (Aven and Renn, 2019); Griffin 2018).

Figure 1: Identified Business Risks

Risk Management (RM)

The principles of RM have been widely researched, both in practice and academics in the past decades. Standard RM procedure explains that all risks need to be identified and known to determine their severity and management styles (Abderisak and Lindahl, 2015; Serpell et al., 2015; A et al., 2017). Risk management allows for equilibrium between taking risks and decreasing them. A more effective risk management approach is one that cares to address the risks an organization faces holistically, as well integrate effective risk-taking strategies for when risk is an opportunity (Wu et al., 2014). And likewise, the risks will then be analyzed and prioritized to plan for mitigation strategies. The RM process arguably needs to be systematic for efficiency and should be structured to consider the following crucial component: risk identification, risk measurement, risk mitigation, risk reporting & monitoring, and risk governance (Aven, 2012; Amundrud and Aven, 2015).

Risk management for small enterprises

Every operating business is not exempt from risks, and small companies are no exception. The importance of risk management cannot be more emphasized in this regard. Enterprises need to be strategic in the way they design their risk management approach to sustain business continuity, and as such, an integrated Business Continuity Plan (BCP) is crucial (Hyder and Lussier, 2016; Torabi et al., 2016). Sahebjamnia et al., (2015)in their research share the same sentiments and further caution that for any BCP to be more integrative, business owner/managers need to factor for limitations like budget availability and shared resources. Unfortunately, small enterprises still fail to comprehend these strategies, let alone defining their risk strategies as per their risk culture; this derails their business success (Yolande Smit, 2012; Gao and Banerji, 2015; Hyder and Lussier, 2016).

The construction industry context

Risks in construction are primarily associated with projects due to the nature of the industry (Abderisak and Lindahl, 2015). Construction risks are regarded as events/activities that adversely affect project objectives such as costs, the scope of work, quality, and time (Yoon et al., 2015). And given the setting of building projects, it is vital to note that human risks should be treated with delicacy (Renault and Agumba, 2016). It is thus, essential to have an effective risk management strategy in the construction industry that prioritizes human safety and development.

When Chileshe and Kikwasi (2014) did their research, one of their objectives was to discover the barriers prohibiting small construction enterprises from efficiently adopting a risk management strategy that works. The following table lists the critical challenges to business development for small construction enterprises around the world:

It is quite evident that risk management is a problem for small enterprises anywhere in the world. The full comprehension of what RM is and what it requires still pose as a barrier to implementing effective risk management, these coupled with risk perception and a budget for RM implementation. There needs to be a more robust and simplistic way in which small enterprises should practice risk management, and a possible solution can be the use of AI software to assist small enterprise owners/managers with risk identification and evaluation. The following

section discusses the concepts of AI and how it can be applied in the construction industry.

Table 8: RM implementation challenges affecting small enterprises around the world.

Region	Barriers
Asia	
Hong Kong	Challenges in getting input estimates and their probability assessment; Time constraints; problems in understanding risk management techniques; IT resources, and managerial support.
Korea	The absence of awareness and expertise in risk management practices; Tangible risk-probability calculations.
Singapore	Competition among SMME contractors; the complication of analytical tools; absence of prospective rewards; budge deficiency; non-existence government legislation; knowledge deficiency; lack of skilled specialists; time constraints; reduced profit margins; and not economical.
America	
United States	Personal prejudices; traditional norms.
Europe	
United Kingdom	Late start to projects; inexperienced employees; attitude towards risk; not robust enough and risk identification incompetency.
Africa	
Tanzania	Risk management awareness; coordination among project team members; risk management styles; effective use of tools and methods; enterprise strategic objectives; interna and external environment; less qualified risk professionals client requirements and cooperative culture.
Ghana	Lack of experience; lack of facts and figures, coordination among stakeholders; accessibility of risk-management specialists; time limitations; lack of knowledge and expertise.

Adapted from: (Chileshe and Kikwasi, 2014)

ARTIFICIAL INTELLIGENCE

Benefits of AI

The definition of artificial intelligence had since evolved from when it formally emerged in 1956. However, AI differs from traditional computer algorithms because of its ability to train itself around its accumulated experiences (Čerka et al., 2015). Rouse (2019) expands on this definition by saying AI is the simulation of human intellect practices by technologies, particularly computer systems. These procedures comprise of: learning the acquirement of data and instructions for using the data, reasoning using instructions to reach approximate or certain conclusions, as well as self-correction. Artificial intelligence has many benefits and compatible with decision making. Mostly decision making will be required where a lot of information is shared amongst groups. Parry et al., (2016) highlight that AI

can de-individualize leadership decision making, especially where trust issues could pose a problem due to a high degree of distance between more senior management and those at the bottom of the organization's structural hierarchy.

Challenges in using AI

AI has been criticized with regards to the loos of a "human touch" in the daily social engagement of human beings. Below is a simplified summary of the trade-offs of AI to human intelligence as adopted from (Jarrahi, 2018):

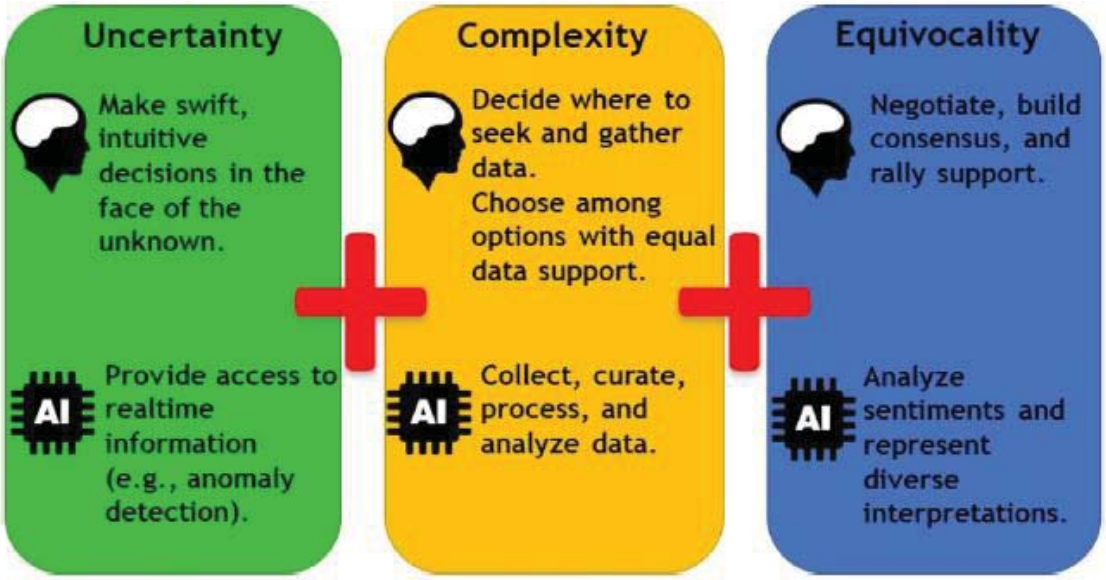

Figure 2: Relationship between AI and humans in decision-making situations. Source: Adapted from Jarrahi, 2018.
Source: Adapted from (Jarrahi, 2018)

Jrrahi's research focused on AI and the future of work. And as such, established an ideal symbiotic relationship between AI and humans, especially where uncertainty, complexity, and equivocality are of concern. AI cannot make intuitive decisions nor build a relationship amongst team members. Another issue with AI is that it reduces people's skills as they no longer need to do much. In extreme cases, jobs are lost (Čerka et al., 2015). These downfalls of AI will need to be understood by an organization that wishes to integrate AI concepts in the running of their businesses. The relationship of the abovementioned is depicted in the following table. The table gives a task that the owner/manager of a small enterprise will need to do when developing an AI risk management strategy.

The table above presents a guide into embracing AI, especially where estimates and decision making are required. Schoemaker and Tetlock (2017) provide a common approach of innovative advances and human capital building in an enterprise. In the table, we see the importance of having a defined strategy that every business aspect will need to answer to. We also get to understand that such a strategy will need to complement the advancement of human skills and innovation in the enterprise. In this regard, the enterprise/business strategy needs to take the technological leap and ensure its collaborative adoption.

Table 2: Strategies for Small Construction Enterprises to Embrace AI

Task	Description
Categorize the strategic edge of the enterprise	When handling prior enterprise's forecasts, identifying areas requiring improvement, particularly where subjective predictions pose a threat, is crucial in implementing an enterprise's strategies.
Assessment and Evaluation of predictions.	Regulate competitive estimating methods by allowing experimentation, innovative thinking, and competition within enterprise employees.
Identify specialists in the business structure.	This has to do with identifying employees/managers that show knowledgeable insights on crucial business structures, and leverage their knowledge when brainstorming or effective technologies to use for the business.
Embrace artificial intelligence.	Use BIM in restricted assignment areas to outperform human specialists and increase value
Expand the enterprises' business goals	Encourage an innovative culture that constantly looks for improved ways to combine the skills of humans and machines/technologies.

Source: (Schoemaker and Tetlock, 2017)

IDENTIFICATION OF THE GAP

Lechner and Gudmundsson (2014) discuss that an enterprise's advancement depends on its entrepreneurial behavior and the application of competitive strategies in its business planning. With enterprises facing various risks in their business operations, such competitive strategies will define each enterprise's risk strategies for mitigating business and financial risks (Investopedia,2019). Risk management helps enterprises manage their risks and making sure that their business objectives are met. Unfortunately, Small and medium enterprises fail in this regard as stressed by Yoon et al. (2015). While the need to adopt more business supporting technologies is advocated in the wake of the fourth industrial revolution (Makridakis, 2017), research in technologies such as AI has grown in the past decade. However, there is a scarcity of research on AI implementation in risk management strategies for small enterprise. Therefore the current study is purposed to identify important benefits of AI and how they can be incorporated into risk management for small enterprises in construction.

RESEARCH DESIGN AND METHODS

A systematic literature review was conducted, which relied on purposively sampled literature. A systematic literature review is based on a deliberate and organized method of identification, assortment, and assessment of previous academic research (da Silva Etges and Cortimiglia, 2017). A significant advantage that a systematic review has is that it allows for a rigorous and unbiased assessment of research outcomes, especially where research quality is of importance (Piper, 2013). In this study, a systematic literature review refined results assisted in answering the research question. The following diagram illustrates the step by step process performed from the Wits online library on the Scopus database. The process is broken down into two tables, the first table gives a search breakdown of related

articles on Scopus, and the second table discusses the steps followed to analyze the content of the papers selected as well as accessing additional papers. In the Scopus database, keywords from the research question and research aim were used to locate the relevant papers/articles. The papers/articles generated were extensive and certain limitations, i.e., publication year, subject area, document type, and research field, had to be used to filter the search. The rest of the steps are explained in the tables below.

Table 9: Scopus Database search entries

Database: Scopus	**Search Limitations/Filters**
First step: Login TITLE-ABS-KEY (keywords Input) risk AND management risk AND perceptions small AND enterprises OR SMEs Total papers generated: 132	Year, Subject Area, Document Type. The first set of the search was limited to research dating back to the last ten years (2019-2009). To broaden the scope of knowledge, articles in the following subject areas were selected: Business, Management and Accounting, Engineering, and, Decision science. Further to these parameters, the following document types were chosen because of their reviewing system: Article, Conference Review, Book Chapter Refined papers generated: 43
Second Search: TITLE-ABS-KEY (Keywords Input) risk management AND Risk perceptions AND small enterprises OR construction industry Total papers generated: 473	**Subject Area Limit:** Business, Management, and Accounting Decision Sciences Economics, Econometrics, and Finance Refined papers generated: 171
Third Search: TITLE-ABS-KEY (Keywords Input) business strategic AND planning, small AND enterprises OR construction industry Total papers generated: 864	**Subject Area, Document Type** The papers selected for this search were reviewed from the following disciplines and journal publications: Construction Management And Economics Journal Of Construction Engineering And Management Journal Of Small Business And Enterprise Development Engineering Construction And Architectural Management Document Type: Article and Conference Review Refined papers generated: 66

Table 4: Paper content selection process

Paper Selection Scopus produced a final set of available papers based on the abovementioned filter inputs. Articles with titles addressing the focus of this study were carefully identified. Their abstracts were read to confirm their relevance. The final stage was downloading the articles above. Scopus searches its sources to download the articles, and where permission was required, it would state so. The natural step henceforth was to search for the remainder of the articles on Google Scholar.
Google Scholar Search Article titles and/authors were typed in to locate the papers that Scopus could not download. To broaden the scope of information studied, an integrative literature review was conducted on google scholar. The following keywords were used for searching through databases: Challenges affecting SMMEs, business enterprise, business strategy, risks, risk management, risk management adoption, risk management in SMMEs, risk management in construction, systematic risk management, strategic risk management in small enterprises in construction, market niche, and market niches in construction. The research time limitation for the papers was five years (2014-2019). The staged approach to the integrative literature review is as follows: A quick perusal of abstracts was conducted to assess the relevance and currency of the papers. The findings in the studied articles demonstrated poor risk management as a barrier to business development and effective running of small enterprises. Following the first step, a search for articles discussing how enterprises can effectively practice risk management was conducted. The stated approach assured alignment to the broader focus of risk management and strategy. The two main knowledge areas were combined to get a more unobstructed view of the challenges around strategic risk management implementation in construction.
Summarizing papers downloaded in preparations of writing the final paper An annotated literature review table with the following headings was used to summarize essentia information from the reviewed papers: Full reference, research problem, consequences of the problem, methods, findings, theory, and relevance of the study. Following an analysis of the information extracted from the review template, available information was grouped under the given headings and resulting sub-headings. As the final step, paraphrased summaries were fitted into the chronological order of the final study paper.

KEY FINDINGS IN LITERATURE

- Small enterprises still fail to comprehend RM strategies, let alone defining their risk strategies as per their risk culture; these derail their business success (Gao and Banerji, 2015; Ajibade, 2016)
- Small enterprises struggle with identifying and ranking risks that affect their business, thereby failing to mitigate such risks holistically (Yolande Smit, 2012; Hyder and Lussier, 2016). However, the inherent nature of small enterprise gives them the advantage to explore with innovative ways to handle risks and as such, adopting AI to analyze business risks can significantly improve the current poor RM practices among small construction enterprises (Makridakis, 2017; Jarrahi, 2018).
- The notable barriers to the successful implementation of RM strategies in construction are: problems in understanding risk management techniques, the absence of awareness and expertise in risk management practices, lack of prospective rewards, personal prejudices, risk identification incompetency, less qualified risk professionals and time limitations (Chileshe and Kikwasi, 2014; Dabari and Saidin, 2014; Ajibade, 2016)
- Integrating AI in business risk management strategies of small construction enterprises can see them achieve a systematic approach of handling risks

which be beneficial in ranking risks, identifying opportunities to improve project performance, and making informed decisions on mitigation plans (Mills, 2001; da Silva Etges and Cortimiglia, 2017).

- Two distinctive forces guide most adaptive businesses: One is the increasing power of computers coupled with big data, which serves as the basis for operation research, artificial intelligence (AI), and projection models. The second force lies in the increasing understanding of an individual's cognitive, judgment, and choice (Schoemaker and Tetlock, 2017).
- Mostly the concept of risk lies in a person's knowledge and valuation of risks, thereby making risk perception a strong factor for risk interpretation and management (van Winsen et al., 2016). It is crucial that small enterprise owners/managers be aware of any personal biases or cultural background that could be affecting their willingness to adopt alternative practical RM approaches as this can be the determining factor of a successful RM adoption or its failure (Yates and de Oliveira, 2016).

DISCUSSION OF FINDINGS

The importance of risk management to a company's success cannot be overemphasized. Findings show that small enterprises are still struggling with grasping the fundamentals of RM and as such limit their business development and growth. This is proven in the literature to be due to problems in understanding risk management techniques, the absence of awareness and expertise in risk management practices, absence of prospective rewards, personal prejudices, risk identification incompetency, less qualified risk professionals and time limitations. There needs to be a feasible solution to assist small enterprises in resolving their inadequate risk management style that will not be time-consuming and financially constraining. Artificial Intelligence (AI) proves to be an effective way for small construction enterprises to identify potential risks for their business and strategically identify financial opportunities through certain risks. Most industries are currently in the wave of the fourth industrial revolution, and a balance between human intelligence and technology is required if companies wish to remain competitive in their line of business. In the construction industry context where small enterprises get their business through construction projects, artificial intelligence comes in handy in this regard because the project information shared is central, meaning every stakeholder has access to the same information at the same time. The more significant advantage of implementing artificial intelligence is its precision in calculations and data handling. It can thus be a crucial tool for businesses to be able to predict flaws in their calculations, which if not seen, would cost the enterprise significant financial losses. These advantages are compelling reasons for incorporating AI in risk management decisions among small enterprises. And as such, the study recommends that small construction enterprises show eagerness to uptake AI to achieve a systematic and efficient RM approach.

CONCLUSION

There has been extensive research on risk management practices of small enterprises which suggest that such practices are flawed (Ekwere, 2016; Aven, 2016). However, specific research on the actual practices and what informs them is

scarce. There is not enough evidence available on technological alternatives to assist the small enterprise in managing their business risks. The purpose of this study was to identify the nature of risk management in small construction enterprises, and how can they integrate AI in their business risk management strategies to achieve business goals. Findings from this stage of the research can be summarized as thus; small enterprises fail to practice systematic risk management because of limited qualitative and quantitative data from previous projects that could enable them to establish a proper risk response strategy for their enterprise (Serpell et al., 2015; Ekwere, 2016). Surprisingly, small enterprises across the globe experience common barriers to implementing an effective and innovative RM strategy, these barriers according to Chileshe and Kikwasi, (2014) are risk attitude of owners/managers, RM budget and adequate skills to derive an effective RM strategy.

Nevertheless, the booming research on AI highlights the advantages of using AI as a means to manage business risks. The construction industry relies on a great exchange of information, of which in most cases decisions need to be based. There needs to be a balance between human understanding and the help of technology, and AI allows for that integration (Yates and de Oliveira, 2016). It is adviced that small construction enterprises start thinking of feasible ways to integrate AI in their risk planning strategies, particularly where business risks are involved. This stage of the study is a literature review, and there is, therefore, an opportunity to explore other relevant theories and bodies of knowledge, beyond the current research. There is a great need for research on the current RM practices of small enterprises and what informs their decision making when handling business risks. Further research can explore those mentioned above and test the success rate of managing risks when AI software is used to identify and analyze risks.

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KNOWLEDGE AND AWARENESS ON PLASTIC SOLID WASTE (PSW) MANAGEMENT IN ZAMBIA: WHERE ARE WE?

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A number of stakeholders are involved in managing Solid Waste (SW) and the role of each stakeholder in Waste Management (WM) is important. However, achievement of Education for Sustainable Developments (ESD) requires imparting knowledge on WM issues to the stakeholders. In developing economies of Southern Africa, a number of goals for sustainable development have been adopted in order to combat a number of SW related issues. Nevertheless, WM challenges are still evident in most of these economies. A study was conducted in Ndola City, Zambia on the current state of Plastic Solid Wastes (PSWs) management. The purpose of the study included assessing the level of awareness and knowledge on PSWs. A survey of 445 households in the urbans of Ndola City was conducted. The results of the survey indicate that, 36.1% of the respondents have obtained college education. Further, the results on knowledge on PSWs recycling indicate that, 70.6% of the respondents are knowledgeable. Despite 70.6% of respondents being knowledgeable and aware about PSWs recycling, only 19.7% of the respondents participate in community PSWs recycling programs. Further only 19.8% of the respondents learnt about PSWs recycling in primary schools. The results from this survey provide relevant information to waste managers, educators and practitioners on the current state of knowledge on ESD in developing economies. The novel contribution of the study is that, there is urgent need for society to be educated on the relevance of recycling for sustainable development. People from whole walks of life should understand the importance of recycling processes especially in industries that utilize non-renewable resources. Further, strategies other than the provision of knowledge and awareness should be investigated in the contextually to promote optimal participation of citizens in recycling programmes.

Keywords: awareness, education, knowledge, sustainable development, plastic solid waste, management

INTRODUCTION

In developing economies, Solid Waste Management (SWM) challenges continue to attract attention worldwide. In Zambia, illegal disposals, lack of enforced

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regulations and legislations, lack of knowledge and awareness on SWM, lack of enforced Extended Producer Responsibility (EPR), SWM related challenges faced by the waste managers and lack of stakeholder involvement are some of the problems preventing sustainable SWM (Mwanza et al. 2018).

One of the Sustainable Development goals is Quality Education. This goal is cardinal for achieving Sustainable Solid Waste Management (SSWM) in developed and developing economies. Therefore, in the Zambian context, a number of issues are preventing sustainable management of SW and this research focuses on assessing knowledge, awareness and education on PSWs in order to present the current status.

Education is considered an enabling factor in driving SSWM. Singhirunnusorn et al. (2012) alluded that, continuous provision of education and awareness on proper SWM and environmental issues is necessary for community participation. Isa et al. (2005) affirmed that, non-participation of the public in recycling programs can be attributed to lack of awareness. Numerous studies have assessed awareness and knowledge on SWM and recycling. The studies by Owens et al. (2000) presented a positive correlation between participation and recycling. Desa et al. (2011) assessed awareness, attitudes, knowledge and behaviour on SWM among students. Tonglet et al. (2004) highlighted that, knowledge on recycling influences recycling behaviour. Nixon and Saphores (2009) indicated that public education and recycling correlate positively. Afroz et al. (2018) alluded that, people knowledgeable about recycling have positive attitudes towards recycling. These studies have looked at knowledge, awareness and education on participation in recycling and SWM related programs. None of these studies have focused on knowledge, awareness and ESD in the Zambian context.

This research is cardinal to the Zambian context as it provides the current status of knowledge and awareness on SWM in particular PSWs. Further, the research is relevant to waste managers, policy makers, educators and practitioners as it provides strategies for implementation that can lead to successful stories on SWM in the Zambian context. Tilikidou (2002) indicates that, research outcomes provide valuable insights that are useful for public offices in designing creative recycling strategies. To this regard, the research focuses on assessing the level of knowledge and awareness on PSWs and how it has impacted sustainable development in terms of participation in recycling programmes. The research focuses on addressing the following research questions.

1. Do you know about PSWs recycling?
2. Where did you learn about PSWs recycling?
3. Do you participate in PSWs recycling?

The novelty of the research is to identify the gap between knowledge, awareness and education on; PSWs recycling and participation in recycling programmes. It is against this novelty, that ESD is considered with regards to focusing on providing knowledge, awareness and education on PSWs recycling. The focus of the research is not limited to schools but every media of information dissemination. Further, ESD forms the basis to achieving the fourth Sustainable Development Goal (SDG 4) which focus on inclusive and equitable education and promotion of lifelong learning opportunities for all.

LITERATURE REVIEW

ESD addresses the strengthening and Development of people's competencies, enhancing people abilities to contribute and participate in various types of sustainable development dimensions and processes (ESD Experts, 2017). The definition indicates that, the relevant skills and competencies that focus on reading, numeracy, and writing are included. For this reason, the study links ESD to knowledge and awareness on PSWs recycling since the competencies aforementioned are fundamental to achieving sustainability. According to ESD Experts (2017), ESD contributes to individuals' ability to take responsible and informed actions on environmental integrity and socioeconomic viability. A number of studies have been conducted to understand the factors that influence individuals or households to participate in waste recycling programmes. A study conducted by Omran et al. (2009) revealed that, participation in household waste recycling depends on the level of understanding and awareness on recycling. Further, the study indicated that, education and increased access to recycling facilities promotes a recycling attitude. To this regard, education, awareness and understanding of recycling is a key to achieving sustainability and ESD provides a platform for the economies to achieve SDG 4. Tikka et al. (1999) also concluded that, high participation rates in recycling programmes occurs in households with better education. However, the conclusion in the study conducted by Tikka et al. (1999) does not indicate the type of education and hence the need to link ESD and Knowledge and awareness to PSWs recycling. A study conducted by Babaei et al. (2015) affirmed that, improving individuals' awareness on solid waste recycling and segregation is necessary for promoting recycling. Alijaradin et al. (2011) analysed knowledge on recycling and participation. The study revealed that, 77.5% of respondents did not have knowledge on recycling and 64.2% did not learn of recycling from schools. Further in a study conducted by Sidique et al. (2010), the findings revealed that, recycling rates increased by cumulative expenditure increases on recycling education.

The studies reviewed from; Babaei et al. (2015), Alijaradin et al (2011) and Sidique et al. (2010) indicate that, education, knowledge and awareness on waste recycling influence recycling participation. Thus in the era of sustainability, it is relevant to understand the significant of knowledge and awareness on PSWs recycling as well as the level of education on PSWs recycling to the communities.

Several other studies have focused attention on understanding the impact of knowledge, awareness and education on participation in recycling programmes. De Feo and De Gisi (2010) alluded that public education and encouragement promote participation in recycling programmes. Chung and Lo (2004) indicated that, achievement of an integrated approach to managing municipal solid waste demands the understanding of knowledge on waste management.

According to Babaei et al. (2015), knowledge is an understanding of a community information in relation to the topic of interest which is acquired through education by learning. In this regard, knowledge and awareness on PSWs is acquired through ESD. The studies reviewed in the research support that, provision of knowledge and awareness on PSWs through ESD contribute to achieving sustainability. Afroz et al (2018) affirms that individuals knowledgeable on recycling respond positively to

recycling programmes and this is supported by Nixon and Saphores (2009). Based on the reviewed studies, the research focuses on assessing the questions indicated in the introduction.

METHODOLOGY

Study area

The research was conducted in Ndola city which is located in the Copperbelt province of Zambia. It is located at 21degrees, Wind SE at 23km/h. Using the Zambian Census report of 2010, the urban areas in Ndola city were selected and the study was conducted in the following urban areas; Kansenshi, Kanini, Twapia, Yengwe. Chipulukusu, Nkwazi, Dag Hammerskjoeld, and Kanini.

Research design

A non- experimental survey was conducted. In order to gather data, a questionnaire was designed and distributed to households in the urban areas of Ndola city. At most, two visits were made to the households. The first visit consisted of explaining the purpose of the visit and distributing the questionnaire. For the households that managed to complete the questionnaire at the first visit, the questionnaire was collected. However, for the households that needed more time to complete the questionnaire, the second visit was made.

Data collection

Using the Zambian census population report of 2010, the population of the selected urban areas in Ndola city were identified. Based on the sampling guidelines of Kothari and Garg (2014), the sample size of the study was determined. A total of 445 households formed the sample size of the study. In order to obtain a validated presentation of the households, stratified sampling was used to determine the sample size in each urban area of Ndola. In order to collect the research data, a questionnaire was designed using the theories from the studies conducted by Afroz et al. (2018); Troschinetz and Mihelcic (2009), Vincent and Reis (2008) and Isa et al. (2008). The questionnaire consisted of three sections and the first section focused on assessing knowledgeability and awareness on PSWs recycling from the households. The second section focused on assessing “where the households learnt about PSWs recycling from.” The third section addressed the participation of households in PSWs recycling programs. A total of 229 questionnaires were collected and analysed from a sample size of 445.

Data analysis

The research data collected from the questionnaires was analysed using the Software Package for Social Sciences (SPSS). Descriptive statistics focusing on the frequency and percentages were analysed. Pie-charts and bar graphs were used to present the data.

RESULTS AND DISCUSSIONS

Do you know about PSWs recycling?

The results depicted in Figure 4.1 indicate that, 70.6% of the household respondents know about PSWs recycling and only 27.4% do not know. The results provide a vital reflection on the current state of knowledge on PSWs

recycling. Provision of education for sustainable development is cardinal in WM issues. Therefore, the results provide a positive direction towards the achievement of ESD strategies for SSWM. Further, it is necessary to point out that, knowledge and education influence stakeholder participation in SWM programs. The studies of Singhirunnusorn et al (2011) concluded that, continuous provision of awareness and education on proper SWM and environmental issues is crucial for community participation. In addition, Nixon and Saphores (2009) found that, public education and recycling correlate positively.

In order to confirm where the households learnt about recycling, it is necessary to investigate the question. The follow up question is necessary as it will provide the information required to bridge the gap on recycling knowledge and ESD. In a study conducted by Alijaradin et al. (2011), 77.4% of the respondents knew about recycling and less than 40% learnt of it from schools. Therefore, it is cardinal to understand where households in Ndola learnt of recycling for the purpose of designing sustainable and contextual strategies in ESD for Zambia.

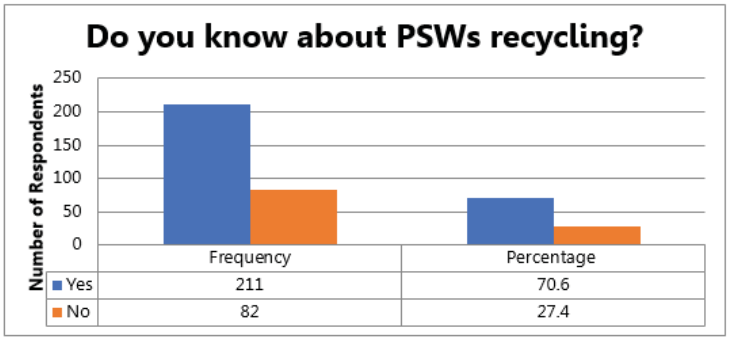

Figure 4.1: Do you know about PSWs recycling?

Where did you learn about PSWs recycling?

The results depicted in Figure 4.2 indicate that, the majority of the household respondents learnt about PSWs recycling from social media (32%). This result is supposed by Omran et al (2009). However, in order to achieve sustainability in the waste management arena, it is regrettable to note that, only 14% of the households' respondents learnt of PSWs in primary schools. Enhancing ESD on WM matters should begin at primary level education if the goals of SSWM are to be achieved. Alijaradin et al. (2011) findings support the results in this study and provide a basis on which to build ESD in schools.

From a developing economy perspective, the results on knowledge and awareness on WM have shown that, majority of the society learnt about SWM related issues from social media (Afroz et al. 2018; Babaeri et al. 2015; Nixon and Saphores, 2009; Vincent and Reis, 2008). Knowing about PSWs recycling from the social media is not a problem; however, few people in developing economies have access to social media. To this regard, the results from this study imply that, knowledge and education on PSWs should begin in primary schools. This is suggested because; one of the goals of sustainable development is provision of good health and well-being. The goal on good health and well-being can only be achieved with effective ESD programs in primary level education.

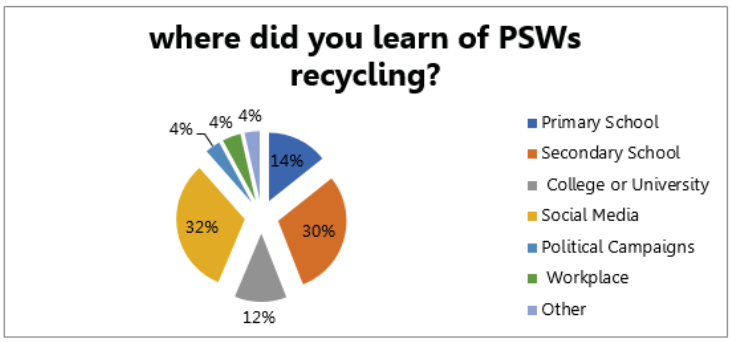

Figure 4.2: Where did you learn of PSWs recycling?

Do you participate in PSWs recycling?

The results in Figure 4.3 depict that, only 19.7% of the household respondents participate in PSWs recycling programs. The majority of the respondents do not participate. The reality of the results is that, knowledge on PSWs by the household respondents has not resulted in participation in PSWs recycling programmes. Isa et al (2005) affirmed that, non-participation in recycling programs by the public can be attributed to lack of awareness. This is in contradiction with the results in this study. The majority of the household respondents know of PSWs (70.6%) yet only 19.7% participate. Nevertheless, Tilikidou (2002) indicates that, research outcomes provide valuable insights that are useful to public offices in designing creative recycling strategies. Therefore, these results provide useful information that can be used in planning for ESD in developing economies on issues of SWM. Further, the findings on this question are relevant since a gap has been identified from the Zambian perspective.

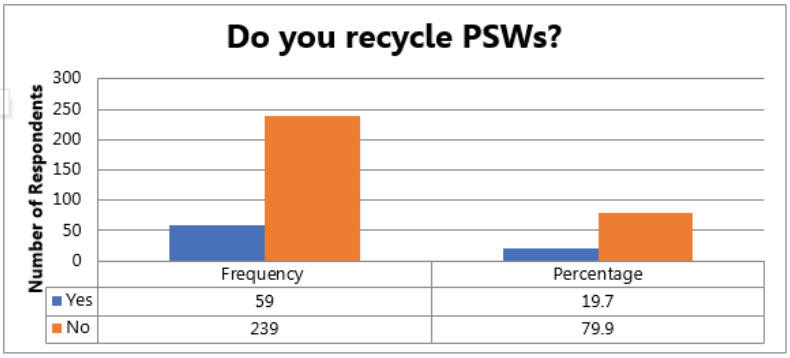

Figure 4.3: Do you recycle PSWs?

CONCLUSION

ESD is a cardinal strategy for achieving the sustainable development goals. In developing economies, a number of challenges in managing PSWs are faced; and knowledge and awareness on the benefits of proper SWM is one of them. This study has shown the gap existing between knowing about PSWs recycling and participation in recycling programs from a developing economy perspective. The study has shown that, only 32% of the households assessed learnt of PSWs from social media while only 14% learnt about it during primary education.

The results in this study are cardinal to education practitioners and educators, policy makers and waste managers. The relevance of the study is in the presentation of the current status on knowledge, awareness and education on

PSWs recycling. The current status has indicated that, 70.6% of the household respondents in the urban areas of Ndola know about PWSs and only 19.6% participate in the PSWs recycling programmes. The gap is relevant as it provides a platform for assessing the factors that can drive the households to participate in recycling programmes.

The study has identified limitations on the none comparative analysis of the demographic factors such as age, education level, occupation and size of the household on the questions assessed in the study. In the context of Ndola or another city, the identified limitation can be researched on.

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LOCAL CONSTRUCTION COMPANIES' CAPACITY BUILDING THROUGH FOREIGN COMPANIES' STRATEGIC PARTNERSHIP

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How the local construction companies in Africa can better manage the challenges they face through strategic partnerships with the foreign construction companies has been under-researched, both empirically and theoretically. Premised on the increasing presence of foreign construction firms in most African countries, this study investigated different approaches of strategic partnership for capacity building of the local construction firms by their foreign counterparts. Using Nigeria as a case study due to its sheer market size, an integrative literature review was used to identify 23 challenges facing local construction firms. 88 registered local client- and consultant-based construction professionals (85% response rate) participated in the cross-sectional survey using a web-based semi-structured questionnaire. Data were descriptively- and content-analysed. Results showed corruption, delayed payment, political instability, research and development, market forces/inflation, and modern innovation as challenges in the 25th percentile. The approaches most frequently recommended for the strategic partnerships centred around training and funding opportunities, laws and regulations for competition and technology transfer, and investments in research and development. This study concluded by flagging the potential downside of focusing on top-ranked challenges because of the systems nature of construction projects, hence the interconnectedness of the challenges. More so, in view of the inevitable broad thinking that characterises and distinguishes a strategic fit from a mere strategy.

Keywords: capacity building, challenges, Nigeria, strategic partnership, pragmatism

INTRODUCTION

The definition of the term 'construction' is expansive (Ofori 1990, pp.23-4; Wells, 1984). Hence, the emerging debate as to whether it is an industry or a sector with many industries (Ofori, 2015). This is a reason that the construction industry has, historically, accounted for a major proportion of the gross domestic product (GDP) of most countries (Crosthwaite, 2000). Keynesian philosophy based models are

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commonly used to analyse the complex relationship between a country's level of construction activity and its stage of economic development (Ruddock & Lopes, 2006). The significant relationship existing between the construction industry and economic growth continues to influence globalization or internationalization of the industry (Dang & Low, 2011). However, the requisite enabling factors to venture into international construction (Gunhan & Arditi, 2005) favour players from the developed countries. The resultant one-sided gain is the basis for the clamour to create strategic partnerships for mutual benefits of players from the developing countries alike (Ngowi et al., 2005). Mutuality is necessary to sustain the much-desired performance trends in international construction (Horta et al., 2013).

Edmonds (1979) has rightly concluded on the inevitable role of foreign-owned construction companies in the delivery of mega infrastructure projects in developing countries, until the time that the domestic sector develops its capacity—technical, financial, managerial, and social. Nigeria is the most populous country in Africa and its about 170million people population, as at date, is poised to more than double by 2050, to become world's third most populous country after India and China (UN-Habitat, 2016). Already noted as having an overall urbanization of 50% (Oluwakiyesi, 2011), towns and cities in Nigeria are growing at 5%-10% annually (Aliyu & Amadu 2017). The unabated growth in urbanization is beyond the existing infrastructure capacity and gap-bridging capacity of the domestic construction players in Nigeria (Mudi, Bioku & Kolawole, 2015). However, the positive impacts of foreign direct investments in infrastructure building in Nigeria (Imoudu, 2012) and general industrial development from globalization (Ebong, Udoh & Obafemi, 2014) have seen to international construction companies making unguarded inroads to the point of dominance (Oluwakiyesi, 2011).

A catch-22 scenario has thus ensued where, on the one hand, foreign construction companies have been noted as contributing to Nigeria's construction industry (Babatunde & Low, 2013). On the other hand, significant threats from imported professional services and diminished opportunities to develop local professionals (Mbamali & Okotie, 2012) shade the opportunities. Protectionist policies do more harm than good to countries with inefficient industries (Fouda, 2012). Consequently, it is worthwhile to embrace the alternative of creating an enabling environment to nurture comparative and strategic advantages (Egan, 2003). Pandey's (2018) Opportunity-Threat Theory, for decision-making under risk, supports the alternative of strategic partnerships. Also, uncertainties and strategic opportunities are conjoined (Price, 1982) and local construction firms in Nigeria are notably developing their competences for improved competitiveness (Ogbu, 2018).

The plausible research question arising from the preceding discussion is what are the different forms of strategic partnership for capacity building of the local construction companies by the foreign construction companies? This study aims to investigate different approaches of strategic partnership to enable capacity building of the local construction companies in Nigeria. The objective is to assess the significance of the factors affecting the local construction companies in Nigeria to propose the best strategic fit partnerships with their foreign counterparts.

LITERATURE REVIEW

The mode of the preceding research question is neglect spotting; specifically, under-researched area (Hällgren 2012, pp.806-7). Challenges facing local construction companies in Nigeria have been well-researched over the years (Aniekwu, 1995; Ilori et al., 2002; Kehinde & Mosaku, 2006; Idoro, 2010; Adeleke et al., 2018). However, how to overcome the challenges through strategic partnerships with the foreign construction companies in Nigeria has been under-researched, both empirically and theoretically. Since theories lay the foundation for empirical works (Koskela & Howell, 2002), this study uses the integrative literature review to identify the major challenges facing local construction companies in Nigeria as a basis to, empirically, establish the significant problems for strategic partnerships. As the name implies, the integrative literature review gathers representative literature on a topic in an integrated manner to offer new viewpoints (Torraco, 2016). Following Torraco's (2005, p.365) steps for writing an integrative literature review, Google Scholar search engine keywords were used to identify the relevant literature. The titles, abstracts and list of references of the studies identified were reviewed to decide if the studies were authoritative and representative. Google Scholar search engine was preferred for a wider spread to access scientific research papers both from the mainstream and alternative publication channels, in so far as they satisfy the inclusion criteria.

Conceptual framework and theoretical framework

The conceptual framework used in this study is strategic fit, which Chorn (1991, p.20) articulates as 'aligning organization and environment'. It can then be reasoned that strategic fit is based on the Alignment Theory (Chorn, 1991) and the Opportunity-Threat Theory (Pandey, 2018). These two theories serve as the theoretical framework in this study. Following from the preceding discussion on the research question, type of literature review, conceptual framework and theoretical framework, the subsequent sub-sections under this literature review focus on the challenges facing local construction companies in Nigeria. The terms local, indigenous, and domestic have been used interchangeably in this study to refer to non-foreign owned construction companies in Nigeria.

Construction business environment in Nigeria

Seminal studies have broadly categorized the problems of the construction industry in Nigeria as structural, arising from inherent conditions and practices (Aniekwu & Okpala, 1988a) and systemic, arising from the application of unsuitable systems (Aniekwu & Okpala, 1988b). A subsequent study (Aniekwu, 1995) re-categorized the structural and systemic problems into four main groups including the business environment, contracts, capacity, and institutions. Most of the factors identified as adversely affecting the construction industry in Nigeria were categorized under the business environment, which, in the first instance, dictates the systems and structures guiding the construction industry's activities. For example, the oil and gas sector remains the biggest contributor to GDP in Nigeria with ongoing efforts to boost economic activities in the industrial and manufacturing sectors to improve the country's global competitiveness (Chete et al., 2014). Added to this macro level challenge is the preference by the more organized clients in Nigeria to opt for expatriates for better performance (Idoro, 2010). This necessitates local construction companies in Nigeria strategically

managing their operations. Strategic management is a 'special management process or system that links strategic planning and decision making with the day-to-day business of operational management' (Gluck, Kaufman & Walleck, 1982, pp.9-10). The strategic efforts by the local construction companies are eventually paying off. For example, the views from Nigerian public and private clients have unearthed statistically significant survival practices among the local construction companies (Ogbu, 2018).

Specific challenges facing local construction companies in Nigeria

The increasing and, arguably, domineering presence of foreign construction companies in Nigeria suggests that the local construction companies should move towards strategic partnerships with their foreign counterparts. The critical development programmes for contractors in Nigeria (Adams, 1995) requires more concerted efforts beyond those that can be provided by local stakeholders. Partnership formation with the foreign players must be guided by strategic fits, which depends on the interplay between competitive situation, strategy, organization culture and leadership (Chorn, 1991). This gives credence to the objective of this study as being to assess the significance of the factors affecting the local construction companies in Nigeria to propose the best strategic fit partnerships with their foreign counterparts.

Table 1: Challenges facing local construction companies in Nigeria

Challenges	Supporting Literature
Access to credit/loan	Akinleye, Olarewaju & Fajuyagbe (2019)
Contract management	Saka, Olaore & Olawumi (2019)
Contract rules and regulations	Rasul & Rogger (2018)
Corruption	Otusanya & Lauwo (2019)
Cost and time performance	Amusan et al. (2018)
Delayed payment	Gambo, Said & Ismail (2016)
Entrepreneurial skills	Okonkwo (2019)
Estimating and tendering	Ahmed, Musonda & Pretorious (2019)
Financial capacity	Oladimeji & Aina 2018
Financial management skills	Ojo & Odediran (2015)
Leadership and communication	Waziri, Ali & Aliagha 2015
Level of professionalism	Ikuabe & Oke (2019)
Market forces/inflation	Adeleke et al. 2018
Material supply base	Garba, Olaleye & Jibrin 2015
Modern innovation	Aduwo et al. 2016
Plant and equipment	Aka et al. (2019)
Political instability	Adetiba (2019)
Procurement procedure	Awodele et al. (2019)
Project planning and control	Ogunde et al. 2017
Research and development	Yapicioglu, Mogbo & Yitmen (2017)
Technical competence	Dosumu & Aigbavboa (2019)
Training opportunities	Oyewole & Dada (2019)
Unfair competition	Anthony, IS, Modo & Anthony, OI (2019)

The following Google Scholar search engine keywords (in alphabetical order) were used to access and review the titles and abstracts of the relevant studies towards

fulfilling the objective of this study: building, challenges, construction, domestic, indigenous, industry, local, and Nigeria. Table 1 presents the specific challenges facing local construction companies in Nigeria, arranged in an alphabetical order to avoid repeating the challenges.

METHODOLOGY

Methodology includes the methods and techniques used to systematically solve a research problem (Kothari, 2004). The research onion is the most common model used to describe the methodology (Holden & Lynch, 2004). This study is based on the pragmatism research philosophy, which bridges the idealist positivism and relativist interpretivism philosophical stances (Morgan, 2014). The research approach is abduction, which borders between the induction approach for theory building and deduction approach for theory testing (Patokorpi & Ahvenainen, 2009). Consequently, this is a mixed-method research based on the qualitative and quantitative approaches or methods (Shannon-Baker 2016).

Research design

Cross-sectional survey design was used because the study intended to obtain a snapshot of opinion for a given time as against establishing a trend over time (Rindfleisch et al., 2008). A cross-sectional study is about the prevalence of the phenomenon under investigation for the selected time-frame, hence its advantages and disadvantages (Sedgwick, 2014). Survey design desirably allows for ample data collection within the available resources and representativeness of the sample from which data were collected (Kelley et al., 2003).

Research method

A 3-section-web-based semi-structured questionnaire was used to collect quantitative and qualitative data from the target population for anonymity, flexibility and ease of data management (Newman et al., 2002). The first section sought data on the profile of the target population. The second section sought quantitative ordinal data on the level of impact of the 23 challenges (Table 1) on capacity building of the local construction firms from 1 (minimal impact) to 5 (very severe impact). The third section sought qualitative data on the strategies for the foreign and indigenous firms to work together for capacity building of the latter. Combining quantitative and qualitative data allows for methodological triangulation (Fielding, 2012), desirable to achieve this study's objective.

Population and sample

For practical purposes, the target population for this study comprised of local construction project consultants and clients, whose total population was, regrettably, indeterminate. A sample of this target population was non-probability-multi-stage-purposeful sampled (Teddlie & Yu, 2007) from a self-designed sampling frame (SF). The SF was generated from email addresses of known registered construction professionals from the researchers' networks. The initial SF was further populated through self-provided email addresses from interested participants identified through close-knit WhatsApp groups of registered construction professionals. 104 sample size emerged and was sent the link to the web-based questionnaire via email. 88 complete responses were returned, representing 85% response rate, attributable to the sampling technique used.

RESULTS AND DISCUSSION

Descriptive analysis of the data obtained via the first section of the questionnaire revealed the 88 professionally-registered respondents to be largely client-based (69%), followed by consultants (24%) and others (e.g., academics) (7%). The respondents were predominantly (62%) holders of MSc degrees or above, followed by BSc honours (31%) and others (e.g., PGDs) (7%). They were engineers (27%), quantity surveyors (26%), architects (23%), project managers (23%) and others (e.g., facilities managers and planners) (1%). The average years of working experience was 15 years with majority (65%) from organizations with employee size of 1-50, involved in residential (67%) and/or infrastructure (51%) projects.

Table 2: Impact of the challenges on capacity building of local companies in Nigeria

Challenges	M	SD	CV	M-4.000	Z-Score	Percentile
Corruption	4.284	0.870	0.203	0.284	0.326	63%
Delayed payment	4.218	0.882	0.209	0.218	0.247	60%
Political instability	3.966	0.999	0.252	-0.034	-0.034	49%
Research and development	3.793	1.036	0.273	-0.207	-0.200	42%
Market forces/inflation	3.784	0.976	0.258	-0.216	-0.221	41%
Modern innovation	3.716	0.934	0.251	-0.284	-0.304	38%
Contract rules and regulations	3.625	1.032	0.285	-0.375	-0.363	36%
Training opportunities	3.602	0.989	0.275	-0.398	-0.386	35%
Access to credit/loan	3.545	1.164	0.328	-0.455	-0.391	35%
Project planning and control	3.409	0.866	0.254	-0.591	-0.682	25%
Financial capacity	3.409	1.228	0.360	-0.591	-0.481	32%
Procurement procedure	3.402	1.005	0.295	-0.598	-0.595	28%
Financial management skills	3.333	0.923	0.277	-0.667	-0.723	23%
Cost and time performance	3.318	1.000	0.301	-0.682	-0.682	25%
Unfair competition	3.307	1.168	0.353	-0.693	-0.593	28%
Level of professionalism	3.261	0.977	0.300	-0.739	-0.756	22%
Plant and equipment	3.239	0.971	0.300	-0.707	-0.728	23%
Technical competence	3.105	1.128	0.363	-0.895	-0.793	21%
Material supply base	3.102	1.104	0.356	-0.898	-0.813	21%
Entrepreneurial skills	3.034	0.933	0.308	-0.966	-1.035	15%
Contract management	2.875	1.015	0.353	-1.125	-1.108	13%
Leadership and communication	2.864	0.937	0.327	-1.136	-1.212	11%
Estimating and tendering	2.375	0.900	0.379	-1.625	-1.806	4%

For the quantitative data obtained through the second section of the questionnaire, Table 2 presents the result of the mean (M), standard deviation (SD), coefficient of variation (CV), z-score (Z) and percentiles of the rating (in descending order) of the 23 challenges affecting capacity building of local construction firms in Nigeria. M has been used to rank the challenges, while SD expresses variability that CV helps to interpret better especially when and where M are almost the same. Z is the number of SDs from M, also referred to as the normal deviate (Colan 2013). Converting the z-score to percentile is a six-sigma technique (Sauro & Kindlund, 2005) based on the following steps (Sauro, 2011):

1. Deciding on and subtracting 80% of the Likert scale adopted (i.e., 4) from M, 80% benchmark is the tolerable possible performance penalty;
2. Dividing the difference by the SD to obtain the z-score, which informs on how many SD falls above or below the benchmark;

3. Converting the z-score to a percentile rank using a calculator (e.g., https://measuringu.com/pcalcz/) or lookup the z table; and
4. Interpreting the percentile as a function of the data points above or below the mean to gauge significance.

For example with respect to Table 2 and based on the preceding steps, corruption ranked topmost as having the most severe impact. Its mean score of 4.284 had a percentile of 63%, thus holding only 37% of the respondents below the mean score. Corruption is endemic in Nigeria with the multinational companies having also been found to be involved (Otusanya, 2011). Estimating and tendering ranked lowest with 96% below its mean score of 2.375. Its z-score of -1.806 correspond to about 2 SDs below the mean (Colan, 2013), meaning its significance is actually low. This is unsurprising considering the existence of self-assessment tools for quantity surveying firms in Nigeria to gauge and improve their performance (Osunsanwo & Dada, 2019).

For the qualitative data obtained through the third and last section on the strategies for the foreign and indigenous firms to work together for capacity building of the indigenous firms, qualitative content analysis was performed. TagCrowd (https://tagcrowd.com) was used to analyse the textual responses received from 72 of the 88 respondents. The following steps were followed to perform the textual analysis:

1. Pasting the full textual responses in the visualization box on tag crowd;
2. Selecting from the default options: (i) maximum number of 50 words to show, (ii) words of minimum frequency of 5 to show, (iii) selecting “yes” to show frequencies, and (iv) indicating not to show the following words considered inevitable in the responses: building, capacity, companies, construction, firms, foreign, indigenous, industry, local, and Nigeria; and
3. Clicking visualize!

Figure 1: Frequent words in capacity building strategies for local construction firms

Figure 1 shows the visual result of the analysis, which reveals the top-three most frequent words to be training (23), projects (19), and work (15).

These top-three frequent words were then linked back to the respondents for contexts.

Table 3: Capacity building strategies for local companies in Nigeria

Category	Verbatim response
Training	"…the foreign companies can provide financial guarantees or funding, training and technical expertise." – Building Service Engineer "All foreign firms must have a training arm which they should use for capacity building. This will also provide [the opportunity of] vocational certification for all graduates of this process." – Architect "Recognizing that indigenous companies are at a competitive advantage, the Nigerian government should provide training grants for indigenous companies or incentivize foreign companies who provide capacity building to local companies or management level training to indigenous staff." – Project Manager
Project	"…some form of law should be enacted by the relevant bodies for foreign firms to be subletting [i.e., sub-contracting] a certain percentage, (let's say 10-15%) of their projects to indigenous firms under their direct supervision, in order to increase their financial base…" – Architect "Research and development [R&D] should be a top priority. Foreign firms tend to use whatever works elsewhere on Nigerian projects and the indigenous firms tend to lift these practices directly. R&D will bring about best practices and materials for construction in Nigeria and gradually indigenous firms will be able to take up a bigger role in the industry." – Architect "Enacting policies that will only allow foreign companies to engage in equal partnership with indigenous companies and subcontracting of projects [to the indigenous companies] by any means should be prevented." – Urban & Regional Planner & Landscape Architect "There should be a sound legislation or a legal framework to require foreign companies to transfer knowledge as well as lessons learnt from indigenous projects. Not only that, there should be a road map that indicates how that can be achieved as well as a sound measure to check how local companies are incrementally learning from these foreign 'expats'." – Quantity Surveyor "… a clear policy on class of projects to be awarded to foreign companies is a good start. … Once this is enforced, some of the activities will be more profitable to the foreign companies if they were [sub-]contracted to indigenous firms … as a result of their need for minimum standards of performance in subcontracted activities [which will naturally develop interest in the competence and capacity of the locals completing those activities…" – Project Manager "… regulatory bodies have strong roles in enforcing quality assurance and quality control. Many construction projects are completed without even a single visit by the regulatory bodies to the project site. This must be corrected to ensure that indigenous companies perform better in the[ir] services." – Electrical Engineer "Joint venture between the foreign and domestic companies is the best strategy for capacity building of [the] indigenous firms. Foreign companies should not be awarded projects without local content." – Architect
Work	"Opportunity should be given to indigenous construction firms to compete with their counterpart foreign companies. It will go a long a way in building the indigenous companies. Most of the works that foreign companies are doing are [actually] the local people doing it except the supervision by the foreign ones." – Quantity Surveyor "Legislation should ensure elimination of double standard in employment of foreign and Nigerian workers on the same level with incomparable salary schemes. More emphasis should be laid on training more project managers as well as artisans and expose them to world class software and building standards." – Civil Engineer

A second-level textual analysis was thereafter performed on responses having the top-three frequent words in sequence to identify theme(s). The second-level

textual analyses followed the same steps as the first-level analysis, except for adding not to show the words training, project, and work (all singular) while performing respective analysis. The second-level analyses returned one most frequent word for training, project and work as “provide” (5), “projects” (19), and “building” (6) respectively. These words were linked back to the respondents as presented in Table 3. A cross analysis of the results in Tables 2 and 3 (for methodological triangulation) suggests that the strategic fit partnerships cannot be based on the ranks of the challenges. This is the major drawback of most of the existing studies that have focused on the top-ranked challenges. The systems nature of construction projects (Li & Love, 1998; Aritua, Smith & Bower, 2009) and complexity in project management (Cristóbal, 2017) cannot be ignored. Table 3 thus validates the elements of strategic fits that Waterman Jr. (1982) advanced. It also resonates with Omokaro-Romanus, Anchor and Konara’s (2019) findings of an emerging/growing internationalization strategy by the Nigerian firms.

CONCLUSIONS

This study aimed to investigate different approaches of strategic partnership to enable capacity building of the local construction firms in Nigeria by the foreign construction firms. Its objective was to assess the significance of the factors affecting the local construction companies in Nigeria to propose the best strategic fit partnerships with their foreign counterparts. Methodological triangulation performed through a cross-analysis of the ranks of the 23 challenges and the frequently-occurring strategies proved that the best strategic fit partnerships would be those that span the challenges. Of course, emphases should be placed on training/funding opportunities for the local firms, laws and regulations on competition and technology transfer should be put in place, and concerted efforts channelled towards investments in collaborative research and development to put the local firms at the frontline of construction innovation. The practical implication of the results of this study is a paradigm shift away from the top-ranked challenges to propose solution to the challenges facing local firms in Nigeria and beyond. This is because of the systems and complex nature of construction projects. For example, corruption, delayed payments, and political instability were ranked high as severely impacting capacity building of the local firms, however, there was no direct link to the most frequently occurring strategies, except implied. The theoretical implication is an in-depth look into the influence of the complex adaptive nature of construction projects in the challenges facing the players therein. The limitation of this study is the potential impact of the selection bias arising from the non-probability sampling technique used. On generalizability of the result, the sample size of 88 corresponds to a confidence interval of 90% and p-value of .10. This restricted limitation presents opportunities for another future empirical study.

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MAKING A CASE FOR MODULAR INTEGRATED CONSTRUCTION IN WEST AFRICA: RETHINKING OF HOUSING SUPPLY IN GHANA

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Concomitant with the rapid population growth in West Africa is the increasing difficulty in providing adequate housing for the masses. As housing constitutes the most expensive individualized basic human need, the gap between incomes and rents for homeless households have created housing hardship of epic proportions. Meanwhile, there is housing glut in Ghana amid the deficit. These indicate that a practical solution must offer a quadruplet benefit of speed, quality, affordability and economy in the housing production. This research examined the failures of previous industrialized housing initiatives in Ghana and highlighted the prevailing opportunities and potential barriers to the delivery of industrialized housing systems (IHS) in Ghana. Methodologically, the paper draws on a review of policy and academic literature to establish strong support for the adoption of modular integrated construction (MiC) to deliver affordable IHS in Ghana. Despite the failures of industrialized housing production initiatives in the 50s and 70s, the research found that opportunities such as improved infrastructure and manufacturing power, existence of prefabricated construction market, government recognition of innovative housing projects in Ghana and the availability of wealth of experiences, lessons and MiC best practices are favorable conditions which render MiC and industrialized housing construction (IHC) feasible in Ghana. The research used two case studies to justify the feasibility of MiC and IHC in Ghana. However, the lack of substantial experience with MiC, failure of previous IHS initiatives, absence of MiC implementation framework, lack of MiC technical guidance, design codes and standards, higher initial capital cost, and the incomplete MiC supply chain are potential barriers to the adoption of MiC in Ghana. A multi-stakeholder framework is proposed to guide the implementation of MiC in Ghana. Thus, this research contributes to the praxis and practice of the affordable housing discourse in Ghana and West Africa.

Keywords: Ghana, housing deficit, modular integrated construction

INTRODUCTION

Though it is estimated that 90% of the global population increase between 2018 and 2050 will occur in Asia and Africa (United Nations Department of Economic

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and Social Affairs, 2015, 2018), such aggregate statistics have a tendency of masking significant regional and national variations in the spate of population growth. Particularly, Sub-Saharan Africa (SSA) recorded unprecedented population growth, following a hitherto population stagnation under the shackles of the slave trade and colonization for several centuries. From the 20th century onwards, SSA witnessed a phenomenal population growth from 100million in 1900 to 229million in 1960 and 1.1billion in 2017 (United Nations Department of Economic and Social Affairs, 2018; World Bank, 2019). This profound population surge provokes increased demand for housing, infrastructure, services, food, energy, and water (UN-HABITAT, 2004). One critical challenge associated with the rapid population growth and urbanization is the provision of adequate, decent and affordable housing for the masses, especially for the lower- and middle-income households (UN-HABITAT, 2016; United Nations, 2017).

Housing accounts for over 70% of the spatial uses in cities and constitutes a critical determinant of urban forms and densities (UN-HABITAT, 2016). The housing and infrastructure deficits in SSA are worsening because the urban transformation in the region is largely chaotic and unplanned (UN-HABITAT, 2004; United Nations, 2017) and in which the spate of urbanization is not accompanied by commensurate industrial and economic growth (UN-HABITAT, 2004). As a result, housing and infrastructure deficit continue to soar up without a sustained supply. Notably, SSA alone accounted for over 56% of the total increase in slum population in developing countries between 1990 and 2014 (UN-HABITAT, 2016). Again, however, these aggregate trends of the SSA region have a tendency of masking the significant national variations in the magnitude of the housing shortfalls. Although the SSA countries share similar trends in developmental challenges, the similarities are more overt among the West African nations.

Ghana whose population is currently estimated at 29 million people (World Bank, 2019) is the focus of the current research. Although the slum population of Ghana declined from 65.5% in 1960 to 37.9% in 2015 (United Nations, 2017), the housing backlog remains higher than 2 million units, of which over 55% of the deficit thrives in the urban areas (Bah et al., 2018). With an estimated shortfall of 2million units in 2010, the UN-HABITAT (2011) estimated that Ghana's housing need will hit 5.7million rooms in 2020. This meant that 3.8 new rooms must be completed in every minute of the working days for ten years, starting from 2011 to successfully meet the shortfall. This rapid and continuous housing production requirement is overwhelming for the traditional cast-in-situ construction approach which is inelastic to supply in the short-run. Additionally, there is a paradox in the Ghanaian housing market as glut exists amid the deficit. According to Smith-Asante (2018), there are over 40% vacancy rates in the national housing estates operated by the State Housing Corporation. Besides, the Ghana Real Estate Developers Association (GREDA) continue to advertise houses for sale amid the exclaimed deficit. This suggests a clear mismatch between the prices (or rents) of homes and wages of preponderances of the masses. Certainly, the gap between wages and rents for homeless households have created housing hardship of epic proportions.

Housing is one of the most expensive individualized basic human need. Yet, over 65% of Ghanaians are situated within the lower and middle-income bracket (Bank of Ghana, 2007), the majority of whom survive under US$2.5 daily (UN-HABITAT,

2016). These pathetic income levels of the masses cannot support their housing and other basic needs. Although the Ghanaian Government "is still committed to improving housing delivery stock, but in line with a current global paradigm shift, it has largely withdrawn from directly providing housing to playing the role of a facilitator" (Ahadzie et al., 2004, pp.620). Essentially, the Ghanaian housing market is dominated by private and individual developers who meet their housing needs through self-help, self-build and incremental building (Amoako and Frimpong Boamah, 2017; Tipple et al., 1998). However, complete house construction under the self-help and incremental building models often span between 5 and 15 years (Bank of Ghana, 2007; Tipple et al., 1998). This longer housing production cycle is not capable of matching the rapid spate of the increasing housing shortfall. The nature of housing supply, income levels of the masses and the increasing rate of the shortfall in Ghana demand a construction business model which can deliver a quadruplet benefit of affordability, quality, economy, and speedy housing delivery. While existing housing studies have suggested policy-related remedies to the deficit, this study argues that technological intervention is required to generate quality mass affordable housing for the masses. This is because as the global housing shortfall persists, most countries have struggled to meet their own housing needs using industrialized housing systems through modular integrated construction (Terner and Turner, 1972). Countries such as China (Zhai et al., 2014), Malaysia (Kamar et al., 2014), the United Kingdom (Gibb and Isack, 2003), and Singapore (Wuni et al., 2019) have established clear roadmaps in using offsite production techniques to meet their rapidly increasing housing shortfalls.

Although Ghana's two attempts at mass housing production using prefabricated construction in 1952 and 1978 failed and were abandoned (Essienyi, 2011; Ofori, 1989; United Nations Technical Assistance Programme, 1957), this research seeks to establish a strong support for the adoption of modular integrated construction (MiC) to deliver industrialized housing systems (IHS) in Ghana based on some prevailing favourable conditions. The paper presents findings of an ongoing Ph.D. research project which seeks to develop a best practice framework for the implementation of MiC in Ghana. Concomitant objectives of the paper include (i) to review and highlight the factors which accounted for the failures of previous IHS in Ghana (ii) to expound on the existing favourable opportunities in Ghana which supports the adoption of MiC, (iii) to highlight the potential barriers to the adoption and implementation of MiC in Ghana, and (iv) to propose a multi-stakeholder framework to guide the implementation of MiC in Ghana. As such, the paper contributes to the policy discourse in seeking a lasting solution to the housing deficit in Ghana and opens a new research gate which will trigger academic debates in helping to rescue the housing conundrum.

RESEARCH BACKGROUND AND CONCEPTUAL BASIS

Industrialized Housing Systems and Prefabricated Construction in Ghana

Mass industrialized housing production and prefabricated housing business models are not entirely new in the Ghanaian construction industry and housing market (Ahadzie et al., 2008). Mass housing production involves "the design and construction of at least 10 speculative standardized house-units, usually in the same location and executed within the same project scheme" (Ahadzie et al., 2008, pp.676). Although there are several mass housing building projects in Ghana, there

have been only two unique attempts at deploying prefabricated construction technique to deliver mass IHS in Ghana (Essienyi, 2011; Ofori, 1989).

In 1952, the Gold Coast (now Ghana) Government attempted to implement IHS through parodying the post-war prefabricated housing model of Britain (United Nations Technical Assistance Programme, 1957). The Gold Coast Government (GCG) commissioned Messrs. N. V. Schokbeton; a Hollander Consultant to ascertain the economic and technical feasibility of producing prefabricated housing in the country. The Schokbeton prefabricated building method was intended to generate mass affordable housing from local precast members (Essienyi, 2011; Ofori, 1989). Amid the feasibility study, the GCG signed two agreements with Schokbeton in 1952 and 1953 to construct 168 prototype houses in Accra, Kumasi, and Takoradi at a lump sum of £336K, of which 64 units alone were constructed at a sum over £160K (Essienyi, 2011). This rendered the costs of construction far expensive compared to those of the cast-in-situ construction approach. As a result, the GCG invited the United Nations Technical Assistance Housing Mission to Ghana in 1954 to assess the practicality and reasonableness of the Schokbeton survey report (United Nations Technical Assistance Programme, 1957). Following a comprehensive review, the Mission advised the GCG to abandon the Schokbeton Housing Scheme because: (i) the project costed 80% higher than the budget and the houses were far expensive than the traditional units, (ii) the project demanded full government intervention and purchase of all produced units, and (iii) there were other affordable IHS options such as partial prefabrication which could meet the housing demand (Ofori, 1989; United Nations Technical Assistance Programme, 1957).

The second attempt at mass production of industrialized housing in Ghana occurred between 1962 and 1978. The Government of Ghana (GoG) signed an official agreement with the Soviet Union or Union of Soviet Socialist Republics (USSR) in 1962 to set up prefabrication plants in Accra to fabricate precast components for mass housing production in the country (Ofori, 1989). The IHS were to be designed and engineered in the Soviet Union and modified in Ghana. The prefabricated concrete panel factory (PCPF) was built in 1996 but owing to political unrest in the country at the time, the first standard structural components were produced in 1972 following substantial rehabilitation of the PCPF (Ofori, 1989). In 1978, the first factory-built house was accomplished in Ghana. The Scheme aimed to construct 2-story houses and 4-story blocks of flats using the slogan ‘own your house in 30-days’ (Ofori, 1989). The Scheme could not meet demands for its units and was eventually abandoned due to (i) non-availability of sufficient supply of cement and mild steel reinforcement to feed the plants, (ii) low production efficiency of the plants following excessive wear and tear, (iii) unfamiliarity of the technology to local contractors, and (iv) lack of cranes and lifting equipment in the country (Ofori, 1989).

However, Essienyi (2011) noted that the significant failures of the 20th Century’s prefabricated construction in most developing countries were due to poor functioning market economies, minimal industrialization, less infrastructure, and poorly structured housing markets. Similarly, this research argues that the post-war prefabricated housing failures were a global syndrome, of which the stigma was even severer in Europe following the collapse of the 22-story prefabricated

Ronan Point Apartment Tower in East London in 1968. However, lessons were learned, and as a result, prefabricated construction has become popular in many countries in the last couple of decades as a construction business model for addressing the rapidly growing housing shortfall. As such, Ghana also has enough reasons to make a third attempt at using MiC to deliver IHS.

Overview of Modular Integrated Construction (MiC)

Modular construction, industrialized building systems, prefabricated construction, and prefabricated prefinished volumetric construction are similar offsite construction techniques and denotes modular integrated construction (MiC) in this study where "free-standing integrated modules (completed with finishes, fixtures, and fittings) are manufactured in a prefabrication factory and then transported to site for installation in a building" (Hong Kong Buildings Department, 2018). Consistent with the concept of modularity in computer engineering and the business model of the automobile industries, MiC constitutes the highest order of prefabricated construction whereby 90-95% of a house can be completed in a manufacturing plant (Jaillon et al., 2009; Smith, 2016). MiC operates in four levels: component manufacture and subassembly, non-volumetric preassembly, volumetric preassembly and complete modular building (Gibb, 1999). The supply chain of MiC can be reified as modular design, manufacturing, engineering, transportation, buffer, storage and onsite assembly (Li et al., 2016). MiC delivers industrialized building systems where the same design details and specifications generate diversified and highly individualized houses (Richard, 2006b). The three major forms of MiC include reinforced concrete modules, steel frame modules, and hybrid modules (Wuni et al., 2019; Wuni and Shen, 2019a). MiC may take the form of post & beam, slab & column, panels & frames, integrated joint, factory-made section module, monolithic systems or boxes, mobile homes, container houses, load-bearing service core, mega-structure, and site mechanization (Richard, 2005). The operation of MiC demands the total integration of all subsystems and components into an overall building system utilizing industrialized production, transportation, and assembly techniques.

For the housing industry, MiC is a revolutionary technology with manifold benefits. Richard (2006a) demonstrates how MiC generates industrialized (ability to amortize a process capable of simplifying the production and reaching a high level of quality); flexible (ability to accommodate functional changes over time and in the space without destroying partitions and/or external walls); and demountable (capability of meeting the needs for reconfiguration or even relocation without demolition) housing systems. The primary benefits and advantages of MiC include speedy construction, improved certainty of cost (Blismas et al., 2006), attractive design, improved and controlled quality, flexibility of use, lower impact on continuity of business (Modular Building Institute, 2017), reduced community disturbance, reduced construction waste (Jaillon et al., 2009) and lower carbon emissions (Mao et al., 2013). Based on the opinions of MiC clients in the UK (Gibb and Isack, 2003), Table 1 shows the benefits of the technology.

There are several ways in which MiC could offer a lasting solution to the quality mass affordable housing needs of Ghana. Firstly, the manufactured modular components are not merely construction products but systems and processes where the modular buildings are houses in boxes (Alderton, 2019). The modular

building components are prefabricated volumetric boxes on an assembly line in a factory which are then transported to a job site for final assembly and installation. The speedy construction associated with MiC has positive implications on the cost and affordability of the housing systems.

Table 1. Benefits of MiC based on the opinions of clients in the UK

Benefit	Descriptions
Time	Less time on construction site – speedy construction *
	Speed of delivery of product
	Less time spent on commissioning
	Guaranteed delivery, more certainty over the programme, reduced management time
Quality	Higher quality – on the construction site and from factory
	Products tried and tested in factory
	Greater consistency – more reproducible
	More control of quality and consistent standards
Cost	Lower cost *
	Lower preliminary costs
	Increased certainty and less risk
	Increased added value
	Lower overheads, less on-site damage and less wastage
Productivity	Includes less snagging
	More success at interfaces
	Fewer site disruptions
	Reducing the use of wet trades
	Removing difficult operations
	Products work the first time
	Work continues on-site independent of the off-site production
People	Fewer people on-site
	People know how to use products
	Lack of skilled construction workforce and labour
	Production off-site is independent of local labour issues
Environment	Less construction waste*, lower resources consumption
	Lower water footprint
	Less greenhouse gas emissions, lower embodied carbon*
	Lower energy footprint

***Note**: * indicates a high incidence (Gibb and Isack, 2003)*

The 30-70% reduced construction time translates into faster solvency for developers and cost-effectiveness for housing authorities. Accepting time as a driver of costs, the speedy construction results in quality affordable housing owing to the controlled factory condition (Alderton, 2019). Secondly, MiC supports mass customization and housing production. Coupled with the speedy construction, MiC is highly elastic to the mass housing demand because supply could be increased within a shorter period. This attribute of MiC has a moderating effect on rent and a ripple effect on the wider housing market. Alderton (2019) noted that rents plateaued at the upper end of San Francisco's housing market owing to the elasticity of supply using MiC. On the ripple effect, Alderton (2019) reported that increased housing supply deflated luxury housing rental bubbles which resulted in increased affordability, lower competition, and cost for middle-income housing and reduced pressure on the residential market. Finally, increased efficiencies due to the repetitive and quicker learning curve associated with MiC facilitates the mass production of affordable housing by housing authorities. Although more does not necessarily mean better as quality may be compromised in mass affordable

housing, MiC can generate quality mass affordable housing. Despite benefits and promises of MiC in meeting the housing needs of Ghana, there are some barriers which may hinder the strategic application of the technology in the country (e.g. insufficient expertise, higher capital costs, absence of design codes and standards, and diseconomies of scale). Some potential barriers are explained in later sections.

RESEARCH DESIGN AND APPROACH

The paper adopted a qualitative research design where the authors have established strong support for the adoption of MiC to deliver IHS in Ghana. The research deployed a comprehensive methodological framework comprising the definition of the research problem, literature retrieval and analysis, qualitative data synthesis, case study analyses, and discussion of findings (Figure 1).

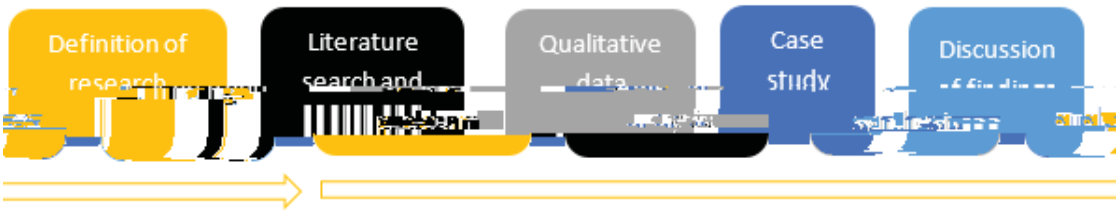

Figure 1. Methodological framework of the research

In making the compelling case, the paper relied heavily on literature review as a methodology and case studies to demonstrate the feasibility of using MiC to quickly generate mass affordable housing. Based on journal articles, conference paper, technical reports, and authoritative policy documents, the paper highlighted the housing needs of Ghana, drew lessons from previous industrialized housing systems and prefabricated construction, provided an overview of MiC, and identified the prevailing favorable opportunities in Ghana which support the adoption of MiC. The paper further described two case studies which deployed MiC to meet the need for quality, affordable and timely housing. The case studies served as demonstration projects to highlight the feasibility of using MiC to deliver IHS in Ghana. The two case studies were purposively sampled because they constitute some of the most successful MiC initiatives in Ghana. Drawing on empirical industry surveys in other developing countries such as China and Malaysia, the paper further documented the potential barriers to the adoption of MiC in Ghana and proposed a multi-stakeholder framework for MiC implementation in Ghana.

FINDINGS AND DISCUSSIONS

Opportunities for MiC and Industrialized Housing Systems in Ghana

Although industrialized housing initiatives failed in Ghana and many other countries in the past, the last few decades witnessed a renaissance and reinvigorated promotion of MiC as a practical and feasible technology for meeting the rapidly growing housing shortfall (Arif and Egbu, 2010; Gibb and Isack, 2003). Like the favorable conditions in other developing countries such as China and Malaysia, there are some opportunities which are congenial for the implementation of MiC and IHS in Ghana, viz-a-viz the lessons from the previous prefabricated construction failures.

Improved infrastructure and manufacturing power in Ghana

The success of the 20th century's prefabricated housing in some developed countries was fuelled by the existence of social infrastructure, substantial industrialization and structured housing industries (Essienyi, 2011). The absence of these factors which hindered the success of the 1952 and 1978 industrialized housing initiatives Ghana have been improved. There is reliable supply cement to feed modular production industry, improved transport systems in the major cities, the improved housing sector, availability of cranes and lifting equipment, and substantial manufacturing power to support the MiC technology in Ghana (Mulgrew, 2017). For instance, of four international branches, Ghana has the biggest housing manufacturing plant located in the Tema free zone operated by the Red Sea Housing Services Department (Red Sea International Company, 2018). Following its establishment in 2004, the Tema manufacturing facility has an annual production capacity of 285, 600 km2. The housing manufacturing plant produces Composite PVC panels, Sandwich panels, Steel containers and Roughneck in larger quantities (Red Sea International Company, 2018). The Housing Services Department of Red Sea International Company delivers innovative housing solutions to African and South American countries using its fast and effective logistics (ibid). These and many other manufacturing plants are critical success factors which could support the effective deployment of MiC in Ghana.

Existence of prefabricated construction market in Ghana

According to Essienyi (2011), mass production of modular components together with a developed market for the produced modules over the number of amortized years of the colossal capital investment are required for the profitability and success of MiC.

Table 2. List of some Prefabricated Building Construction Companies in Ghana

Name of company	Location	Name of company	Location
Red Sea International Company	Tema	Mammut Building Systems	Accra
Karmod Prefabricated Technologies			

142 prefab homes Ghana suppliers located in Asia currently supplies 100% of prefabricated homes to Ghana. Although the list (Table 2) is not exhaustive, the existence of at least 30 PBCCs in Ghana suggests that MiC is gaining increasing attention in the country. It is also an indication that MiC recognized as a modern construction technique and a potential technological solution to housing delivery in Ghana.

Given that these companies exist even though MiC is not explicitly recognized in the national housing policy suggest that there is a growing MiC supply market in Ghana which can be improved.

Government recognition of innovative housing projects and financing schemes

The use of MiC to deliver industrialized housing systems is an innovative technology which engenders significant changes to entrenched construction practices and conventions (Smith, 2016). Owing to the long-standing conservative mindset of the construction industry towards innovation and the higher initial capital requirements of MiC (Blismas et al., 2006), governments have been at the forefront of the industrialized construction paradigm. Typically, government recognition and financing are critical success factors (CSFs) for early stages of MiC (Jaillon et al., 2009). Consistent with these CSFs, the Ministry of Works and Housing (Ghana) recently extolled Forever Construction and Consultancy Limited (FCCL) for its affordable housing scheme involving two semidetached housing projects at Tsopoli-Agotor within the new proposed Airport site (Sam, 2019). The scheme deployed IHS to construct houses within a shorter time span and was recognized as a useful technology for meeting housing needs. Additionally, the United Nations Office for Project Services (UNOPS) under the Social Impact Investment Initiative (S3i) signed a deal with the government of Ghana in 2019 to deliver at least 100,000 affordable houses nationwide to be constructed using innovative technologies and local materials (United Nations Office for Project Services (UNOPS), 2019). This project is expected to last for 6 to 10years at a gross development cost of $5.3 billion. Given that this project will deploy innovative housing systems, it offers a useful basis for making strong support for the adoption of MiC in Ghana.

Availability of wealth of experiences, lessons and MiC best practices

Although the post-war prefabricated housing projects failed in many countries, especially in the third world economies (Essienyi, 2011), countries such as Sweden, the Netherlands, Singapore, Canada, UK, USA, Australia, and Germany have sought to overcome the post-war prefabricated housing stigma and reinvigorated the IHS. They have succeeded in achieving substantial progress in MiC implementation within the 20th and 21st centuries. Noteworthy developing countries making similar efforts include China and Malaysia (Jiang et al., 2017; Kamar et al., 2014). Notably, the Construction Industry Development Board (CIDB) of Malaysia implemented the 2003 – 2010 and 2011 – 2015 Industrialized Building Systems Roadmaps with concomitant revisions to the building codes, regulation, and permits to support and promote the uptake of the MiC technology in the country (Kamar et al., 2014). Similarly, the Chinese government under the National New Urbanization Plan 2014-2020 developed roadmaps and strategies to promote the uptake of MiC in the country (Jiang et al., 2017). With the increasing availability of exemplary projects, MiC is resisting all barriers and gaining increasing application in these countries. Thus, Ghana may learn from the existing wealth of experiences,

Properties Ltd whose major shareholder is Trasacco Estates Development Company Ltd. Although this project is a hotel project, it demonstrates the feasibility and potential of MiC and industrialized housing systems in Ghana.

Potential Barriers to the Adoption of MiC in Ghana

Although there are greater potentials in deploying MiC and IHS to rescue the housing crisis in Ghana, there are also potential barriers, constraints, challenges and risk factors which may hinder the adoption of MiC. Table 3 shows some of the most reported barriers to the adoption of MiC in developing countries (Kamar et al., 2014; Mao et al., 2014; Zhang et al., 2014). Although these barriers were identified in China and Malaysia, they are also widely reported in developed

a lack of well-established market demand for modular projects constitute potential barriers to the implementation of MiC (Kamar et al., 2014; Mao et al., 2014; Zhang et al., 2014).

Conceptual Framework for the Implementation of MiC in Ghana

MiC is a disruptively innovative technology in the construction industry (Wuni and Shen, 2019a). The adoption and implementation of MiC in Ghana is a classical problem of innovation diffusion. According to the innovation diffusion theory, the five stages of the innovation adoption process included knowledge, persuasion, decision, implementation, and confirmation (Rogers, 1983). Based on the knowledge of the potential barriers to the adoption of MiC, the feasibility of industrialized housing systems and the prevailing favorable opportunities for MiC in Ghana, a conceptual framework is proposed to enhance the decision to implement MiC. The framework grossly clusters the MiC stakeholders into government, industry practitioners, researchers, and clients. The framework also emphasizes the critical role of policymakers in MiC implementation because government spearheads the MiC revolution in Sweden, UK, China (including HKSAR), Singapore, Canada, Malaysia, among others (Wuni and Shen, 2019b).

Similarly, the implementation of MiC (Figure 2) must be driven by government and supported by other stakeholders. The government of Ghana is responsible for public or social housing and if MiC is to be deployed to deliver mass affordable housing, the government must explicitly recognize the technology, develop a legal framework to guide its implementation and provide leadership by undertaken demonstration projects. The government should create financial support and incentives for private developers to adopt the technology and secure long-term financing models such as public-private partnership to sustain the housing production process. Since MiC is largely an innovation in the Ghanaian construction sector, there is less expertise available to champion its excellence. As such, both government and industry practitioners (e.g. GREDA) must collaborate to provide relevant MiC knowledge to contractors, developers, architects, engineers, manufacturers etc. through training programs.

Industry practitioners need to establish MiC implementation teams and expertise towards establishing a positive attitude about MiC and encouraging standardization to improve MiC projects' quality and productivity. Researchers in Ghana must have to collaborate with researchers in countries with developed MiC technologies to generate bespoke information in Ghana to guide the MiC policy discourse. They will also need to develop best practice frameworks for implementing MiC in Ghana to minimize project failures and may also develop Aristotelian rhetoric strategies including Ethos, Logos, and Pathos as persuasive discourse mechanisms to be deployed by actors in diffusing MiC into the construction industry. Finally, industry practitioners would need to work closely with clients to ensure that the latter are convinced to adopt MiC solutions in their construction projects.

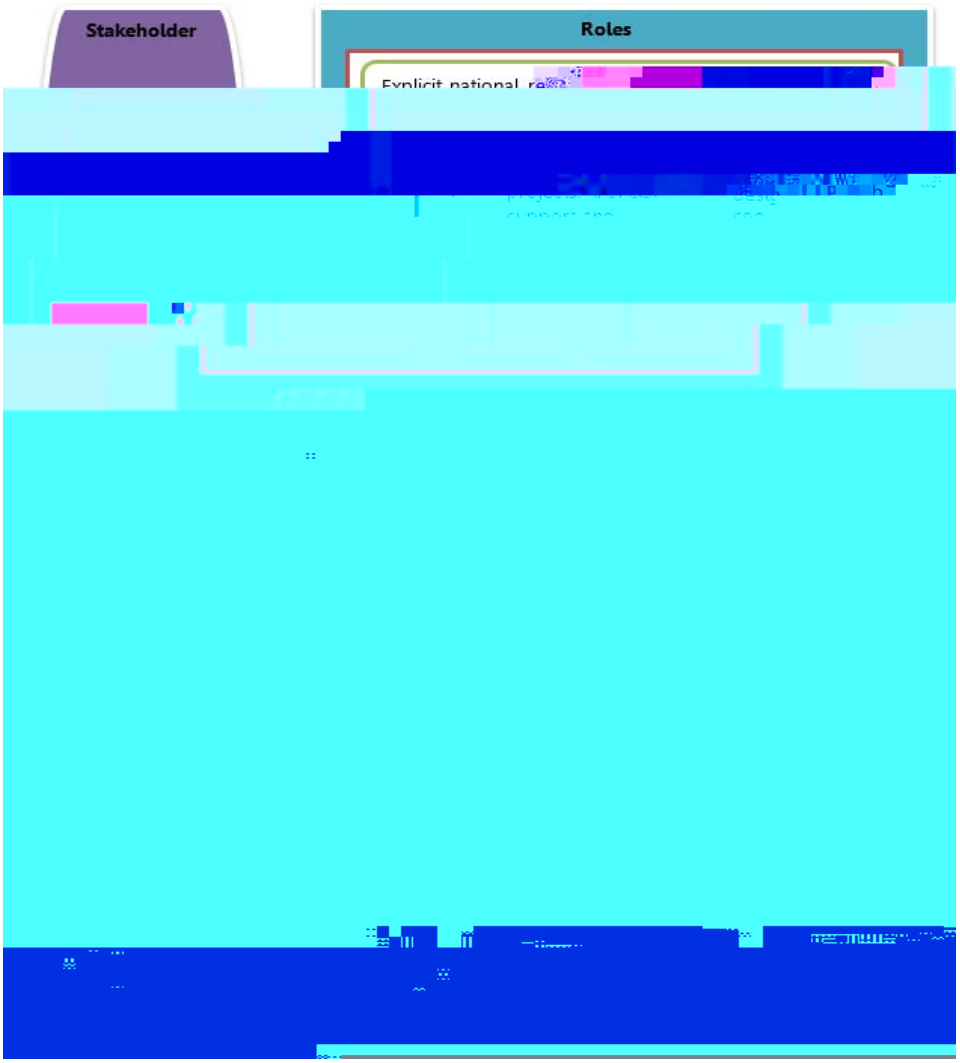

Figure 2: Multi-stakeholder framework for MiC implementation in Ghana

CONCLUDING REMARKS

The housing crisis in Ghana is associated with the combined physical housing deficit and the inability of many citizens to rent or purchase the available houses in the market. The affordability crisis is a product of the severe gap between wages and rents for the low- and middle-income families which have created a housing hardship of epic proportions. In addition, the rising shortfall in the supply of actually affordable housing overwhelms the traditional construction approach. Based on the experiences in many countries, modular integrated construction has proven to be capable of delivering quality affordable mass housing to match the pace of increasing shortfall. Drawing on literature review as a research methodology, this research found that the failures of the prefabricated housing construction initiatives in Ghana in the 50s and 70s were due to the lower level of industrialization, absence of well-defined housing market, poor infrastructure network, and less developed construction sector. It is further found that the implementation of industrialized housing systems in then Gold Coast was ill-informed and did not recognize the lower level of industrialization and the dominant self-build and incremental building models in the country. However, the presence of opportunities such as improved infrastructure and manufacturing

power, the existence of prefabricated construction market, government recognition of innovative housing projects in Ghana and the available wealth of MiC experiences, lessons and best practices in other countries provide a useful reference for the implementation of MiC and IHS in Ghana. The research, however, found that the lack of MiC expertise, absence of policy framework, higher initial capital cost and the cloudy market for industrialized housing systems constitute potential barriers to the adoption of MiC in Ghana. Whether MiC will succeed as a panacea to the housing deficit in Ghana remains to be seen. However, for the housing ordeals and plights of the low- and middle-income households in Ghana, the government, developers and industry practitioners must give the technology a chance. As a unique contribution to policy discourse, the paper proposed a multi-stakeholder framework for implementation of MiC in Ghana. However, the authors recommend that the choice of modular option and solution to be implemented in Ghana must be informed by the prevailing conditions, dominant income levels of the homeless, political climate, dominant house building models, level of industrialization and the capacity of the available social infrastructure to support the technology. Thus, the paper contributes to the policy discourse in seeking a lasting solution to the housing deficit in Ghana and initiates a debate for rethinking housing supply in Ghana and West Africa.

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OVEREXERTION-RELATED CONSTRUCTION WORKERS' ACTIVITY RECOGNITION AND ERGONOMIC RISK ASSESSMENT BASED ON WEARABLE INSOLE PRESSURE SYSTEM

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Work related activities that led to overexertion are a major cause of work-related musculoskeletal disorders (WMSDs) among construction workers. However, existing risk assessment methods (e.g., self-reported and observational-based methods) have failed to fully recognize these activities and assess the corresponding risk level exposure to mitigate WMSDs. This study examines the feasibility of using acceleration and foot plantar pressure distribution data captured by a wearable insole pressure system for automated assessment of construction workers' activities and overexertion risk levels. The accuracy of five types of supervised machine learning classifiers was evaluated with different window sizes to investigate individual participant performance and further estimate physical intensity, activity duration and frequency information. The results showed that the Random Forest classifier with 2.56s window size achieved the best classification accuracy of 94.5% and 94.3% and a sensitivity of more than 90.1% and 88.4% for each category of activities. Overall, the proposed approach provides a non-invasive method and objective assessment of ergonomic risk level based on acceleration and foot plantar pressure distribution data captured by a wearable insole pressure system which could help other researchers and safety managers to: understand the level of workers' risks; and provide an effective intervention to mitigate the risk of developing WMSDs among construction workers.

Keywords: activity recognition; construction workers; overexertion risk; supervised machine learning classifiers; wearable insole pressure system; work-related musculoskeletal disorders

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INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) are a leading cause of nonfatal occupational injuries within the construction industry (Eaves et al., 2016). In the United States, WMSDs account for 32% of all injuries and illness cases that result in absenteeism throughout industry (Bureau of Labor Statistics, 2015). WMSDs (e.g., low back pain) impose substantial direct and indirect costs, schedule delays and lost time claims to the industry (Umer et al., 2017a). To prevent WMSDs, the potential risk factors must be identified in order to provide practical interventions to mitigate the risk. Among the various biomechanical risk factors (e.g., awkward postures, overexertion, repetitive motions), overexertion (i.e., force exertion) has been identified as the leading cause of WMSDs among construction workers (BLS, 2016).

Previous studies have successfully demonstrated the use of wearable inertial measurement units (IMUs) for activity recognition and risk assessment (Akhavian and Behzadan, 2016; Nath et al., 2018; Ryu et al., 2018). For instance, Ryu et al. (2018) examined the feasibility of the wrist-worn accelerometer-embedded activity tracker for automated action recognition of four different subtasks of masonry works. Despite the inherent advantages of wearable IMU-based systems, these approaches are intrusive and require multiple sensors to be attached to a construction worker's body. Consequently, they are often uncomfortable to wear and/or instigate epidermal irritation. In addition, little research has been conducted to automatically recognize overexertion-related work activities and evaluate the amount of physical intensity (i.e., grip effort), activity duration and frequency information. Against this contextual backdrop, this paper proposes a non-invasive wearable insole pressure system for recognizing overexertion-related work activities and assessing ergonomic risk levels.

LITERATURE REVIEW

There are four thematic groupings of ergonomic risk assessment methods for identifying the development of WMSDs, namely: i) self-reported methods; ii) observational-based methods; iii) vision-based methods; and iv) direct measurement methods. Self-reported methods are relatively straightforward to implement and have an initial low cost as workers are asked to provide self-assessment risk-related data. However, researchers have stated that workers' self-assessments on exposure levels are often imprecise, unreliable and biased (Wang et al., 2015a). Observation-based methods involve real-time assessment or analysis of recorded video footage. However, these methods are mostly impractical due to the substantial cost, time and technical knowledge required for post-analysis of large amounts of non-heterogeneous data (David, 2005). Vision-based methods use depth sensors or stereo camera systems to capture human motion data (Han et al., 2013; Han and Lee, 2013). These methods provide accurate, non-invasive and automated human motion data for analyzing workers' safety behaviors or unsafe actions (Han et al., 2013). Despite the advancements in automation, these methods still require a direct line of sight to register human movements (Han and Lee, 2013). Direct measurement methods use wearable sensor-based systems to collect human motion-related data and provide accurate and reliable data for identifying WMSDs' risks (David, 2005; Akhavian and Behzadan, 2016; Antwi-Afari et al., 2017b;

Antwi-Afari et al., 2018a). Akhavian and Behzadan (2016) used a smartphone with embedded accelerometer and gyroscope sensors to capture body movement data

Model assessment

The performance of the classifiers (i.e., accuracy and sensitivity) was assessed by the stratified 10-fold cross-validation method (cf. Attal et al., 2015).

Activity recognition

Once the model was trained, and its parameters are finalized, it can be used for recognizing activities for which it has been trained. The overexertion-related workers' activities involved in this study can be allocated into four categories of activities that may lead to developing WMSDs among construction workers.

Estimation of physical intensity, activity duration and frequency

The physical intensity was calculated by subtracting the participant's self-weight from the total ground reaction force (Yu et al., 2018). The activity duration of each instance was calculated by counting the number of windows in that category and multiplying the result by half of the window size (Nath et al., 2018). The total

and window sizes, participant I had higher accuracies compared to participant II. The confusion matrices of the best classifier (i.e., RF) at 2.56s window size of participant I and participant II are presented in Fig. 2a and Fig. 2b respectively - the sensitivity of each category of activity was more than 90% and 88% respectively. This result suggests that there are between-participant variations among the two participants although they performed the same activities. Also, the most misclassified category of activities was 4.8% in participant I (Fig. 2a) and 8.1% in participant II (Fig. 2b).

Table 2. Classification accuracy (%) for each participant

Window size		ANN	DT	KNN	RF	SVM
0.32s	Participant I	65.2	71.6	75.2	80.6	77.5
	Participant II	64.9	71.1	74.8	80.2	77.1
0.64s	Participant I	67.5	73.9	78.8	85.5	80.6
	Participant II	66.9	73.4	78.3	85.3	80.2
1.28s	Participant I	69.4	76.7	83.7	90.8	88.6
	Participant II	68.8	76.4	83.2	90.5	88.1
2.56s	Participant I	72.1	79.6	86.9	94.5	91.7
	Participant II	71.5	79.2	86.1	94.3	91.4

True class					
	1	90.1%	3.6%	1.5%	4.8%
	2	1.1%	96.6%	1.3%	1.0%
	3	0.3%	3.8%	94.5%	1.4%
	4	4.3%	2.3%	0.6%	92.8%
		1	2	3	4

Predicted class

(a) Participant I

True class					
	1	88.4%	2.6%	0.9%	8.1%
	2	1.6%	95.6%	1.9%	0.9%
	3	1.4%	3.8%	92.5%	2.3%
	4	4.9%	3.1%	1.8%	90.2%
		1	2	3	4

Predicted class

(b) Participant II

Fig. 2. Confusion matrix of the RF classifier for each participant at a window size of 2.56s in all category of activities

Table 3 presents the actual and estimated physical intensity, activity duration and frequency of each participant in each category of activity. Table 3 illustrates that the estimated physical intensity, activity duration and frequency of the first participant were within ± 5, ± 2.2%, and < -2, from the actual values respectively. Conversely, the estimated physical intensity, activity duration and frequency of the second participant were within ± 5, ± 3.8, and < -4, from the actual values respectively. These findings suggest that the estimated values in participant I was slightly accurate as compared to participant II. Table 4 illustrates the calculation of

overexertion related ergonomic risk levels (where these values are based upon the risk levels presented in Table 1). All estimated risk levels are similar to actual risk levels in each participant. Given above, it is plausible to conclude that the proposed approach is feasible to calculate all the actual and the estimated risk levels, which are within the same level of risk for each participant.

Table 3. Actual and estimated physical intensity, activity duration and frequency

Participant	Activity category	Physical intensity			Activity duration			Frequency		
		Actual (kg)	Estimated (kg)	Error	Actual (s)	Estimated (s)	Error	Actual	Estimated	Error
PI	1	15	14	1	226	221	2.2%	21	23	-2
	2	17	22	-5	2168	2164	0.2%	52	55	-3
	3	28	25	3	3128	3120	0.3%	64	69	-5
	4	20	18	2	430	435	-1.2%	11	14	-3
PII	1	14	17	-3	218	225	-3.2%	20	28	-8
	2	15	20	-5	1230	1235	-0.4%	56	60	-4
	3	27	24	3	2586	2642	-2.2%	62	79	-7
	4	18	15	3	345	332	3.8%	12	16	-4

Table 4. Calculation of overexertion-related ergonomic risk levels

Item	Activity category	Physical intensity		Risk level	Duration/Shift			Risk level	Frequency per minute			Risk level
		Actual	Estimated		Actual	Estimated	Diff.		Actual	Estimated	Diff.	
PI	1	> 5 kg or high effort	> 5 kg or high effort	H	4%	4%	0%	L	0.23	0.25	0.02	L
	2	8-23 kg	8-23 kg	M	39%	39%	0%	M	0.57	0.60	0.03	L
	3	>23 kg	>23 kg	H	57%	57%	0%	H	0.70	0.75	0.05	M
PII	1	> 5 kg or high effort	> 5 kg or high effort	H	5%	5%	0%	L	0.30	0.41	0.11	L
	2	8-23 kg	8-23 kg	M	30%	30%	0%	M	0.83	0.88	0.05	L
	3	>23 kg	>23 kg	H	64%	64%	0%	H	0.92	1.16	0.24	M

CONCLUSIONS

The current study examined the feasibility of using acceleration and foot plantar pressure distribution data captured by a wearable insole pressure system for automated assessment of construction workers' activities and overexertion risk levels. The results found that the RF classifier (with 2.56s window size) provided the best classification accuracy of 94.5% (PI) and 94.3% (PII) and a sensitivity of more than 90.1% (PI) and 88.4% (PII) for each category of activities. In addition, all actual and the corresponding estimated ergonomic risk levels fall into the same level of risk. The study's findings illustrate that using acceleration and foot plantar pressure distribution data measured by a wearable insole pressure system is feasible for automated recognition of overexertion-related workers' activities. Overall, the findings could help develop a non-invasive wearable insole pressure system as a piece of personal protective equipment for continuous monitoring and activity recognition. Such a tool could assist researchers and safety managers in understanding the causal relationship between overexertion-related ergonomic risk and WMSDs among construction workers. Despite these promising findings, the number of study participants was small and all the experiments were conducted in a laboratory setting vis-à-vis actual construction site. Future research should therefore be undertaken to validate our experimental protocol by using a larger sample of experienced construction workers on site to generate a more robust

evaluation and recognition of overexertion related workers' activities and ergonomic risk assessment.

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Opeoluwa Akinradewo, Clinton Aigbavboa and Ayodeji Oke (2019) Performance Benchmarking System for the Nigerian Construction Industry In: Laryea, S. and Essah, E. (Eds) Procs 10th West

organization participation in construction activities. With the high number of foreign organisations, it was evident that there is low level of human resource development in indigenous construction organisations. These resources are needed for designing, planning, constructing and maintaining the size and number of conceived projects by the government (Idoro, 2009). Nevertheless, by enhancing the education system, employment of expatriates, coaction between expatriates and indigenous entrepreneurs, improved policies and stability of the political system, the apparent gap of human resources needed for completing a complex project between indigenous organisations and their foreign counterparts is being bridged gradually (Mbamali and Okotie, 2012).

In 2007, Osofisan criticized the Nigerian construction industry as one of the slowest to integrate technological advancement. The researcher added that the issue of Information Technology (IT) in the building industry is hence relatively limited compared to other sectors. Osofisan (2007) stressed further that IT implementation across all sector of the building industry may be more difficult than in other industries and thus advocated the need for innovative ideas and improved processes for the industry to remain competitive in present day digital economy. Universally, decision makers in the industry are always making efforts to ensure there is improved quality in the activities of the industry such as strategic planning, marketing, restructuring, financial management etc. Despite the importance of performarforTturing, financial mana

Secondary data was used to arrive at the proposed performance measurement indicators for the Nigerian construction industry. Search for literature was carried out using "construction industry", "benchmarking" and "performance measurement" as keywords on the ISI Web of Science and SCOPUS databases. The choice of using these databases is based on the submission of Guz and Rushchitsky (2009) that ISI Web of Science and SCOPUS databases are the mostly widespread databases for research articles that are related to scientific fields. The search produced over 300 publications which were carefully examined to determine if they are related to the focus of this research study. 69 articles met the criteria to be considered for this study but the search was limited to publications between 2000-2018 and filtered further by limiting the search to conference publications and journal articles. A total of 28 published articles were eventually found relevant as they address performance benchmarking studies of developed and developing construction industries across the world. Performance benchmarking for this study therefore refers to all indicators used for measuring performance of stakeholders on construction projects within the reviewed construction industries.

BENCHMARKING

Kyro (2003) submitted that the term benchmarking has gained recognition in business life as a tool useful for improving organisation's competitiveness and performance. Ball (2000) together with McAdam and Kelly (2002) corroborated this stating that benchmarking scope has extended beyond large firms to both small business and the public sector including semi-public sector. By definition and classification, benchmarking varies depending on the criteria and the time the research works centres on while the idea remains the same. According to Ball (2000), "Benchmarking is first and foremost a tool for improvement, achieved through comparison with other organisations recognised as the best within the area". This involves learning how to upgrade basic organisation activities, procedures and management routines. It helps in the evaluation and application of best practice which will give room for improving quality. Supporting the above definition, Prado (2001) defined benchmarking as "a research and observation of the best practice of competitors and/or search for the best industry practice leading to producing the more superior performance". Ajelabi and Tang (2010) took the definition further by stating that benchmarking doesn't only carry out comparative performance measurement, it also analyses the process of attaining exceptional performance which are keyed out by performance indicators measures referred to as benchmarks and the preceding activities to the exceptional performance referred to also as enablers. All these definitions show that evaluating performances of competitors as well as analysing ways of improving on them are the core concepts of benchmarking which was pointed out by different researchers (Ball, 2000; Longbottom, 2000; Zairi and Whymark, 2000a, b; Comm and Mathaisel, 2000; Fernandez et al., 2001; Prado, 2001; Carpinetti and de Melo, 2002; Yasin, 2002; Ajelabi and Tang, 2010).

Benchmarking can be in three forms which are Internal, Competitive and Generic benchmarking. When there is a comparison of operations internally within an organisation based on two or more different projects being executed, this is referred to as Internal Benchmarking which helps the organisation in achieving 'best in company' level of performance. Competitive Benchmarking occurs when

there is a comparison of products, function of interest or service against specific competitors. It is more complex and difficult to carry out but it will provide information based on what competitors are achieving. Generic Benchmarking is said to be a comparison of business process/function across industry or country as long as they are the same in approach (Construction Excellence, 2010). This study therefore adopts the generic benchmarking system to evaluate performance measurement across the construction industry.

Application of benchmarking concept in the construction industry has commanded considerable interest over the last decades as reported in literatures based on project duration context, partnering performance, contractor selection, safety management and information technology evaluation (Palaneeswaran and Kumaraswamy, 2000; Li et al., 2001; Yasin, 2002; Mohamed, 2003; Stewart and Mohamed, 2004; Costa et al., 2006). Benchmarking therefore being a process of assessment encourages continuous learning for low level staffs, managers and the organisation at large (Barber, 2004). The process of benchmarking gives room for generating innovation within a receptive environment which can be in form of clubs or forums for individual organisation to learn from local support network best practices (Mohamed, 2003; Constructing Excellence, 2010). Over the years, developed and developing countries have adopted a performance benchmarking system for their construction industries among which are the United States, Chile, Denmark, Australia, Brazil, United Kingdom, Hong Kong, Singapore and Netherlands (CII, 20180; Byggeriets Evaluerings Centre 2002; Barber, 2004; Costa et al., 2004; Constructing Excellence, 2010; Bakens et al., 2005). All these authors have succeeded in giving extensive reports on how the benchmarking systems were formulated, implemented and the challenges encountered. The chief target of the programs is to identify the key factors required for effective design and performance measurement implementation system. These programs were set up in these countries related to performance measurement creation and implementation with some set of aims and objectives which are (i) to formulate benchmarks for establishing business goals and objectives by individual companies; (ii) to offer performance measurement guidance; and (iii) to disseminate and identify industry best practices through reports generated from benchmarking clubs/networks.

Performance Benchmarking – Other Nations' Experience

In the United Kingdom (UK), Key Performance Areas (KPA) was launched in 1998 by the Best Practice Programme with the purpose of enabling measurement of organisation and project performance using large number of projects thereby providing indications as regards performance of the UK construction industry. To further progress the performance measurement, "the Construction Excellence body was created which is an amalgamation of Rethinking Construction and the Construction Best Practice Programme (CBPP)". Construction Excellence body was created to tackle market failures in the UK construction industry and sell business case for improvement. Some set of KPAs were formulated which are updated annually by the CBPP. These KPAs are used by organisations for improving performance opportunities and market advantages. Presently, the KPAs in use are but not limited to: "Client Satisfaction, Construction Time & Cost, Defects, Productivity, Employee Satisfaction, Profitability, Health & Safety, Staff Turnover, Working Hours, Sickness Absence, Impact on Environment, Qualifications & Skills,

Waste, Whole Life Performance, Commercial Vehicle Movements etc". These KPAs can be applied at company level or project level depending on which indicator is to be put into use (Beatham et al., 2004; Construction Excellence, 2010).

In Chile, The National Benchmarking System (NBS) came into existence in 2001 by the collaboration of the "Corporation for Technical Development (CDT) of the Chilean Chamber of Construction and Program for Excellence in Production Management of Pontificia Universidad Catolica de Chile (GEPUC)". The benchmarking system was aimed at identifying best practice, analysing them and then generate improvement opportunities on short-term basis for participating companies. Several performance indicators were identified which were analysed having carried out empirical research and conducted meetings with companies' representatives before the approved indicators were established for use in the Chilean Construction Industry. The NBS therefore, came up with the following sets of performance measurement indicators: "deviation of cost by project, risk rate, deviation of construction due date, accident rate, change in amount contracted, efficiency of direct labour, rate of subcontracting, productivity performance, client cost complaints, planning effectiveness and urgent orders". These sets of indicators are applicable to five sections of the Chilean Construction Industry which are: low-rise building, high-rise building, civil works, light industrial construction and heavy industrial construction (Costa et al., 2006).

Construction Industry Institute Benchmarking and Metrics (CII BM&M) programme for United State of America (USA) kickstarted in 1993 by the Construction Industry Institute with the aim of providing a self-analysis tool to its member organisations which will help in quantifying the use and value of best practice. Over the years, the CII BM&M program continues to evolve in order to meet the needs of participating organisations, construction industry objectives and support the institute's strategic goals. Database for the CII BM&M consists of both local and international participants with about 25% amounting to the international input. Projects considered includes building sector, light industrial sector, heavy industrial sector and infrastructure industry sector with the larger part from heavy industrial sector. It was reported that organisations that use benchmarking more tend to experience a better cost, safety and schedule performance. The indicators adopted by the CII BM&M includes: "Project Cost Growth, Project Budget Factor, Project Schedule Growth, Project Schedule Factor, Lost work day case incident rate, Recordable Incident rate, Change cost factor and Total field rework factor" (CII, 2018; Ahmad, Svalestuena, Andersena and Torp, 2016).

The "Building Innovation Research Unit (NORIE) of the Federal University of Rio Grande do Sul (UFRGS), the Association of Building Contractors of the State of Rio Grande do Sul (SINDUSCON/RS) and the Agency for the Support of Micro and Small Businesses (SEBRAE/RS)" in 1993 established the Performance Measurement System for the Brazilian Construction Industry (SISIND) project with the aim of propagating the concept, practice and principles of measuring performance in the Brazilian Construction Industry. The benchmarking system focused more on small scale firms because they make up the larger percentage of the Brazilian Construction Industry both in output and number of establishments. The "Building Innovation Research Unit (NORIE) of the Federal University of Rio Grande do Sul (UFRGS) together with the Association of Building Contractors of the State of Rio

Grande do Sul (SINDUSCON/RS) with the support of the National Council for Scientific and Technological Development (CNPq)" came up a more recent initiative for the Brazilian Construction Industry which was termed SISIND-NET project with focus on implementing measurement of performance system which the initial project only succeeded in propagating its concepts, practices and principles. The SISIND-NET project came up with ideas such as setting up a web-based tutorial for performance measurement trainings and also promoted workshops/training courses that facilitated dissemination and implementation of performance measurement across the Brazilian Construction Industry. The SISIND-NET project came up with the following set of indicators for performance measurement in the Brazilian Construction Industry: Cost, Plan, Time, Sales, Client and Product quality, Supply, Construction Product Quality, Safety, People Involved and Quality Management System (Formoso and Lantelme, 2000; Costa and Formoso, 2003; Taticchi, Tonelli, and Cagnazzo, 2010).

Department of Public Works and the Construction Industry Development Board (CIDB) with the assistance of the Centre for Scientific and Industrial Research (CSIR) developed the Construction Industry Indicators (CIIs) for the South African Construction Industry which are being reported yearly since 2003. The CIIs are aimed at monitoring the development needs and trends in the South African Construction Industry; keeping the industry participants and stakeholders informed about key performance factors; and facilitate project and company benchmarking. The CIIs consist of five categories of indicators which are based on the annual report carried out on construction projects executed during the year on review. The categories are client satisfaction, contractor satisfaction, economic indicators, procurement indicators, health and safety. Some category has sub-categories which are used in measuring performance in the South African Construction Industry. "Client satisfaction is measured on performance of agent/consultant team; performance of contractor; construction schedule; quality of work delivered; resolution of defects; and level of defects. Contractor satisfaction is measured on performance of client; quality of tender documents and specifications; and management of variation orders. Economic indicators are measured on profitability; payment of contractors; and payment of client's agents/consultants. Procurement indicators are measured based on general conditions of contract and adjudication of tenders while Health and Safety of all project participants are considered for Health and Safety indicator" (Marx, 2014; CIDB, 2016).

Lessons Learnt and Benefits of Performance Benchmarking System

From the performance benchmarking systems reviewed above, it was learnt that for effective evaluation of performance benchmarking systems, a club/forum needs to be put in place known mostly as benchmarking club. These clubs are peculiar to benchmarking systems of the construction industries reviewed and comprises of construction industry professionals and stakeholders who partake and assist in decision making procedures (Lantelme et al., 2001; Costa and Formoso, 2003; Costa et al., 2006; CII, 2018; Constructing Excellence, 2010). In implementing performance benchmarking systems in these construction industries, there are some problems encountered among which are: most of the systems do not consider suppliers' input as part of the construction stakeholders and therefore do not evaluate their performance (Beatham et al., 2004); Some systems use lagging measures in evaluating performance (Beatham et al., 2004; Costa et al., 2006); Lack of corporate

commitment to benchmarking club/forum by organisations and firms (Costa et al., 2006; CII, 2018); Little use of performance indicator measures and ineffective communication/dissemination of result of analysis (Costa and Formoso, 2003).

Benefits derived from performance benchmarking systems among others are: it gives room for evaluating the impact of present interventions by government and stakeholders of the construction industry for quick and timely execution of development programmes, strategies and reviewed legislation which will make the industry grow (Marx, 2014); It focuses improvement efforts on issues that are critical to success of the industry (Construction Excellence, 2010); It gives guarantee that improvement targets are coined out from the achievements from practice in the industry (Construction Excellence, 2010; Marx, 2014); It gives room for the exchange of ideas among construction professionals and provide the environment for meeting to deliberate on best practice measures thereby coming up with improvements (Costa et al., 2006).

Performance Measurement in the Nigerian Construction Industry

Christiana (2008) submitted that the Nigerian Construction industry needs to take performance measurement seriously and the Government needs to formulate policies on Performance Measurement practice while setting up departments that will be in charge of bringing in global trends and making sure the industry adopts them. Christiana (2008) stressed further that there should be a general awareness and orientation on the importance of implementing performance measurement within the Nigerian Construction Industry. It was concluded that most construction firms have interest in knowing their performance and actually measure their performance. Although few of the construction firms have performance measurement concepts knowledge, they mostly engage in using traditional performance measures (which has been highly criticised). Only few construction firms adopted the use of non-traditional performance measures.

In view of these submissions, it is therefore imperative that the Nigerian Government formulate policies on benchmarking to evaluate performance of the Construction Industry by taking knowledge from international experiences of KPA, CII BM&M, NBS, SISIND-NET and CIIs. In order to achieve the objective of this study, some qualities a performance measurement system ought to have as outlined by Tangen (2004) was crosschecked which are: it must support strategic objectives; it must guide against sub-optimization; it must consist of performance measures that has comprehensive specification; and it must be easily accessible with limited number of measures. To this end, the performance measurement indicators shown in Table 1 are proposed for the Nigerian construction industry at the different stages of construction based on the reviewed performance benchmarking systems of construction industries.

CONCLUSION

It is no gainsaying that performance benchmarking system has helped businesses with the construction industry not an exception. Over the years, developed countries has implemented performance measurement into their construction industry to encourage competitiveness. This in turn has benefited the construction industry with the evolvement of best industry practices. This has also enabled

government policies be fashioned into assisting the activities of the industry be driven towards ensuring best practice is ensured in all facets.

Table 1: Proposed Performance Indicators for Stakeholders in the Nigerian Construction Industry

Client	Consultant	Contractor	Supplier
PROCUREMENT STAGE - PERFORMANCE			
Project attribution Procurement & delivery Strategy Project viability Contractual arrangement Briefing Process Communication Decision effectiveness Risks and opportunities Excessive bureaucracy Social Obligations	Project management capabilities Good working relationship Competency Consultation mode Commitment Strategic cost advise Meeting functional requirements Meeting technical specification Proper communication Interactive process Efficiency of technical approval authorities	Level of experience Financial stability & financial management Past performance Management capabilities Performance of project personnel Construction method and technology Manpower and technical capabilities Project innovation	Quality assurance on products Quality control system Product life span Replacement value Product mechanisation Track record Level of service Team turn-over rate Capabilities of key personnel Top management support
PROJECT PHASE - PERFORMANCE			
Management structure Project interfaces Fragmentation Conflicts Control measures Political, economic, social legal & environment influences Loyalty Quality of work life	Team Management Project interfaces Coordination Accountability Conflicts management style Communications and reporting Quality control system Quality assurance Dispute resolution process	Performance standard Good working relationship Construction method & technology Labour utilisation & relaxation Productivity rate Safety Communications and reporting Cost control mechanism Efficiency	Material Procurement Co-operation Commitment Coordination Ability to deliver Product reliability Delivery time Contractual agreement Product defects
PHASING-OUT STAGE - EXPECTATION			
Meets pre stated objectives Meets time Meets budget Technical specification Acceptable quality Meets Corporate prioritie Absence of any claims & proceedings Transfer of experience Investment opportunity Value for money	Profitability Future Jobs Learning & growth Generated positive reputation Harmony Absence of any legal claims & proceedings Increase the level of professional	Profitability Achieve business purpose (strategically, tactically & operationally) Learning and growth Settlements of conflicts Minimum risk (reduction of disputes) Business relationship New market penetration Generated positive reputation Develop new knowledge & expertise	New market penetration on products Future potential Exploit technology Profitability

Adapted from: Lantelme et al.,. 2001; Takim and Akintoye, 2002; Beatham et al., 2004; Costa et al., 2006; Constructing Excellence, 2010; CII, 2018

The Nigerian construction industry in a bid to level up with the global trends need to adopt performance measurement system by setting up a body to oversee the dissemination, evaluation and implementation of performance measurement. To achieve success, a clear understanding of performance which needs to be improved, and why it should be improved must be established; Careful selection of who to benchmark against must be carried out; The reasons for any difference

in performance must be well researched; Goals and targets must be established which are both challenging and achievable once effort is put into it; There must be willingness to implement the benchmarking findings.

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PREMATURE PROJECT CLOSURE: THE ROLE OF CONSULTANTS AND CONTRACTORS

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supposed to only occur when project objectives have been accomplished, however,

selection (Mohammadi et al., 2014); leadership style (Bossink, 2004); personality and emotional intelligence (Zhang and Fan, 2013); and role of project leaders (Sommerville et al., 2010).

To maintain a continuous flow of work, contractors and consultants must put together interdisciplinary teams to ensure that individual skills are collectively harnessed in order to make best possible decisions within a reasonable time (Janis, 1989). However, every project team usually encounter divergence of ideas in the bid to achieve its objectives and solve problems encountered along the way. These disagreements and conflicts must be handled delicately, ideas must be tested, varieties of assumptions and perspectives must be discussed to make better decisions that will ensure project success (Quinn, 1990). Members of a construction team are jointly liable for the completion of the particular task assigned to the team. Individual construction teams are usually headed by subcontractors or consultants who are responsible for the su

closure. Fraud can arise as a result of evasion of progress billings as well as manipulation of project records which can disrupt cash flow among contractors, subcontractors and suppliers and ultimately interrupt the smooth progress of the project. Furthermore, Fraud can also be in form of wasteful spending that could lead to the abandonment of construction projects (Arni, Nurul and Tan, 2013). Liphadzi, Aigbavboa and Thwala (2015) emphasized that construction project leaders are ultimately accountable for their project team performance as well as the achievement of desired project objectives. Consequently, Project teams tend to perform better when they work under contractors with reputable skills and efficient management styles. Sebestyen (2017) stipulated that during project execution, it is important for project contractors to note that too much deviation from the original designed plan can drastically increase the risk of project failure since the success of a project is usually attributed to good planning.

The theoretical overview has reviewed variety of studies on project life cycle and premature project closure. It can be deduced that previous studies have been carried out on how contractors and consultants can contribute to success and failure of construction projects. The major factors highlighted and discussed in the review include; labour selection and management; conflict management; tasks management; project management style; design synchronisation and accurate implementation; work progress interruptions; financial management and fraudulent practices; teamwork and interpersonal relationship; job knowledge; job dedication; task proficiency; experience; and competence.

The review exposed that previous studies have explored how contractors and consultants can contribute to success and failure of construction projects, however, little attention has been paid to premature construction project closure in the South African context. The current study seeks to explore how contractors and consultants can contribute to premature project closure from the perspective of the South African construction industry.

RESEARCH METHOD

The study is descriptive in nature as the study seeks to examine the part played by contractors and consultants in premature project closure in the South African construction industry. Kothari (2004) pointed out that the quantitative method is used to find out people's opinion, attitude and behaviours. Hence the quantitative research model was used for the study. This study was carried out in the Gauteng Province of South Africa and used construction professionals including Architects, Civil Engineers, Quantity surveyors, project managers, contracts managers and construction project managers as the source of primary data. Gauteng province was deemed suitable for the study because it houses two megacities in South Africa (Johannesburg and Pretoria). It is also the seat of the executive capital of the country. As both cities are constantly developing megacities, numerous construction projects are ongoing which makes construction professionals in the province suitable for the study.

A close-ended questionnaire was designed and distributed to relevant professionals in the construction industry with the aim of establishing the role of contractors, subcontractors and consultants in premature project closure in construction projects. This was achieved by requesting construction professionals

within the study area to rate the individual attributes of contractors and consultants on how they could easily lead to premature project closure. One hundred and twenty questionnaires were distributed, but only eighty-two were received back and deemed usable which formed the bases of data analysis for the study. In order to determine the level of importance of each rated factor, the five-point scale from the questionnaire was converted into Mean Item Scores (MIS) for each of the rated factors.

The collated data were tested to check the reliability with the aid of Cronbach's alpha test. The test returned values of 0.939 and 0.949 respectively for the contractors and consultants related factors measured in this study. This indicates that the collected set of data is reliable since Cronbach's alpha test scores a set of collated data between 0 and 1, where 1 means the data has maximum consistency (Akinshipe and Aigbavboa, 2018), hence the data were deemed very reliable.

The study was limited by inadequate previous studies on premature project closure in the construction industry. This was managed by using literature on construction project failures and life cycle of construction projects in relations to premature project closure. Furthermore, due to cost implications and time frame of carrying out the research, Only Gauteng province was covered by the study.

FINDINGS

Background data collected revealed that 47.56% of the respondents are Civil Engineers, 21.95% are Construction Project Managers, 12.20% are Quantity Surveyors, 9.76% are Architects, 6.10% are Contracts Managers and 2.44% are Project Managers. Distribution of the respondents based on the length of work experience in the construction industry shows that 64.63% has 1-5 years of experience, 30.49% has 6-10 years of experience while 4.88% has above 10 years of experience in the construction industry. 61.11% of the respondents worked in the private sector, 32.94% of the respondents worked for both private and public sectors while 6.15% of the respondents worked in the public sector.

Table 1: Contractor related factors which may cause premature project closure

Contractor-related factors	Mean Item Score	Std. deviation	Rank
Management of labour	3.83	0.625	1st
Relationship between main and subcontractors	3.76	0.779	2nd
Conflict management skills	3.74	0.814	3rd
Site management	3.70	0.781	4th
Level of experience	3.70	0.812	4th
Management of subcontractors	3.65	0.807	6th
Adequacy of planning	3.65	0.912	6th
Construction methods used	3.60	0.768	8th
Payment to subcontractors	3.49	0.892	9th
Management of finances	3.39	1.003	10th

Table 1 ranks contractor related factors that contributes to premature project closure. From the table, it can be deduced that the dominant factors initiated by contractors which are most likely to cause premature project closure includes; Management of labour; Relationship between main contractors and sub-contractors and; Conflict management skills with mean item scores of 3.83; 3.76

and; 3.74 respectively. Closely next to these three are Site management and Level of experience with mean item scores of 3.70 each.

Table 2: Consultant related factors which may cause premature project closure

Consultant-related factors	Mean Item Score	Std. deviation	Rank
Conflict management skills	3.80	0.728	1st
Relationship between consultants	3.79	0.733	2nd
Consultants level of experience	3.76	0.779	3rd
Support from the client	3.76	0.810	3th
Design changes	3.74	0.750	5th
Contractual changes	3.74	0.767	5th
Effective contract management	3.73	0.754	7th
Site inspections	3.73	0.861	8th
Accuracy of designs	3.67	0.861	9th
Effective project planning	3.59	0.666	10th
Financial management	3.40	0.901	11th

Table 2 ranks consultants related factors that contribute to premature project closure. From the table, it can be deduced that Conflict management skills and Relationship between consultants are topping the table with mean item scores of 3.80 and 3.79 respectively, closely followed by consultants' Level of experience and Support from the client with mean item scores of 3.76 each.

DISCUSSION

Miles (1996) agrees with the findings of the current study by emphasizing how labour should be taken seriously as it is often overlooked by main contractors, leaving subcontractors and consultants to do all the work with no coordination. Buildrite construction (2016) also agrees with these results as it forwarded that labour and relationship between contractors can make or break a project. Furthermore, sub-contracting and external consulting are rife in the construction industry, but this does not mean main contractors should ignore labour and let subcontractors and consultants do all the work on their own.

Verma (1998) laid emphasis on the importance of conflict management skills when working in teams consisting of individuals from different societies, cultures and fields of expertise. To support that, Doraisamy, Akasah and Yusun (2014) submitted that poor conflict management skills, mismanagement of subcontractors and lack of motivated site workers are part of the major reasons why premature project closure occurs in construction projects.

Furthermore, Abbasi, et al. (2014) submitted that level of experience, adequacy of planning and management of finances have greater influence on premature project closure. Doraisamy, Akasah and Yusun (2014) also affirmed that consultants' level of experience may contribute greatly to premature project closure in construction projects. Sarda and Dewalker (2016) also supported the findings of this study as it highlighted the importance of having experienced consultants as a means of ensuring successful completion of a project. However, Masurkar and Attar (2014) emphasized the importance of conducting site inspections, just to make sure everything is done according to specifications, stating how it is one of the most important activities to perform during a construction project.

The study revealed that poor management of any aspect of a project will likely cause the project to fail, thereby leading to premature project closure. An aspect of a project that could be mismanaged by the contractors and consultants includes finance; labour; conflict; site; contracts; relationship among different subcontractors and consultants; as well as modification of project designs.

Labour management is a very important aspect of construction project management. And since the overall responsibility of the project falls on the contractor, he/she is ultimately responsible for the management of all labour involved with the project. As observed by Wu, et al. (2017), success in construction projects largely depends on engaging a huge number of specialized project teams who are experts in handling individual task. Managing and coordinating a huge number of human resources can be a herculean task, but project contractors must devise necessary techniques to efficiently operate all human resources.

Relationship and conflict among project teams, consultants and subcontractors are to be managed by the contractor. Furthermore, the relationship or lack of relationship between the main contractor, subcontractors and consultants may lead to communication barriers, thus causing instructions to not be conveyed correctly. When information is not conveyed properly among construction team members and project leaders, important elements that are supposed to influence project decisions are misplaced or misinterpreted. This will, in turn, increase the risk of project failure that will ultimately lead to premature project closure.

Conclusively, the empirical and theoretical findings of this study revealed that poor management of the individual aspect of a project will likely lead to premature project closure. Therefore, contractors and consultants must ensure that the site; finance; labour; conflict; relationships; contracts; and modification of project designs are efficiently organized and managed all through the project life cycle to ensure successful completion.

CONCLUSION

Every construction project must have a definite closing point. Whether the project is successful or not largely depends on the stage the project is closed. This study was aimed at exploring the part played by contractors and consultants in premature project closure within the South African construction industry. The empirical and theoretical findings of this study revealed that poor management of the individual aspect of a project will likely lead to premature project closure. It is therefore recommended that contractors and consultants engaged in a particular project must ensure that the site; finance; labour; conflict; relationships; contracts; and modification of project designs are efficiently organized and managed all through the project life cycle to ensure successful completion. All aspects of project planning and management should not be taken for granted as they all interrelate to achieve the project objectives. Little negligence can lead to not achieving the stipulated project goals which will cause the project to close prematurely.

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do better (McGraw, 1978). Studies have also established a relationship between professional fee and quality of service (Hoxley, 2000; Okonkwo and Wium, 2018). For instance, the low fee has been reported to affect the quality of professional services given by consulting engineers (Hoxley, 2000; Okonkwo and Wium, 2018). Therefore, issues around pricing of services in the service industry have been the areas of interest among researchers in many fields. However, the aspect remuneration is hardly seen as an object of discourse among real estate literature, especially valuation studies as it is obtainable in other professional fields like accounting.

The increasing sophistication of users of valuation reports (Ogunba and Ajayi, 2007) is by implication an increase in the demand placed on valuer to deliver optimum professional service. The ability to render such quality of service to meet the high expectations of clients and uphold professional ethical standards requires much effort on the part of the valuer and, therefore, should be adequately remunerated. Thus, as the saying goes 'to whom much is given much is required', the question that comes to mind is 'can this be said in the case of valuation that what is given in terms of fees justifies what is required of valuers'? This raises concern about the possible relationship between the valuation fee and valuer's disposition to professionalism. That is, could the valuation fee be a contributing factor to bias in valuation?

The concerns relating to valuers' remuneration and quality of valuation service was raised in the study by Hutchison et al. (2005) where valuers called for an increase in income for them to put extra effort into enhancing how risk is communicated to clients in their reports. Lorenz et al. (2006) refuted this claim by arguing that improving communication to clients through valuation reports does not require extra costs but the realignment of what valuers give concentration to in their reports; that is, more on issues like yield figure and less on building descriptions. While Lorenz et al.'s argument may be reasonable, the concern raised by Hutchison et al. goes beyond the issue of reporting alone, it is rather more of whether or not, given a level of remuneration, a valuer is motivated to go the extra mile to ensure utmost professional service is delivered, especially in terms of what goes into the valuation. More importantly, it has long been proven that fee is one the weapons clients use in influencing valuers to alter value opinions (Levy and Schuck, 1999; Amidu and Aluko, 2007). Therefore, it may not be appropriate to wish such sensitive concerns away in such a fee-dominated and competitive market where valuers operate.

In Nigeria, the regulatory body for real estate profession, Estate Surveyors and Valuers Registration Board of Nigeria (ESVARBON), publishes the scale of professional charges to be used by valuers in charging their professional fees. However, it has become the practice for some sets of clients, especially financial institutions, to fix valuers' remuneration because of their market dominance. This practice and some other issues around pricing of valuers' services have been on for some years with little or no research insights from literature. Therefore, this study evaluates how property valuation services are priced in Nigeria. The specific objectives are to examine the valuation services pricing systems within the Nigerian property market, investigates factors responsible for this practice, and assess the effects it has on valuers' delivery of professional services.

STUDIES ON SERVICE PRICING

The issue of pricing of services in general has received less attention in the literature compared with the pricing of goods (Docters et al., 2004). Therefore, empirical research on the pricing of services are generally limited (Avlonitis and Indounas, 2005). More specifically, despite the importance of reward to service provision, issues relating to professional service pricing in real estate profession tend to be under-researched. Empirical studies in this area are hard to come by among real estate literature. Hence, this review relies more on literature from other professional fields like accounting and engineering. Literature shows that valuation and auditing industries share some similar features (see Kinnard et al. 1997).

Professional service providers or consultants are trained experts specialised in the provision of a particular or broad consultancy service(s) belonging to a particular profession. The provision of real estate service is the application of knowledge and skills by experts to meet client's needs either in standardised professional services like valuation or in non-standardised professional services like bespoke portfolio management strategy (D'Arcy, 2006). Also, clients' organisations can insource or outsource their professional service needs depending on some factors such as costs, the sensitivity of the service, the frequency of need, and legal requirement (statutory purposes). When it is insourced, the service provider is remunerated by being placed on the organisation's payroll while remuneration takes the form of consultancy fee when the service is outsourced to an external consultant. In the case of property valuation, the services are mostly outsourced because of the need for objectivity. Services of a valuer may, however, be needed for many purposes as there are decisions regarding real estate property which include mortgage, insurance, property development/investment, sales/purchases, probate, taxation, among others.

The financial implication associated with the use of external service providers is the professional fee. Hence, to the service provider, the fee represents the measure of service 'given'; and, to the client, it represents the worth of service 'received'. In this case, the fee is expected to be fair and reasonable to both parties (Owusu-Manu et al., 2016). However, what is equitable in term of fee is always an issue of contention between parties involved because of the inability to quantify the inputs. Hence, achieving a mutually satisfying and fair fee structure for intangible products like services require a mutually satisfying pricing policy which involves both service providers and clients (Alliott Group, 2017).

The fairness in pricing is mainly to avoid the mispricing phenomenon of either under-pricing or overpricing. Under-pricing is a situation where price is set below the market value (Ma, 2005) while overpricing is when the price is set above what a reasonable purchaser would want to pay (Wathieu and Bertini, 2007). Under-pricing limits the ability of service provider to research, innovate and improve quality (Owusu-Manu et al., 2012); hence, under-pricing has the tendency of affecting the quality of service negatively. Based on the premise that tangible resources that go into the production of goods are more fixed and quantifiable than efforts, trainings and experiences needed to render services, Naquin et al. (2015) conducted experiments to assess people's perceptions of fairness associated with the pricing of goods as against the pricing of services. They found

that people have a lesser feeling of fairness with money spent on services than that of goods. This suggests that it is more difficult to convince consumers of the fairness of the price charged for services than it is for physical goods.

Overpricing, on the other hand, raises ethical questions. For example, Indounas (2008) examined the relationship between pricing and ethics in industrial service contexts. The study found that the pricing method that leads to excessive profits or takes advantage of customers' needs is unethical, while markets mechanisms and agreement among service providers, among other factors, were found to be more effective in reducing such behaviour than government intervention. Also, Owusu-Manu et al. (2016) identified the relationship between the important variables responsible for price fairness within construction cost consultancy services in Ghana. The study found that fairness in consultancy pricing is significantly related to value and affordability, pricing objectives, pricing strategies, taxes and international trade.

Furthermore, pricing of services has a relationship with the quality of services, just like goods. Chen et al. (1994) conducted an empirical study on the relationship between perceived quality and perceived price of services in three types of service industries – pure service, mixed service, and quasi-manufacturing service organisations. The authors utilised questionnaire to assess the customers' perceptions of the overall quality and perceived price. The study revealed that perceptions of customers on the relationship between price and service quality are rather service specific than general. That is, customers' perceptions vary across different types of service. The finding of Chen et al (1994) is similar to the conclusion of Avlonitis and Indounas (2007: 760) who stated that 'different service, organizational and environmental characteristics were found to lead to different pricing policies especially in different service contexts'. Therefore, quantifying professional services depends on the nature of the industry.

Several means of quantifying professional services have been developed in different fields. For example, Okonkwo (2014) identified four methods of quantifying engineering services in South Africa, as prescribed by the Engineering Council of South Africa (ECSA)'s 2014 Professional fee scale guidelines, which are time-based fees, reimbursable expenses, fixed sum, and value-based fees. There are also cost-oriented and competitive-oriented pricing strategies (Dearden, 1978; Hoffman and Arnold, 1989). Also, among several pricing models in the economics literature, Fong (2000) identified four models which have been repeatedly used over time. These are: (1) cost-based pricing, under which price is set to cover cost of production and profit margin; (2) demand-based pricing, which is based on economic principle of the higher the demand the higher the price; (3) competitive based pricing, where pricing is according to the industry's going rate for a product of service; and (4) optimum or pricing according to value, under which several factors like customers' needs, market segmentation, etc are taken into consideration in setting price.

In the same vein, the degree of competition in the market, cost of production, and the level of demand for the product jointly influence how services are priced. As earlier stated, consultancy service is intangible in nature hence the cost of input cannot be precisely determined. However, it is important to consider the cost of

inputs in the pricing of any product, whether goods or services. For consultancy services, the fee should be able to reward the qualifications, skills, training, and experience of the service provider (ACENZ, 2004; Owusu-Manu et al., 2012). However, competition in the market plays an intermediary role between cost and demand in determining price. According to Owusu-Manu et al., (2012: 361), 'demand sets the ceiling, cost sets the floor and competition determines where on this continuum the price falls'.

Real estate literature provides very little evidence on the pricing of valuation services. The only study relating to this phenomenon, to our knowledge, is the study by Adjekophori et al (2014) which focuses on the practice of valuers enlistment and fees standardisation by financial institutions in Nigeria. While Adjekophori et al.'s study makes an appreciable contribution to the discussion, the study does not provide a detailed insight into the pricing system existing for valuation practice in Nigeria. This limitation could be attributed to the positivist paradigm and quantitative methodology approach employed by the authors which do provide for deep probing into personal experiences and views of valuers on issues associated with the phenomenon. The present study, therefore, employs an interpretive paradigm through qualitative approach to provide a deeper insight into the perspectives of valuers on prevailing pricing system for valuation services including factors responsible for the present pricing system and the effects of the present pricing system on the quality of service provided by valuers.

METHODOLOGY

This study assumes an interpretive paradigm which allows researchers to develop meanings out of the participants' experience in the process of seeking to understand the world around them by relying on participants' views of the phenomenon being studied (Creswell, 2009). This study was carried out in Lagos state, Nigeria. The choice of Lagos is justified based on the high commercial activities and vibrancy of real estate sector. Lagos is the commercial hub of Nigeria where the highest volume of transactions including real estate transactions take place. Furthermore, all commercial banks and some other financial institutions in Nigeria have their headquarters in Lagos. Subsequently, the highest number of valuation briefs in the country emanate from the Lagos market. For this reason, almost all estate firms in Nigeria either have their head office or at least a branch/an affiliated office in Lagos in order to be part of the commercial activities in the state (Oladokun and Gbadegesin, 2017). Hence, Lagos houses the highest number of estate firms operating in Nigeria.

Data were elicited through in-depth semi-structured interviews conducted individually with 24 Estate Surveyors and valuers (ESVs) practising in Lagos. Snowballing sampling technique was applied for this study. Snowballing technique, also known as chain-referral sampling, is defined by Noy (2008: 330) as 'when the researcher accesses informants through contact information that is provided by other informants'. According to Atkinson and Flint (2001), one of the advantages of snowballing technique is that it affords the researcher the opportunity to get the attention of seemingly busy or hard-to-get individuals like practising professionals who are the focus of this study. Because of the specific nature of the information being sought, participants selected were either the

principal partners of firms, heads of valuation units of the firms, or at the least senior valuer where either the operations were not departmentalised, or principal partner was not available.

Data collected were transcribed verbatim manually by the researcher while Thematic Analysis technique was employed in analysing the data through the use of Nvivo 12 tool. This was achieved through 'themeing the data' approach to coding (Saldaña, 2015). 'Themeing the data' is the coding process whereby portions of data are coded and analysed based on thematic statement relating to the goal of the study or theoretical constructs (Saldaña, 2015).

3.1 Participants' information

Details of the participants are presented in Table 1. For the purpose of confidentiality, identities of the participants are denoted by an alpha-numeric form in the analysis starting with 'R' which stands for 'Respondent' and followed by the sequence of figures (that is, R1 [Respondent 1] - R24 [Respondent 24]). Table 1 shows the analysis of the characteristics of respondents including academic qualification, professional qualification, position in firm, and respondents' years of experience in valuation.

Table 1: Participants' information

Characteristics	Profile	Frequency	Percentage (%)
Academic Qualification	HND	10	42%
	BSc.	8	33%
	MSc.	6	25%
Professional Qualification	ANIVS	22	91%
	FNIVS	2	9%
Position in Firm	Principal Partner	12	50%
	Partner	2	8%
	Head, Valuation	10	42%
Years of Experience	5-10	5	21%
	11-15	7	29%
	16-20	5	21%
	Above 20	7	29%

ANIVS= Associate member of NIESV; FNIVS= Fellow of NIESV; FRICS= Fellow of RICS

RESULTS AND DISCUSSIONS

Based on the research question of this study, the overarching question the respondents were asked was 'what can you say about how valuation services are being priced?'. Further follow-up questions were then generated from the responses to this question through probing. Through thematic analysis of the data collected, three main themes emerged. Each theme is further described in depth through their associated sub-themes as follows:

How are valuation services priced in Nigeria?

In probing participants on issues around pricing of valuation services, emphasises was placed on the place of the professional scale of charges (as prescribed by ESVARBON) in the pricing of valuation services. The respondents commented on the challenges they face charging their clients based on the professional scale. They further narrated their experiences about the other forms of pricing approaches including negotiation and fixed rate system how they are practised.

Professional scale of charges

It was discovered that it is almost impossible for valuers in Lagos to get their fees based on the prescribed professional scale of charges. Virtually all respondents commented on their inability to enforce the professional scale in charging their fees and expressed their deep displeasure about the circumstance. For this reason, the scale has either been jettisoned in most cases or it just serves the purpose of formality. Some respondents commented that:

> *…well, if you go by our professional scale of charges nobody will do valuation, that's the truth….(R19)*
>
> *The use of scale has been watered down. Most clients don't want to use the scale….(R1)*

In some instances, where the scale might not be considered as being totally boycotted, it is only seen or used as a tool for negotiation; that is, providing a basis for negotiation. In this case, valuers use the figure generated through the use of scale as a tool to appeal to the conscience of the client so as to be considerate in negotiation. One of the respondents commented this way:

> *I won't say it's not working. It works because it has provided a basis. Ordinarily, if there is no basis anybody will just give you anything. It would have been terrible if there was no basis. Because it appeals more to the conscience if it is known that …ok, this your job has cost N5 million, if you want to price you have been given a benchmark. It may not be cast in iron but it provides a basis for negotiation…. (R20)*

Most of the respondents, therefore, agreed that they hardly get their fee based on the scale. For this reason, other strategies have been devised by valuers and clients to determine the professional fee.

Negotiation

All respondents confirmed that they always go for the negotiated fee. However, while it is not surprising that fees are negotiated as this is also obtainable in other fields and since the scale of charges also allows for negotiation in some instances, the approaches adopted by ESVs to negotiation are of interest to this study. Some of the common guiding rules and methods adopted by valuers in negotiating valuation services in the study area are discussed here.

(i) Initial discounting of fee

The common practice among the respondents can be described as initial discounting of fee. This takes the form of the valuer first calculating the fee based on the professional scale and giving the client a discount of a certain percentage

of the fee as a concession. The discounting is done right at the point of generating the fee invoice. That is, the fee is discounted even before the client opens up any negotiation discussion. This initial discount takes up to about 50% of the calculated fee. A respondent commented on this as follows:

> *What we do in our firm is that we calculate our fee based on the scale and send in our invoice and when we are sending our invoice, either based on our previous discussion or thereafter, we give a discount……. (R16)*

The comment by another respondent shows that the reason for this practice is to maintain business relationship and appeal to the emotion of clients so as not to negotiate further. However, even with this, clients still negotiate. The respondent said:

> *Our practice here is that we are still abiding by the professional scale. But we give rebate or concession. What we do is that we will tell our client that this is our fee as prescribed by NIESV but to maintain good business relationship with you, we will reduce it by 50%. We do that in our fee note before the client even raise any objection. Even with that, people still complain that it is too much and still negotiate it down……..(R3)*

However, it seems the practice is not peculiar to valuers alone as Okonkwo and Wium (2018) also reported the prevalence of the practice of discounted against the recommended fees scale among consulting engineers in South Africa. However, the common fee discount in engineering services ranges between 16 and 30% of the recommended professional scale.

(ii) Pre-negotiation and on-site negotiation

The data also revealed that some firms have it has their policy to either negotiate their fees before proceeding to the site or negotiate right on site before commencing any work. To negotiate before proceeding to the site, the valuer first considers the size of the job and the likely value of the property to be valued based on experience; and, based on this the valuer roughly calculates the fee and commences negotiation with the client from there. In the case of on-site negotiation, the executing officer (the staff who goes to site for inspection) is given free hand to negotiate with the client on site before commencing inspection. Some of the respondents submitted that:

> *If you want to commission us for a job, we always ensure we do the inspection first, snapshot though, to understand what we want to do. From there, we can have a rough idea of the likely value and we use that to calculate our fee based on the professional scale. From whatever comes out as fee, we take 50% away and we ask the client to pay 50%……..(R5)*

> *We negotiate fee on site from the beginning. …in our letter of instruction, there is a portion for fee negotiation which must be filled by the client. So, before the execution officer leaves (the site), he must achieve that negotiation. Any fee negotiated by the execution officer, the company accepts because it is the execution that knows the likely value the property may command. So, they know the appropriate fee to collect…….(14)*

(iii) Setting benchmark

Some respondents alluded to the fact that they have set some minimum benchmark below which they do not go and this policy guides them in negotiation. Sometimes, this benchmark varies according to location and type of property being valued. Therefore, individual or firm-based benchmarks guide negotiations.

> *So, we normally have challenges in fee negotiation and collection. But this is what we do. We have a benchmark. Like, a bare land at certain location should not be less than a certain amount. For instance, valuation of a bare land in Lekki axis, phase 1 and other developed parts of Lekki, cannot be less than N70,000, while buildings are like N150,000, N200,000. But in the Mainland, we can collect like N50,000 …….(14)*

Fixed rate system

Another popular system of pricing valuation services in Nigeria is through fixed rate pricing system. Fixed rate method of pricing, according to the respondents, is the practice whereby an agreed amount is fixed as remuneration for a particular type of service. This practice is more prevalent with financial institutions (banks), although it is now gradually being embraced by other categories of clients. Most ESVs confirmed that a larger portion of their valuation briefs comes from banks. Hence this practice is rampant in the study area.

> *Most of the banks fixed their fee in a range of values which surveyors are involved. It is called Service Level Agreement (SLA)……(R15)*

> *We are on retainership with at least 10 banks. Banks have fixed their figures that they pay. … They will tell you this is what we want to be paying. It is part of the retainership package……(22)*

The major concern of virtually all ESVs interviewed was the fact the average fixed fee being paid by banks was too low. Many respondents considered the rate fixed by banks too ridiculous when compared with what the fee would be if calculated based on the professional scale of charges. For example, respondents commented that:

> *The rate is very very unreasonable. At times when the bank is paying N50,000, the professional scale may be giving like N250,000 to N300,000 as fee….(R3)*

> *They pay like N40,000…N50,0000 for regular valuation like normal building like this. But when it comes to complex one, you must negotiate it …..(R1)*

Therefore, on the average, banks' fixed fee for regular valuations ranges between N30,000 to N50,000 even when the fee should have been as high as N300,000. This, in essence, means that the fixed fee can be as low as 20 per cent or less of the actual fee. In summary, the fixed fee system of pricing was generally described by ESVs as gross under-pricing of valuation services.

Another peculiar practice associated with the fixed rate system by financial institutions is the practice of 'Personal Relation' or sometimes called 'kickback'. Almost all respondent referred to this practice as being rampant in the market. This is further described below:

The practice of 'Personal Relation'

This is the practice whereby the valuer is expected to give a percentage of the fee back to the bank officer in charge of the transaction as a form of appreciation. Respondents confirmed that this must be done in order to be considered for further jobs. Hence, despite the meagre nature of the fee, valuers still pay back a part of their remuneration to bank officer in order to keep the job coming.

> *In Nigeria, nothing goes for nothing. There is something they call PR that they normally collect as a gift. It has to be a certain percentage of the fee collected on the job. If it has to do with all these pegged fee banks, they are the ones that will pay through the customer's account. They will pay, say N40,000. Out of this N40,000, a certain percentage is coming back to the officer as a gift (PR)……..(R14)*

When respondents were probed further on the range of percentage of their fee they normally give back as PR, it was discovered that it ranges between 20% to 30% of the fee paid.

Furthermore, while 'appreciating' a client is expected to be a voluntary action or at the discretion of the valuer, it was found that the practice of giving PR has become a tradition and norm within the practice space of valuation in Nigeria. Obviously, such provision does not form part of the contract between parties, but it is an undocumented practice or unwritten rule that has been firmly established. Therefore, while appreciating clients seems to be modest on the surface, the practice of giving 'PR' in the case of valuation practice in Nigeria can be viewed as bribing one's way to securing brief and therefore poses moral and professional questions in some respects, especially on the process of selecting valuers for valuation jobs.

Factors responsible for the present pricing system

The sub-themes that emerged from the submissions of the respondents showed that the present pricing systems strive majorly because the professional scale of charge is not effective. Furthermore, clients, especially banks, are taking advantages of the professionals because of the advantage of buyers' market and because of the stiff competition in the market. The following factors emerged from data collected:

Ineffectiveness of the professional scale of charges

It was found that the major reason why various other means of pricing valuation services emerged was because of the valuers' inability to enforce the professional scale of charges. Therefore, the researcher probed into reasons why the professional scale has not been effective or adhered to. Respondents' comments pointed to some reasons which include the fact that charges from the professional scale are always too high; the scale is realistic considering the economic situation; and, the inappropriate drafting of the profession scale of charges. For example, some respondents believe that the scale of charges produces fees that are too high for most clients to pay. This is to the extent that any valuer that insists on charging strictly based on the scale may not get any valuation instruction to execute. Some of their arguments include:

> *'Another challenge we are facing is that we have our professional scale of charges but it seems it is making people to run away…. by the time we calculate the fee based on this graduated scale and the bill is high, some of them will just abandon the report' …..(R3)*

> *'Our fee looks so bogus and outrageous, I know….. I think it is bogus.' …..(R17)*

Many respondents established that one of the major reasons why charges according to the scale are not being adhered to most of the time is because the scale is not realistic especially when considering the economic conditions which determine the ability of clients to pay. In fact, some confirmed that fee derivable from the scale of charges is always too high.

> *When you look at two things – the client ability to pay and the economy. For example, a property between N50 million and N100 million value. When you put it into fee calculation, it's going to be around N500,000. So, if you look at it,…N500,000 fee for one house? … in this economy? …with this client? …with what he wants to use it for…… can he pay? So, we say let's have N250,000 (that's 50%) ….(R5)*

> *…Well, it is reasonable, but the (Nigeria) economy within which you want to use that scale cannot support it ….(R5)*

This corroborated the fact that the practice of initial discounting of about 50% as earlier reported in this study presupposes that valuers themselves have the feeling that the fee based on the professional scale seems to be too high.

Another reason for the ineffectiveness of the professional scale of charges has to do with the way it was drafted. Respondents claimed that the scale was designed as 'one cap fits all'. That is, all valuation services are to be charged using the graduated scale of charges only. This, in the views of the respondents, is not working. Valuation services are required for many purposes and each of these purposes has its peculiar characteristics which may not justify charging every assignment on the same basis. Therefore, opinions of the practising professionals suggest that this 'one cap fits all' approach is not realistic. For instance, respondents gave these examples:

> *….You can't say you have a scale of charges and it is for all comers affair, it will not work, and I will tell you why it will not work. If someone is taking a loan, for example, and you are using a scale that even your own fee is higher than the interest bank is charging, you are already compounding the problem of the obligor (the customer)……(R6)*

Business competition and survival syndrome

Competition for jobs among valuers is stiff and has given room for varied forms of practices. For example, the need for survival in the face of the slow economic state makes many firms take up valuation job for any amount, no matter how ridiculous. This, in turn, puts pressure on others to accept the low fee, else they will not get any brief.

> *…you know it is because of the desperate behaviour on the part of our colleagues. While some will say N30,000 is too low, some will say …'at all at all na him bad pass' (Nigerian pidgin English for 'little is better than nothing')…Let me do it and have something in my pocket……..(R3)*

Banks' strategy to mitigate risk and protect their customers

According to the respondents, financial institutions are taking advantage of the situation in the market to dictate the price for valuation services for the purposes of reducing their own risks and also to protect their customers from excessive charges as valuation fee is just one of so many expenses involved in the process of securing credit from banks.

> *They (banks) are trying to protect their clients because there are so many charges they levy on them like application fee, legal fee etc…..(R19)*

As a result of the recent collapse of banks which led to recapitalisation in the financial sector in Nigeria, banks and other financial institutions have heightened their risk management system. One of the risk management strategies of banks is to pre-qualify or retain valuers and have control of their remuneration because bankers believed that since valuers' remuneration is based on property value, valuers might be tempted to report high value in order to get a high fee. An ESV said:

> *They thought maybe valuers give high value in order to get a high fee because fee is a function of the value returned. So, they decided that let's have a control. This happened some years ago. They came up with policy. Some will say they have a fixed rate per job, like N40,000 per valuation……..(R2)*

Another strategy is to give one valuation assignment to more than one valuers so as to have a wider spectrum of opinions. However, this system affects valuers' remuneration because, in order to minimise cost, banks tend to spread the fee for one valuer over the two or three valuers used for the same valuation job.

> *And one of the reasons why some banks regulate fee is that we have a case of a xxx bank who will give the same job to like 3 firms so that they can compare. So, valuer must be on their toes. They do this to mitigate their loss because of the incidence of overvaluation. So, the fee they supposed to give to one surveyor (valuer), they spread it across…….(R2)*

Therefore, by giving the valuation of property to more than one firms at a reduced fixed rate, banks are able to get a confirmatory opinion which helps them in making a better decision.

The game of numbers

Another reason why the practice of fixed rate system continues to strive in the market is because of what the respondents described as 'the game of number' which financial institutions play on valuers. This is the system whereby a professional is persuaded to take up an assignment for a very low fee because of the promise of getting multiple instructions from the same client. By this, ESVs believe that getting jobs in volume will compensate for meagre fee being charged.

Most of our valuations are from banks. …..well, if they are giving you more jobs, if the volume is high it can pay you…….(R22)

…. by the time they give them like 3 of such N40,000 job in a day or a week, the multiplier effect of it, at the end of the month, it is something…….(R21)

Inaction on the part of the professional and regulatory bodies

Because of the size of the market and the business competition among the practitioners, it is difficult for an individual firm or valuers to effect any substantial change in this regard. Hence, ESVs expected the intervention of the regulatory body (ESVARBON) to at least reduce the control financial institutions have over valuers' remuneration. However, there is yet to be any concrete intervention in this regard.

I think the challenge is that in Nigeria we are eager to run after money, and not professionalism. And this is affecting the system and the institutions (NIESV and ESVARBON) cannot monitor things as they ought to. In Nigeria, you will see people scrambling for money, even if you don't do it to satisfaction, all you want is that you win the job and make money…….(R9)

So, I can conclude that the issue of remuneration is getting worse. In most cases, people are not standing on the professional scale of charges any longer, and unfortunately, the board and our institution are not doing enough to help in this regard……..(R13)

However, respondents' views on what can be done in this respect suggest that the professional scale needs to be revisited by the regulatory authority. For example,

I think the Board should look at it and peg it to something reasonable. I am not saying it should not be based on value, but maybe they can lower it to have a human face. Laws are made to be obeyed, but when you make laws that are not obeyable, it becomes rubbish……(R17)

Effects of the present pricing system on valuation practice

Responses from the participants in this respect were coded into three sub-themes which include the fact that it leads to valuers' inability to cover costs; it encourages sharp practices among valuers thereby affecting the quality of valuation; and, it discourages some valuers from valuation consultancy services.

Valuers' inability to cover costs

Respondents alluded to that fact that sometimes the fee being offered by clients could barely cover expenses they needed incur to ensure the delivery of professional service. This is often the experience when carrying out regular valuation for financial institutions. However, due to the reasons of business survival and competition in the market, as earlier stated, most ESVs still take up the jobs. Therefore, this makes valuers to rationalise some processes, as much as possible, in order to reduce the cost of input.

..sometimes the remuneration will not cover the cost. For example, I had an experience recently. We sent somebody (staff) to Calabar to go and do a job for us, and the bank wanted to pay only N50,000 – their own fixed rate. To

worsen the case, by the time you reject, some other firms will take up the brief and they will still go ahead to do it……(R13)

Sometimes, you even spend more than they pay. I have such experience before. By 'net income' I mean our own income (fee) cannot entertain too much expenses. So, where you can dodge it, you dodge it……..(R1)

Encourages sharp practices and discourages professionalism

When either negotiated or fixed fee is too low, valuers tend to involve in some 'sharp practices' in order to maintain a certain level of profit margin within such meagre income. The most common of such practices, as alluded to by the respondents, is when the property to be valued is located at another far part of the country and the valuer feels that the fee cannot accommodate the cost of transportation and other logistics, he/she carries out the valuation based on the information supplied by somebody else around the property location. This is common among smaller firms that do not have a network of branches across the This practice has a tendency to affect the objectivity and quality of valuation.

…now I have property to value at Benin (a state in Nigeria) and I don't have an office at Benin. Am I not supposed to travel there? hotel expenses is also there. Will N30,000 take care of all that? Then, you now have to look for

There are some firms that are not even doing valuation again because of this issue of dictating fee…….(R4)

This forms one of the reasons why some estate firms are not on retainership with banks apart from the rigorous process involved. For example, when one of the respondents was asked if his company was on retainership with any bank, he responded that:

'No. Do you know how much banks pay for valuation? N20,000. Then out of the N20,000, the bank officer will still ask you to give him part of it. You can ask people. I can never do such'…..(R17)

CONCLUSION AND STUDY LIMITATIONS

The findings of this study indicate that though there is an approved professional scale of charges which provides standards for valuers' remuneration in Nigeria, valuation services are priced mostly on the basis of 'negotiation' and 'fixed rate' systems due to the fact that valuers find it difficult to enforce the use of the scale in determining their remuneration. Furthermore, in practising negotiation as a system of pricing their services, valuers adopt various guiding rules and methods so as to achieve good bargain and also to maintain a level of reasonability in bargaining. These guiding rules take the form of initial discounting of fee up to 50%; pre or on-site negotiation; and, setting of a benchmark. On the other hand, the practice of fixed rate system of pricing is associated with financial institutions who have their respective specific amount they pay for all regular valuations. It was also found that the fixed fee can be as low as less than 20 per cent of the actual fee derivable based on the scale of professional charges. It is also striking to found that, despite the ridiculously low pricing, valuers are made to pay between 20 to 30 per cent of their fees to bank officers in form of 'PR' (Personal Relation) or appreciation package in order to be considered for further assignments. The study also revealed the factors responsible for the continuous striving of the present pricing system and their effects on the practice of valuation.

The findings hold implications not only for the practising valuers, but also for the client and the regulatory bodies. The findings raise questions about the relevance of the professional scale as well as the regulatory roles of the ESVARBON. Furthermore, the ineffectiveness and unenforceability of the provisions of the scale of charges allow for varied forms of practices among the valuers and clients. And, as expected of a typical buyers' market, this has skewed the pricing system in favour of clients. Hence, valuation services are often priced ridiculously low.

In the same vein, because valuation services are considered to be poorly remunerated in the study area, especially for jobs from financial institutions, valuers have also devised means of getting the job done in a 'cheaper' way. This raises concerns about the quality of valuations and subsequently the decisions taken by clients based on the valuers' opinions which valuations represent. Furthermore, while financial institutions have heightened the risk management strategies as a result of the recent recapitalisation and consolidation exercise, it is important to note that leaving financial institutions solely to dictate the fee of valuers creates another impending danger as this has led to gross under-pricing of valuers'

services. This, therefore, calls for a harmonious and workable agreement between the professional and regulatory bodies of valuers (NIESV and ESVARBON) and financial institutions (Chartered Institute

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PRIORITIZATION ASSESSMENT OF HOUSING DEVELOPMENT RISK FACTORS: A FUZZY ANALYTIC HIERARCHICAL PROCESS-BASED APPROACH

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The construction industry and housing subsector are fraught with risks that have the potential of negatively impacting on the achievement of project objectives. Political and legal risks, social risks, technical risks, financial risks and other similar risks inhibit housing development projects. The success or otherwise of most construction projects depends to large extent on how well these risks have been managed. The recent paradigm shift by the subsector to use of formal risk management approach in contrast to hitherto developed rules of thumb means that risks must not only be identified but also properly assessed and responded to in a systematic manner. The research aim at identifying and assessing risks associated with housing development projects with a view to prioritising the identified risks to provide basis for informed decision. The study used a three-step identification framework: review of literature for similar projects, expert consultation and questionnaire based survey to identify potential risk factors. Delphi survey method was employed in carrying out the relative prioritization assessment of the risks factors using computer-based Analytical Hierarchical Process (AHP) software. The results show that 19 out of the 50 risks factors significantly impact on housing development projects. The study concludes that although significant numbers of risk factors have been identified as having relevance and impacting to housing construction projects, economic risk group and, in particular, 'changes in demand for houses' is prioritised by most developers as posing threat to the achievement of their housing development objectives. Unless these risks are carefully managed their effects would continue to impede success in these projects. The study recommends the adoption and use of the combination of multi-technique identification framework and AHP prioritization assessment methodology as a suitable model for the assessment of risks in housing development projects.

Keywords: analytical hierarchical process, multi-criteria decision, risk assessment, risk identification

INTRODUCTION

The complex nature of mass housing construction projects, usually involving multiple of stakeholders, inputs and processes all aimed at creating valued products result in huge risks and uncertainty to the project success which in turn

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contributes to poor performance with attendant cost and time delays. Study by Rezakhani (2012) has shown that there is strong correlation between the construction industry's performance and its capability in managing project risks. The industry is characterized with high risk which has not always been dealt with adequately.

To cope with this challenge and other recent industry challenges such as internal competitions; rapid technological changes; need for more prudency by clients and overriding need for improved performance in the industry (Tah and Carr, 2001), the promoters of mass housing projects have developed series of rules of thumb that relies on intuition to manage risk (Mustafa and Al-Bahar, 1991). However, with increasing complexity and uncertainty, these rules of thumb have failed to effectively respond to the challenge and hence the need to deploy more robust, logical and systematic approach to risk management.

Management of risks has become more critical nowadays and forms an important and integral aspect of project management required for the realization of project objectives. The approach to risk management within the industry has been in two ways: the use of intuition and past experience as the only way (informal approach) and the deployment of robust systematic procedure in managing the risk complexities (the formal approach). Previous studies (El-Sayegh, 2009; Laryea & Hughes, 2008) have found low usage of formal (systematic) risk management (RM) techniques and greater reliance on informal approach among stakeholders in the construction industry. The informal approach has not only been criticized for lacking rational, straightforward approach that can combine all the facets of risk systematically into a prioritized manageable scheme but according Tah & Carr (2001) it also makes products price models unrealistic in competitive business environment. Although there is great disparity on concept and scope risk management (RM) within the project purview but the level of convergence on the key stages, processes and procedures required achieving success in managing risks is high. Scholars are in concordance that systematic risk management (RM) requires planning, assessment and response. RM within the formal realm entails RM planning to conceptualize and select the framework of operation, resources requirements, the input-output expectations and similar other factors. The RM planning is followed by risk assessment (RA) which most scholars considers as the most essential stage and forms the basis for risk response and mitigation. RA involves two essential processes: risk identification and risk analysis.

Over the last few decades, the systematic risk management approach has attracted so much attention and exponential growth in a number of system approaches, methods, models and techniques developed both from academia and practitioners (Mehdizadeh, Breysse, Taillandier, & Niandou, 2013; Shen, Li, Chung, & Hui, 2004; PMI, 2004) to guide project promoters to the achievement of project risk management objective. Risk analysis methods ranging from traditional independent event probability-based such as Decision Analysis (Jeljeli & Russel, 1990), Stochastic Simulation (Floyd, Barker, Rocco, & Whitman, 2017), etc. to deterministic methods (Laryea & Hughes, 2008; Odeyinka, 2000) have been developed. But with increasing complexity and uncertainty in construction system which diminishes the ability of human beings to make precise judgement, as earlier opined by Zadeh (1965), more modern conceptual models that are based on

artificial (computational) intelligence (AI) and more robust techniques are favoured. In recent years, according to Chan et al. (2009), the computational techniques in fuzzy set (Zheng & Ng, 2005; Choi et al, 2004), fuzzy logic (Shang et al., 2005), etc. and the hybrid fuzzy techniques such as Fuzzy Neural Network (Zhao, Bon Gang & Yan, 2016; Liu and Ling, 2007; 2005), Analytic Neural Network (Chatterjee, Zavadskas, Tamošaitiene, Adhikary, & Kar, 2018), Fuzzy Expert System (Fayek & Oduba, 2005), Analytic Hierarchical Process (Zayed et al., 2008; Hsieh, Lu & Tzeng, 2004), Bayesian Hierarchical Network (Li et al., 2017), etc. have increasingly been applied due to the techniques' interfacing humans with computers capability and better modelling of uncertainties.

Despite the growing challenges of risk and uncertainty in the housing development projects and the adverse effects to the attainment of project objectives caused by the use of informal approach vis-à-vis the potential benefits associated with successful deployment of risk management system in project environment, previous studies have been more specific in approach targeting specific types of risks or concentrating on particular area of construction (Odeyinka, 2000; Odeyinka, Lowe & Kaka, 2008) rather than holistic approach to identify the risk factors and determine their impacts nor attempt to prioritised them.. This paper introduces a novel model that uses multi-techniques identification framework in combination with analytic hierarchical process (AHP) as a risk prioritization method to identify and analyse the risks involved in such development.

LITERATURE REVIEW

Constructions projects are fraught with risks due to complexity caused partly by multi-tasks, multi-stakeholders, dynamic technology, use of innovative procurement systems, often volatile environment, long project duration, etc. These factors in turn result in an array of major risks including political and legal risks (Deng et al., 2018), social risks (Liu et al., 2016), technical risks (Liu, Zhao, Zhou, & Tang, 2018; Zeng at al., 2008), financial risks (Ameyaw et al., 2017; Kumar, Jindal, & Velaga, 2018), etc. Risk assessment within the plan-assess-control RM framework is the most difficult (process) task according to Thomas et al. (2006) involving identification of the risk, measuring the impact of the risk, analysing using suitable tools to determine the level of priority. Baba et al., (2017), however, asserts that it also involves evaluation of the probability of occurrence of risk events and their impacts on projects, objectives such as time, cost, quality and safety.

Risk identification

Although the first step in risk identification task involves sourcing the risks, which entails identifying sources of risk, sometimes in a source-event-effect manner, Mehdezadeh (2012) highlighted the need to outline the type, cause, description, state, likely consequence, chances of occurrence in qualitative and quantitative and incidence of the occurrence. Similarly, Rezkhani (2012) opined that risk grouping (classification) is an important second step as it attempts to structure the diverse risks that may affect a project and the information generated from risk sourcing and grouping is essential for setting up of a systematic hierarchical structure of risks or risk breakdown structure (RBS) as highlighted in the studies by Mehdezadeh (2012) and Thomas et. (2006). Classification process provides the basis for subsequent structuring of risks by distinguishing each with characteristic

features. Accordingly, scholars (Dekmen et al., 2007; Li and Zou, 2010) classified construction risks in different ways. However, most previous studies have failed to note the essential factor to successful risk identification which is the selection and deployment of suitable techniques, methods and tools for risk sourcing and providing the detail information that ensures risks are interlink coherently and in orderly manner that facilitate structuring. It is in this respect that Raz and Hillson (2005) provided a compendium of these techniques, methods and tools ranging from interviews, survey and research, external expert consultation, literature review, project document review, influence diagram use, etc..

Risk analysis

The second step in the risk assessment process is the risk analysis. It involves thorough and systematic measurement of key variables that tends to define risk within project environment. To evaluate the impact of risk on project objectives, many approaches have been developed essentially differentiated based on the technique use in analysing the risk data obtained from measurement. The analyses range from qualitative to quantitative. Similarly, within the realm of the quantitative assessment various techniques have been employed, such as Fault Tree Analysis(FTA), Event Tree Analysis (ETA), Probability and Impact Grids, Sensitivity Analysis, Estimation of System Reliability, Failure Mode and Effect Analysis, etc., which are mostly probability based assessment that depends on mutuality of events (precise and discrete).

However, the inadequacy of high quality data in construction projects and the difficulties in analysing statistical data have hampered the use of most statistically based methods for risk assessment and more analytical techniques that are Fuzzy Set Theory (Zadeh, 1965) based with strong ability for vague data, are favoured according to both Nieto-Morote & Ruz-vila (2007) and Chan, Chan & Yeung (2009). These analytic approaches have been based on using linguistic assessment, which is better in agreement with subjective human mind (blunt boundaries) instead of numerical values. To this end, several research studies on assessment of construction projects using fuzzy approaches have been undertaken.

The Analytic Hierarchical Process (AHP) Analysis

Chan, Chan & Yeung (2009) after review of fuzzy techniques in construction research submitted that the use of fuzzy techniques have been found to be effective and practical especially in developing models to make decisions and analysing problems encountered in the CI, which are regarded as complex and full of uncertainties. The AHP is one variant of the fuzzy set concept that extends the concept beyond conventional usage. Baba et al. (2017) asserts that the AHP uses fuzzy reasoning, in terms of measurement of variables, to advance prioritization approach by structuring. The AHP approach have been greatly used in risk assessments (Li & Zou, 2010; Zayed et al., 2008) involves building of a model of the whole project. It is a robust and flexible multi-criteria decision analysis methodology and the concept is based on three general principles (Saaty, 2005): i) Hierarchy representation and decomposition: breaking down the problem into separate elements; ii) Priority discrimination and synthesis: ranking the elements by relative importance, and iii) Logical consistency: ensuring that elements are grouped logically and ranked consistently according to a logical criterion.

In this risk assessment approach, usually the expert judgment are defined in linguistic scales such as “low probability”, ‘serious impact’, or ‘high risk’ etc., according to (Wang, Wang, Zhang, Huang, & Li, 2016) these crisp judgment are not easy task to assess because of the imprecise information and the uncertainty nature of risks hence use of fuzzy set inference and defuzzification.

The Fuzzy inference and defuzzification

In fuzzy risk assessment the relationship between fundamental input parameters and output parameters can be defined in form of “If – Then” rules or in form of mathematical function defined by an appropriated fuzzy arithmetic operator. Similarly, as the result of the fuzzy inference stage is a fuzzy number, defuzzification is used to convert the fuzzy result into exact numerical value that can adequately represent it (Nieto-Monrote and Ruz-vila, 2011). The fuzzy arithmetic follows the fuzzy set theory introduced by Zadeh (1965) suitable for dealing with imprecision and uncertainty associated with data. The arithmetical operations involves complex set theory and beyond this piece. To overcome some of these challenges, computerized systems that integrate the arithmetic have been widely proposed (Yoo, Yang, Kang, & Lee, 2017).

Determination of priority (weigh) and consistency under AHP

In AHP the determination of priority involves pair-wise comparative judgement on the impact of the RF on the overall framework of the project for each RF pair-wise of the same level and group in the hierarchical structure. These linguistic measures are converted into corresponding fuzzy members and forms the fuzzy matrix for each RF. The respondent’s comparison matrix for the group and the level in fuzzy inference are aggregated into fuzzy number using fuzzy arithmetic average. The priority is obtained by determination of the eigen value of the aggregated matrix for each RF. In SuperDecisions software (SuperDecisions, 2013) this is indicated as the weighing value of the RF. According to Niero-morote and Ruz-vila (2011) generally the pair-wise comparison information given by respondents has inconsistency. The inconsistency level is determined (and indicated in SuperDecisions) based on transitivity method (as outlined by Ma et al., 2006; Wang and Chen, 2008).

RESEARCH METHODS

The research focuses on the two vital processes of risk assessment in construction projects: identification and analysis hence the approach too. In order to capture all possible risk factors associated with housing projects and ensure accuracy of the result the study explored two survey approaches in eliciting data from respondents: general survey for identifying risk factors (RF) and Delphi survey involving focal group to elicit the critical pairwise judgements needed for AHP based analysis and prioritization. Delphi survey method was deployed to ensure more accuracy and consistency in judgment.

Identification Survey: The study employed a novel multi-techniques (three) identification framework. This involves a systematic review of literature cases on similar projects generally to extract a pool of risk factors associated with construction in general and housing development projects in particular. A total of 54 RFs were collected. The study subjected this extracted risk factors to experts’

review. After diligent reviewed by experts the RFs were reduced to fifty (50). The third identification technique employed is the general questionnaire based survey. A total of 220 structured questionnaires were distributed to mass housing developers and 42 questionnaires were returned duly completed. The data were used to analyse the significance of the RFs.

Delphi Survey: In order to solicit data for the analysis of the identified significant RFs using the AHP methodology, which is laborious and skill based, and to enhance reliability of the data, a focal group of five (5) respondents were selected, from the identification survey pool, based on years of experience on job and educational qualification. With the growth of AHP methodology, the technique has been adopted into computer software to facilitate easy processing. This study employed the SuperDecisions software (SuperDecisions, 2013) in carrying out the AHP pairwise judgement analysis.

Data Analysis: The data collected from the study were subjected to quantitative analysis. Two approaches were adopted for the analysis of the data: significant and severity analysis and prioritization analysis. In order to carry out an initial assessment of the potential RFs to determine the significance and severity, data on likelihood of occurrence and possible impact of the RFs were soughed. Likert scale of 1-5 using natural linguistic terms (Table 1) were employed in the measurements. It is noteworthy that the study used singular (integrated) measurement of the impact on key project objectives (cost, time, quality, scope, etc.) (as presented in Table 2). The study used the mean values of the two measurements (likelihood and impact) to determine and filter the significance or otherwise of each of the RFs. This is to allow easy restructuring and final AHP prioritization analysis. Using the Shen et al.' (2001) Significance Index (SI) formula given by the equation 1 below, the criticality of each of the RFs was calculated for both the likelihood of occurrence and the impact of the RF. The RFs were, accordingly, ranked based on Wang et al.'s (2004) criticality ranking method which uses Mean Scale value.
The Shen et al.'s Significant Index is given by the formula

$$SI_i = \frac{\text{Likelihood} \times \text{Impact}}{n} \quad \text{Equation (3.1)}$$

Where:

$$SI_i = \frac{\sum_{j=1}^{n} L_{ij} \times I_{ij} \times S_{ij}}{n}$$

SI_i = Significant Index of risk i

L_{ij} the likelihood of risk i occurrence assessed by respondent j (in scale weight =1, 2, 3, 4 or 5)

I_{ij} the degree of impact of risk i occurrence assessed by respondent j (in scale weight =1, 2, 3, 4 or 5)

n= number of risks in the assessment.

S_{ij} = Signifcant score assessed by respondent j for risk i

Table 1 Likelihood of Risk Events Scaling

Score	Descriptor	Explanation
1	Rare	Not expected to happen
2	Unlikely	Small likelihood but could well happen
3	Possible	50 – 50 chance
4	Likely	More than 50 – 50 chance
5	Most likely	Almost certain that it will happen

Further, the results of the significance indexing, in terms of both likelihood of occurrence and impact, was used to determine the most significant risks for further structuring and final assessment.

Table 2 Impact of Risk Events Scaling

Score	Very low 1	Low 2	Moderate 3	High 4	Very High 5
Cost	Insignificant cost increase	< 5% cost increase	5 – 10% cost increase	10-20% cost increase	>20% cost increase
Time/Schedule	Insignificant schedule slippage	Schedule slippage less than 5%	Overall project slip 5-10%	Overall project slippage 10-20%	Overall schedule slips >20%
Scope	Scope decrease barely noticeable	Minor area of scope affected	Major area of scope affected	Scope reduction unacceptable to the developer	Project end product is effectively useless
Quality	Quality degradation barely noticeable	Only very demanding applications are affected	Quality reduction requires developers approval	Quality reduction unacceptable to the client	Project end product effectively unusable

In the final AHP based prioritization analysis, the identified significant RFs were restructured in hierarchical way and subjected to pairwise comparism as outlined by AHP procedure in SuperDecisions software using Delphi assessment l n e d e v

Figure 2: Typical Priorities window of SuperDecision showing Priorities and inconsistency values

RESULTS AND DISCUSSIONS

Results of the Analysis of severity of risks

The study used the likelihood of occurrence and impact of the RFs measurements to assess the severity of the RFs for initial assessment and structuring for final prioritization analysis. Table 3 shows the computed mean values for both the Likelihood of occurrence (LoO) and impact for each of the RFs based on the respondents' submissions. 'Delay in the approval of designs by public supervising agencies (B07)'has the highest likelihood of occurrence while 'Inappropriate documentation (B12)' with mean score of 1.57 has the lowest possibility of occurrence. Similarly, the computed results shows that "schedule (time) overrun (B14)' with mean score of 3.69 is ranked highest in terms of impact on project whereas 'Technical and managerial complexity (B31)' and 'Failure in bidding system

Table 3: Risk Factors identification and Severity ranking

S/No.	Risk ID#	Risk Factor	LoO** Mean score	Impact Mean score

Table 4 Reviewed Risk Hierarchy structure

Risk ID#	Risk Factor	Risk ID#	Risk Factor
L0101	Political	L105	Land Acquisition
A01	General insecurity in the economy	B01	Delay in land acquisition
A02	Lack of policy continuity of government	B04	Illegal title of land
A04	Instability in government	L106	Design
L102	Economic	B05	Defective design
A05	Exchange rate fluctuation	B07	Delay in design approval
A06	Inflation in the economy	L108	Construction
A08	Interest rate fluctuation	B14	Scheduling (time) overrun
A11	Demand for house change	B18	Site condition variation
L104	Force Majeure	L109	Financial
A15	Industrial strike	B24	Bankruptcy of suppliers
A16	Outbreak of war and conflict	B25	Cost overrun
A17	Community resistance	B26	Cash-flow challenges

Results of Fuzzy-AHP based Risk Prioritization Analysis

In order to achieve high precision, Delphi survey methodology was deployed with a group of five experts to measure and determine the relative priority indexes (weights) of each of the RFs and each RF cluster (RF group) in line with the AHP prioritization assessment technique which uses pairwise comparison judgments. The evaluation of this analysis data was carried out using computer-based AHP-structured software – SuperDecision (version 2.2). Data was solicited using natural linguistic terms provided within the Questionnaire mode and these inputs are automatically converted in line with fuzzy arithmetic to numerical values by the system. It is worth noting that maintaining lowest level of inconsistency in judgment is important and key in SuperDecision Software as CR above 0.10 is not acceptable.

Presented in Table 5 are the relative priorities of the Macro-level (cluster/group) RFGs, which indicates that Economic risk group (L102) has the highest ranking while Force Majeure group (L104) has the least risk priority.

Table 5: Relative Priorities and Ranking of Macro-Level Risk Factors Groups

S/N	Risk ID#	Risk factor Group	Priorities by respondents					Average weight	Ranking
			A	B	C	D	E		
1	L102	Economic	0.3845	0.3905	0.4128	0.4371	0.3816	0.4013	1st
2	L105	Land acquisition	0.2602	0.218	0.2549	0.2765	0.2418	0.2502	2nd
3	L106	Design	0.0973	0.1821	0.1682	0.0890	0.0734	0.1220	3rd
4	L109	Financial	0.1031	0.0784	0.1386	0.1246	0.1056	0.1101	4th
5	L108	Construction	0.0798	0.0596	0.0512	0.0604	0.0557	0.0613	5th
6	L101	Political	0.0403	0.0515	0.0428	0.0386	0.0470	0.0440	6th
7	L104	Force Majeure	0.0109	0.0357	0.0414	0.0092	0.0091	0.0211	7th
Consistency Ratio(CR)			0.0414	0.051	0.0313	0.0159	0.0258		

At Micro-level (RFs level), the result after synthesis of the pairwise judgements data submitted by the five panel shows significant variations in the weightings between each RF. The highest average weight score by the RF is 0.2019 for RID#A11 while the lowest weighting is 0.0105 for RID#A02. Other RFs average relative priorities range from 0.1308 (RID#A08) to 0.0110 (RID#B24). Table 6 shows details of the relative priorities of each RF and the overall ranking of the RFs as submitted by the experts and synthesized in SuperDecisions. To ensure that consistency is within the

threshold level of 0.10, the respondents were offered repeated chances to review their judgments.

Similarly, the average weight scoring was used to prioritise and ranked the RFs accordingly. Top highest ranking is an economic RF 'Changes in demand for houses' (RID#A11). The second ranked risk factor by experts is another economic risk group element 'the interest rate fluctuation' (RID#A08). Placed third (3rd) and fourth (4th) are two construction execution risk factors that are so regular in construction management: 'Cost overrun' (RID#B25) and 'scheduling (time) overrun' (RID#B14). Least ranked, among the lowest of the 19 RFs are 'defective design' (RID#B05), 'bankruptcy of suppliers' (RID#B24) and 'lack of policy continuity' (RID#A02) probably due to prototype nature of housing development projects which allows defect in designs to be corrected easily.

Table 6: Relative Priorities and Ranking of Micro-level Risk Factors

S/No	Risk ID#	Risk Factor	Weights (Priorities) by respondent					Average weight value	Ranking
			A	B	C	D	E		
1	A11	Changes in demand for houses	0.2328	0.1894	0.1718	0.2379	0.1775	0.2019	1st
2	A08	Interest rate fluctuation	0.1183	0.1283	01008	0.1580	0.1458	0.1303	2nd
3	B25	Cost overrun	0.0753	0.1398	0.0963	0.1308	0.1117	0.1108	3rd
4	B14	Scheduling (time) overrun	0.0579	0.1078	0.1024	0.0804	0.0795	0.0856	4th
5	B04	Illegal title to land	0.0478	0.0467	0.0703	0.0502	0.1082	0.0647	5th
6	B07	Delay in design approval	0.0703	0.0802	0.0533	0.0402	0.0302	0.0548	6th
7	A16	Outbreak of war and conflict	0.0506	0.0417	0.0703	0.0511	0.0402	0.0508	7th
8	A01	Gen. insecurity in the economy	0.0328	0.0996	0.0525	0.0236	0.0324	0.0482	8th
9	B26	Cash-flow challenges	0.0503	0.0618	0.0229	0.0412	0.0408	0.0434	9th
10	A06	Inflation in the economy	0.0731	0.0211	0.0311	0.0415	0.0289	0.0391	10th
11	A04	Instability in government	0.0523	0.0492	0.0310	0.0320	0.0291	0.0387	11th
12	B01	Delay in land acquisition	0.0253	0.0470	0.0529	0.0263	0.0358	.0.0375	12th
13	B18	Site condition variation	0.0275	0.0110	0.0117	0.0313	0.0133	0.0190	13th
14	A15	Industrial strike	0.0157	0.0295	0.0182	0.0026	0.0195	0.0171	14th
15	A05	Exchange rate fluctuation	0.0079	0.0133	0.0122	0.0073	0.0249	0.0131	15th
16	A17	Community resistance	0.0142	0.0229	0.0131	0.0114	0.0003	0.0124	16th
17	B05	Defective design	0.0021	0.0107	0.0015	0.0047	0.0453	0.0111	17th
18	B24	Bankruptcy of suppliers	0.0232	0.0253	0.0032	0.0021	0.0001	0.0110	18th
19	A02	Lack of policy continuity in govt.	0.0118	0.0069	0.0151	0.0097	0.0091	0.0105	19th
Consistency Ratio (CR)			0.0346	0.0675	0.0513	0.0482	0.0611		

The study results show that the most critical risk cluster is the Economic group (RID#L102). Economic risk is one of the general risk events that affect the industry as a whole and not tight to specific project. The most critical RF that contributes more to the high exposure of housing development projects to economic risk is the demand for housing (RID#A11) during the study period as shown in the micro-level prioritization analysis results.

The results of this study are distinctively clear as to the 19 RFs that are significant and relevant to the housing project development in Nigeria. The results also show

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QUALITY CONTROL IN ABUJA MASS HOUSING

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has continued to pose a challenge to the Sub-Saharan Africa with Nigeria inclusive. In addition, Andrew (2007) stated that the country is bugged with a housing insufficiency of about 18 million units in which about N60 trillion is needed to remedy the deficit. Thus, the Federal Government of Nigeria (FGN) since independence of the country in 1960 has adopted various strategies in its efforts to provide affordable housing to the citizenry. Anthony et al. (2017) provided an overview of Housing delivery efforts' in Nigeria, and re-counted that from 1962 to 1968, the government focused principally on the provisions of housing in Lagos (the the Federal Capital of Nigeria);it had proposed the construction of 61,000 housing units, but sadly only 500 units were actually built. Government again in 1979 launched the National Housing Scheme (NHS) with the aim of building 400,000 housing units across the country; and again in 1983, government initiated the National Prototype Housing Scheme (NPHS) with the intention of building a variety of houses in selected states of the Federation. But Anthony et al. (2017) lamented that not much was achieved with all these schemes and programmes on the housing delivery efforts of the country. In 1980 for instance, government proposed the construction of 202,000 houses in Lagos and the State Capitals of the federation, again regrettably only about 28,000 units were constructed. But commencing from 1992, the FGN focus its housing programme on Abuja when it became the Administrative Capital of Nigeria in December 1991.The city at that time had an estimated population of 387,671people; but it had grown to 2,245,000 in 2012 with a growth rate of approximately 9.3% (Abdullahi and Wan, 2010; Elaigwu, 2009).

Muhammad et al., (2015) reported that as a result of Abuja population growth, the city is faced with acute housing shortage compelled by the spontaneous relocation of federal capital to Abuja in 1991 without adequate provisions on the anticipated influx of people to the new administrative capital city. Thus, in order to address the housing challenges, government rolled out three new Housing Policies for affordable housing for the FCT (Ogunsanya, 2011; Muhammad et al., 2015); by pegging of interest rates on Housing Loans to a maximum of 6%; introduction of Estate Development Loans (EDL); and the rolling out of guide lines for Build, Operate and Transfer (BOT) initiatives, under the operations of Public Private Partnership (PPP) scheme. These policies created the enabling environment for active private sector participations in housing delivery in the FCT. Under these initiatives, Government provide the primary infrastructure and allocate land to private developers; and the private developers, in turn, provide secondary and tertiary infrastructure as well as developed and sell completed houses to members of the general public (Umoh, 2012; Muhammad et al.,2015). Thus, Ogunsanya (2011) reported that, the Estate Developers turn out en-mass to participate in the Mass Housing scheme.

Lamentably, the housing units being produced and marketed by the private developers are flawed with defects and are of poor quality. Dorcas et al,.(2019) asserted that this poor quality project delivery is a major problems that Nigeria construction industry is faced with ; and that the factors that cause defects in newly constructed housing, chiefly among them are construction mistakes, use of inexperienced labours, poor management commitment and leadership styles. (Zane, 2005) averred that developers of mass housing are in habit of producing defective works as a result of their QC operational deficiencies. As a result,

Ogunsanya (2011) asserted that that this make defects in Abuja mass housing very common. Some of these defects include failures in finishes; mechanical and electrical malfunctions; and that in some instances defects in new houses could cost the new owners' considerable financial resources in repairs after purchases (Mastin,2008).The consequences of these defects are that they affect the quality of the finish buildings and the environment. Defects are a foremost a challenge in the Nigeria building Industry particularly with the mass housing projects in Abuja. But amazingly, Ojo and Ijatuyi (2014) reported that defective housing construction is global and not limited to Nigeria or developing economies alone; and there are proofs of the existence of the problem of defective construction claims on defective construction in the California Housing Market Project in the United State of America.

But defects are faults that could affect the quality, durability, functionality of newly completed housing; and would harm the societies' especially in the present efforts of environmental sustainability and development (Zane, fects in the 108 housing units of Integrity Court, Lake View and Savannah Estates and proffer permanent solution to defects menace and quality control issues in estates development in Abuja.

LITERATURE REVIEW

Quality control in housing construction

Adeoye (2016) stated that quality is a mental or moral attribute of things which can be used when describing the nature, condition or property of that particular thing; and further assertion is that though quality is a product of subjective judgment housing must be of good quality in compliance with tolerable standard and must among other special effects be free from serious despair and energy efficiency. The function of the construction firms QM hence is to produce quality housing. Tang et al. (2005) stated that QM includes continuous methodical and independent assessments for the establishment of, whether quality activities results conform to plan objectives of management. In housing production, QM is the process of identifying and administering all activities needed to achieve the quality objectives of the organization. Though, Mass Housing production does have the challenges of Quality Control (QC) from the substandard works of both Contractors and Sub Contractors, it is the responsibility of the QC managers to insure that housing productions are carried out by professionals according to the satisfaction of prospective home owners (Zane, 2005; Mastin,2008).

Defining defects in housing construction

Defects in newly completed buildings have continued, in spite of the available of technical information globally on quality house production practice. Diverse researchers thus, have made divergence definitions of what constitute defects in buildings. Buys & le Roux (2013) stated that the word 'Defects' itself referrers to construction faults that exceed ordinary imperfections, which could affect the basic structural element of the building; and could reduce the value and functional characteristics of the building, installation, or the structure. Even as Atkinson (1999) appraised defective construction works as works which fell short of complying with the specific requirements of the contract on quality, workmanship, aesthetics and performance of the facilities. Sulieman et al (2014) in contrast,

defined building defects as building or house flaws, or design mistakes that reduce the functionality of the house to the occupants. Other researchers asserted that defects are: failing or shortcomings in the functions of the building; any breach of contract affecting the quality of work (structural or decorative); felling short of meeting the terms of the specific descriptions or requirements of the contract with any implied terms as to durability, quality, workmanship, permanence and artistic views of the project (Chamber, 1994; Atkinson, 1999; David, 1999).

Defects in housing

There are a variety of causes leading to defects in housing construction. Dorcas et al, (2019) asserted that severe factors affecting project quality in Nigeria construction industry are: construction mistakes, use of inexperienced labours; and poor, inspection, and management commitments and leadership styles. Buys & le Roux (2013) stated that other factors leading to defects in newly completed housing include inadequate artisan skills, projects management failures and defects dominated by over design related origins. Richardson (2001) added that negligence on the part of workmen, use of substandard building materials; absence of professionals in the project building team; and use of unqualified contractors are some of causes of common defects in recently built houses. Other researchers asserted further that major causes of defects in fresh buildings include non-compliance with Building Code and Building Regulations Standards; deficiencies in designs, planning and supervision of construction of new buildings (Bakri and Mydin,2013;San-Jose et al (2011).The consequences of these causes of common defects associated with mass housing construction and newly completed housing, Richardson (2001) asserted that these defects include cracks; water seepages; electrical malfunctions; faulty drainages; plumbing defects; peeling and fading of paints. Bakri and Mydin (2013) added that other common type's defects include faulty ventilation, cooling or heating systems and insufficient insulation or sound proofing.

THE STUDY AREA

Abuja FCT: The city is located in the central part of Nigeria, north of the confluence of the Niger and Benue Rivers (Muhammad et al, 2015).and lies at latitude 9.072264, and the longitude 7.491302. Global Position System (GPS) coordinates of 9° 4' 20.1504'' N and 7° 29' 28.6872'' E (newworldencyclopedia.org).According to Jibril and Garba (2012), Abuja Capital City is made of 22 Administrative Districts; its area covers7,315km square (newworldencyclopedia.org).Each of the districts is further divided into neighborhoods for planning and development purposes. A population of 3.2 million was envisaged for the FCT at the inauguration of the capital city in 1991 as an ultimate population (Ukoje and Kanu, 2014).

MATERIALS AND METHODS.

A Developer built 108 Housing Units in tree Estates in the hearth of the city namely:

(i).Integrity Court Estate: - this is made up of 30 units of 4-Bedroom Executive Terrace

Table1: Common defects of Integrity Court, Lake View and Savannah Estates in Abuja

SN	Types of Defects	Locality and Nature of Defects
I	Cracks	Cracks in Foundation
		Walls – interior and exterior
		Scooping Floors
		Plaster –interior and exterior
		POP/ceilings
		Broken Tiles
II	Leakages / Dampness	Ground water seepage
		Seepage from doors
		Floor dampness
		Broken pipes
		Defective taps/sanitary wares
		AC Seepage
III	Roof defects	Roof sagging
		Ceiling
		Roof leakages
		Defects in roof covering
		Eaves defects
IV	Electrical	Low power supply
		Some shocking components
		Loss of power phase
		Fittings malfunctions
V	Wood and carpentry	Door twisting
		Gab at floor(shrinking)
		Fungi attack(interior doors)
		Non alignment of doors
		Wardrobe sagging
VI	Mechanical/Water Supply	No water supply
		Low water pressure
		Irregular water supply
		Connecting pipe leakages
		Defective Hot water Supply
VII	Painting and Decorations	Paints peeling
		Paint fading
		Poor colouring
		Paints
VIII	Plaster Defects	Peeling of walls plaster
		Failed Plastering
		Failed Rendering
IX	Drains Defects	Blocked Drains
		Failed Plaster

Project management tool kit (Melton, 2007)

Houses, built on a 13,200 square meters of land. (ii). Lake View Estate:-this Estate is made up of 30 units of 4-Bedroom- Semi-detached Duplexes and constructed on 14,000 square meters of land and (iii). Savannah Estate:-this Estate is serviced with 48 units of 4-Bedroom Semi- detached Duplexes with a unit of 1-Room Boys' Quarters, built on about 19,540 square meters of Land. This research involved the evaluation of the defects in the 108 units of the newly completed houses and to establish the causes of the defects in the housing units. The study was carried out carried out by the use of structured questioners and semi structured interviews with relevant participants in the development of the Estates. The selections of common defects and the categorisations of the defects were adopted from Project Management Tool Kits for measurement of defects in buildings (Melton, 2007). The Project Management Toolkit was used to conduct preliminary studies and

The developer engaged a total of 26 Contractors in the constructions of the 108 units. The condition of the housing were evaluated by structured questionnaires and semi-structured interviews as adopted from the Project Management Tool Kits. Accordingly the management of the developer and contractors were asked similar questions in relation to past jobs executed; plants owned or hired by the companies for the work, organization structure and staffing.

A total of 140 questionnaires were administered: The Management of the Developers – 1no; 31no to the contractors and sub-contractors; and 108 no to the occupants/ new owner of the housing units. The management of the Developer returned its questionnaire fully completed. The occupants/new owners returned 101 questionnaires fully completed. While the contractors returned only 4 questionnaires. The data obtained from the semi-structured interviews were transcribed and content analysis was used to determine the themes and constructs leading to the identification of various types of defects and there occurrences presented in Fig. 1 to Fig. 8 and Table 3 and Table 4.

RESULT AND DISCUSSION

Result

The data obtained from the structured questionnaires and the semi structure interview questionnaires were analysed using mean ranking analysis of factors associated with the causes of the various defects in the estates. Also the data obtained from the semi-structured interviews were also transcribed and content analysis was used to determine the themes and constructs leading to the identification of various types of defects from categorisations based on the categorisations of defects adopted from Project Management Tool Kits for measurement of defects in buildings (Melton, 2007) of the defects in Table 1. The results of the analysis are presented in Fig 1 – 8; and Table 3 and 4

Fig. 1 – 8 are the percentage of occurrences of the categories of the defects in each of the three estates from the data from the questionnaires and interviews with the occupants/owners' of the housing units. The measurements of occurrences of the categories are as follows:

Category 1 defects: cracks

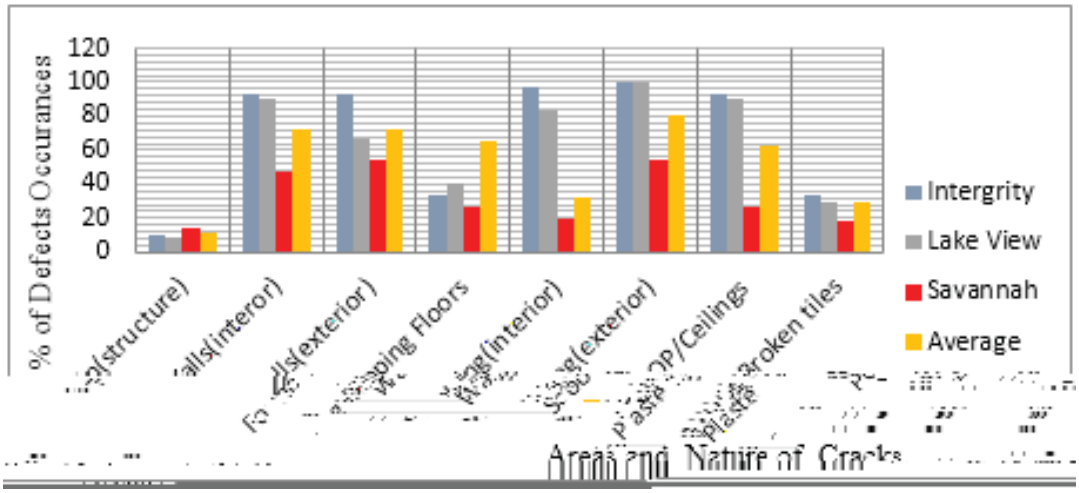

Figure 1: Cracks Defect

Defects resulting from cracks were mainly in the interior and Plaster failures 100% of all the houses studied. Cracks in foundations were also detected in 10, 9, and 15% of Integrity Court, Lake View and Savannah Estates respectively. While Plaster of Paris Ceiling finishes failures dominated Integrity Court Estate (93% of the Units affected).

Category 2 defects: roof defects

Figure 2: Roof Defects

There were defects in roof covering of 57% Integrity Court Estate and 50% of Lake View Estate. It was observed that 55mm aluminum gauge use as against the specifications of 70mm gauge for the project. Failures of ceiling works were detected in Integrity (87%) and roof leakages were identified in Lake View (90%).

Category 3 defects: leakages and dampness

Leakages (83%) and Dampness (70%) Defects in Integrity Court were seepages of water from doors and broken pipes. Whil

Category 4 defects: electrical malfunctions.

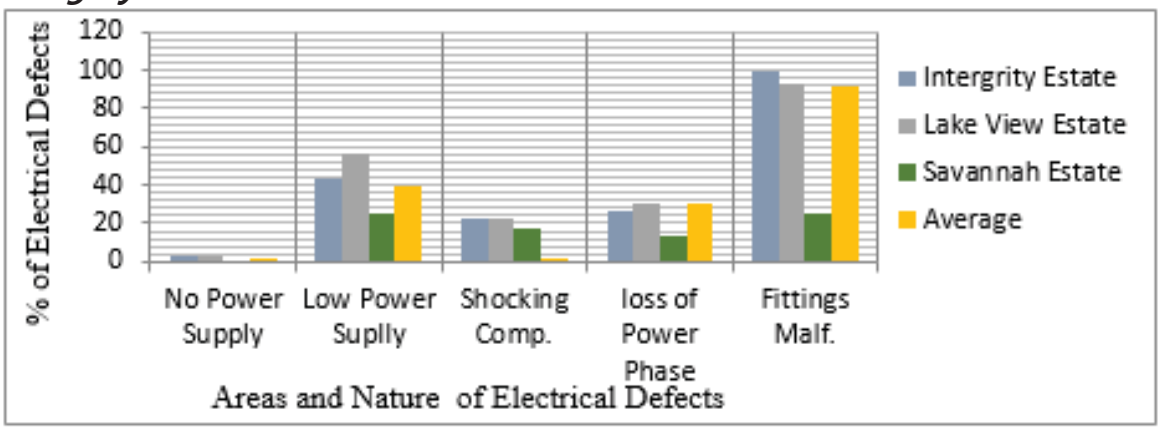

Figure 4: Electrical Defects

Malfunction of electrical fittings were ascertained in 92 % of the 108 housing followed by low power supply (39%) while 12% of houses had no power supply at all at the time the new owners took possession.

Category 5 defects: wood and carpentry.

The common defects in this section were door shrinking (gab between the doors and the floors) affecting 48% of the houses in Integrity Estate and the door twisting in Lake View Estate were 38%. In addition defects resulting from Non-Align doors were evaluated in 26% of the houses

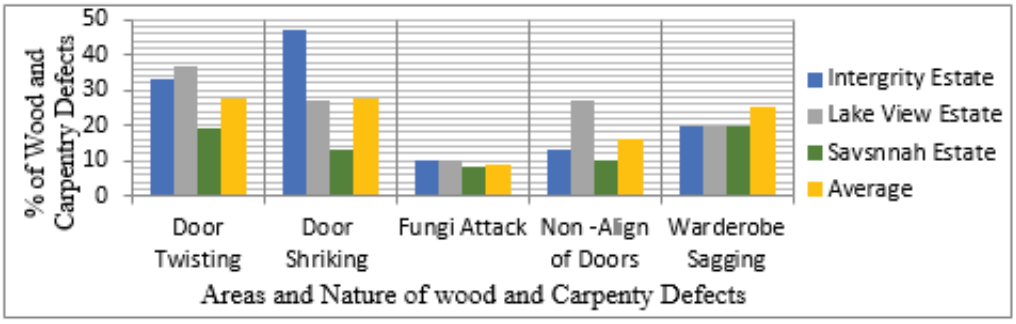

Figure 5: Wood and Carpentry Defects

Category 6 Defects: Paints and Decorations.

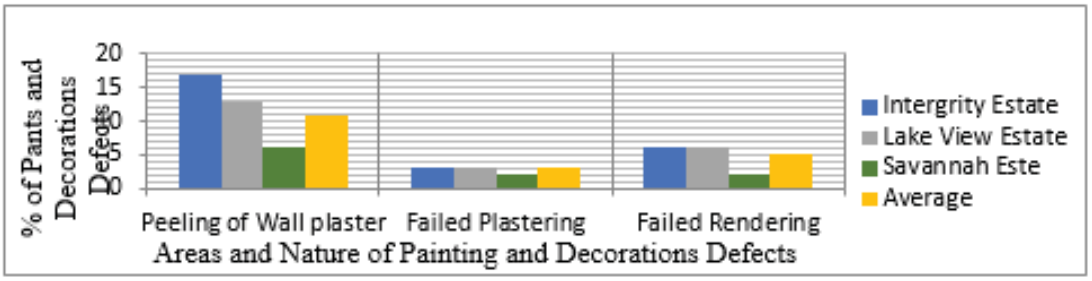

Figure 6: Plains and Decorations Defects

Pain staining defects affected 82% of the houses (particularly the ceiling portions) followed by pains flaking with 63%. Fading paints ranked high with a percentage of 100 and 97 % in Integrity Court Estate and Lake View Estates respectively.

Category 7 defects: mechanical and water supply defects.

Figure 7: Defects in Mechanical and Water Supply

Low water pressure (89%), irregular water supply (60%) and leakages of connecting pipes (84%) are the most frequent Mechanical and Water supply defects in the 108 Units of the three Estates studied. There are extreme cases of no water supply in 4% of the housing units.

Category 8 defects: drains defects.

The drainage systems were characterised blockages (5%) and failed finishing (14) in the three Estates.

Figure 8: Drains Defects.

Developers' and contractors' capacity

The analysis of the data from the questionnaires and the interview administered to the contractors, managing tem of the developer of the housing and the professionals that took part in the housing projects are presented in table 3 and 4.

Table 3: The Property Developers' Capacity and Competence

SN	Areas of Management Competence and Capacity	Attainment
1	Experience in Mass Housing Development.	None
2	Experience in Similar Projects	None
3	Organization Management Structure	Not defined
4	Engagement Professions: Builders, Engineers and Architects	< 5%
5	Management system of QM for the project	None
6	Quality Control Unit	None
7	QC and QA operational techniques in place	None

Table 3 reveals that the developer and its Management did not exhibit inexperience and also lack knowledge and understanding of QM in Mass Housing Production.

Contractors' capacities

Table 4: Contractors' capacities and experiences

SN	Areas of Capacity and Competence	Score
1	Experience in similar jobs.	15%
2	Contractors Technically Qualified	10%
2	Organization Structure	None
3	Quality Control Unit	None
4	Employments of Professionals: Builders, Engineers and Architects	< 5%
5	Engagement Professions: Builders, Engineers and Architects	19%
6	Staff on Regular Employments.	0%
7	Plants and Equipment	None

Table 4 indicated that only 4 (10%) of the contractors were technically qualified to be engaged by the Managements of the developer for the Mass Housing execution.

DISCUSSION

The evaluation of the occurrences of common defects in under the Abuja mass housing project was carried out in 108 housing units made up of: 30 units each of 4-Bedroom Executive Terrace and 4-Bedroom- Semi-detached; and 48 units of 4-Bedroom Semi - detached Duplexes with a unit of 1-Room Boys' Quarters. The results and findings are contained in Fig.2 to 10. These shows the percentage occurrences of common defects in the houses.

Defects resulting from cracks were mainly in the interior and plaster failures in occurred in all the houses studied. Cracks in foundations were also detected in three Estates. Ceiling finishes failures. Leakages and air conditions seepages; defects in roof coverings and leakages in ceiling works. Doors twisting and non-aligned were found in over 50% of the houses were dictated. Also malfunction of electrical fittings; Low water pressure; pain staining defects affected; leakages of connecting pipes were ascertained in over 80 % of the 108 housing units evaluated. These numerous defects confirmed the assertion of Bakri and Mydin (2013) and Richardson (2001) and other researchers, that these are the common defects associated mass housing productions.

The Property Developers' Capacity and Competence (Table 3) is exposed. The data and analysis showed that the Management of the Estates' Developer has no Quality control plan for the estates development; and did not exhibit inexperience, knowledge and understanding of Quality Management in Mass Housing Production. This lack of understanding in what QM was reflected in selection of unqualified contractors' for the execution of the housing projects. The outcome of the exercise is poor quality products and defective works such as cracks, water and plumbing; electrical and faulty drainages; plumbing fading of paints. This confirmed the assertion of (Zane, 2005) that developers of mass housing do produce defective works due to Quality Control operational deficiency. Additionally result confirmed the averments of other researchers that deficiencies in planning and supervision of construction of new buildings; absence of

professionals in a project building team; and use of unqualified contractors are major causes of common defects in newly built houses. (Bakri and Mydin, 2013; San-Jose et al, 2011; Richardson, 2001). It can be averred that Housing Developer's Management did not involve a system of QM that could have ensured standard quality of material and labour for effective QC operational activities and techniques in the construction of houses.

From Table 4 exposes the quality of contractors employed for the projects. This confirms. There are a variety of causes leading to defects in housing construction. Dorcas et al, (2019) assertion that severe factors affecting project quality in Nigeria construction industry include use of inexperienced labours; and poor, inspection, and management commitments and leadership styles. Buys & le Roux (2013) stayed that factors leading to defects in newly completed housing include inadequate artisan skills and projects management failures. All these defects are attributable to poor workmanship. (Rachardson, 2001; Ransom, 1987; Mastin, 2008;

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QUANTITY SURVEYING EDUCATION FOR SUSTAINABLE DEVELOPMENT: INDUSTRY PERCEPTION

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Research has shown that a lacuna exists between the industry and tertiary educational institutions in terms of acquired competencies by Quantity Surveying graduates. It has also been found that there exists an absence of policy moderating the competency threshold for Quantity surveying graduates. Due to the aforementioned, employers of labor have overtime been left unsatisfied with the competency exhibited by graduates. This gap has not really been explored by researchers, thus the expectation of the industry is relatively undocumented. This study, therefore, is aimed primarily at bridging the gap by determining the industry expectations of Quantity surveying graduates and the competence acquired by the graduates. Thus the study is from the employers' perspective. It employed quantitative method of data gathering. Questionnaires were administered. Over 100 structured questionnaires were distributed through online platforms and 34 were returned with 33 fit for analysis and 1 was unfit for analysis. Therefore, a total of 33 questionnaires were analyzed. 17 number of competencies were highlighted as the competencies expected of QS graduates by employers. Analysis through SPSS was applied for the quantitative data. The study established the top ten preferred competencies by employers as trustworthiness, effective communication, team player, knowledge of construction technology, meticulousness, creative thinking, problem-solving, positive attitude, valuation of work done, and information literacy skills. It is evident that soft skills are preferred over professional

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education. Education is the bedrock for future accomplishments. The failure or otherwise of graduates to get adequately educated is apparent in the skills obtained and competencies exhibited on the job. Graduates metamorphose to professionals in the industry, putting into practice the skills acquired in the place of learning. The graduates without required skills end up unemployed in their chosen field of study (Hanapi & Nordin, 2014). Consequently, it leaves most graduates wondering if obtained competencies meet up with the employers' specification for most job openings. A direct relationship between education citadels and industry requirements is inevitable (Industry Oriented Education(IOE)) (Gharehbaghi, 2015). Education being the bedrock of the industry must be executed in line with the requirements and expectations of the industry it feeds. The success or failure of this leads to unqualified graduates and unemployment.

Graduates unemployment has no significant connection with the economy but with their incompetence (Hanapi & Nordin, 2014). A study by Menon & Athanasoula-Reppa, (2017) established that many graduates exit the unemployment web through the acquisition of additional skills and competencies. The unemployment rate the world over keeps soaring; it is not an exception in Nigeria, it was 18.8% in Q3(third quarter) of 2017 and increased to 23.1% in Q3 of 2018(NBS, 2018). Employability or otherwise of a graduate lies in the competency exhibited by the graduate. This stems from the quality of education (learning curriculum) received by the graduate; tertiary education institutions should "continually aspire for graduates to be provided with relevancy and effectiveness of work so as to escalate their employment"(Woya, 2019).

Industry Oriented Education (IOE) is the solution to meeting the industry expectation of graduates that meets the 21st-century demand of the industry (Gharehbaghi, 2015). The competencies of the graduates are a function of their

to close up the existing gap. Oyediran (2004) in a study found out that Architecture, Engineering, and Construction (AEC) educators lack ICT facilities capable of integrating IT culture into the educational system of the AEC industry graduates. It is obvious that the educators are ill-equipped for the 21st century, thus they (educators) cannot give what they do not have in terms of knowledge transfer. Therefore, it can be said that the students and educators are not adequately equipped for the 21st-century construction industry. This present state is in contrast with education serving as the incubation unit for practice. The knowledge applied in practice is an offshoot of a firm foundation gotten from education. According to RICS, Quantity Surveyors are highly trained professionals offering expert advice on construction costs. A professional Quantity surveyor must have gone through the necessary education and training to carry out the expected roles and responsibilities. Therefore, it suffices to say that the present crop of graduates are not measuring up to the definition aforementioned.

Various studies has been conducted on the competency of the Quantity surveyor

However, achieving education for sustainable development will be in terms of cognitive and non-cognitive approaches. Its orientation must be situated within the basis of these consequences: competence-orientation, societal orientation, and individual centering (Barth et al., 2007). Therefore, achieving education for sustainable development is beyond the traditional curriculum of academic exercises but one that ensures practical orientation and accommodates well-rounded components (extracurricular activities, learning in group, interdisciplinary learning, volunteer work, learning by doing among others) tailored towards achieving key competencies required to sol2007). Therefore, achieving education for

an average QS graduate is information literacy skill. Industry professionals expect graduates to possess the abilit

Pearson, Robson, & Ekundayo, 2011). These expected must be covered in the school curriculum so as not to enhance the relevance of the QS graduates (Gharehbaghi, 2015; Refrigeri & Aleandri, 2013; Sais, Shafiei, & Omran, 2010).

Table 4: Gap analysis of observed against expected competencies of QS graduates

Competency (N=33)	t	p
Effective communication	-5.75	.000
Creative thinking	-5.51	.000
Team player	-5.59	.000
Strong interpersonal skills	-3.75	.001
Problem solving	-4.68	.000
ICT	-3.29	.002
Meticulousness	-5.40	.000
Positive attitude	-3.55	.001
Information literacy skills	-3.18	.004
Contract documentation	-4.89	.000
Knowledge of construction tech	-4.75	.000
Knowledge of construction law and regulation	-2.49	.018
Managing tender process	-5.04	.000
Cost monitoring	-4.03	.000
Cost advice	-3.24	.003
Preparing feasibility studies	2.82	.009
Negotiation competences	3.83	.001
Preparation preliminary cost estimate	2.13	.041
Valuation of work done	2.36	.024
Project management	2.27	.031
Knowledge of BIM	3.86	.001
Measurement of civil engineering works	5.89	.000
Measurement of building services	3.73	.001

Significance level is p>0.05

CONCLUSION

It has been established that to be sustainable, a competence must respond to the dynamics of the external environment (Sanchez, 2004). This study has established that the current quantity surveying curriculum is inadequate and that the Quantity surveying graduates are not meeting up with the dynamism of industry competence requirement. Thus, the current curriculum cannot be referred to as meeting the criteria of education for sustainable development. Furthermore, the tertiary education institution as an incubator is not effective in the delivery of its duties. Thus it is imperative that tertiary education institutions offering Quantity surveying must work in synergy with and study the need of the industry so as to respond effectively to its dynamics. Also, students are to be encouraged to hone their soft skills (while in school) as competencies acquired during extracurricular activities are also important; Learning is not restricted to formal education settings only. The study reveals the preference of soft skills over professional competence by the industry. Lastly, a review of the traditional curriculum to a competence

centered curriculum is important if the quantity surveying education in Nigeria is to be sustainable. This will be achieved with the help of all stakeholders.

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REAL ESTATE INVESTMENT TRUSTS IN NIGERIA AND THE STRUCTURE-CONDUCT-PERFORMANCE PARADIGM

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This study examined the correlations among the structure, conduct and performance of Real Estate Investment Trusts in Nigeria (N-REITs) with a view to providing information that will enhance and guide real estate investment decisions. The study population consisted of all the three REIT companies in Nigeria namely: Skye Shelter Fund, Union Home REITs and UACN Property Development Company (UPDC) REITs. Secondary data on dividends and share prices of N-REITs; Total Business Revenues (TBR) and Total Individual Expenditure (TIE) on conduct variables were sourced from periodicals of the respective companies covering the period from 2008 to 2016. The data series for the study were analyzed by means of the Granger Causality tests, Kwiatkowski-Phillips-Schimidt-Shin (KPSS) unit root tests, Philip-Perron (PP) unit root tests and the ordinary least square regression (OLS). The study showed a Herfindahl Hischman Index (HHI) that ranged between 41.81% (recorded in 2010) and 100% recorded in 2008. This suggested a high concentration in the N-REITs industry. Similarly, the study found that the returns on investment in the industry ranged between -0.24% and 22.07%. The Granger Causality Test conducted revealed a bi-directional causal relationship among the structure, conduct and performance of N-REITs. The study provided essential information for stakeholders in the real estate sector regarding the influence of structure and conduct on the performance of N-REITs. This information will be valuable for equipping asset managers, insurance companies, pension funds as well as individual real estate investors in making informed investment decisions. This study is unique as it is the first to draw a link between the structure, conduct and performance of REITs in an African emerging real estate market which was hitherto not considered in previous studies.

Keywords: conduct, investment performance, real estate, returns, market structure, property

INTRODUCTION

Real Estate Investment Trusts (REITs) was first introduced in the United State of America in 1960. The purpose for the creation of REITs is to provide opportunities for all categories of investors to enjoy the advantages and benefits of investing in direct real estate without actually financing its entire development/construction (Naido, 2014). Manoj (2016) posited that 'REIT is a trust that pools capital from various investors and uses same to purchase and manage income producing real

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estate or real estate related assets'. REITs can be classified into: Equity, Mortgage and Hybrid (Seguin, 2016).

Drew (2016) asserted that REITs have become one of the vital investment vehicles in the economy of many countries. This is shown by the amount of investments in REITs industries across the globe. For example, Aro-Gordon, Bashir, Abdulsalam and Abdullahi (2014), Li and Chow (2015), NAREIT (2018) and NAREIT (2019) revealed that in 2012, REITs market capitalizations for US were $400 billion; Singapore REITs was $30.5 billion; and Japan REITs was $42 billion (Aro-Gordon, et al, 2014). In 2013, the estimated global REITs capitalization was about $1.1 trillion (Li and Chow, 2015). In 2016 the global REITs market capitalization was estimated at over $2 trillion and more recently (2018/2019) it was estimated at over $3 trillion (NAREIT, 2018; NAREIT, 2019). Despite the fact that REITs is said to be one of the viable and profitable investment asset classes in global markets (Jackson, 2008), it has been observed that REITs are underperforming in Nigeria (Akpan and Ogunba, 2015; Dabara, Tinufa, Soladoye, Ebenezer and Omotehinshe (2018). The first Nigerian Real Estate Investment Trusts (N-REITs) was introduced by the Skye Shelter Fund in 2007 with an IPO (Initial Public Offering) of ₦2billion ($6,535,948). In 2008, Union Home Hybrid REITs was similarly created with an IPO of ₦50billion ($163,398,623), while the UPDC (UACN Property Development Company) REITs was introduced in 2013 with an IPO of ₦30billion which is estimated at $98,039,216 (Annual Reports and Accounts of Skye Shelter Fund, 2007; Union Home REITs, 2008 and UPDC REITs, 2013).

Previous studies such as Akpan and Ogunba (2015), Olanrele, Said and Daud (2015) and Dabara, et al. (2018), revealed that all the N-REITs companies provided low and in some cases even negative return values on investment. This has negatively impacted on the N-REITs industry by impeding the growth of the industry and patronage from both domestic and foreign investors. This scenario is quite contrary to what was found in literature on the performance of REITs in other parts of the world (Jackson, 2008; Manoj, 2016). The problem is exacerbated and becomes more perplexing by the fact that the property assets in Nigeria (from which REITs derive their income) are performing well in terms of returns on investment (see Dabara, Ogunba and Araloyin, 2015; Dabara and Oyewole, 2015). This is also a true reflection of the performance of real estate in other African countries. For example the study carried out in South Africa by Ntuli and Akinsomi (2017) revealed that REITs are good return-enhancers as well as having diversification benefits in a mixed asset portfolio. The underperformance of N-REITs has generated questions with respect to the possible causes of the said dismal performance. In order to provide answers to these questions, it is important that an empirical research be carried out which will determine or seek to unravel why the performance of Nigerian REITs industry is contrary to what was found in literature and also provide insight into the causative factors for the dismal performance. This is important as Nigeria is adjudged to be one of the fastest growing economies in Africa. Nigeria is also considered as one of the top ten most improved Doing Business Economies in the world, thereby making it a good playing field for both domestic and foreign investments in the real estate sector (Ankeli, Dabara, Omotehinshe, Adamu, and Adaranijo, 2017). Furthermore, Nigerian REITs industry is still new with only three REIT companies whose major investments focus are mainly in commercial and residential properties. Similarly,

the fact that N-REITs falls under developing markets is another motivation for this study. However, there is dearth of data on N-REITs to assist investors, hence, this study will add to the scanty existing research work in yet another important African emerging real estate market (Nigeria). The study adapts the Bain's (1951) Structure, Conduct and Performance (SCP) theory as a major initial underpinning to addressing the research problem in this study. The theory purports that there is a one way causal relationship between the Structure (characteristics of an organization e.g market structure), Conduct (the actions or behavior of a firm in the market e.g advertisement) and Performance (the outcome or results obtained from a firm e.g returns).

This study which aimed at examining the correlations among the structure, conduct and performance of Real Estate Investment Trusts in Nigeria (N-REITs) is the first study (to the best knowledge of the researchers) that drew a link between the structure of the Nigerian REITs industry, its conduct, as well as its performance. This is because the SCP theory postulates that if there are faults in the structure of an industry this affects the conduct of that industry which in turn affects the performance of the industry. Hence, the study examined the following research questions: what were the structure, conduct and performance of N-REITs within the study period?; what are the correlations among the structure, conduct and performance of N-REITs?. The paper is presented in the following sections. The next section reviewed relevant literature, this was followed by a section on the methodology adopted for the study; next is the presentation and discussion of results and the paper closes with a conclusion.

LITERATURE REVIEW

Jackson (2008) asserted that REIT is one of the viable and profitable investment asset classes in global real estate markets. This is evident in the performance of REITs in developed economies such as the US, UK, and Germany among others (NAREIT, 2018). On the other hand, REITs in most developing nations, particularly African nations, are still new and characterized by property market immaturity, non availability of data for investment decisions and challenges of liberalization and integration into the global market (Bekaert, Harvey and Lundblad, 2003; Dabara, Omotehinshe, Chiwuzie, Asa, & Soladoye, 2018).

It is obvious that maximizing profits is the objective of rational investors. To achieve this, both investors and researchers all over the world are assessing the investment performance of various asset classes. In the real estate sector (specifically REITs), a group of studies have examined the inflation-hedging potentials of REITs. These studies include Aik (2012) and Arnason and Persson (2012). Similarly, studies such as Khoipham (2013) and Naidoo (2014) have investigated the diversification benefits of REITs with contradictory findings. Another group of studies have evaluated the performance of REITs in terms of their risk/return characteristics. Such studies include Niskanen (2012). More recently studies such as Olanrele, Adegunle and Fateye (2018) investigated the correlations between REITs and Money Market Indicators such as Treasury Bills among others. A group of studies conducted in South Africa by Akinsomi, Kola, Ndlovu and Motloung (2016) investigated the performance of the broad based black economic empowerment (BBBEE) of both listed and delisted property firms in South Africa. The study

covered the period from 2006 to 2012. The return and risk performance of the property firms were obtained by means of holding period returns formulae, capital asset pricing model, sharpe ratio and alfa among others. Findings from the study revealed that Black Economic Empowerment (BEE) compliant firms outperformed the non BEE compliant firms with respect to both returns and risk performance. Similarly, Akinsomi, Balcilar, Demirer, and Gupta (2017) revealed that speculation in gold market have impact on REITs returns in South Africa, particularly during the global economic meltdown experienced around 2008 to 2011. In the same vein, Ntuli and Akinsomi (2017) found that South African REITs are good return-enhancers with diversification benefits which could encourage shrewd investors to consider its inclusion in their mixed asset portfolios. Another study conducted in South Africa by Ijasan, Tweneboah and Mensah (2017) showed evidence of anti-persistence in South African REITs returns.

Unlike the aforementioned previous studies, this present study aims at investigating the performance of REITs from the perspective of internal factors using the structure-conduct-performance model. Some specific studies that considered performance of an industry from the perspective of internal factors (structure and conduct) include the following:

Bain (1951) conducted the earliest study on the structure, conduct and performance (SCP) framework. The study examined the relationship between the market structure of manufacturing industries in the US using variables such as buyers and sellers' concentration, level of product differentiation as well as condition of entry/exit from the market and how it relates to the conduct as well as the profit rate of the companies in the industry accordingly. Data for the study covered the period from 1936 to 1940. The methodology used involved the use of both z test and regression analysis. Findings from the study indicated that firms/industries with higher level of concentration (above 70%) recorded higher profits. However, this study focused solely on market structure while organizational, administrative and legal structures which could equally impact on the performance of the industry were not considered in the study. This present study considered the structure, conduct and performance of the Real Estate Investment Trust industry in a developing economy (Nigeria) in a more holistic approach.

Delorme, Klein, Kamerschen, and Voeks (2002) examined the correlations between structure, conduct and performance of manufacturing industries in the US in 1982, 1987 and 1992. The methodology employed the simultaneous equation model. In the study, structure (concentration) is measured by Herfindalh Hirsman Index (HHI), conduct was measured by advertising and performance (profit) was measured by returns on sales. The methodology used employed the Kambhampati's (1996) 3 equation model as well as 2 stage least square regression (2SLS). The study found that the conduct of the manufacturing industry in the study area (proxied by advertising) do not influence the profitability in the industry. However, the study did not consider other investment performance indicators such as risk/return and inflation-hedging capability which might be of interest to investors. Tung, Lin, and Wang (2010) examined the performance of tourist hotel industry in Taiwan using the Structure, Conduct and Performance (SCP) paradigm. Data was obtained to cover a period spanning from 1995 to 2006. The methodology involved the use of

3 simultaneous equations as well as regression analysis. Findings from the study revealed that the profitability or performance of the tourist hotel industry in the study area was significantly influenced by the market structure of the industry. The paper focused on only direct investment in real estate (hotel) and did not consider investment in indirect real estate such as REITs which is the focus of this present paper.

In the real estate industry, the SCP methodology was used by Ogunba (2004) to examine the conduct of valuation exercise in Nigeria using the Bain (1951) SCP model which was subsequently modified. The study proxied conduct of valuation exercise using variables relating to 'valuer's use of investment valuation inputs and some unconventional manipulations of data amongst valuers' The methodology adopted in the study used descriptive statistical tools such as mean, percentages, and charts in analyzing the data obtained for the study. Findings from the study revealed that valuation inaccuracy which was observed to exist in the study area arises due to the way the valuation exercises were conducted in the valuation profession. The study showed that the conduct of valuation exercise in the study area was characterized by non-uniformity of valuation inputs used by valuers as well as the observable practice of valuers resorting to unconventional manipulation of data. However, this study focused on a developing nation, a different scenario may be demonstrated by similar professions in a developed nation. Tung, et al. (2010) examined the performance of tourist hotel industry in Taiwan using the SCP paradigm. Data was obtained to cover a period spanning from 1995 to 2006. The methodology involved the use of 3 simultaneous equations as well as regression analysis. Findings from the study revealed that the profitability or performance of the tourist hotel industry in the study area was significantly influenced by the market structure of the industry. The paper focused on only direct investment in real estate (hotel) and did not consider investment in indirect real estate such as REITs. The REITs industry was however investigated by Chan, Erickson, and Wang (2003) where the structure, performance and investment opportunities in real estate investment trusts were the focus of the study with findings consistent with Ogunba (2004).

Lee (2012) evaluated the performance of accounting firms (a service industry) in Taiwan from 1992 to 2003 using the SCP model. The study used stepwise regression model in the analysis of the data obtained for the study. Findings from the study revealed that there was a significant relationship between market structure, conduct and performance of accounting firms in the study area. The methodology used only utilized the stepwise regression model ignoring other vital methods such as the simultaneous equations and least square analysis which could give a better view of the performance of the industry. Nabieu (2013) analyzed the structure, conduct and performance of commercial banks in Ghana over a period from 2007 to 2012 using the SCP hypothesis. Both descriptive (mean, percentages, standard deviations) and inferential (regression) statistical models were used in the study. Findings from the study suggested that market structure and conduct significantly determined the performance of commercial banks in Ghana within the study period. The timeframe used for the study i.e. 6 years seems to be short, an updating of the timeframe to capture longer investment period could be desirable. Kaonga (2015) evaluated the performance of the insurance industry in Zambia from 2005 to 2013 using the SCP model. The author employed the three-Stage-Least-

Square (3SLS) model in analyzing data. Findings showed that there was no significant relationship between the structure, conduct and performance of insurance industry in Zambia within the study period. The study did not consider other performance indicators such as return/risk characteristics of the firms which could greatly influence the performance of the industry.

The main problem gap observed from these groups of studies is the dearth of studies on REITs from real estate markets of African countries that looked at the performance of REITs from the perspective of internal factors such as the conduct and structure of the REITs companies. Therefore this present study will extend the frontier of knowledge in this field by considering the correlations among the structure, conduct and performance of Nigerian REITs.

METHODOLOGY

The study population consists of all the N-REITs companies in Nigeria namely: Skye Shelter Fund REITs, Union Home REITs and UPDC REITs. Data required for the structure of N-REITs comprised of the Total Business Revenue (TBR) of the N-REIT companies within the study period (2008 to 2016). These data were sourced from the annual reports and accounts of the respective N-REITs companies. Data required for the conduct component of N-REITs comprised of the Total Individual Expenditure (TIE) on conduct variables proxied by factors such as advertisement, maintenance of properties, insurance of properties and administrative expenses. These data were also sourced from the annual reports and accounts of the respective N-REITs companies for the study period. Data required for the performance of N-REITs comprised of dividend and share prices of the respective companies.

Descriptive and inferential statistical tools such as averages, frequencies, mean scores as well as ordinary least square (OLS) regressions were used in analyzing the data obtained. The structure of the N-REITs industry was analyzed by means of Equations 1, 2 and 3 in a chronological order. That is, the market structure of a company which is proxied by the Herfindahl-Hirschman Index in line with previous studies such as Tung, et al. (2010) and Kaonga (2015) was calculated accordingly by firstly obtaining the market share using Equation 1; secondly, the market share was used to obtain the Concentration Ratio using Equation 2 and finally the market structure of the company was obtained using the Concentration Ratio to calculate the Herfindahl-Hirschman Index by means of Equation 3.

The Market Share is given as:

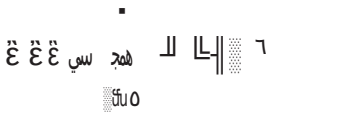
$$\text{MKS}_{n1,n2,n3} = \frac{\text{TBR}_{n1,n2,n3} \times 100}{\text{Total Industry TBR}} \quad (1)$$

Where:
MKS = Market share
TBR = Total business revenue for a particular REITs company
n1, n2, n3 = Individual N-REITs companies

The Concentration Ratio is given as:

CRn = MKS1 + MKS2 + MKS3 (2)
Where:
CRn = Concentration ratio of N-REITs companies
MKS1-3 = Market share of individual N-REITs companies

The Herfindahl-Hirschman Index is given as:



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Where:
HHI = Herfindahl-Hirschman Index
MKSi = Market share of the ith N-REITs company
n = Total number of N-REITs companies
i = The ith N-REITs company (e.g. UPDC REITs)

According to Kwoka (2007), the HHI ranges from 1/N to one, where N is the number of companies in the market or industry. If percentages are used as whole numbers e.g 85 instead of 0.85, the HHI index can range up to 1002, or 10,000. The decision rule is that an HHI below 0.01 (or 100) indicates a highly competitive industry. An HHI below 0.15 (or 1,500) indicates unconcentrated industry; an HHI between 0.15 and 0.25 (or 1,500 to 2,500) indicates moderate concentration, while an HHI above 0.25 (above 2,500) indicates high concentration.

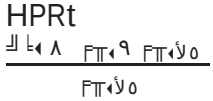
The conduct equation used is as follows:

(4)

Where:
Xn = Individual Conduct Indicator (e.g advertisement)
TIE = Total Individual Indicator's expenditure
TBR = Total REITs Company' Business Revenue for individual REITs company

Similarly, the researchers used Equation 5 to measure the holding period return of the N-REIT companies

The holding period returns is expressed as



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HPRt = Holding Period Return
CVt-1 = Capital value of N-REITs at the beginning
CVt = Capital value of N-REITs at the end
NIt = Income of N-REITs received during the holding period

Furthermore, the researchers analyzed the correlations among the structure, conduct and performance of N-REITs. To realize this first, unit root test (test of stationarity) of the data sets used in the study was carried out using the Kwiatkowski-Phillips-Schmidt-Schin (KPSS) as well as the Philip-Perron (PP) models

for analyzing the stationarity characteristics of the data series. Second, the Granger Causality analysis was conducted to determine the causal relationships among the structure, conduct and performance of N-REITs within the study period. Third, the relationships among the structure, conduct and performance of N-REITs in line with previous studies on the SCP concept such as Tung, et al (2010) and Kaonga (2015) was determined using ordinary least square regression models.

Decision rule for Granger Causality tests

If P-Value > 0.05, do not reject the null hypothesis of no Granger causality (there is no causal relationship).

If P-Value < 0.05, reject the null hypothesis of no Granger causality (there is a causal relationship).

Decision rule for stationarity test

If KPSS Statistics > KPSS critical value, do not reject null hypothesis, i.e., unit root exists (non stationary)

If KPSS Statistics < KPSS critical value, reject null hypothesis, i.e., unit root does not exist (stationary)

If PP Statistics > PP critical value do not reject null hypothesis, i.e., unit root exists (non stationary)

If PP Statistics < PP critical value reject null hypothesis, i.e., unit root does not exist (stationary)

In line with previous studies such as Delorme, et al. (2002), Tung et al. (2010), Nabieu (2013) and Kaonga (2015), the model specification for the regression model adapted for endogenous variables of Structure (STR), Conduct (CON) and Performance (PER) in this study is given as follows:

$$STR = f(CON, PER) \quad (6)$$
$$CON = f(STR, PER) \quad (7)$$
$$PER = f(STR, CON) \quad (8)$$

$$STR = a0 + b1CON + b2PER + e1 \quad (9)$$

Where:

STR = Structure of N-REITs; a0 = The intercept; b1 = Conduct; b2 = Performance; e1 = The error term

$$CON = a0 + c1STR + c2\ PER + e2 \quad (10)$$

Where:

CON = Conduct of N-REITs; a0 = The intercept; c1 = Structure; c2 = Performance; e2 = The error term

$$PER = a0 + d1CON + d2STR + e3 \quad (11)$$

Where:

PER = Performance of N-REITs; a0 = The intercept; d1 = Conduct; d2 = Structure; e3 = The error term

RESULTS AND DISCUSSIONS

This section presents and analyzes the data collected for the study; Table 1 presents the Total Business Revenue (TBR) for the N-REIT industry.

Table 1: Total Business Revenues (TBR) of the N-REITs industry

Year	N-REITs Annual TBR	Number of Share Units Subscribed	N-REITs TBR Per Unit Share
2008	594,417,008 (1,942,539)	20,000,000	29.72 (0.097)
2009	1,918,470,009 (6,269,509)	270,019,781	7.11 (0.023)
2010	1,000,829,010 (3,270,683)	270,019,781	3.71 (0.012)
2011	1,145,809,971 (3,744,477)	270,019,781	4.24 (0.014)
2012	1,274,980,353 (4,166,602)	270,019,781	4.72 (0.015)
2013	1,102,936,216 (3,604,366)	270,019,781	4.09 (0.013)
2014	6,852,999,381 (22,395,422)	2,938,289,281	2.33 (0.007)
2015	6,907,443,855 (22,573,345)	2,938,289,281	2.35 (0.008)
2016	6,819,902,942 (22,287,264)	2,938,289,281	2.32 (0.007)
Mean	3,068,643,194 (10,028,245)	1,131,662,972	6.73 (0.022)

Source: Annual reports/statement of accounts and online database of Skye Shelter Fund, Union Homes REITs and UPDC REITs.
Note: The figures in parenthesis are the USD equivalent of the TBR within the study period ($1 to ₦306 at Central Bank of Nigeria' official exchange rate).

Table 1 presented the annual TBR for the N-REIT industry which was calculated as the summation of the annual revenues of the three N-REIT Companies for each of the investment year accordingly. While the total share units subscribed and fully paid for was similarly calculated as the summation of all the share units subscribed and fully paid for by investors from the three N-REIT Companies accordingly. These data were used in calculating the revenue per share unit for the industry over the study period.

From Table 1, the highest TBR per share unit for the N-REIT industry was obtained in the year 2008 (₦28.72 i.e $0.097). This was the early years of the establishment of REITs industry in Nigeria and there was high demand for the REITs shares. The least TBR per unit share for the industry was obtained in 2016 (₦2.32 i.e $0.007). This could be attributed to the recent economic recession experienced in the country around that period. There was a gradual decrease in TBR generated from 2009 to 2011 (this were the period of the global economic meltdown). In 2012 there was a slight increase which was sustained in 2013 (at this time there was improvement in the economy). The TBR generated by the N-REITs industry within the study period seem to be very small when compared to REITs industries of other nations such as the UK and Germany which started there REITs industry the same year with Nigeria (that is in 2007). This could be attributable to the level of acceptability of REITs by investors in these countries as well as variation in the stability and strength of the economy of these nations (Olanrele, et al. 2015).

Table 2 presents the Total Individual Expenditure (TIE) on the conduct variables in the N-REITs industry within the study period. There was a sharp consistent decrease in the amount expended on advertisement from 2009 to 2015. The highest amount

expended was in 2009 (9.7%) of the TBR; while the lowest was in 2011 (0.02%). There was some level of fluctuations in the amount expended on maintenance of properties in the N-REITs. The highest amount expended was in 2013 (4.83%) while the least was in 2011 (0.1%).

Table 2: Total Individual Expenditure (TIE) on conduct indicators in the N-REITs industry

Year	ADV	MP	IP	ADM	TOTAL
2008	0	0	0	13.94	13.94
2009	9.74	0	0.74	15.14	25.62
2010	0.36	2.33	0.88	28.6	32.17
2011	0.02	0.1	0.81	25.39	26.32
2012	0	2.23	2.26	23.06	27.55
2013	0	4.83	1.45	20.85	27.13
2014	0.59	3.37	2.64	24.62	31.22
2015	0	0.8	0.54	13.41	14.75
2016	0.87	1.64	1.92	14.89	15.07
Mean	1.2	1.7	1.3	20.0	23.8

Source: Analyses of survey data, 2017
Note: ADV = Advertisement, MP = Maintenance of Properties, IP = Insuring of Properties, ADM = Administrative expenses

There was a gradual but consistent increase in the amount expended on insurance of properties between 2009 and 2012; however in 2012 there was a gradual decrease to 2015. The highest amount expended was 2.64% in the year 2014 while the least expended within the study period was 0.54% in the year 2015. Administrative expenditure had the highest amount expended when compared to other variables. There was a consistent increase from 2008 to 2010, the figures decreased in 2011 and the decrease kept on to 2014. The highest amount expended on administrative expenditure was 28.6% in the year 2010 while the least was 13.41% in the year 2015. The mean percentage expenditure for advertisement, maintenance of properties, insurance of properties and administrative expenses were 1.2%, 1.7%, 1.3% and 20.0% respectively. Studies such as Niskanen (2012) and Kaonga (2015) indicated that higher percentages of the companies' TBR were used in conduct activities. This implies that there may be need for the Nigerian REIT Companies to increase the amount expended on operation of conduct indicators. The data on Table 2 was used in analyzing the conduct of N-REITs using Equation 4. The result is presented in Table 4.

Table 3 presents data on the annual dividend and share prices of the N-REITs companies covering a period from 2007 to 2016. From inception in 2007 to 2016 Skye Shelter Fund's share prices ranged between ₦98.55 ($0.322) and ₦117.42 ($0.384) per share unit and dividend ranged between ₦4.04 ($0.013) and ₦7.15 ($0.023) per share unit. The share prices of the Union Homes REITs ranged between ₦45.55 ($0.149) and ₦50.00 ($0.163) per share unit within the study period. While its dividend ranged between ₦0.75 ($0.003) and ₦4.01 ($0.013) per share unit. The UPDC REITs sold shares from ₦9.50 ($0.031) to ₦10.00 ($0.033) per share unit from 2013 to 2016 with dividend payout that ranged between ₦0.23 ($0.001) and ₦0.43 ($0.001) per share unit within the same investment period. The share prices and dividend of N-REITs is considered low when compared to other global REITs companies (Jackson, 2008; Naido, 2014).

Table 3: Annual data on dividend and share prices of N-REITs companies from 2007 to 2016

	Skye Shelter Fund		Union Homes REITs		UPDC REITs			
Year	Share Price	Dividend	Share Price	Dividend	Share Price	Dividend	N-REITs Share prices	N-REITs Dividend
2007	100	0	-	-	-	-	100 (0.327)	0 (0)
2008	117.42	4.65	50.00	-	-	-	167.42 (0.547)	4.65 (0.015)
2009	103.21	7.00	50.00	4.01	-	-	153.21 (0.501)	11.01 (0.036)
2010	99.55	6.40	50.85	0.75	-	-	150.4 (0.492)	7.15 (0.023)
2011	98.55	4.04	50.00	2.27	-	-	148.55 (0.485)	6.31 (0.021)
2012	100	5.00	50.00	2.13	-	-	150 (0.49)	7.13 (0.023)
2013	100	5.25	50.00	-	10.00	-	160 (0.523)	15.25 (0.05)
2014	98.56	5.80	48.54	-	9.50	0.31	156.6 (0.512)	6.11 (0.02)
2015	100	7.15	45.55	-	9.78	0.43	155.33 (0.508)	7.58 (0.025)
2016	100	5.3	50.00	-	10.00	0.23	160 (0.523)	0.23 (0.001)

Source: Annual report and online data bases of Skye Shelter Fund, Union Homes REITs and UPDC REITs
Note: The figures in parenthesis are the USD equivalent of the TBR within the study period ($1 to ₦306 at Central Bank of Nigeria' official exchange rate).

The share prices and dividends presented in Table 3 were used to calculate the performance of N-REITs (Holding Period returns) and the result is presented in Table 4.

Table 4: Data on the structure, conduct and performance of N-REITs industry

Year	N-REIT Structure	N-REIT Conduct	N-REIT Performance
2008	100	13.94	22.07
2009	63.8	25.62	0.94
2010	41.81	32.17	2.93
2011	69.35	26.32	2.93
2012	68.83	27.55	5.4
2013	64.12	27.13	2.63
2014	70.69	31.22	-0.24
2015	67.97	14.75	2.86
2016	68.94	16.98	2.93

Source: Analysis of survey data, 2017

Table 4 showed that from inception of the N-REITs companies to 2016 the HHI of the N-REITs industry ranged between 41.81% (recorded in 2010) and 100% recorded in 2008. This indicates a high concentration in the N-REITs industry which indicated an oligopolistic market structure. In comparison, the US has over two hundred REITs companies operating in a perfect competitive market structure; similar REIT industries includes the UK, Australia and Malaysia which have about 22, 52 and 15 REITs companies respectively (NAREIT, 2018). From Table 4 the highest amount expended on conduct indicators was in the year 2010 (32.17%)

while the lowest was in 2015 (0.02%). There was some level of fluctuations in the amount expended on the conduct variables over the years. The highest amount expended was in the year 2013 (4.83%) while the least was in the year 2011 (14.75%) this could be attributable to the national economic recession experienced in Nigeria at this time. The performance of N-REITs in terms of holding period returns was observed to have fluctuated between -0.24% and 22.07%. The highest return value recorded was 22.07% obtained in the year 2008. The least return value was recorded in the year 2014 (-0.24%). It is important to note that all the return values within the study period were positive except for the year 2014 (-0.24%). This implies that investment in the N-REITs industry provided positive return values in most of the years within the investment period.

Table 5: Descriptive statistics of the structure, conduct and performance variables of N-REITs industry

Statistics	N-REIT structure	N-REIT conduct	N-REIT performance
Mean	68.39	23.96	4.7
Std. Deviation	14.80	6.94	6.7
Skewness	-1.3	-1	0.7
Kurtosis	0.3	-1	1.7
Minimum	41.81	13.94	-0.24
Maximum	100	32.17	22.07

Source: Analysis of survey data, 2017

Table 5 presented the descriptive statistics of the structure, conduct and performance variables of the N-REITs industry. Hence it showed the mean, minimum and maximum values of the variables. It also showed the standard deviation, skewness and kurtosis for each of the variables. Table 6 presents the Granger Causality test for the structure, conduct and performance of N-REITs.

Table 6: Granger causality tests for structure, conduct and performance components of N-REITs industry

Null Hypothesis:	F-Statistic	P-Value
N_REIT_PERF does not Granger Cause N_REIT_COND	0.65565	0.0078
N_REIT_COND does not Granger Cause N_REIT_PERF	0.01585	0.0045
N_REIT_STRU does not Granger Cause N_REIT_COND	4.24982	0.0244
N_REIT_COND does not Granger Cause N_REIT_STRU	7.63015	0.0480
N_REIT_STRU does not Granger Cause N_REIT_PERF	0.23871	0.0073
N_REIT_PERF does not Granger Cause N_REIT_STRU	1.79972	0.0372

Source: Analysis of survey data, 2017

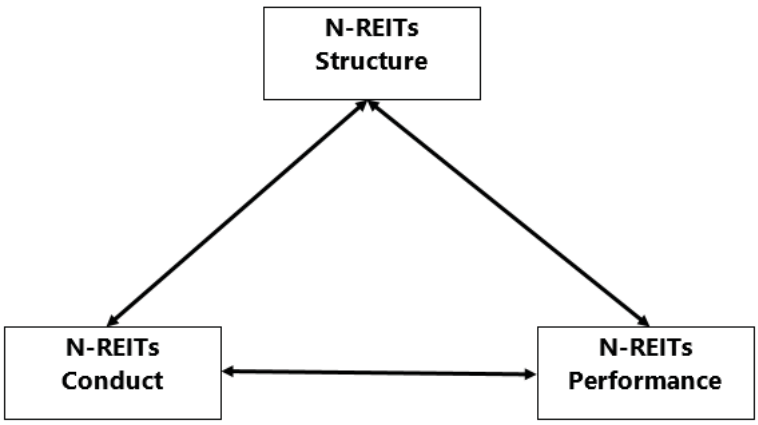

Figure 1: Bi-directional causality relationships among the structure, conduct and performance of N-REITs.

Table 6 presented the results of Granger Causality tests of the N-REITs industry and Figure 1 showed the causal relationships among the structure, conduct and performance of N-REITs. The results obtained indicated a bi-directional Granger Causality for the N-REITs industry, this implies that there was a two way positive relationships existing among the structure, conduct and performance of N-REITs. This means that the structure of N-REITs affected both the conduct (with P-value as 0.0244) and performance (with P-value as 0.0073) of the N-REITs industry. Similarly, the conduct of N-REITs also affected both the structure (with P-value as 0.0480) and performance (with P-value as 0.0045) of the N-REITs industry. By the same token, the performance of the N-REITs also affected the structure (with P-value as 0.0372) and conduct (with P-value as 0.0078) of the N-REITs industry. This is congruent with what was found in literature as confirmed by studies such as Muazu et, al. (2013) which posited that the SCP concept has a reverse causal relationship referred to as 'feedback'. However, this refutes the hypothesis postulated by Bain (1951).

Table 7: KPSS and PP unit root test on data for the structure, conduct and performance of N-REITs

SCP Variables	KPSS Statistics	1% Critical Value	5% Critical Value	10% Critical Value	PP Statistics	1% Critical Value	5% Critical Value	10% Critical Value
N-REIT structure	0.225299*	0.739	0.463	0.347	-4.2413*	-4.18265	-3.32097	-2.80138
N-REIT Conduct	0.202396*	0.739	0.463	0.347	-3.8771*	-5.60462	-3.69485	-2.98281
N-REIT performance	0.346833*	0.739	0.463	0.347	-12.523*	-4.58265	-3.32097	-2.80138

Source: Analysis of survey data, 2017;
*Note: * = stationary at level*

The computed KPSS and PP test-statistics as seen in Table 7 are integrated of order I(0). It was observed that the KPSS and PP statistics were smaller than the critical values - "tau" at 10%, 5%, and 1% significant levels respectively; therefore we can reject Ho for the SCP variables. This means that the data series are all stationary series at 10%, 5% and 1% significant levels and are integrated of order I(0) at level. In other to analyze the relationships among the structure, conduct and performance of the N-REITs, Equations 9, 10 and 11 were used in line with previous studies such as Zietz, Sirmans and Friday (2003), Tung et al, (2010) and Kaonga (2015). The result is presented in Table 8.

Table 8: Regression analysis of the structure, conduct and performance of N-REITs industry

Dependent Variable	Independent Variables	R	R^2	Beta	T	P-Value	Level of Significance
N-REITs Structure		0.753	0.567				
	N-REITs Conduct			2.67	2.312	0.045	0.05
	N-REITs Performance			0.355	0.147	0.008	0.01
N-REITs Conduct		0.817	0.667				
	N-REITs Structure			0.176	2.312	0.045	0.05
	N-REITs Performance			-0.736	1.352	0.025	0.05
N-REITs Performance		0.611	0.373				
	N-REITs Structure			0.01	0.147	0.008	0.01
	N-REITs Conduct			-0.317	-1.352	0.025	0.05

Source: Analysis of survey data, 2017

Table 8 showed the regression analysis of the structure, conduct and performance of N-REITs. When the structure component of the SCP was used as dependent variable, the regression results indicated a strong positive correlation of 0.753 between all the variables, with a coefficient of determination (R2) of 0.567 which means that the model explains 56.7% proportion of variance in the dependent variable by the independent variables in the N-REITs industry. Looking at the significance values of the individual β's, it was revealed that all the predictors i.e performance and conduct significantly predicted the structure of N-REITs with t = 2.312, p = 0.045 ' 0.05 and t = 0.147, p = 0.008 ' 0.01 respectively, hence they are statistically significant (note that 0.05 and 0.01 above indicates the significance levels at 5% and 10% respectively).

When Conduct was used as the dependent variable and structure and performance as the independent variables, the regression result indicated a strong positive correlation of 0.817 between all the variables, with a coefficient of determination (R2) of 0.667. The beta coefficients of the individual β's, showed that all the predictors significantly predicted the conduct of N-REITs with t = -1.352, p = 0.025 ' 0.05 and t = 2.312, p = 0.045 ' 0.05 respectively, hence they are statistically significant at both 5% level of significance. When performance was used as the dependent variable and structure and conduct as the independent variables, result from the regression analysis indicated a positive correlation of 0.611 between all the variables, with a coefficient of determination (R2) of 0.373. From the significance values of the individual β's, it was shown that both structure and conduct significantly predicted the performance of N-REITs with t = 0.147, p = 0.008 ' 0.01and t = -1.352, p = 0.025 ' 0.05 respectively, hence they are statistically significant at both 5% and 10% level of significance accordingly. From the analysis above, it is evident that there exist a strong positive relationship among the structure, conduct and performance of N-REITs). This finding is congruent with other similar studies in the real estate industry such as Chan, et al. (2003), Ogunba (2004) and Tung, et al. (2010). The implication of this for the REITs industry borders on the need to ensure that the respective REIT companies are properly structured and conduct activities given priority to enhance performance, as the study revealed that both structure and conduct influences performance and vise-versa. This information can be used by stakeholders in the real estate industry such as pension funds, asset managers, individual investors and insurance companies in making informed investment decisions.

CONCLUSION

This study examined the structure, conduct and performance of N-REITs. Findings from the study suggested a positive significant and bi-directional causal relationship among the structure, conduct and performance of N-REITs. This is congruent with what was found in literature as confirmed by studies such as Ogunba (2004) and Muazu et, al. (2013). However, this refuted the hypothesis postulated by Bain (1951) which purports that there is a one way causal relationship between the Structure, Conduct and Performance of firms/industries. The implication of this result to the N-REITs industry is that to improve the performance of the industry, the respective companies in the industry must be properly structured. Similarly, conduct indicators such as advertisement among others

should be given priority. It has been shown from this study that these internal factors (structure and conduct) can greatly impact on the performance of the industry. This is also congruent with findings of previous studies such as Tung, et al (2010), Nabieu (2013) and Kaonga (2015). The study concluded that the below optimal performance of N-REITs was traced to the deficiencies inherent in the internal factors impacting on the N-REITs industry as it relates to the structure and conduct in the N-REITs industry. This suggests that there is need to improve in the aforementioned areas. This is pertinent because the study revealed that there is a strong positive bi-directional relationship among the structure, conduct and performance of N-REITs. The study is limited by the number of observations used with respect to the available data. This is because REITs is still new in Nigeria when compared to other REITs industries such as the US and hence provided limited data from inception to date. Data covering a longer period of time could present a better picture of the REITs industry in Nigeria.

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INTRODUCTION

According to The Global Status Report 2017, "progress towards sustainable buildings and construction is advancing but improvements are still not keeping up with a growing buildings sector and rising demand for energy services" (UN Environment and International Energy Agency, 2017, p. 6). Globally, buildings and construction are responsible for 36% of final energy use and 39% of energy-related carbon dioxide (CO2) emissions when upstream power generation is included (UN Environment and International Energy Agency, 2017). Yet, the Sustainable Development Goal 11 of the 2030 Agenda for Sustainable Development which was endorsed in 2015 in New York, seeks to make cities and human settlements inclusive, safe, resilient, and sustainable by 2030 (United Nations, 2015). To be able to achieve this goal, changes in construction processes are imperative since the activities of the building construction industry contribute significantly to the emission of carbon, which is regarded as a major contributor to climate change (Zhang et al., 2011b, Jagarajan et al., 2017). According to Kibert (2007), different terms such as 'sustainable construction', 'green construction', and 'green building' amongst others are used to refer to the pursuance of sustainability in the construction industry. But this paper make use of the term 'green construction' to signify *the use of healthier and more resource-efficient techniques and materials to deliver building projects for the attainment of sustainable cities and communities*.

As a result of the need for the attainment of sustainable cities and communities, there are plentiful commitments and actions by countries, city authorities, industry and related stakeholders through various policy mechanisms to help put the global construction sector on a sustainable path. Yet, construction practitioners and clients (building construction stakeholders) are reluctant to pursue this sustainable path (UN Environment and International Energy Agency, 2017). The paradox is that, with the exception of a few people5, everyone agrees that the climate is changing (United Nations Treaty Collection, 2019). It is also widely acknowledged that: (1) the climate is changing as a result of the increase in carbon emissions (UN Environment and International Energy Agency, 2017); and (2) energy use in the building and construction sector contributes to 25% of global carbon emissions (Monahan and Powell, 2011). Specifically, The 2017 Global Status Report pointed out that the building and construction industry is one of the most significant sources of carbon emission in various countries (UN Environment and International Energy Agency, 2017). However, energy-efficient and low-carbon technologies are slowly diffusing in the building and construction industry (Gluch et al., 2014, UN Environment and International Energy Agency, 2017). This means, there is a misalignment between the high-level consensus for the adoption of green construction and the willingness of building construction stakeholders to adopt. This situation is described in this study as the 'consensus-behaviour discrepancy'.

Several researchers have investigated this 'consensus-behaviour discrepancy' and suggested possible barriers (see for example Zhang et al., 2012, Shari and Soebarto, 2014, Windapo and Goulding, 2015, Wadu Mesthrige and Kwong, 2018, Martek et

[5] As of May 19, 2019, the countries yet to formally ratify the Paris Agreement were Angola, Eritrea, Iran, Iraq, Kyrgyzstan, Lebanon, Libya, Oman, Russia, South Sudan, Turkey, and Yemen.

al., 2019). According to these studies, there are multiple barriers responsible for the unwillingness of building construction stakeholders to adopt green construction including high costs, lack of regulations, lack of knowledge and awareness, lack of promotion form government amongst others. However, the most reported challenge is the perception that it costs more to apply sustainable technologies and practices (Dwaikat and Ali, 2016). In contrast, other researchers have also claimed that the perceived higher costs associated with the application of sustainable technologies and practices are mere illusions (Bartlett and Howard, 2000, Rehm and Ade, 2013). More so, if we assume that building stakeholders are rational decision-makers then they should seek to minimise costs and maximise profit. However, the puzzling tension is that, even though it is widely cited that sustainable technologies and practices have long-run cost savings features and outperform their conventional counterparts during their lifecycle, their application still remain at a lower rate. Another interesting observation in the literature is that most of the studies report lack of incentives, lack of building codes and regulations, lack of knowledge and awareness even in settings where they acknowledge that the government have created strong green construction environment (Hammond et al., 2019).

Even though most of these studies do not point out their theoretical foundations (Mensah et al., 2018), it can be inferred from their findings that they come from the mainstream (neoclassical) economics paradigm where building construction stakeholders are regarded as cost-minimisers or profit-maximisers. Therefore, the 'perceived high upfront cost' will lead to a rational response – non-adoption. However, from the perspective of the same neoclassical economics theory, rational (profit-maximising) agents should adopt green construction, because it is widely cited that green buildings outclass conventional (non-green) buildings in several areas during their life-cycle. Particularly, it is reported that the life-cycle operational cost savings associated with green buildings outweigh the high upfront cost (Dwaikat and Ali, 2018). Thinking along this line, then non-adoption constitute irrational and inefficient behaviour.

While the findings from existing studies explain parts of the green construction 'consensus-behaviour' discrepancy, the influence of the 'real-world decision-making' of building construction stakeholders (decision mechanisms in the adoption of green construction) remains unexplored. In terms of the real-world, building construction stakeholders might not be acting as cost-minimisers or profit-maximisers, but just choosing acceptable solutions – satisficers (Barros, 2010). Behavioural Economics (BE) which integrates insights from the behavioural sciences and mainstream economic theories, advocate that human decision-making and behaviour violate the maxims of mainstream economic theories (Tversky and Kahneman, 1992, Altman, 2017). Specifically, human decision-making and behaviour are powerfully influenced by context, and particularly subjected to cognitive biases, emotions, and social influences (Kahneman and Tversky, 1979, Thaler and Sunstein, 2008). BE is devoted to reintegration of behavioural concepts that were removed from economics over a century ago to improve the realism and generation of theoretical insights, in order to make better predictions of field

construction stakeholders' decision-making and bring about the tendency for them to prefer non-adoption to adoption (of green construction) in spite of the high-level consensus for the attainment of sustainable cities and communities

It is discussed in this paper that social norms and status quo bias bring about the tendency for building construction stakeholders to prefer conventional (non-green) construction to green construction in spite of the outstanding benefits associated with the latter. This is because these elements impact the individual level decision-making, which in turn aggregate into the group-level decision-making and choice (Hammond et al., 2019). After this introduction, follows the methodology section. The next section present a literature review demonstrating the need for this study, and an explanation of the bounded rationality approach to decision-making. After this follows an overview of how social norms and status quo

process – 'green construction' or sustainable construction'. The pursuance of sustainability in the construction industry revolves around the application of materials and techniques that minimise environmental impact, enhance occupant's health and well-being and provide high returns on investment through reduced life-cycle operational cost.

Benefits of Green Construction and Policies Encouraging the Adoption of Green Construction

There is a widespread agreement about the benefits accompanying green construction (Dwaikat and Ali, 2016). Generally, the reduction of the negative environmental impact of construction activities is the defining feature of green construction. Adopting green construction will lead to sustainable land use and reduction of waste and carbon dioxide emissions. The output of green construction – green building – also has several benefits. Green buildings cost less to operate as there are reduced water consumption and energy savings (Zhang et al., 2018). Energy-efficiency is one of the primary features of green buildings. It is also reported by several studies that green building have enhanced indoor environmental quality, resulting in comfortable, healthier, and productive occupants (Ahn et al., 2013, Vandenbroucke et al., 2015, Balaban and Puppim de Oliveira, 2017). Other green building benefits include enhanced corporate reputation and increased market value (Zhang et al., 2018). In spite of these benefits, there are cases where green construction adoption is undeveloped, even though there exist adequate steering mechanisms such as regulatory policies and incentives. Examples of such cases include Malaysia (Shari and Soebarto, 2014, Isa et al., 2018), South Africa (Windapo and Goulding, 2015), Hong Kong (Wadu Mesthrige and Kwong, 2018), Australia (Martek et al., 2019), China (Deng et al., 2018) amongst others. Specifically, this occurrence was recently captured by the UN Environment and International Energy Agency (2017) that, there is continued use of less efficient techniques and materials even though energy efficient and low carbon products are available in most markets. Citing China as a case, Zhang et al. (2011c) questioned why residential developers are not adopting green construction given the strong green environment (market) as well as policy mechanisms.

Barriers Impeding Green Construction

Darko and Chan (2017) reviewed 36 empirical studies on barriers to the adoption of green building practices and a total of 61 barriers were identified. The study concluded that the major barriers to the adoption of green building practices are lack of information, education and research, knowledge, awareness, and expertise; higher cost; lack of incentives/support; lack of interest and demand; and lack of green building codes and regulations. The perceived high upfront cost is one of the widely cited barriers impeding the adoption of green construction (Ahn et al., 2013, Yu et al., 2018). Therefore, incentives, both financial and non-financial are provided to offset the high initial cost (Choi, 2009). Lack of knowledge and awareness is considered as a critical barrier to green building practices adoption in China and Australia (Zhang et al., 2011a, Zou and Couani, 2012). Zainul Abidin (2010) claimed that adopting sustainable construction practices starts with awareness and knowledge, thus, awareness and knowledge of green building practices is regarded as the most critical barrier in Malaysia. On the contrary, Ofori and Kien (2004) pointed out that, architects in Singapore indicated they are aware

of the environmental impacts of buildings and knowledgeable about possible measures which would help avoid these problems. However, they seem to be unable to translate their environmental awareness and knowledge into appropriate design solutions (Ofori and Kien, 2004).

Bounded Rationality: The Impact of 'Real-World Decision-Making' on Green Construction Adoption

The diffusion of green construction requires choices to be made by building construction stakeholders (Du Plessis, 2007). However, choice results from decision-making. Typically 'decision-making' and 'choice' in building projects is made by a 'group' of individuals and groups – clients, users, building professionals, and external parties (Olander, 2007, Mok et al., 2018). However, group decisions are mostly a combination of individual preferences (Grubb, 2014, Savage, 2018). Also, group decisions are normally preceded by discussions among individuals who have varying opinions and preferences and individuals with convincing arguments can drive group decisions in their individual preferences (Hinsz and Davis, 1984, Ambrus et al., 2015). Therefore, it can be put forward that, building construction stakeholders' decision-making in the adoption of green construction can be influenced by the factors that can influence individual building construction stakeholder's decision-making (Hammond et al., 2019).

The investigation of decision-making has long been a dominant research area in psychology and economics. Mainstream economics assumes a world containing calculating and utility maximizing decision-makers with unbounded rationality, unbounded willpower, and unbounded selfishness (Altman, 2017). Nevertheless, "at the core of behavioural economics is the conviction that increasing the realism of the psychological underpinnings of economic analysis will improve economics on its own terms – generating theoretical insights, making better predictions of field phenomena, and suggesting better policy" (Camerer and Loewenstein, 2004, p.1). Explicitly, behavioural economics has proven that people will respond to interventions based on their framing, the methods through which they are transmitted, and the decision-making environment (Loewenstein et al., 2013).

"A choice is a selection of one, among numerous possible behaviour alternatives, to be carried out" (Barros, 2010, p. 457). Decision-making is a process that produces a choice. Theoretically, rationality is regarded as the gauge used in decision-making, leading decision-making agents to make the best choices. According to mainstream economics (rational choice theory), a rational agent is assumed to take account of available information, and potential cost and benefits in determining preferences, and to act consistently in choosing the self-determined best choice of action (Bicchieri, 2004). Form this standpoint, humans are perfectly rational decision-makers with an undoubtedly order

According to Simon, decision-makers tend to make decisions by satisficing rather than optimizing. A key hypothesis according to Simon is that human beings are 'satisficers' – try to find a course of action that is 'good enough'. At the core of this behavioural perspective on human rationality is that decision-makers display 'bounded rationality' which leads to a considered choice behaviour based on the choice environment and the decision-making capabilities of the decision-maker. (Kahneman and Tversky, 1979, Altman, 2017). The key idea is that just because decision-makers are not behaving according to neoclassical rationality does not imply that they are irrational (Altman, 2017). From this perspective, sometimes, behaving according to the postulations of mainstream economics can also be irrational given the decision-making environment (Altman, 2012, Altman, 2017). Bounded rationality can provide likely explanation for the 'consensus-behaviour discrepancy'. As a consequence of bounded rationality, building construction stakeholders may neglect the benefits of green construction and stick with conventional (non-green) construction, even when good information is given and suitable incentives are provided.

LESSONS FROM SOCIAL NORMS AND STATUS QUO BIAS

From the explanation of the principle of bounded rationality, human decisions and behaviour are significantly influenced by biases, emotions, and social influences, deviating from the classical economic theory of rationality (Dolan et al., 2012, Thaler, 2015). These factors bring about human limitations which can lead to outcomes that were either unforeseen or incompatible with their intentions. To explain why there is a sustained inclination towards conventional (non-green) construction in the construction industry in spite of the benefits associated with green construction, and the manifold policy mechanisms, a review of two factors that can be impacting decision-making is presented below.

Social Norms

Human minds depend on heuristics to interpret information and make decisions (Tversky and Kahneman, 1974). There are three main types of heuristics: representativeness, availability, and adjustment and anchoring (Tversky and Kahneman, 1974). The availability heuristic is a mental shortcut that comes into a person's mind when appraising a specific topic, concept, or decision (Tversky and Kahneman, 1973). However, it has been suggested that social norms perform the same role as availability heuristic (Banczyk et al., 2018). According to (Bicchieri, 2005), a social norm is a behavioural rule for a situation (or type of situations) that a sufficiently large share of the population: (a) knows the rule and knows that it applies to this particular type of situations, and (b) conditionally prefers to conform to the rule in this type of situation. It has also been reported that social norms are the behavioural prospects, within a group to which individuals try to conform (Axelrod, 1986). Social norms can influence behaviour because, individuals take their cues from what others do and use it as the standard against which to compare their own behaviours (Clapp and McDonnell, 2000). The operation of social norms is at least partly sensible since we may obtain pleasure from choosing to behave like everyone else, even though this choice may not be maximising overall utility (Dolan et al., 2012). Social norms can lead to behaviour that is difficult to explain in terms of mainstream economics rationality. The more widely that a norm is followed by members of a group, the more everyone wants to adhere to it (Dolan

et al., 2012). Another reason why social norms can be of importance is that it impacts social uncertainty. Two types of norms are relevant to social norms. Social norms that characterise the perception of what most people do is referred to as descriptive social norms whereas those that characterise the perception of what is approved or disapproved by others is referred to as injunctive social norms (Thøgersen, 2008).

Proposition 1: *Social norms impact on the decision-making of building construction stakeholders leading to an inclination for conventional (non-green) construction.*

In the choice of green construction, what other building construction stakeholders do may lead others to over-estimate or under-estimate the cost and benefits. If it is known that few are prepared to adopt green construction, or do not consider it an obligation to adopt, people may be less inclined to stand up for the common good. On the other hand, a non-adoption choice may be considered unequivocal 'immoral' if most people adopt (Dawes, 1980).

Status Quo Bias

Status quo bias is the tendency to choose the current state over more optimum alternatives (Samuelson and Zeckhauser, 1988). Status quo bias is different from a preference for the status quo when it is objectively superior to the available alternatives (Rippon, 2012). According to (Samuelson and Zeckhauser, 1988), when a university added new options to its employment-based healthcare plan, faculty joining after this point understandably took advantage of most of the new options.

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SIZE AND ADEQUACY OF LIVING SPACE IN THE HOME: AN EVALUATION OF PUBLIC APARTMENTS IN CAPE COAST, GHANA, BASED ON SPACE PER PERSON (SPP)

Agyefi-Mensah, S[1] and Kpamma Z. E.[2]

The size and adequacy of space in the home affects the quality of life of occupants in many important ways - physically, psychologically, socially and economically. But how much space is adequate, and on what basis may this be established? In view of the limitations of traditional overcrowding measures such as number of bedroom standard and room density, the UN now recommends the use of Space Per Person (SPP). Using the case of six designs in Cape Coast, this study evaluates the size and adequacy of living space in public apartments in Ghana, based on SPP. First, ISO 9836 – 2011 (E) intra-muros method of measurement is used to measure the useful floor areas of the apartment design obtained from the Architectural Engineering Services Limited (AESL). Structured interviews were then conducted with 115 households to obtain information about the household size. The mean dwelling sizes were then divided by the mean household size to obtain the SPP values. Compared with the provisions in the National Building Regulations as well as recommendations in other international standards used for architectural practice in Ghana, the study found that the size of litns idwellunain tnEshce

Agyefi-Mensah, S and Kpamma Z. E. (2019) Size and adequacy of living space in the home: an evaluation of public apartments in Cape Coast, Ghana, based on space per person (SPP) In: Laryea, S. and Essah, E. (Eds) Procs 10th West Africa Built Environment Research (WABER) Conference, 5-7 August 2019, Accra, Ghana, 907-920

living area (not overcrowded)" as one of the five housing conditions selected for measuring gains towards the attainment of the human settlement goal. Among the Organisation for Economic Cooperation and Development (OECD) countries, adequate housing is one of the principal dimensions of the framework for measuring wellbeing (OECD, 2015). From the point of view of public health, inadequate housing is considered a public health risk (Novoa et al., 2015; Bashir, 2002).

Adequate housing, however, means more than a roof over one's head (UN Habitat, n.d). In addition to providing security of tenure, the availability of basic service materials and infrastructure (such as indoor toilet, safe drinking, energy for cooking, heating, lighting, food storage or refuse disposal), as well as access to social amenities (such as health-care services, schools, childcare centres and other social facilities), adequate housing also means adequate living space (UN-Habitat, n.d; The Habitat Agenda, paragraph 10, UNCHS, 1997). In many developing countries, however, the adequacy of living space is a cause for concern. According to one UN Habitat (2006) report, the lackG.M.rch ashalthal, the availabilcial28 0 651.1(mosw[cul, in0

2001). These are however limited as outcome measures because they are essentially overcrowding measures, which assess the amount of space in the home based on the number of bedrooms in a unit, and not on the actual space available (in square metres) to support living and household activities. In view of this limitation, the United Nations now recommends the use of Space Per Person (SPP) as the basis for determining the adequacy of living space. Using designs for public apartments in Cape Coast, Ghana, this study evaluates the size and adequacy of living space based on space per person (SPP). The goal is to demonstrate the usefulness of SPP as a context-responsive measure of the adequacy of space in the home relative to known traditional measures. The paper is organized as follows: Section 2 reviews literature relevant to the study. This focuses on the necessity of adequate living space in a housing unit in light of the physical, psychological, social and economic wellbeing of occupants. It then highlights the limitations of existing measures for assessing the adequacy of space in the home, and in view of these, present the merits of Space Per Person. Section 3 presents the methodology employed in the study; Section 4 presents the study results and discussion with conclusions in Section 5.

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life, creating a difficult dynamic which may play a part in the breakdown of relationships. On the other hand, adequate space can create opportunities to work at home, increasing productivity. According to Çavusoglu et al (2008), having space to install a desk and computer may allow someone to start a home business or, it may allow an occupant to spend part of the working week at home, improving their life-work balance and working in a more focused way.

For practical usability, the floor and living space is critical to the effectiveness and efficiency with which household activities may be carried out. The amount of space in the home facilitates sensible arrangement of furniture/equipment, storage, while contributing to efficiency in circulation. There is also evidence that for most occupants, dissatisfaction with housing quality is related to the limited amount of space in general, and storage and kitchen space in particular (Swenarton, 2009; BRE, 1993; Oseland & Raw, 1991). In the long term, the amount of space in a dwelling can constrain functionality by restricting flexibility in use, disallowing multiple uses of spaces as residents' requirements change (Schneider and Till, 2007; Slaughter, 2001; Atlas & Ozsoy, 1998). Çavusoglu et al (2008) argue that adequate space in dwellings will allow residents to adapt space to their changing needs over the life course, delivers long-term accessibility and sustainability, and hence future proof homes. The size and adequacy of space is in the home is thus important not only for the physical, psychological, social and economic wellbeing of occupants. It is also critical to the functionality and long-term sustainability of the unit in terms of effectiveness, efficiency and satisfaction with use.

Measures of adequacy of space in a housing unit

One of the common approaches used to determine the adequacy of dwelling space is to compare design provisions with the minimum space standards stipulated in Building Regulations, both national and international. These standards specify the minimum acceptable amount of space necessary to meet the requirement for safety and public health. But minimum standards are only as good as minimum.

simplistic as it obscures knowledge of the actual amount of space for living in the home.

In light of the limitations of the measures above, the United Nations recommend the use floor area (space) per persons as the measure for assessing the adequacy and hence quality of living space (UN, 2004). Floor area per person is defined as the average useful floor area of a housing unit divided by the average household size. In this definition, the term useful floor area is refer to all the available space in a housing unit for household activities, including all living spaces, along with bathrooms, internal corridors and closets. Covered semi-private spaces such as corridors, inner courtyards or verandas are also included in this calculation if used by the household for cooking, eating, sleeping, or other domestic activities. This is consistent with Rapoport (2005), who argues that a house properly conceived and conceptualized, is a system of settings within which particular activities and systems of activities take place. Accordingly, it is the support spaces provide for activities in a given dwelling unit that should form the basis for determining whether the space is adequate or not. For example, citing the example of the miscalculation of housing density/crowding in the West End of Boston, USA, Rapoport (2005) attributes the error to the conceptualization of a house used. which can greatly change what is considered to be crowded. This is because in the West End of Boston example, "when one considered people's activity systems as occurring within [a] larger system of settings, the dwellings were, in fact, adequate; density was not too high, and there was no overcrowding" (Rapoport, 2005, p. 22).

As a measure, floor area (space) per person is deemed useful not only because it relates the amount of space in a dwelling unit directly to the requirements for household activities. More importantly, it takes into account the size of the household. For policy decision, SPP is considered to be more sensitive (UNCHS, 1996). SPP is therefore now used as one of the key indicator for assessing progress toward sustainable development. In an empirical model of new housing starts based on the theoretical treatment of urban growth, Jayantha and Lau (2008) conclude that SPP is a sustainable human settlement development indicator that reflects the quality of housing. According to Jayantha and Lau, SPP is a highly income-sensitive factor and a change in the household's income may be reflected through changes to the SPP. Thus, as a measure, space (floor area) per person is of practical significance for users, designers, realtors, planners and policy makers. In Ghana, this paper represents one of the foremost empirical studies on the subject, and thus provides an avenue for demonstrating the usefulness of the measure for purposes of design and policy-decision-making.

Space Per Person (SPP) as a measure of adequacy

Space Per Person (SPP) is defined by two main variables: the average useful floor area, and the average size of the household. Floor area constitutes one of the key parameters for assessing the quality of a dwelling (Emmitt & Gorse, 2002). A basic

what counts or do not count as useful space. In general, the 'useful space' encompasses the total floor area of all functionally connected rooms - bedrooms, dining rooms, and living rooms. In addition to this, some countries include secondary rooms or auxiliary spaces (such as kitchen, entrance hall/hallways corridors, bathroom, toilet, pantry, storage room, built-in cupboards, etc.) considered necessary or suitable for habitation (Dol & Haffner, 2010). But while most countries exclude balconies, terraces, cellars, loggias, lofts, and in multi-storey dwellings, common spaces, others like Spain include balconies while in Portugal, the useful floor area excludes entrance halls, corridors, bathrooms and toilet rooms, cella) and other similar areas (Dol & Haffner, 2010). Thus, apart from spaces for sleeping, living and cooking space, differences exist among countries in terms of whether sanitary facilities, storage space, and ancillary areas as well as circulation and common areas, are included in the calculations. In Ghana, the National Building Regulations makes no provisions regarding which functional spaces count as 'useful' space.

Besides the variations in the functional spaces covered in the estimates, differences also exist in the approach to measurement i.e. how the useful space is measured - whether dimensions are taken from the internal or external face of the finished wall, and hence whether the measured space is the net or gross floor area. ISO 9836 – 2011 (E) recognizes these differences in method and refers to them respectively as the intra-muros (net floor area) and extra-muros (gross floor area) methods of calculation. For example, while most countries in Europe follow the net floor area method, in Greece, estimation of the useful floor area includes the width of the outer/external wall – gross floor area (Dol & Haffner, 2010). In Ghana, the intra-muros method is used. Tipple (1994) describes it as all areas within the external and/or party walls of building used for residential purposes. According to the National Building Regulations, floor areas are measured from the "inner finished surfaces of …enclosing walls or where there are no enclosing walls the outer edges of the floor." (National Building Regulations, L. I. 1630, Schedule 7, Part II, section 5, 6). This includes all internal and partition walls, as well as balconies and verandas provided that to any storey building they taken within the enclosing walls of the storey.

Broadly, ISO 9836 – 2011 identifies spaces in a building as usable area, service area and circulation spaces. The usable area describes the 'main usable areas' and the 'subsidiary usable areas,' and covers all spaces the functions of which correspond to the purpose of the building. The main usable floor area is used to describe spaces that are primary to the purpose of the building, while subsidiary cover spaces ancillary to this purpose. The service areas accommodate the technical installations which service the building such as pipes for the distribution of water, or disposal sewage. Circulation areas facilitate movement and hence access within and between spaces in the building. In a housing unit, the kitchen and sanitary facilities are referred to as the service core areas (Schneider and Till, 2007).

In view of the foregoing background, the useful floor area can be defined as the total floor area of all functionally connected rooms and spaces in a dwelling unit necessary or suitable for human habitation and/or household activities. As specified by the National Building Regulation, these comprise of all spaces required for sleeping, cooking, eating, and living, sanitary conveniences, and storage plus

circulation areas. The useful floor area thus includes bedrooms, dining rooms, living rooms, kitchen, bathroom, toilet, entrance hall/hallways, balconies, corridors, storerooms, and built-in cupboards, and any such space provided it is used to support household activities.

Household is a socio-cultural concept influenced by the structure and composition of the household. Differences therefore exist in the definition of the term household across countries. For example, while a household does not include a house help and/or guests in some countries, in Greece, “strangers are considered as household members if they have at least one principal meal a day with the family or with the head of the household” (Dol & Haffner, 2010). According to Nukunya (2011) a household describes a group of people who share the same housekeeping and eating arrangements, referring to the people who “eat from the same pot.” For the purposes of national population and housing census, the Ghana Statistical Service defines a household in the same way as Nukunya but clarifies this to include house helps (GSS, 2012). A household can thus be defined as a person or group of persons who live together in the same housing unit, and who share the same housing keeping and eating arrangements. The household size refers to the total number of people who constitutes the household obtained at the time of the census or inquiry (UN Habitat, 2007; GSS, 2002, 2012).

METHODOLOGY

The study adopted a quantitative research approach based on a case study research strategy. The cases (unit of observation) consist of the apartments as realized through design and occupied. A case Y ecenh.le wp48 -ndculh1 Tc-.d. n743 Td knowri

design - was then determined by finding the ratio of the floor area to the mean household size.

Table 1 Case study designs and respondents

Unit type	Case study flat	Total no. of Unit	Respondents sampled	Respondents percent
1-bedroom	RCC	42	32	78.5
	Black Star	18	11	61
2-bedroom	GPS	48	18	37.5
	Mfantsipim	24	18	75
3-bedroom	CRH	48	32	66.7
	C-Poly	8	4	50

RESULTS AND DISCUSSION

Table 2 presents the net floor areas of rooms and spaces (in square meters) as measured from the floor plans. These values are compared with the national minimum standard. The Table shows that except in a few cases such as the kitchen (with a mean size of 5.83 m2) and bathroom in the 1-bedroom unit, which is less (2.68 m2), the provisions of the designs far exceed the national minimum standard. Table 2 also shows that the mean net internal floor area of the 1, 2 and 3-bedroom units were 54.9, 87.73 and 138.73 square meters respectively. The mean household sizes of the units according to the household survey were 4, 5.1 and 6.15 in the 1-bedroom, 2-bedroom, and 3-bedroom units respectively (Table 3). This give an overall mean household size of 5.1, which exceeds the national estimate of 4.4 (GSS, 2012). A maximum of 9 and 14 household sizes were however found in the 1B and 3B units respectively. The high household size in the 3B units was due to observed sharing arrangement (by two or three households) in some of the units. Based on the mean NIFA and the mean household size, the estimated SPP for the units are 13.73, 17.32 and 22.51 square meters per person for the 1-bedroom, 2-bedroom and 3-bedroom respectively (Table 3 presented as Appendix A).

The results of the study as presented in Table 2 shows that the size of bedrooms in all the cases evaluated exceed the national minimum standard by as much as 26% to 100%. In other words, the size of bedrooms in the units exceed the national minimum by approximately one-fifth to double. In the case of the living-dining space, except in the 1-bedroom units where the national minimum exceeds the provisions marginally by some 1.6 percent, the provision in the units exceed the national standard by as much as 4 to 92 percent. Similarly, in the case of the kitchen, except the 1-bedroom unit which is lower in size by margins up to 23 percent, the provisions in all the units exceed the national minimum by margins up to 54 percent. In all cases, however, the provision for the combined shower/WC space exceed the minimum standard, albeit only marginally. Overall, the sizes of the spaces can be said to be generous and adequate. This is true when compared to other minimum international standards such as Time Saver Standards in the USA (De Chiara & Crosbie, 2001), Metric Handbook in the UK (Littlefield, 2000) and Ernst and Neufert Architect Data (Neufert et al., 2000) across Europe suggesting that houses built by the government have relatively generous space standards.

Table 2 Type and sizes of spaces provided in the units

Space	Unit Area in m2					
	1 -Bedroom		2 - Bedroom		3-Bedroom	
	RCC	Black Star	GPS	Mfantsipim	CRH	C-Poly
Master bedroom					22.48	22.5
Bedrooms 1	14.06	14.64	14.57	16.2	20.44	15.81
Bedroom 2			14.57	13.5		13.8
Guestroom					14.7	
Living room			16.31		11.48	
Dining room			4.46			
Study						12.6
Living + dining	18.36	19.89		22.14	38.36	
Kitchen	5.67	5.99	7.69	7.29	11.48	10.46
Store room			4.46			11.88
Shower	3.47	1.89	2.03	1.8	3.80	1.82
WC	1.5	1.62	1.58	1.58	1.58	1.69
Washroom lobby		2.21				3.75
Guest WC						1.69
Balcony	5.63	3.15	3.24	9.84	9.57	6.75
Front porch (LR)			5.47	14.85	10.46	
Box room						4.78
Net Internal Floor Area (NIFA)	55.15	54.65	85.02	90.44	144.47	132.4

Nevertheless, in terms of space per person, the units are small and the spaces inadequate. The results show that the mean space per person for the 1-bedroom, 2-bedroom and 3-bedroom units are respectively 13.73, 17.32 and 22.51 square meters per person (Table 3).

Table 3 Space per person in different unit type

Unit type	Case study flat	Net Internal Floor Area	Mean NIFA	Household size	Mean household size	Space per person (m2)
1-bedroom	RCC	55.15	54.9	4	4	13.73
	Black Star	54.65		4		
2-bedroom	GPS	85.02	87.73	5.1	5.1	17.32
	Mfantsipim	90.44		5		
3-bedroom	CRH	144.47	138.43	7	6.2	22.51
	C-Poly	132.4		5.3		

Considering all 6 cases of floor plans, the mean living space per person in the units is 17.96 m2. This value is very much reflective of the space per person standards in all Africa (less than 20 sqm) according to the UNDP (2004) although small compared to other international standards (Hui et al., 2004; Dol & Haffner, 2010). This is attributable to the size of household. Although the contexts are different, it is noteworthy that the mean useful area per dwelling for the six case study designs of 96.19 m2, approximates closely to what is in even many developed countries such as the UK (86.9) and Netherlands (98.0). However, the space per person is about 50% less when compared to these countries. The Space Per Person (SPP) is 41 m2 in the Netherlands and 44 m2in the UK attributable to the size of the household (or the number of persons per dwelling) which is 2.2 in the UK and 1.9 in The Netherlands (Dol & Haffner, 2010), but 4.4 across Ghana (GSS, 2010), and

5.3 in the case of the units investigated. Thus, it is the large household size in Ghana that contribute to the relatively low space per person measure. This underscores the significance of household as a concept in defining the adequacy of living space. Unlike overcrowding measures such as the bedroom standard, which is based on arbitrary number of bedrooms, space per person assesses the adequacy of dwelling space on the basis of the household size, and how much space is actually available to support household activities.

This is significant because different cultures the world over use space in the home differently (Rapoport, 2005; Hillier, 1996). Dawson (2008) found that Inuit families in Arctic Cananda use space in ways that often do not match the functional categories that structure Euro-Canadian houses such as bedroom, kitchen, and living room. Among these residents, communal sleeping arrangement in the living room was common. In Saudi Arabian homes on the other hand, there are two living rooms – one for strangers and non-family members and one for family and women visitors (Sherwood, 1996). This functional provision and differentiation is thought to reflect Middle Eastern cultural tradition that women must be veiled and protected from strangers. In most large Asian countries and cities, also where living space is at a premium, apartments are relatively small in size with an average floor space per person as low as 15.6 m2 in Hong Kong and 18 m2 in Japan (Hui et al., 2004), and in large Chinese cities, most apartments are without a separate kitchen and bathroom and residents share facilities (Sherwood, 1996). This differs from typical American cultures where individualisation and privacy is at a premium (Pader, 2002). The conclusion is that cultural differences affect the requirement, and hence provision of space in the home. Adequacy of space in terms of size must thus be viewed in light of the prevailing social and cultural practices.

This is the sensitivity that makes space per person a more useful measure of the adequacy of space in the home because it takes into account the differences in the way different societies and cultures organize themselves in a dwelling space, differences that affect the requirement, provision, and hence the adequacy of living space. In addition to the functional requirements for durability and safety, therefore, the World Health Organization (WHO, 2001) observes that each dwelling must provide “sufficient number of rooms, and usable floor area to satisfy human requirements for health and a healthy family life consistent with the prevailing social and cultural pattern of life of the Ghanaian people.” This is the cultural adequacy of housing (UN-Habitat, n.d). According to UN-Habitat, a housing unit is not adequate if it does not respect and take into account the expression of cultural identity of the users. The implication is that the adequacy of living space in the home must be viewed in the light of particular social and cultural practices of a people. It is thus context-sensitive.

CONCLUSIONS

The size and adequacy of space in the home affects the quality of life of occupants in many important ways - physically, psychologically, socially and economically. However, different cultures conceive and use space in the home differently, making what can be considered adequate a subject to contextual factors. To meet the wellbeing of occupants while accounting for these differences in the design of houses as well as policy decisions in terms of specification of space standards, the

study demonstrates that space per person (SPP) is more useful measure. This is because it defines the adequacy of living space in terms of the requirement for household activities and the size of the household, two variables that are particularly useful because of their socio-cultural sensitivity, and hence context-responsiveness. For theory development, the study emphasises the need for what Kohler and Hassler, (2002) describe as “context-relevant scientific research", which means seeking the best possible understanding of existing situations in terms of the social, cultural, economic, and physical aspects using local data. The implication is that the concepts, approaches and measures used in research must also be context-relevant, context-sensitive and context-responsive. For practice, it is consistent with how designs are conceived and delivered because (household) activities constitute the unit of analysis in architectural design. Space per person (SPP) also provides a more scientific basis for housing pricing in terms rent prices, as well as real and nominal houses prices compared to the arbitrariness of the number of bedrooms. Overall, the study demonstrates that it is important to constantly rethink the concepts, approaches and methods applied in understanding various social phenomenon. The study has some limitations, nonetheless. First, it was based on only six cases of apartment designs purposively sampled in Cape Coast, Ghana. Although case studies generally provide for an in-depth understanding of phenomenon, the study recognizes that they are also limited in terms of generalisation. Secondly, adequacy of housing as a concept is multi-dimensional with several indicator parameters. This study focused specifically on the adequacy of living space as an indicator of the habitability dimension. In future research, comparing results of similar nature in other context can help further validate the results of this study and establish space per person as an empirically more grounded measure of the adequacy of living space in a dwelling unit.

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STRATEGIES FOR ENHANCING EXTENDED PRODUCER RESPONSIBILITY ENFORCEMENT: A REVIEW

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Packaging Wastes (PWs) management is a global environmental challenge especially in cities of developing economies. Globally, it is a growing and critical waste stream. In order to achieve sustainable recovery rates in this waste stream, strategies such as source separation schemes should be adopted with the consideration of other techniques. In developed economies, a number of strategies to sustainably manage PWs have been successfully implemented. One of the strategies is the implementation and enforcement of Extended Producer Responsibility (EPR) on the manufacturers and distributors of packaging products. The purpose of this study was to assess the EPR schemes enforced in developed economies for proposal to developing economies. The study focused on developed economies in order to identify the key strategies that have enhanced the application of EPR schemes on the manufacturers and distributors. A total of twenty (20) studies that have focused on the subject were reviewed. The study reveals some key strategies that enhance EPR schemes enforcement and these include; systems approach; information and awareness; monitoring systems and definition of the roles of the stakeholders. The study has highlighted a number of factors and strategies that can impact the enforcement of EPR schemes in developing economies. These factors and strategies are key to policy makers, manufacturers and waste managers in the different packaging industries globally.

Keywords: extended producer responsibility, packaging wastes, policy, recovery, sustainability

INTRODUCTION

Provision of optimal waste collection services while ensuring effective and efficient enforcement of legislations and laws continues to be one of the major challenges in developing economies. The local authorities are responsible for solid waste management (SWM) in developing economies and these are faced with insufficient funds to provide optimal services. In most cases, 20-50% of the municipalities budget is spent on SWM which only covers less than 50% of the population (Memon, 2010; Henry et al 2006). Hoornweg and Bhada-Tata (2012) note that, less than 41% of waste is collected for disposal in lower income countries. As a result of the inefficiencies in the provision of SWM services to the communities in developing economies, inclusion of the private sector was thought to be one of

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the key solutions (Massoud and El-Fadel, 2002). To this regard, several public-private partnerships (PPP) have emerged (Abdrabo, 2008). Despite the new partnerships, the regulatory aspects of SWM remains a critical challenge to achieving sustainability especially in the management of packaging wastes (PWs). To this regard, this requires ensuring optimal recovery of PWs from the different points of generation with the engagement of the government, manufacturers and distributors. Engagement of the manufacturers and distributors of packaging products is accomplishable through enforcement of policies such as EPR. In developed economies, effective enforcement of EPR by the government continues to contribute to sustainable management of PWs (Xevgenos et al., (2015; Zhang and Wen, 2014).

This study focuses on filling the gap by analyzing the factors that have contributed to successful implementation of EPR in developed economies while pointing out strategies on how sustainable enforcement of EPR can be improved in the management of PWs in developing economies. The operation of EPR schemes on the recovery of PWs is also discussed from the developed economies' perspective. In order to highlight the strategies for enhancing EPR enforcement to developing economies, the following research questions are addressed;

1. What is EPR?
2. What are the operations of EPR on the recovery of PWs in developed economies?
3. What strategies have enhanced the enforcement of EPR in developed economies?

LITERATURE REVIEW

Extended Producer Responsibility

Hickle (2014) notes that, EPR is a policy for internalization of environmental costs of products in order to ensure greener products and smaller environmental footprint. Producer fees are used as implementation schemes and recovery and recycling responsibility is reflected on the industries and their related distributors (Hickle, 2014). In most case, fees are country specific and are bound to be material-specific or weight-based.

EPR schemes differ contextually depending on the spectrum of the packaging waste. It can involve commercial or household wastes or both (Cahill et al, 2010). In this study, the emphasis is on packaging wastes.

EPR has been enforced in a number of European nations and the Producer Responsibility schemes are in place. Two broad categories are used in the operation of the responsibility of producer responsibility scheme. These are financial responsibility and physical responsibility (Fernie and Hart, 2001). The physical responsibility lies with the local authority while the financial responsibility lies with the industries. In form of license fees paid on an annual basis, the members contribute to join and stay in the scheme to the Producer Responsibility Organization and thus contributing financially from the financial responsibility aspect.

Operations of EPR on Packaging Waste recovery

The amount of PWs going to the landfill sites continues to pose environmental challenges. Plastic Solid Wastes (PSWs) have a major environmental problem as a result of their non-degradability properties. Appropriately 50 million tons of PSWs is generated annually in Japan, Europe and USA (Hoornweg and Bhada-Tata, 2012). The increase in PSWs generation rates has not excluded developing economies. Hoornweg and Bhada-Tata (2012) indicate that, the amount of PSWs generation will increase from 8 to 13% by 2050. With these observations in the expected increase in PSWs generation in developing economies, strategies for sustainable management should be addressed. As for developed economies, a number of strategies, polices and regulations have been successfully implemented. For example, in 1996 the government of the United Kingdom (UK) introduced a landfill tax to encourage sustainable waste recycling and management (Fernie and Hart, 2001). In 1997, the Producer Responsibility Regulations (PRR) was enforced and focused on ensuring companies accept responsibility for recycling and recovering their PWs introduced on the market (Fernie and Hart, 2001). In Europe, the PWs Directive introduced in 1994 focused on "prevention of packaging waste." The essence of the directive was to administer a legislative framework for encouraging member countries to reuse, recycle and recover packaging wastes. To support the directive, member states were instructed to set packaging recycling targets in the range of 25 percent to 45 percent with a minimum waste type recycling target of 15 percent (Fernie and Hart, 2001).

In the study conducted by Xevgenos et al (2015) a number of success stories on the implementation of EPR are highlighted. In Austria, a total of 114 million pounds was raised in 2012 from more than 15000 licensees (packers, retailers, producers, importers and fillers). The EPR system in Austria is regarded as one of the most effective systems in Europe and the physical and financial responsibility lies with the producers while the local authorities can be involved and reimbursed for collecting packaging wastes (Xevgenos et al., 2015).

In terms of recycling rates, Germany is considered one of the EU nations with the most effective applied scheme and its Duales System-Deutschland (DSD) is responsibility for coordinating the recovery and collection of packaging wastes. DSD has 15000 licensed members and covers household packaging wastes. In terms of financial and physical responsibilities of EPR, industry bears all the costs while the municipalities are reimbursed for contractual collection activities (Xevgenos et al., 2015).

A recycling rate of approximately 96% was achieved in Belgium (Xevagenos et al, 2015) as a result of the recycling system. Belgium utilizes the Green Dot system which is performed by a private non-profit organization. A total of 5233 companies are registered with it and covers household packaging waste. The financial responsibility is covered by the private and the local authority are reimbursed for performing collection activities hence covering the physical responsibility.

A Green Dot company operates in Ireland and focuses on household and industrial waste streams. It contracts local authorities and private companies. In terms of cost responsibility, the industry is responsible for commercial wastes while for

household packaging wastes, the local authorities and industry share the responsibilities (Xevgenos et al., 2015).

Italy has implemented a producer fee scheme which is a sole national compliance scheme and is based on the "first transfer." Approximately 1.5 million members are registered from both producers and users of packaging products. The physical responsibility is covered by the municipalities while the industry covers the financial responsibility (Xevgenos et al., 2015).

Japan has a well-defined EPR scheme in which the responsibilities and, roles of the industry and the local authorities are well outlined in the Packaging Recycling Act. The EPR scheme is managed by the Japan Container and Packaging Recycling Association (JCPRA) (Zhang and Wen, 2014). It is a sole national compliance scheme in which the costs are split between the industry (45%) and the local authorities (55%). Municipalities are reimbursed on recycling costs relative to the quality achieved. One aspect that has contributed to the quality of the product recycled is that, some municipalities demand source segregation of waste.

Strategies to effective EPR enforcement

Effective enforcement and implementation of EPR on the manufacturers and distributors can never work in isolation of the product consumers and waste generators. In many nations, post-consumer products' recycling is implemented to reduce the amount of waste that goes to the landfills and also conserve resources. To support EPR schemes, recycling programs and targets have been set in developed economies and this is usually not in isolation of the consumers. Buelow et al (2010) notes that, majority of the recycling programs are dependent on consumers segregating their wastes and participating in the programs. Involvement of the consumers in recycling programs is a strategy that has not fully been implemented in developing economies. Mwanza (2018) designed an African reverse logistics model for PSWs and the study highlighted a number of factors that prevent households from participating in recycling and recovery programs for PSWs. Lack of information and enforcement of EPR were highlighted.

A number of EPR schemes focus attention on the reduction of packaging waste from the industry and households' perspective. However, despite this being the responsibility of the producers and distributors, policy makers should understand that, the EPR schemes do not work in isolation of the waste generators and managers. Further, a number of strategies are required to facilitate successful implementation of the policies and schemes. It is also important for the manufacturers and distributors to understand the framework of the policy in order for them to positively respond to the existing and new challenges. In most cases, the pressure imposed by the policy obligates most manufacturers and distributors to understand the environmental issues for their success and survival.

In order to understand the strategies that have contributed to the success stories on the implementation of EPR schemes in developed economies, Table 1 below highlights the strategies that contribute to effective implementation of EPR. Further, the table outlines the strategies, the context in which the study was conducted, the methodology and the nature of the industry.

Table 1: Strategies that contribute to effective enforcement of Extended Producer Responsibility

Author Names	Methods Used	Context	Industry	Strategies to Support EPR
Fernie and Hart (2001)	Interviews and Case study	UK	Food Industry (Packaging Waste)	Design of legislative frameworks Systems to support recovery; Databases to monitor the amount recovered, recycled and reused Set recycling and recovery targets Design drop-off centers at supermarkets and encourage the consumers to participate
Corbett and Cutler, (2000)	A Case-Study of 7 companies	New Zealand	Plastic Industry (Packaging Waste)	Characteristics of NZ plastic industry Regulatory Control Public Perception Preventive approach and raw material and waste management practices Customer and suppliers Culture and leadership People Practice
Mandaraka and Kormentza, (2000)	Empirical Study, Questionnaires	Greece	Plastic, Paper, Aluminum, Glass (Packaging Industry)	Information and sensitization of consumers Formulation of outlines and other necessary terms Information and training of manufacturers, suppliers, transporters and users Open and public dialogue for the harmonization of the Greek legislation to the EU regulation Continuous study and evaluation of management systems and recycling programs.
Zutshi and Soha (2003)	Case-study of nine companies	Australia	Manufacturing and Service Industries	Methods of identification of improvement areas Need and usage of audit findings Monitoring progress Role of communication Role of senior management Role of employees Role of suppliers Role of consumers
Jecton and Waema (2013)	Collecting data using interviews, direct observation and literature review	Kenya	Electronic Industry	A clearly defined e-waste collection system; Universities, NGOs and investors; Clearly defined transport logistics; Producers and manufacturers of electrical and electronic equipment; The informal sectors Collaboration Monitoring of illegal imports and dumping.
Xie and Breen (2014)	Literature review and in-depth interviews	UK	literature review with empirical work, benchmarking method, survey and interviews	Recapturing product value processing approaches System cooperation and enforcement Drivers and motivations System design and facilitation.

MATERIALS AND METHODS

An extensive review of articles focusing on EPR and waste management was conducted. Using the research engine, articles were downloaded from the following online publishers; Elsevier, Emerald, ScienceDirect and Wiley. A total of 40 articles were downloaded using the search themes of; "extended producer responsibility AND waste management," or "extended producer responsibility AND packaging wastes.' A total of 20 articles were selected to form the sample size because the studies focused attention on the aforementioned themes. Further, the studies were conducted in developed economies and hence met the criteria of selection.

The study reviewed the articles and focused attention on the methods that were used to conduct the study, the context that the study was conducted in and the strategies that have contributed to the successful implementation of EPR. The methods used to conduct the study are relevant to highlight as they present to the developing economies, the research designs that can be used as well as the gap in the methodology. For the context, it was necessary to present the context to show where most of the studies have been conducted and also highlight that, the strategies outlined in these contexts should not be applied directly in developing economies but to indicate that, studies of the same nature should be conducted in order to appreciate the differences.

Based on the nature of the research questions presented in the introduction section, a systematic analysis of literature was conducted to address the questions. Further, the strategies identified in the reviewed literature were analyzed using the thematic approach and this formed the basis on which the discussion section was presented. The study is therefore an analytic type of study, as it reviews the different articles with the aim of identifying and highlighting the strategies that have contributed to EPR success in developed economies. According to Ghosh (2013), analytic methods focuses on breaking down a phenomenon into its constituent elements and it is conducted in order to understand the effect of a complex phenomenon. It determines the elements that are relevant and irrelevant to the phenomenon. The study also highlights the industries in which the study was conducted in order to identify the gap as well as show the industries in which EPR has been successful.

Based on the above criteria, the packaging industry was used as a result of the environmental profile. In addition, the results from the study are important for most developing economies' manufacturing and recycling industries. According to Sarkis el a (2010) recovery and recycling of PWs is still at its infancy in most developing economies despite the introduction of legislations and laws. Analysis of the strategies behind the successful implementation of EPR schemes is thus relevant to developing economies.

RESULTS AND DISCUSSIONS

Based on the research questions presented in the introduction section, the lessons learnt from the reviewed studies are discussed. Further, using thematic analysis, the strategies for enhancing EPR are presented and discussed.

Lessons from EPR enforcement

EPR is a key policy for economies to achieve a circular economy and sustainable management of wastes. In the studies reviewed above, a number of EU nations if not all, have enforced EPR through the PPW legislation. It is also clear that, the EPR is categorized into two broad concepts, the financial responsibility and the physical responsibility. The categorization of EPR has clearly defined the stakeholder's responsibility. For example, in Austria, Germany and Belgium, the municipalities are reimbursed by the industry for the physical responsibilities performed.

It is also interesting to note that, a compliance scheme exists in Belgium, Italy, Germany and Austria, and the industry is mandated to register and obtain licenses in order to practice EPR. For example, in Italy almost 1.5 million members are registered from both producers and users of packaging wastes. Xevgenos et al (2015) indicates that, approximately 114 million pounds was raised in Austria from the license fees. This aspect is a success story for developing economies, to understand that, producers and users of PWs should be involved. For example, users of packaging wastes should pay for collection services but it should not end there. In Japan, households are required to segregate their wastes and this has increased the quality of the wastes recovered. A total of 96% recycling rates was achieved in Belgium as a result of clearly structured EPR.

Fernie and Hart (2001) have alluded that, the purpose of the PRR legislation is for companies to be responsible for the recovery and recycling of PWs. To facilitate the implementation of PRR, the EPR scheme guides the industry through the producer fees. These fees differ contextually and for this reason, countries should conduct feasibility studies and involve the relevant stakeholders. Further, setting of recycling rates for the industries has contributed to successful implementation of EPR schemes, for example, 25% to 45% recycling rates were set in the EU nations (Fernie and Hart, 2001).

Hoornweg and Bhada-Tata (2012) indicate that, the amount of PSWs will increase from 8 % to 13% by 2050 in developing economies. It is also clear that, developing economies have waste management challenges. To this regard, the success story of Japan's enforcement of the EPR scheme is relevant to developing economies. For example, the costs for managing PWs are split between the industry (45%) and local authorities (55%). Further, the municipalities are reimbursed for any recycling costs and this is subject to quality.

Strategies to enhance EPR enforcement

A number of studies reviewed have highlighted strategies that enhance effective enforcement of EPR schemes. From different contexts, research methods and different industries, a number of commonalities in the strategies are noted.

Systems approach

A systems approach to the management of PWs and other wastes is highlighted. Design of systems for the recovery of PWs (Fernie and Hart, 2001); characterization of the plastic industry (Corbett and Cutler, 2000); continuous study and evaluation of management systems and recycling programs (Mandaraka and Kormentza, 2000); and system design and facilitation (Xie and Breen, 2014). These studies indicate that, a systems approach to managing PWs enhance the enforcement of EPR schemes. These strategies are relevant for adoption in the legislation

frameworks for PWs. For example, Japan has implemented a framework that is clearly defined to the stakeholders (Xevgenos et al, 2015). A system approach to the enforcement of EPR is viable in the sense that, the stakeholders involved are aware of their roles and responsibilities as well as the chain of management.

Roles of the stakeholders

A number of stakeholders are involved in the waste management arena. To this regard, their roles should be clearly outlined to enable successful engagement and implementation of EPR schemes. Zutshi and Sohal (2003) indicates that, the roles of the senior management, consumers, suppliers and employees should be clear in the management of PWs. In the EPR schemes operations, the financial responsibility and physical responsibility are clearly categorized as well as the stakeholders' responsibility. It is thus clear that, outlining the roles of the consumers, senior management, suppliers and employees is relevant to enhancing EPR enforcement. People practice is noted by Corbett and Cutler (2000) and Jecton and Waema (2013) indicate that, producer, manufactures and informal sector engagement loyeess( )TJs' r3071 -1[(c TDay c7igthe wastat, pmanulWaem)62 Tc[(andd)- 0 0 berout

contextually. Further, it is noted in the findings that, the PRR enforced in a number of the EU nations have been adjusted to suit the context of each nation.

A number of lessons can be drawn from this study. Firstly, EPR is categorized into physical and financial responsibilities. The stakeholder mandated to each responsibility performs the roles and this has enhanced EPR schemes enforcement. Other strategies that have contributed to EPR include and are not limited to the; systems approach, information and awareness; monitoring systems and definition of the roles of the stakeholders.

For developing economies and the stakeholders involved in the enforcement of EPR schemes, the study provides information that can contribute to the success stories noted in developed economies.

The study has highlighted a number of strategies that have contributed to successful implementation of EPR in developed economies. However, the study has some limitations in terms of the sample size of the studies that were reviewed. To this regard, consideration of a larger sample size would provide more strategies for consideration. Further, the study has not discussed the challenges that face developing economies in the implementation of EPR.

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STRENGTH PROPERTIES OF LOCALLY PRODUCED REACTIVE POWDES14 Tw[(STRENGTH PRO)Byea, S. nd 0 by EENTH I

A.G. Ibrahim, M.M. Garba, O.G. Okoli, I.K. Zubairu, D. Dahiru and J. Usman (2019) Strength properties of locally produced reactive powder concrete with unrefined metekaolin In: Laryea, S. and Essah, E. (Eds) Procs 10th West Africa Built Environment Research (WABER) Conference, 5-7 August 2019, Accra, Ghana, 931-943

Powder Concrete (RPC) was first made possible by Richard & Cheyrezy in 1995. It is produced by the application of a certain number of basic principles relating to the composition, mixing and treatment of the concrete.

RPC was developed through microstructure enhancement techniques for cementitious materials which include eliminating coarse aggregates, reducing the water-to-binder ratio, lowering calcium oxide (CaO) to silicon oxide (SiO2) ratio by introducing the silica components and incorporating steel micro-fibres (Yazici, Yardimci, Aydin, & Karabulut, 2009). There are a lot of researches carried out across the globe which indicate that RPC is a future concrete material because of its high mechanical properties.

RPC has a compressive strength of more than 170N/mm2, flexural strength of up to 60N/mm2 (Richard and Cheyrezy 1995) and tensile strength of up to10N/mm2 (Qureshi et al. 2017) using silica fume as the pozzolan. A compressive strength of 80N/mm2, tensile strength of 10 N/mm2 and flexural strength of 20 N/mm2 was achieved using local materials available in Pakistan (Qureshi, Tasaddiq, Ali and Sultan, 2017). RPC exhibits varied compressive strength when cured under different conditions.

The basic mechanical properties of RPC were examined under different curing conditions and the results indicated that the compressive strength at 28 days varied between 170 N/mm2 and 202 N/mm2 for heat treated specimens; up to 400 N/mm2 for autoclaving and between 130 N/mm2 and 150 N/mm2 for non-heat treated specimens (Cwirza, et al., 2008, Maroliya, 2012, Yazici, et al., 2009, Tam et al, 2010, Yazici, et al., 2010). However, the use of cement in conventional RPC is high and silica fume (SF) content is up to 25% (by weight of cement). Some of the shortcomings of SF are high cost, increase heat of hydration which causes shrinkage problems (Peng et al., 2015) and non availability in some countries like Nigeria. Moreover, steel fibre used in the production of RPC is also not available in Nigeria. The non availability of these two major materials of RPC production is becoming worrisome to the Nigerian construction industries as they have to battle between importation cost and delivering projects as an acceptable price to their clients.

Therefore, using other mineral admixtures in the production of the RPC has been proven to be a feasible solution to the problems of SF (Rougeau & Borys, 2004; Yazici et al., 2009; Yazici et al., 2010; Agharde & Bhalchandra, 2015; Kushartomo et al., 2015). When fly ash was used to replace SF in the production of RPC, compressive strength of between 62.9 N/mm2 to 324N/mm2 and a flexural strength of 8.8 N/mm2 to 32 N/mm2 were obtained (Yazıcı, Yigiter, Karabulut & Baradan 2008; Yazici et al. 2009; Ding 2010; Demiss, Oyawa & Shitote 2018). A compressive strength of 128 N/mm2 to 250 N/mm2 and a flexural strength of between 25.6 N/mm2 to 32 N/mm2 were ob

effective. Some researchers like Foti (2013) studied concrete specimens reinforced with fibers made from waste polyethylene terephthalate (PET) bottles. Jalal (2012) used waste steel fibre recovered from milling and machining in concrete production and the results indicated improvement of the fragile matrix, mostly in terms of toughness, energy absorption and post-cracking behavior. Study on the influence of adding waste materials like lathe waste, soft drink bottle caps, empty waste tins, waste steel powder from workshop at a dosage of 1% of total weight of concrete as fibres was undertaken by Murali et al., (2012). These materials were deformed into rectangular strips of 3mm width and 10mm length. Results showed that a concrete block incorporated with steel powder has increase in compressive strength by 41.25% and tensile strength by 40.81%. Concrete made with soft drink bottle caps exhibited an increase in flexural strength by 25.88%. The effect of polyethylene terephthalate (PET) as fibre using different volume (0%, 0.5%, 1.0% and 1.5%) in mortar production was investigated by Pereira de Oliveira & Castro-Gomes (2011). Results showed that the incorporation of PET fibres significantly improves the flexural strength and toughness of mortars, so also, 1.5% was regarded as optimum for desired workability. More recently, Ibrahim, Garba, Usman and Gambo (2018), used waste gear inner wire as fibre (WGIW) in mortar production. Results showed that the fibred mortar sample has higher compressive and tensile strengths at 56 days by 19% and 21.1% respectively than the unfibred one and concluded that WGIW at 2% volume fraction could be used as fibre in mortar production.

However, for RPC to be produced in Nigeria there is the need to find similar, available and alternative material to SRoRogecttivly 0 Tc the un1.1uor .175 TD.5(re.01)5.9per

Table 2: Mix proportion of RPC specimens

Specimen ID	20SF	10MK	20MK	30MK	20SF	10MK	20MK	30MK
	Non fibred				Fibred			
Cement	1	1	1	1	1	1	1	1
Silica fume	0.20	0	0	0	0.20	0	0	0
Metakaolin	0	0.10	0.20	0.30	0	0.10	0.20	0.30
Sand (150-600Öm)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Crushed quartz	-	-	-	-	-	-	-	-
Superplasticizer	3.5	2.8	3.8	4.5	3.6	3.2	3.9	5.0
(GIW) L=12mm	-	-	-	-	0.02	0.02	0.02	0.02
Water	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Comp. press.	-	-	-	-	-	-	-	-
Heat treatment temp. (ºC)	27	27	27	27	27	27	27	27

Note: Cement Content = 900Kg/m^3, Fibre Content= % of weight of concrete, SP content=% of binder

Specimens preparation

To prepare the specimen, the cementitious materials were dry mixed in a mortar mixer for about one minute at low speed of 10 rpm. Premixed water (about 80% of the mixing water) and superplastizer were added into the mixer and the mixing continued for three minutes at medium speed (140 ± 5 rpm). Fine sand and GIW as fibre were then added into the mixer and mixing continued for another four minutes. The remaining mixing water (about 20%) was then added to the mixer and mixed at high speed (285 ± 10 rpm) for additional four minutes. Finally, the mixer was then returned to the medium speed (140 ± 5 rpm) and mix for three minutes. This mixing method was adopted from Hiremath & Yaragal (2017). All the fresh mixes had consistency of 270±5 mm. After mixing, the fresh specimens were cast and kept in moulds for 24 hours in the laboratory condition (27 ± 2oC). Cube moulds of 50x 50 x 50 mm, cylindrical moulds of 50mmx100mm and prismatic moulds of 40x40x160mm were cast the specimens for compressive strength, split-tensile strength and flexural strength tests, respectively. Specimens were then taken out from the moulds and cured in water until the testing ages of 7, 14 and 28 days.

Testing Methods

Flowability

The Flowability of the different mixes was tested using a flow table in accordance with ASTM C143. This was conducted by filling a mini-slump cone. The cone was then carefully removed to allow the mix to flow under the influence of gravity. The flow of the mix was obtained by measuring the spread using a measuring tape. Average of four measurements of the spread was reported for each mix.

Strength properties

Compressive strength, split-tensile strength and flexural strength tests on the specimens were carried out according to BS EN 12390-3:2002, ASTM C496, ASTM C78 respectively. The average of five measurements was reported for each test.

RESULTS AND DISCUSSIONS

Characterization

Tests conducted under characterization include XRD, chemical composition and strength activity of MK, so also the geometry of the Gear Inner Wire.

X-Ray diffraction

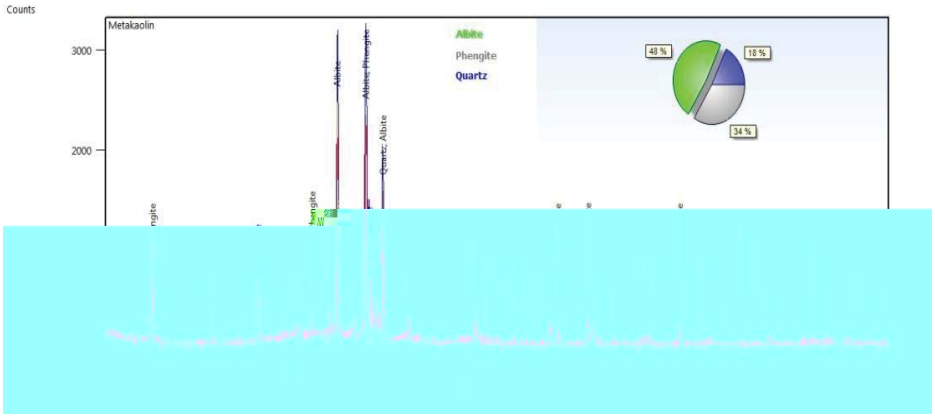

Figure 1: XRD result of Metakaolin

Figure 1 shows the XRD result of MK which showed a product of low crystallinity. Crystalline phases consisted of quartz and Phengite, mainly Albite. Phengite is a high silica variety of muscovite on the chemical join between muscovite, celadonite, and aluminoceladonite while Albite, a common feldspar mineral, is a sodium aluminosilicate (NaAlSi3O8) that occurs most widely in pegmatites and felsic igneous rocks such as granites. Figure 1 also shows no sign of kaolinite on the fix and the 2θ value (between 10 -30) shows hallow in shape. This indicates that the material used in the experiment is MK.

Chemical composition

Table 3: Oxide c compositions and physical properties of RPC constituents

Oxide (%)	Sand	Cement	Silica fume	Metakaolin
SiO_2	86.53	17.519	92.00	65.05
Fe_2O_3	2.94	2.768	0.50	2.59
Al_2O_3	1.64	4.74	0.70	20.65
CaO	0.40	71.297	0.50	0.82
CuO	0.00	0		0.02
NiO	0.00	0	0.015	0.03
MnO	0.01	0.072	0.128	0.08
Cr_2O_3	0.00	0	0.006	0.03
TiO_2	0.00	0.105	0.071	0.00
MgO	0.60	0	0.50	1.66
SO_3	0.10	0.00	0.00	0.18
ZnO	0.00	0.007	0.006	0.01
$SiO_2 + Al_2O_3 + Fe_2O_3$				88.29
LOI	0.84	3.492	3.00	1.80
Physical properties				
Surface area (m^2 /kg)			2 0, 000	509.0
Strength activity index (%)			-	87
Specific gravity			2.21	2.53

Flowability of RPC

Figure 2. Flowability of RPC

Figure 2 shows the flowing nature of the RPC produced. RPC is considered to be self flowing concrete. ASTM C143 (AASHTO T119) states that for concrete to be regarded as self compacting concrete, the flow value or workability of such concrete should be ¸ 190mm and ASTM C1611 states that the value should be Ó600mm (24 in). Therefore, it was based upon this range and series of trials that the flow value of the RPC produced was fixed at 270±5mm. This value was achieved by the addition of superplasticizer. Figure X shows the effect of MK and SF on the consumption of superplasticizer to achieve the targeted flow (270±5mm) of RPC. It can be observed that the superplasticizer (sp) dosage for RPC increased with the increasing MK content. The dosage of sp required for the RPC specimens produced with 10%MK, 20%MK, 30%MK and 20% SF, were x, y, z, respectively. The increasing sp demand of MK can be ascribed to its high surface area.

Compressive strength of RPC

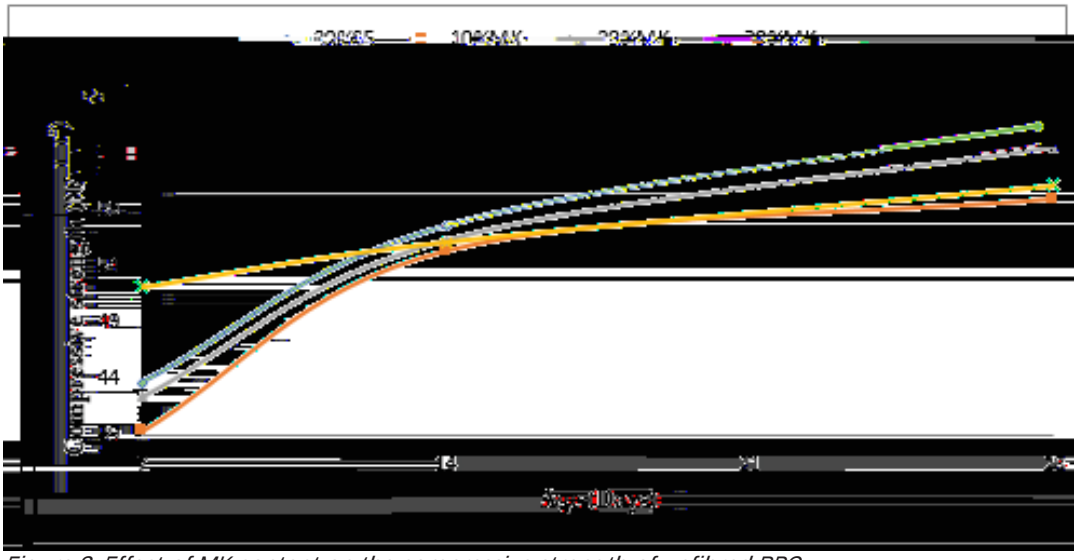

Figure 3. Effect of MK content on the compressive strength of unfibred RPC

Figures 3 and 4 show the effect of MK content on the compressive strength of unfibred and fibred RPC at different ages, respectively. For the fibred and unfibred specimens, increase in compressive strength with age can be observed. At 7 and 28 days, the compressive strengths of unfibred specimen with 20% MK were comparable to those for the reference (20%SF). However, the specimen with 30%

MK showed higher strength at 7 days but lower at 28 days. The improved strength exhibited by the specimen with 30%MK could be due to the fast pozzolanic reaction of MK at the early age due to the presence of more SiO2 that reacted with the Ca(OH)2 liberated during hydration to produce additional cementitious compounds such as C-S-H and CSAH.. On the other hand, the control concrete has higher early compressive strength compare to 10%MK due to high pozzolanic activity and finer particle sizes of the SF than the MK. At 28 days, the compressive strengths of specimens with 10%MK, 20%MK and 30%MK are 89.1%, 97.1% and 91.3% of that of the control (64.5 N/mm2). Hence, 20% seems to be the optimum content of MK to produce RPC with comparable compressive strength to that of the control.

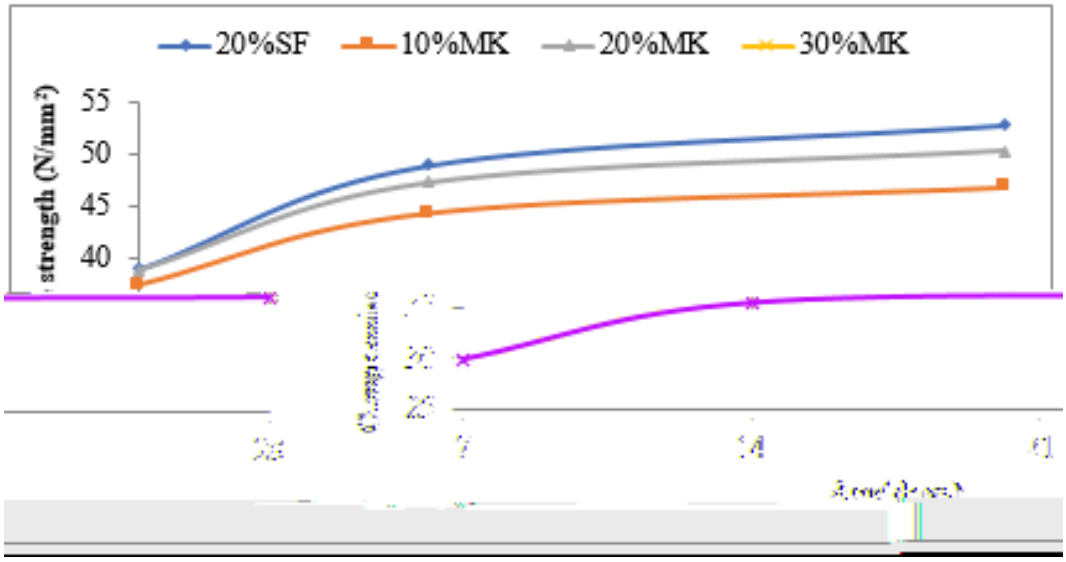

Figure 4. Effect of MK content on the compressive strength of fibred RPC

However, the fibred specimens showed variation in compressive strength compared to the unfibred as shown in Figure 4. At 7 days, the compressive strengths of the fibred specimens with 20%SF, 10%MK, 20%MK and 30%MK are 38.9N/mm2, 37.4 N/mm2, 38.8 N/mm2 and 29.9 N/mm2 respectively. While at 28 days, the compressive strengths of the specimens with 10%MK, 20%MK and 30%MK were 87.2%, 100% and 86.5% of that of control (50.3N/mm2). Apparently, the introduction of fibre caused reduction in strength probably due to its slippery surface that could hinder adequate bond between the fibres and cement paste. This is line with what Iqbal, Ali, Holschemacher and Bier, (2015) reported that there is around 12% reduction in compressive strength with increase of steel fiber content from 0% to 1.25%. The compressive strength of RPC produced with 20%MK in this study is superior to those obtained when rice husk ash (RHA) and fly ash were separately used as reported by Asteray, Oyawa & Shitote (2017) and Demiss, Oyawa & Shitote (2018) respectively.

Tensile strength

Figure 5. Effect of MK content on the tensile strength of unfibred RPC

Figure 6. Effect of MK content on the tensile strength of fibred RPC

Figures 5 and 6 depict the split tensile strength of unfibred and fibred RPC samples respectively. As shown in Figure 5, the tensile strength of unfibred specimens with MK at all ages were generally higher than that of the control. At 7 days, the tensile strength of the 20%SF, 10%MK, 20%MK and 30%MK are 2.7 N/mm2, 3.8 N/mm2, 3.01 N/mm2 and 3.2N/mm2 respectively. At 28 days, the strengths for 10%MK, 20%MK and 30%MK were higher than that of the control by 29%, 10% and 16% respectively. The improvement in the tensile strength of the specimens with MK could be due to the filler and pozzolanic effects of MK that enhance the microstructure of RPC (Vipat and Kulkarni, 2016).

For the fibred specimens, as shown in Figure 6, it is clear that the inclusion of fibre

Flexural strength

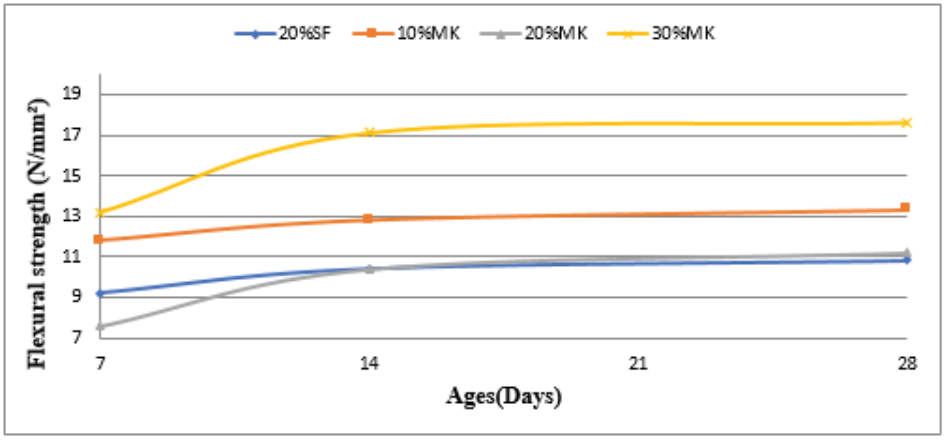

Figure 7. Effect of MK content on the flexural strength of unfibred RPC

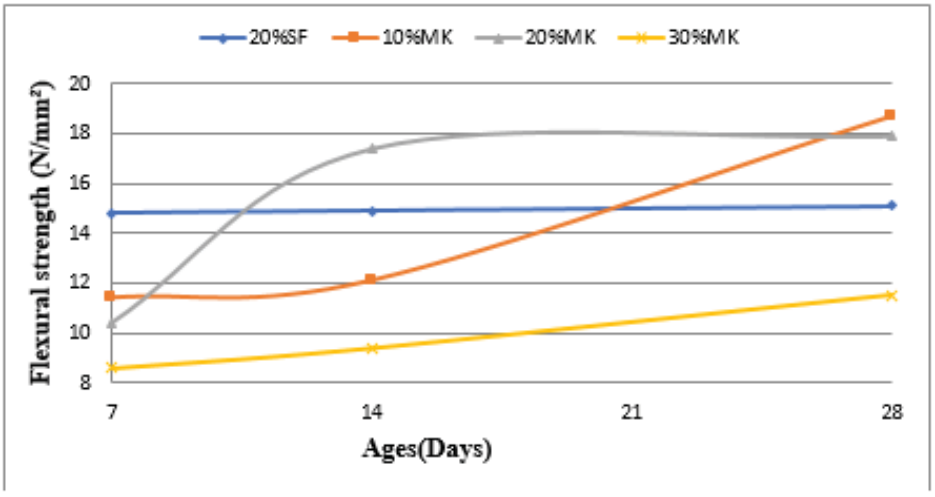

Figure 8. Effect of MK content on the flexural strength of fibred RPC

The flexural strengths of fibred and unfibred RPC are presented in Figures 7 and 8. Compared to the control, MK improved the flexural strength of unfibred RPC, and the improvement goes along with the increase in MK content. At 28 days, the range of flexural strength of the MK based RPC is 11.23- 17.6 N/mm2. However, the flexural strength of the control is 11.2 N/mm2. As shown in Figure 8, fibre improved the flexural strengths of all the specimens. However, extent of improvement over curing ages is more pronounced with the specimens made with MK but low with SF. Overall, 20% MK outperformed the other specimens at all ages. Hence, the 20% is the optimum MK content for flexural strength enhancement. The improvement in the flexural strength of the MK RPC could be due to the micro filling effect and pozzolanic reaction of MK (Vipat and Kulkarni, 2016). Results similar to this study was also reported by (Haroon, Ashad, Vikas and Alvin, 2017) and Demiss, Oyawa & Shitote (2018).

CONCLUSIONS

The unrefined metakaolin and gear inner wires have been found to be suitable in the production of reactive powder concrete (RPC). Unrefine metakaolin of up to 20% by the weight of cement and GIW of up to 0.25% could be used in the production of the RPC with compressive, tensile and flexural strengths of up to

64.5N/mm2, 4.7 N/mm2 and 18.7 N/mm2 respectively. However, GIW has been found to decrease the compressive strength and improves tensile and flexural strengths of the RPC. Reactive powder concrete of this type can easily be produced without necessarily the need for pressure and heat treatment. Moreover, the use of the unrefined MK and GIW can lead to production of cheaper and sustainable RPC by cutting down importation cost of both SF and fibre materials.

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STUDENT HOUSING REQUIREMENTS IN NEAR CAMPUS NEIGHBOURHOODS: A CASE STUDY OF SAMARU ZARIA, KADUNA STATE, NIGERIA

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Studies on the relationship between students' influx into near-campus neighbourhoods had focused on the negative impacts of studentification on the neighbourhoods, established residents and conversion of single-family housing into houses for multiple occupancy (HMO). But there has been limited understanding on the housing preference of students in near-campus neighbourhoods or how best to absorb the student population in these neighbourhoods. To this end the study attempts to highlight the housing needs of students in Samaru near-campus neighbourhoods (North-West Nigeria) using the Student Accommodation Preference Index (SAPI) instrument also considering neighbourhood attributes that would affect their housing needs. A questionnaire survey was used as means of data collection. 118 questionnaires were distributed and 109 were retrieved and analysed using SPSS V.21. results are presented in form of means (M), Relative Agreement Index (RAI) and Percentages. A reliability test was done to test the viability of the instrument for the study which was found to be reliable. Results show that the housing need of students were private room, bath, small fridge, kitchen, laundry, dry area, fire protection system, gated house, common room and waiting area. It also showed that provision of Automated Teller Machine (ATM) points, hospital, places of worship, recreation areas and bus park amongst others will improve quality of life of students within near-campus neighbourhoods. The findings are pertinent to design professionals, architects, planning authorities and developers as it gives insights on the housing needs of students which is helpful for effective planning and zoning of student housing within near-campus neighbourhoods.

Keywords: near-campus neighbourhoods, student housing preference, studentification

INTRODUCTION

The historical background of studentification dates to the early 2000s, it is defined as an ''influx of students within privately-rented accommodation in particular neighbourhoods'' (Smith., 2005 Munro et al., 2009). This significantly changes the

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residential profile and tenure system in such neighbourhoods, leading to the emergence of student areas where owner occupier housing stock deteriorates through conversion to private rented Houses for Multiple Occupancy (HMO) (Smith and Hubbard, 2013). These environmental changes resulting from increased student influx in these once quite neighbourhoods manifest its unpleasant effects in diverse ways ranging from; resentment towards students by residents; increased property prices; increased crime rates; neighbourhood deterioration; loss of social cohesion and character; pressure on infrastructure and a host of other menace (Allison, 2006; Anderson, 2013; Donaldson, 2014: Kinton, 2013; Smith and Hubbard, 2013). This, therefore, begs for the question of how near-campus neighbourhoods could be designed to thrive and foster social cohesion between student population and resident population. Studies shows that sociospatial segregation i.e. the formation of exclusive student area and resident area is in constant collision with the aspirations of maintaining social cohesion and acceptance of diverse social groups within communities (Dorling et al., 2008; Lees, 2009).

Munro et al. (2009) highlights that to date, student population have been neglected within social segregation discusses despite studies that shows that student gravitate to near-campus neighbourhoods due to insufficiency of on-campus accommodation, activities of landlords, developers, agents and above all their need for privacy (Anderson, 2013 Donaldson et al., 2014). It therefore, becomes vital to relate the trends in students housing supply in these neighbourhoods to their actual housing needs and preferences as the students have a distinct lifestyle and culture which should be reflected in their housing design. The study therefore aimed at understanding student housing needs and preferences in a bid to mitigate the effects of studentification. The following objectives were used to achieve the aim of the study: (1) Identification of students' spatial requirements in near campus neighbourhoods from literature. (2) Establishing housing requirements of students in Samaru near-campus neighbourhood. The study literature is organized into three subsections to capture (1) The concept of studentification, (2) Investigate how to integrate students in near-campus neighbourhoods (3) Identify student housing needs. Following the introduction, the second section provides the review of related literature, research methodology, results and discussions and finally conclusions and recommendations. The paper proceeded through four sections.

REVIEW OF LITERATURE

Studentification

Zhang et al. (2012), identified that the urban space is in a constant state of change which may tend towards its' growth or deterioration. Studentification happens to be a key influence on the changes seen in university towns as it does not occur in vacuums but in urban spaces (Boersma et al., 2013). It is vital to note that the manifestation of studentification and its corresponding effects on its host communities may differ from place to place as it is affected by a number of underlying factors: cultural, religious, political and various role-players. Hubbard, (2006) identified six role-players: students, higher education (HE) institutions, local authorities, developers, home owners and permanent residents. Then Munro et al., (2009) gave a brief description of the profile of a typical HE student to be a young individual, without dependents, usually from a middle-class background, brought-

up to be relatively well mannered. But this population are also associated with experiencing freedom from guardians, rules and regulations for the first time hence are inclined to explore the lengths and breadths of that freedom (Smith and Holt, 2007: 152; Smith, 2007; Munro et al., 2009).

Students who study away from their hometown require accommodation for the duration of their study and studies show that majority of full-time students' study away from home (Ackermann and Visser, 2016; Duke-Williams, 2009). This results in two main events that are likely to occur. They may either reside in accommodation provided by universities termed as self-segregated university halls of residence or in privately provided accommodation in near-campus neighbourhoods alongside established residents. Ahmadu Bello University with above 40,000 full time students, accommodates about 12,000 students which is 30% of its population, this coincides with the national policy within Nigeria requiring tertiary institutions to accommodate at least 30% of her students (Sagada, 2009; Student Affairs Division ABU Zaria, 2017). This leaves an approximate total of 28,000 students seeking refuge in the arms of private investors in near-campus neighbourhoods taking advantage of the niche market (Sage et al., 2012). Johannesburg Municipality (2009) defined a student house as a habitable room rented out for extended periods of time to unrelated students who share communal facilities such as kitchen, lounge, dining room and bathroom. Kenna (2011) then classified student housing in near-campus neighbourhoods into two categories: namely, housing in multiple occupation (HMO) and purpose-built student housing. While living alongside other social groups could be beneficial to the students, their presence could be seen to trigger resentment if resident perceive they are becoming the minority social grouping (Rugg et al., 2004; Alisson, 2006). The concerns of studies pertaining to studentification is not limited to the fact that near campus neighbourhoods have become home to students but is tied to the array of negative effects rising from concentration of student population within neighbourhoods, ranging from: neighbourhood deterioration, demographic imbalance, increase crime and property prices, pressure on infrastructure and social decadence emanating from the proliferation of HMOs and large student numbers (Munro et al., 2009; Smith and Holt, 2007; Murtagh, 2011). Sadly, little or no studies have gone into understanding the concept of studentification in the Nigerian Context or housing needs of students in near-campus neighbourhoods and that is the gap this study intends to fill.

Integrating students into near-campus neighbourhoods

There has been an observed surge in the supply of student accommodation in near-campus neighbourhoods typically taking form of conversion of owner-occupied family housing to HMOs. This was due the observed accommodation dearth in universities and student housing demands as there was absence of national policies governing the strategic development of student accommodation or regulating the conversion of owner-occupied family housing to HMOs (Hughes and Davis, 2002) the landlords of HMOs became the main providers of student accommodation in near-campus neighbourhoods (Hubbard, 2008). Based on analysis carried out by (Smith and Hubbard, 2013) it was found that 40 towns and cities in the UK had at least one ward with 10 percent or more of full-time students living in shared rented housing. More recently it claimed that 730,000 students (51% of the total population) resided in HMO (King Sturge, 2008). Smith, (2005)

identified the markers of studentification to be evidently seen in reconfiguration of local shops and services to student oriented markets including closing down of schools (crèche, primary and high school) leading to lower family appeal of the neighbourhood and also disputes arising from night noise nuisance, overspill of refuse and littering, untended gardens, vandalism, hooliganism and increased property prices which causes inflationary pressures evident across a range of housing market (Garmendia et al., 2011; Kenna, 2011; Sage et al., 2013; Smith, 2008). Between 2003 to 2008 specific towns in London experienced rise in house price growth due to the presence of one or more universities within the region. With a changing market and increased interest in student housing it made such neighbourhoods unfavourable for young households and first-time buyers (Adams et al, 2009). This is a case where student housing distorts the existing housing market, act as gentrifiers and displace established household from studentified neighbourhoods (Wyly et al., 2010). From studies to absorb student population into near-campus neighbourhoods is done in two ways either in HMOs or PBSH which is seen to have different effects on the environment in which they are situated (Ackermann and Visser, 2016) with the later identified to be more favourable to host neighbourhoods (Hubbard, 2009). HMO student housing is described as a traditional single-family house with a front garden and a backyard which accommodates university students. In this setting students usually have their own rooms and share communal facilities like kitchen, bathroom, and living room (Garmendia et al., 2011).

In Nigeria HMOs have a slightly different setting usually they have up to three typologies: it could comprise of a compound accessed from a small gate with single rooms access from a courtyard. In this type of HMO, the owner dwells with the students in a separate one or two-bedroom apartment. The only shared facility for the students is the bathroom usually located at the extreme end of the house to avoid odour. Students living in this type of housing are expected to cook in their rooms. The second case is where self-contain rooms are designed either alongside a landlord's house within the same compound or could be non-owner occupier. In this case the only shared facility is the access through a courtyard and the third typology is one in which the house formerly family oriented one- or two-bedroom apartments are rented to students who have shared living room, kitchen and bath. In all these cases there is little or no consideration to landscaping or neighbourhood outlook.

Based on the resistance from residence towards students living in near campus neighbourhoods and the continuous demand for accommodation by students, it led to the rapid development of blocks of PBSH. PBSH developments are usually all-inclusive complexes having a bedroom ensuite with bathroom and kitchens, providing students with facilities like parking, laundry, gym, fitness centre, swimming pool, coffee and wine bar; high level of surveillance; 24/7 security and convenience store located in specific areas close to universities (Davidson and Lee, 2010). Sage et al., (2013) identified PBSH as a recession proof investment venture as the number of students are on the increase which makes it remain a viable business venture for investors and developers. PBSH have experienced a surge in South Africa e.g. Uniloft and Campus Key in several cities in South Africa. A number of establishments have been seen identified as pioneers in provision of PBSH in the UK such as UNITE (38,300 bed spaces in 23 cities), University Partnership

Programme (UPP) (20,000 in 10 cities), Liberty Living (15,000 in 17 cities) and Derwent Living (3500 in 8 cities). In many senses, the production of student housing is indicative of how politics relies upon sociospatial segregation to create opportunities for capital investment (Macleod, 2002). This information establishes the viability of student housing scheme in near-campus neighbourhoods as a lucrative business which has been seen to be recession resistant. PBSH is also seen as a remedy to mitigate the effects of studentification and foster neighbourhood revitalization and regeneration (Sage et al, 2013). Although, minimal studies have been seen to capture the spatial requirements of students living in studentified neighbourhoods in a bid to better cater for students housing needs in the Nigerian context and study area.

Student housing preference

Student accommodation is perceived as an essential component of tertiary institution and seen as an important parameter for the choice of an institution by guardians as the environment they live and learn affect general performance of individuals (Kolawole and Boluwatife, 2016). The provision of adequate and comfortable accommodation has been tied to academic success, retention rates and satisfaction by quite a number of scholarly works (Onclin, 2014). Tertiary institutions are saddled with the responsibility of providing accommodation for its students but due to the increase in student enrolment which is not commensurate to the available accommodation more students are not catered for, hence, they rely on privately provided accommodation usually in close proximity to the institution. Matters pertaining to students' choice of accommodation should not be disregarded due to its crucial influence on the living satisfaction and academic pursuit of students (Zotovie, 2017). Ubong, (2001) observed that although student housing accommodation may be seen as a management issue the user preferences and choices are to be considered as upon satisfaction a design project is seen to be successful. Adu-Gyanfi et al., (2014) defined accommodation as a place to live which is rented over a period of time of pursuing a degree in a university as well as other services enjoyed during this time, this could be situated within or outside the campus (Owolabi, 2015). Many studies have discussed factors that affects students' accommodation preferences. Roche et al., (2010) examined housing preferences of undergraduate students and the findings showed that the students were inclined to stay in a housing that promotes privacy and provided adequate amenities. Moore, (2000) found that the factors that influenced student housing preference were privacy, noise influence and sharing of bed space which is associated with on-campus accommodation. Price of housing, proper layout, convenience and security are key influences on students housing preference (Wang and Li, 2006). Khozaei et al., (2010) identified security, proximity to school, room size, facilities and amenities as factors that affect student accommodation preference. Furthermore, (Khozaei et al., 2011) developed a 64-variable instrument under six categories called the student accommodation preference index (SAPI) instrument. The six categories are namely: facility and amenity, visual, convenience of student' s room, location, social contact and security. The instrument was designed on the bases that student want to live in houses that bear resemblance to their homes which was to be used as an instrument to measure student housing preference and satisfaction suitable for use in several fields of study like architecture, planning amongst others. On observation that the instrument was

lengthy it was reviewed and a 29 variable under six categories instrument was tested for reliability and validity. The six categories were: facilities and amenities, visual, convenience of the room, location, social contact and security. These constitute the main variables for this study. facilities and amenities have (5 items), visual (7 items), convenience of the room (5 items), location (4 items), social contact (3 items) and security (4 items). Facilities and amenities included 24hour study rooms, indoor pools (especially for women), fitness rooms, ATMs and storage rooms. Visual preferences included a beautiful exterior and facade, a new or newly renovated building, proper natural and artificial lighting in students' rooms, attractive interior in students' rooms, new or good-condition furniture in students' rooms, modern and stylish furniture in students' rooms, and beautiful and stylish furniture in the TV room and other social spaces. The dimension of room convenience consisted of 5 items: mini refrigerator in the room, air conditioner in room, the ability to move furniture and redecorate the room, the potential to divide the room into studying, eating and sleeping spaces, and underbed space that could be used as storage. The location aspect included the following items: proximity to the bus stop and university. The social contact aspect consisted of 3 items: a double shared room, a large area for students to gather, and a sitting room for every few rooms. Finally, the security aspect included the following: requires card access to enter the residence hall, requires card access to enter the room, room doors equipped with viewing devices, and 24-hour security. other factors identified from literature that affect student housing preference were size of place of residence (Tremblay et al., 1980), functional congruity (Sirgy et al., 2005) and neighbourhood attributes (Wang and Li, 2006). Other factors in residence housing preferences include outdoor environmental quality (Jim and Chen, 2007), location (Thamaraiselvi & Rajalakshmi, 2008; Karsten, 2007), local landscape (Nasar, 1983), safety, and proximity to the city, public transportation, proximity to workplace, sense of safety, medical and health facilities, and educational facilities (Wu, 2010). Mohit et al., (2010) conceptualized the factors that would influence residential neighbourhood satisfaction into three categories namely; public facilities with 9 variables; social environment with 5 variables; and neighbourhood facilities with 12 variables.

Public facilities play an important role in producing housing quality and hence, these should be incorporated in residential satisfaction. The variables included in this component are: open space, play area, parking, prayer and multi-purpose halls, perimeter roads, pedestrian walkways, public phone, local shops and food stalls. Social environment which are likely to impact housing satisfaction include variables such as noise, crime, accidents, security and community relations. Neighbourhood facilities influence residential satisfaction in many ways, because they refer to the position of the housing area with respect to work place and other facilities such as distances to town centre, school, police station, hospital, market, shopping centres, public library, religious building, LRT, bus and taxi stations.

METHODOLOGY

The paper is based on the case study of Samaru near campus neighbourhood in Zaria opposite Ahmadu Bello University (ABU) main campus Zaria, Kaduna State, Nigeria. This neighbourhood was chosen for the study because of its proximity to the university and the characteristic changes observed in its general outlook

caused by uncontrolled influx of students due to accommodation issues in the university (Sagada, 2009). The case study design was used for the study because it is associated with a particular phenomenon in the area. Furthermore, the researcher had little control over events and the focus was addressing the issue of studentification by understanding the housing needs of students to mitigate the effects of studentification in a real-life context. The use of multiple sources of evidence makes case study design an acceptable research design (Creswell, 2007). Primary and secondary data were used for the study. Questionnaire survey approach was adopted. Primary data were collected with the aid of questionnaire. Questionnaires were administered to students of ABU residing in the study area, to understand their housing need in near-campus neighbourhoods. Secondary data was obtained from books, journals and paper related to the study. Simple Random sampling was used a means to distribute the questionnaires within the study area. This was done by area within Samaru neighbourhood as it had four distinct areas namely: Hayin Dogo, Hayin Danyaro, Danraka and Samaru Market in order to select samples for the questionnaire survey. The sample size of the study was 118 based on sample size of similar studies (Olugbenga and Muyiwa, 2012; Sen and Antara, 2018; and Sekaran, 2003). The researchers had to use sample size based on other studies of this sort which was 80-100, because data on the number of students living in Samaru near campus neighbourhood was non-existent. The questionnaires were then distributed based on proximity to school in relation to the areas and student population within the areas as it was found that the farther away the areas were from school the lower the population of students as the students saw proximity as a key determinant of their housing preference. A total of 118 questionnaires were distributed randomly in this proportions 15 to Hayin Dogo 10 retrieved, 28 to Samaru Market, 30 to Hayin Danyaro 29 retrieved, and 45 to Danraka 42 retrieved, this gives a total of 109 retrieved questionnaires which were used for analysis. The questionnaire design was a five scale Likert design from 1 to 5 from not important (1), slightly important (2), Neutral (3), Important (4) and Very important (5). It was categorized into three sections: one demographics of students; two the level of importance of housing attributes to students and the three the level of importance of neighbourhood attributes to the students. The responses (N) from the questionnaire were analysed using statistical package for social science (SPSS) and the results were presented using Means (M), Relative Agreement Index (RAI) and percentages on tables.

$$M = \frac{\text{ذ}\text{ش}\text{گ}}{\text{ح}} \quad \text{and RAI} = \frac{\text{B ډ}}{\text{إ ـ}} = \frac{\text{٣ح٣ ٨ ٢ح٢ ٨ ١ح١ ٨ ٠ح٨ ٥ح٥}}{\text{٣ إ}}$$

Where: M= mean, f = frequency of each class, x =mid-interval value of each class and n = total frequency

Where w is the weighting given to each factor by the respondents, ranging from 1 to 5. For example, n1=No. of respondents for not important, n2= No. of respondents for slightly important, n3= No. of respondents for neutral, n4= No. of respondents for important, n5 = No. of respondents for very important. A is the highest weight (i.e. 5 in the study) and N is the total number of respondents. The relative agreement index ranges from 0 to 1 for formula see (Somiah et al., 2015).

FINDINGS AND DISCUSSION

Demographic Profile

Ahmadu Bello University students residing in Samaru neighbourhood are predominantly male (68%) and females (28%) they are single, prefer to stay with students than residents and prefer off-campus housing due to their need for privacy. Convened upon the demographic information in (Table 1) the student populace comprised of more undergraduate than postgraduate students, who are mostly within the age range of 21-25years (43%) and have relatively good academic performance with a second-class lower class of degree (34%). More students operate on a rent-based tenure system, have stayed there for at least 2years, get 10,000-20,000-naira stipends monthly and can afford to stay in houses well above 120,000 naira (38%). These results shows that guardians are willing to pay for a comfortable living environment for their Students to further enhance their learning experience. The result also concurs with the profile of students identified by (Munro et al., 2009, Sen and Antara, 2018, and Khozaei et al., 2012) that there are relatively younger people in schools for undergraduate and postgraduate programs.

Table 1 Respondents' Profile

Variable	Category	N	%	Variable	Category	N	%
Gender	Male	74	68%	Marital Status			

Students Housing Attribute Preference

Table 2 Level of importance of Housing attributes

S/N	Factors	Variables	RAI	N	Sum	Mean	Ranking	Category Ranking
	Amenities	Laundry with washing machine	71%	108	388	3.59	18	3.62 (3rd)
		Dry area and tumble dryer	70%	106	383	3.61	17	
		Fitness room	69%	109	378	3.47	21	
		Fire protection system	85%	108	465	4.31	5	
		Onsite parking	69%	104	377	3.63	16	
		Swimming pool	52%	105	284	2.70	25	
		24-hour study	79%	106	429	4.05	10	
	Convenience	Kitchen	89%	109	487	4.47	2	4.25 (1st)
		Private room	83%	106	452	4.26	7	
		Private bathroom	86%	106	469	4.42	3	
		Ability to move furniture	74%	105	406	3.87	14	
		Indoor air quality	82%	103	446	4.33	4	
		Air conditioner in room	77%	106	421	3.97	13	
		Small sized fridge	79%	105	433	4.12	9	
		Storage space in room	83%	106	450	4.25	8	
	Visual	Landscaping/garden	70%	109	384	3.52	20	4.05 (2nd)
		Aesthetics of the building	76%	103	414	4.02	11	
		Modern style furniture	77%	105	422	4.02	11	
		Proper lighting	90%	106	493	4.65	1	
	Social	Waiting area in student housing	68%	105	372	3.54	19	3.21 (5th)
		Common room	74%	109	404	3.71	15	
		Double shared room	46%	1.5	250	2.38	26	
	Security	Card access to enter room	58%	105	318	3.03	23	3.37 (4th)
		Gated houses	86%	109	466	4.29	6	
		Thumbprint identification access	53%	105	291	2.77	24	
		Surveillance camera	66%	106	357	3.37	22	

Source: Authors fieldwork

Results in (Table 2) shows that the housing attributes that were most preferred by students were proper lighting (4.65), kitchen (4.47), private bath (4.42), indoor air quality (4.33), fire protection system (4.31), gated houses (4.29), private room (4.26), storage space in room (4.25), small size fridge (4.12) and 24-hour study (4.05). The other variables all ranked above significant of the study which is at 3.5 except for the following variables which was identified based on discussion with students and results from questionnaire to be their least preferred housing attributes: double shared room with (2.38), swimming pool (2.70), thumbprint identification access (2.77), card access to enter room (3.03), surveillance camera in room (3.37) and

fitness room (3.47). These results reflect the context of the study which is within northern Nigeria, as culture and religion are key influences on the way of life of the people. Hence attributes pertaining to privacy and convenience ranked highest. Studies have identified that presence of swimming pools, surveillance and fitness rooms as key features of student housing in near-campus neighbourhood in the UK (Davidson and Lee, 2010) but in this context they are seen as extravagant and unnecessary. Based on the mean ranking of each category under student housing attribute preference, the convenience category ranked highest with 4.25 followed by visual with 4.05, then facility and amenity had 3.62, security had 3.37 and social had 3.21. From this result the inferences made is that the housing needs of students in Samaru near campus neighbourhood is a self-contain paying attention to aesthetics, lighting (natural and artificial), landscaping and communal and social spaces within the design.

Students Neighbourhood Attribute Preference

Table 3 Level of Importance of Neighbourhood Attributes

S/No	Factors	Variables	RAI	N	Sum	Mean	Ranking	Category Ranking (M)
	Public Facilities	Children playground	54%	105	297	3.04	23	3.74 (3rd)
		Landscaping/ Recreation Parks	71%	106	389	3.67	19	
		Neighbourhood Center	66%	104	359	3.45	21	
		Cinemas	67%	107	363	3.39	22	
		Restaurants/Cafeterias	86%	105	466	4.44	5	
		Public Gym	72%	106	392	3.70	16	
		Local/Corner Shops	85%	106	462	4.36	8	
		Parking	75%	106	407	3.84	14	
	Social Environment	ATM	91%	107	494	4.62	1	3.96 (2nd)
		Police Station	77%	107	419	3.92	13	
		Fire Service	82%	106	448	4.23	10	
		Postal Agency	68%	107	370	3.46	20	
		Sport Complex (Golf Course, Swimming Pool)	71%	104	387	3.72	15	
		Waste Disposal Unit/ Recycling unit	86%	106	466	4.40	6	
	Neighbour-hood Facilities	Day-care to Secondary School	59%	105	319	2.83	24	4.07 (1st)
		Public Library and Book store	78%	106	423	3.99	12	
		Shopping Malls/ Market	80%	106	438	4.13	11	
		Service Industry	71%	104	385	3.70	16	
		Offices/ Banks	79%	98	429	4.38	7	
		Places of Worship (Churches & Mosques)	91%	107	494	4.62	1	
		Bus, Motorcycle, Tricycle Station	88%	107	478	4.47	4	
		Hospital	89%	107	486	4.54	3	
		Filling Station	72%	107	394	3.68	18	
		Proximity to School/ Work/Facilities	84%	105	456	4.34	9	

Source: Authors fieldwork

Results in Table 3 show that the neighbourhood attributes that would least influence student satisfaction within near-campus neighbourhoods is pre-tertiary schools ranging from day-care to secondary school which had the lowest mean of 2.83. others that ranked least were children playground with 3.04, cinemas with 3.39, neighbourhood centre with 3.45 and postal agency with 3.46 all having means less than 3.5. This result could be said to have been affected by technological advancements globally experienced and many delivery services in Nigeria today as neighbourhood attributes such as postal agencies are gradually fading away due to home delivery and a host of other platforms. Also, the result rightly showed that most students are single without dependents hence would not find the presence of pre-tertiary schools appealing within the neighbourhood. On the other hand, the neighbourhood attributes the students preferred most were: ATM and places of worship ranking highest with 4.62 means each, hospital with 4.54, bus park having 4.47, restaurants having 4.44, waste disposal unit had 4.40, offices and banks had 4.38, local/corner shops had 4.38, proximity to school had 4.34 and fire service station had 4.23. The other neighbourhood attributes had means well above 3.5 making them significant variables for the study. The result show what attributes should be strongly considered in the planning and zoning of near campus neighbourhoods as the presence of students in such neighbourhoods are inevitable. The cumulative ranking of the categories shows that neighbourhood facilities ranked highest with an average mean of 4.07, social environment ranked second with 3.96 and public facilities ranked third with 3.74.

Reliability of instruments

The instruments used for this study were a combination of student accommodation preference index (SAPI) instrument which captured student housing preference and neighbourhoods' attributes as conceptualized by Mohit et al., 2010. The variables under housing attributes and those of the neighbourhood attributes were tested for reliability using SPSS V.21 and the result of the test are described in the following tables. Reliability simply refers to the extent to which the variables of an instrument consistently serve as a reliable measure for a concept, i.e. the ability of an instrument to measure a concept. Cronbach Alpha and Intraclass Correlation Coefficient (ICC) are ways of measuring the strength of that consistency. The higher the value the higher the reliability and vice-versa, it ranges between 0 to 1 i.e. no reliability to perfect reliability which is rear. A Cronbach α and Intraclass Correlation Coefficient of 0.7 and above is considered to have strong reliability.

Cronbach α is represented mathematically as

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum \sigma_{Yi}^2}{\sigma_X^2}\right)$$ where

K refers to number of scale items

σ_{Yi}^2 refers to the variance associated with items

σ_X^2 refers to the variance associated with the observed total score

Student Housing Attribute Reliability Test

Tables 4 and 5 gives the reliability test results for the N=26 housing attribute variables used for the study. Based on the reliability test run the Cronbach alpha value is equal to the average intraclass correlation coefficient which is 0.843 this is above the 0.7 reliability margin which establishes that the SAPI instrument is suitable for the study of student housing preference in Northern Nigeria Ahmadu Bello University being one of the oldest Institutions in Nigeria and is a focal point for education discusses (standard and quality of education) in Northern Nigeria which was one of the criteria for selection of the case study.

Table 4: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.843	.847	26

Table 5: Intraclass Correlation Coefficient

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.171[a]	.126	.235	6.378	80	2000	.000
Average Measures	.843[c]	.790	.889	6.378	80	2000	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type C intraclass correlation coefficients using a consistency definition-the between-measure variance is excluded from the denominator variance.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Student Neighbourhood Attribute Reliability Test

Table 6: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.862	.867	24

Table 7: Intraclass Correlation Coefficient

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.206[a]	.156	.275	7.243	84	1932	.000
Average Measures	.862[c]	.816	.901	7.243	84	1932	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type C intraclass correlation coefficients using a consistency definition-the between-measure variance is excluded from the denominator variance.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

The results from Tables 6 and 7 show that the Cronbach α value and the average intraclass correlation coefficient is also equal, it is 0.862 also confirming that the neighbourhood attributed conceptualized by Mohit et al., 2010 is a viable tool for the measurement of the neighbourhood preferences of students in near-campus neighbourhoods in the Nigerian context.

CONCLUSION AND RECOMMENDATION

In conclusion the study aimed at understanding the housing requirements and preferences of students within near-campus neighbourhood in a bid to mitigate the effects of studentification. The study concludes that students' housing preferences within Samaru near-campus neighbourhood is affected by their need for privacy and convenience with key variables such as private room, bath, kitchen, laundry, proper lighting, indoor air quality, gated houses. Also, neighbourhood attributes that are most important to students are ATM, places of worship, bus station, proximity to school, waste management services, restaurant, local/corner shops and recreation areas. Students housing need is concluded to be a well thought out self-contain space with supporting facilities and amenities within the housing environment and in the neighbourhood. The reliability test run on the two instruments used for the study showed high reliability values of Cronbach α which was 0.843 and 0.862 for housing and neighbourhood attributes respectively. These results are important to design professionals, planning authority and major stake holders in off-campus student housing matters as it has established the instrument for measuring student housing and neighbourhood needs in near-campus neighbourhoods and gives a bases for the replication of this study in other region in order to identify a national archetype for the study of student housing in Nigeria. The study concludes that in the Nigerian context culture and religion is a strong determinant of students housing needs therefore this study could be tested in other regions to either confirm or negate this conclusion as this study is limited to northern Nigeria. It also provided design professionals with spatial requirements for effective planning and development of PBSH in near-campus neighbourhoods in Nigeria.

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STUDENTS' PERCEPTION ON THE QUALITY OF TEACHING OF ARCHITECTURE IN SOUTH-EAST NIGERIA

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The past decade has witnessed a decline in the quality of graduates from architecture schools in Nigeria in terms of knowledge and skills in architectural design and project execution on site. This notion supports the need to evaluate the distinctiveness of design education in these schools. This paper is a study carried out with the aim of determining students' perception on the quality of teaching of integrated architectural design considering the following assessment factors; learning experience, assessment of learning, curriculum content and lecturer quality of architecture schools in south-east Nigeria. The objectives include; to ascertain the specific assessment factors that students consider most important in the quality rating of lecture delivery of integrated architectural design and to determine if the overall teaching quality rating of students is dependent on the lecturer's gender. A set of questionnaires (totalling 120 copies) were evenly distributed to sort for information in the schools studied. The Cronbach's Alpha, used to determine the reliability of the sample size, revealed that the sample size is reliable and adequate. The Mean and Variance statistic were used in the test while Chi-square test of independence and ANOVA were carried out on objective two. The results show that the students perceive the relevance of their learning experience (exhibited in the lecturer's dedication, confidence, punctuality and knowledge of the course content) highly with a mean score of 4.08 in developing skills, knowledge and experience as the most important factor in their learning of integrated architectural design, closely followed by the curriculum content with a mean score of 4.04. The values obtained shows that the overall teaching quality rating by students is independent on the lecturer's gender. The study recommends that students' evaluation of teaching quality should be considered for the annual performance appraisal of lecturers' promotion so as to improve the quality of teaching in architecture schools. It further suggests that there is the need to review the curriculum and encourage continuous professional development (CPD) in order to make necessary changes to ensure quality delivery of the integrated design module.

Keywords: architecture, assessment factors, gender, quality of teaching, students' perception

INTRODUCTION

Scholars Asiyai (2016), Ikoli(2018), Masaruf and Mohammed(2016), Olotuah and Adesiji (2005), Onyegiri, Okofu and Chinedu (2014), have reiterated that schools of

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architecture exist to equip students with the education required to make them contribute to the promotion of an orderly development of the human environment. Architectural education leads to the production of professionals who are sensitive to human needs and aspirations and who have the requisite knowledge, intellectual and aesthetic skills to evolve expressive design solutions of problems of the built environment and the society at large. Architecture students acquire these professional skills required for effective shaping, re-ordering and articulation of the built environment through the process of teaching and learning in architecture schools.

The study of architecture in Nigeria is categorized into seven instruction modules namely; architectural design, arts and drawing, historical and theoretical studies, building systems technology, humanities and social studies, environmental control system and physical sciences. Greater emphasis is however placed on the architectural design module which is considered as the nucleus of the entire programme in which the students are equipped with the knowledge and skills required to solve environmental problems. More than 40% of the required credits for the degrees are earned from the architectural design module (Olotuah, 2000).

Teaching is defined as the ability to increase students' knowledge and skills in reading, critical thinking, reasoning and personality traits. It has been further asserted as the most important school based factor that affects learning (Bietenbeck,2017). Research by Fapohunda (2015) indicates that the primary duty of the university academic revolves around teaching, knowledge impartation and creation of human resources for national development. Learning in the words of Banks and Banks (1995), is a relatively permanent change in the behaviour or attitude of a person over time. It is the expansion of what one may already know or perceive. It is the accumulation of knowledge but more importantly the application of this knowledge by the learner. It is therefore evident that the student is a core participant, or the key user of the knowledge acquired in this learning process. Hence his/her input in appraising the quality of learning received is of utmost importance.

Dauda, Jambo and Muhammad (2016) submitted that more often than not, students' perception and opinions on the quality of learning in architecture schools receive little mention in literature and academic discourse. This assertion is further corroborated by Gallistel (2008), who submitted that there are not many research works concerning students' opinions and perceptions on education. It is often assumed that the students are not able to express their needs in terms of their quality of learning in an academic environment. In the words of Agbonye, Igboekwe and Ugo-Okoro (2015), performance appraisal is a systematic process through which employees are given feedback on their performance, reward and promotion. They further stated that the criteria for academic staff appraisal in Nigerian universities fall under three broad categories of teaching research and service. Teaching which is classified by what and how it is done is the primary assignment of the academic.

It is however observed that the performance appraisal of lecturers in Nigerian tertiary institution give low priority to teaching as a criterion for promotion of academics rather emphasis is placed on research and publications as depicted by

Ofoegbu(2001) and Oranu(1983).This is spelt out in the criteria weighting of their appraisal process as presented by Okafor (2005): quality of teaching=15%,length/tenure=5%,workload=10%,currentresearch=30%,qualityofpublication=30%, contribution to university/country=5% and community service=5%. Nakpodia (2011) further suggested that there are methodological weaknesses in the current ways of evaluating the performance and progress of lecturers and teachers. This evaluation is currently carried out by the means of the Annual Performance Evaluation Report (APER) part of which is completed by the evaluated personnel and the other part by his head of department or unit head.

This evaluation is carried out for the sole purpose of promotion. However, this evaluation report does not put into consideration the physical evaluation of each staff progress performance during the period under consideration. It does not provide information on the evidence of effective teaching, good character, loyalty to the institution and personal integrity. This notion supports the argument of Bartlett (2000) and Bennett (1999) that assessment of competency of academics based on publication records is not enough as academic quality begins with excellence in teaching. Fapohunda (2015) explains that this undue emphasis and rating of one aspect of the academic's work(publishing) above the other aspects of teaching and community service is likely to result in diminished commitment and poor performance in the long run.

Research by Adomi(2007),Baird and Jones(2017) which was supported by findings by Ansfield, Cappuccini and William(2007),Hill, Lomas and MacGregor (2003), posited that students in tertiary institutions are the primary consumers of the quality of education delivered in these schools hence their views on all aspects of their learning experiences are essential to the effective monitoring of quality in the universities. Studies by Curtis (2002), Emery, Kramer and Tian (2003) show that students in the USA, Europe and other developed countries of the world participate in teaching evaluation as part of faculty members performance evaluation criteria. In Nigeria, performance evaluation with respect to the teaching quality of academics by students does not form part of the criteria for their assessment. Agbonye, Igboekwe and Ugo-Okoro (2015) suggested a remodelling of the current performance appraisal structure such that students' input is incorporated in the assessment criteria. This approach as suggested by Tomlinson (2014) will see to the rise in standards and quality of higher education.

Aim and objectives of the study

The aim of this study is to determine students' perception on the quality of teaching of integrated architectural design considering the following assessment factors; learning experience, assessment of learning, curriculum content and lecturer quality. The objectives include; to ascertain the specific assessment factors that students consider most important in the quality rating of lecture delivery of integrated architectural design and to determine if the overall teaching quality rating of students is dependent on the lecturer's gender.

LITERATURE REVIEW

In the words of Aniya and Lawal (2006), the teaching of design in schools of architecture presents special needs and challenges as design in itself is an

extremely complex process which requires mental exertion, skills and innovations. Coe, Aloisi, Higgins and Major (2014) observed that good teachers have deep knowledge of the subjects they teach, and when teachers' knowledge falls below a certain level it is a significant impediment to students' learning. This implies that the quality of teaching will inextricably reflect in the quality of learning that takes place. Onwuegbu (1979) succinctly stated that qualitative teaching is one in which the teacher has adequate knowledge of the subject matter, relates cordially with the learner and has a delivery method that emanates from research, experimentation, discussions, individual and group activities so as to get the knowledge intended to the learner.

Several researches(Clark(1995),Marsh and Roche(1993),Ralph(2003) and Ryan and Harrison(1995) have shown that the evaluation of teaching quality in universities by students based on their perception of the strength and weaknesses of the delivery of various teaching components should form part of the learning management system to ensure quality of knowledge delivery in tertiary institutions. Three basic approaches have been identified in the teaching of architecture designs namely: theory and project approach method, studio module method and the integrated module (Nkwogu,2001). This paper deals with students' perception of the quality of teaching of integrated architectural design in architecture schools of South-East Nigeria.

The integrated architectural design module has been found to be procedural, contextual and at congruence with the environment having potentials for developing a research based architectural practice culture that is sustainable (Ukanwa, 2004). It is broken down into various pedagogical stages namely: community study, reconnaissance (study of base map and survey of selected area of the chosen community) documentation and graphical presentation, analysis, synthesis and identification of needed architectural projects within the area of study and finally the design of the public facility/non domestic project and housing project which are products of the established needs that arose from the analysis and synthesis.

Research (Berk, 2005; Harvey, 2003 and Kwan, 1999) has shown that obtaining feedback from students is an essential requirement of evaluating the quality of teaching effectiveness and educational activity in any institution of learning. This will ensure professionalism and quality assurance in university evaluation procedures. Crosier, Purser and Schmidt (2007) further stated that improvement of the learning process, promotion and recognition of teachers will require inputs by students on their quality of learning as supported by Dalton, Denson and Loveday (2010). In their discourse, Collins, Filer, Moore, Onwuegbuzie, Wiedmaier and Witcher (2007), indicated that evaluation of the academic quality delivered by the teaching staff, is an important element in the learning process.

Location

This paper evaluates students' perception of the quality of teaching of architecture in schools of south-east Nigeria. With specific focus on the integrated architectural design module of the Architecture Departments of Abia and Imo States Universities.

Figure 1: Map showing location of Southeast Nigeria
Source: https://www.researchgate.net/fig

Figure 2: map of southeast Nigeria

South-eastern Nigeria is located between latitude 04°151 and 07°N and longitude 05°501 and 09° 30 1E (Chukwu and Mbanaso,1999).It is bounded in the north by Kogi and Benue states of North-Central geo-political zone and on the east, west and south by cross River, Akwalbom, Rivers, Bayelsa, Delta and Edo States of South-South geo-political zone. It covers the present Abia, Anambra, Ebonyi, Enugu and Imo States.

Research questions

The literature review identified some existing gap in knowledge regarding students' perception on the quality of teaching of architecture in South-East Nigeria. This paper seeks to answer the following questions:

I. Which specific factor do students consider most important in the quality rating of teaching integrated architectural design?
II. Is the overall teaching quality rating of students dependent on the lecturer's gender?

Research method

The study adopted case study research methodology in which a sample of 120 respondents comprising of students in year three, four and five of their university education in Abia State University (ABSU) and Imo State University (IMSU) was taken for investigation via purposive sampling technique. The rationale for this choice is predicated by the fact that only these two universities in the South-East offer the integrated architectural design module. Of the 120 structured questionnaires sent out only106 were completed and returned (response rate of 88.3%) while the secondary data constitute information obtained through extant literature. The Cronbach's Alpha, used to determine the reliability or internal consistency of the data set, revealed that the sample size is reliable and adequate. The Mean and Variance statistic were used in the test while Chi-square test of independence and ANOVA were carried out on objective two.

The Cronbach's alpha is computed by correlating the score for each scale item with the total score for each observation (usually individual survey respondents or test

takers), and then comparing that to the variance for all individual item scores. The resulting coefficient of reliability ranges from 0 to 1 in providing this overall assessment of a measure's reliability. A Cronbach alpha less than 0.5 is assumed to be unreliable while a Cronbach alpha value of 0.5 and above is assumed to be reliable. However, the closer the Cronbach alpha value to 1, the more reliable the data set is said to be. The Cronbach alpha value obtained from the analysis was 0.6. The data is then concluded to be reliable as well as valid.

Fig.3: Frequency Distribution of respondents

Results from table 2 and figures 3 and 4 imply that the questionnaires were evenly distributed (60) to each school studied, 20 per class cumulatively 40(33.33%) for each class across both schools. More questionnaires 59(49.20%) were returned from Imo state University as against the 47(39.1%) of Abia state university. More questionnaires were picked up from the 5th year class (39(32.5%) and the least was

clear, transparent and valid. 3. Curriculum; the curriculum develops skills, knowledge and experience relevant to the programme. 4. Lecturer Quality; the lecturer is professional, punctual, dedicated and confident in lecture delivery. Adopted from Marsh and Hocevar (1991).

Table 3: Data on rating of teaching quality of integrated architecture design

S/N	Teaching quality rating	Strongly Disagree(d)	Disagree(d)	Neutral (n)	Agree (a)	Strongly agree (sa)	Total
1	Learning experience	5	6	8	68	19	106
	%	4.7	5.7	7.6	64.2	17.9	100
2	Assessment of learning	5	9	17	49	26	106
	%	4.7	8.5	16.0	46.2	24.5	100
3	Curriculum content	0	10	11	46	39	106
	%	0	9.4	10.4	43.4		

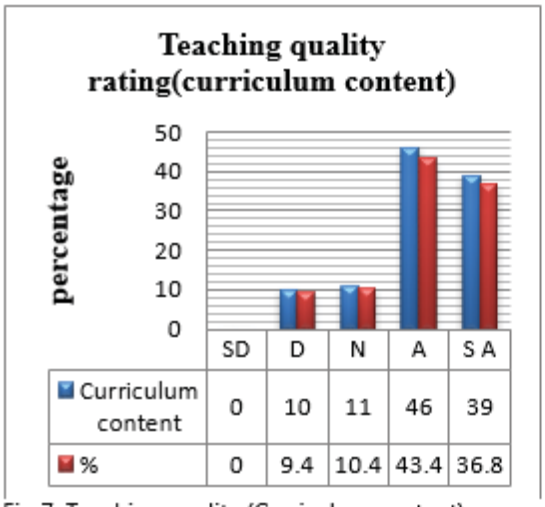

Fig 7: Teaching quality (Curriculum content)

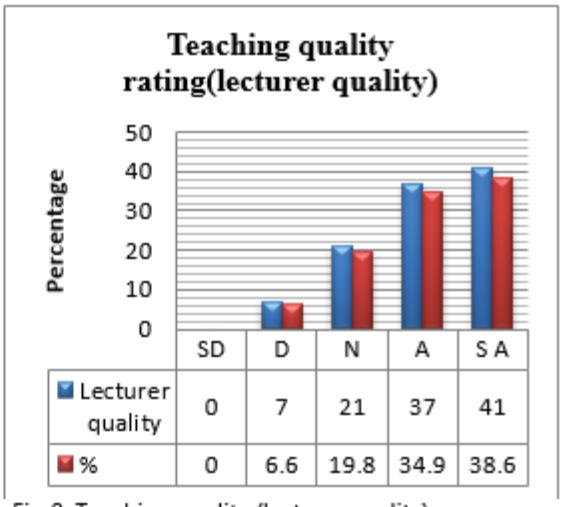

Fig 8: Teaching quality (lecturer quality)

RESEARCH QUESTION 2: Is the overall teaching quality rating of students dependent on the lecturer's gender?

Data was collected using the 5-point Likert scale SD=Strongly disagree, D=Disagree, N=Neutral, A=Agree and SA=Strongly Agree.

Table 4: Data on dependence of teaching quality on lecturer's gender

S/N	Gender	SD	D	N	A	SA	Total
1	Male	43	14	0	16	0	73
	%	40.56	13.21	0	15.09	0	68.86
2	Female	20	0	3	9	1	33
	%	18.87	0	2.83	8.49	0.94	31.14

Table 4 shows that 53.77% of the male respondents (40.56%; strongly disagree,13.21%; disagree) and 18.87% of the female respondents disagree with the notion that gender is connected to the lecturer's teaching quality of integrated architectural design course. This finding is further confirmed by the chi-square test presented on table 8.

ANALYSIS AND DISCUSSION OF RESULTS

Table 5: Analysis on teaching quality rating

Item Statistics	Mean	Std. Deviation	N
Learning experience	4.08	.923	106
Assessment of learning	3.77	1.063	106
Curriculum	4.04	.975	106
Lecturer's quality	3.90	.816	106

Table 6: Scale Statistics

Mean	Variance	Std. Deviation	N of Items
15.78	6.152	2.480	4

Table 7: ANOVA with Cochran's Test

		Sum of Squares	df	Mean Square	Cochran's Q	Sig
Between People		161.502	105	1.538		
Within People	Between Items	6.083	3	2.028	8.703	0.034
	Residual	216.167	315	.686		
	Total	222.250	318	.699		
Total		383.752	423	.907		
Grand Mean = 3.95						

A significance value of 0.034 (< 0.05 level of significance) in table 7 revealed that the test carried out is significant and the mean of rating teaching quality is significantly different.

Table 8: Chi square test

	Value	Df	Asymp.sig. (2-sided)	Exact Sig.(2-sided)	Exact sig. (1 sided)
Pearson chi-square	1.964[a]	1	.161		
Continuity correction[b]	.873	1	.350		
Likelihood Ratic	3.442	1	.064		
Fisher's Exact Test				.351	.181
Linear-by-linear association	1.945	1	.163		
N of Valid Cases[b]	106	1			

Table 8 shows results obtained from the analysis of research question two (table 4). The values obtained in table 8 shows that overall teaching quality rating by students is independent on the lecturer's gender.

CONCLUSION AND RECOMMENDATIONS

Teacher quality by research is said to be the ability to increase students' knowledge and skills which ultimately brings about human capital development in the society. Hence the rating of lecture quality by the direct recipients (the students) is beneficial in improvement of the quality assurance of pedagogy of architectural design education as well as teacher performance. The paper found out two key areas of importance in enshrining quality into architectural design education; the curriculum and the teacher quality. It hence concludes on the need to review the curriculum in order to make necessary changes to ensure quality delivery of the integrated design module.

It further submits that there is need to encourage continuous professional development (CPD) of architectural educators to ensure quality in their

dissemination of knowledge. Finally, the paper submits that students' evaluation of teaching quality should form part of the consideration for the annual performance appraisal for lecturers' promotion as a way to improve the quality of teaching in architecture schools.

This study recommends a comparative research on students' perception of the quality of other architectural design modules in other to reach a logical conclusion and develop a model for assessing quality delivery of architectural education.

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Figure 2: The 3-Legged Model of Sustainability (World Conservation Union IUCN, 2006)

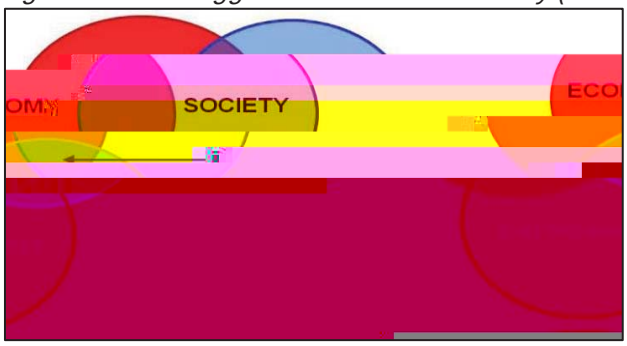

Figure 3: 3-Overlapping-Circle Model of Sustainability (Newman & Kenworthy, 1999 as cited by Kats, 2004)

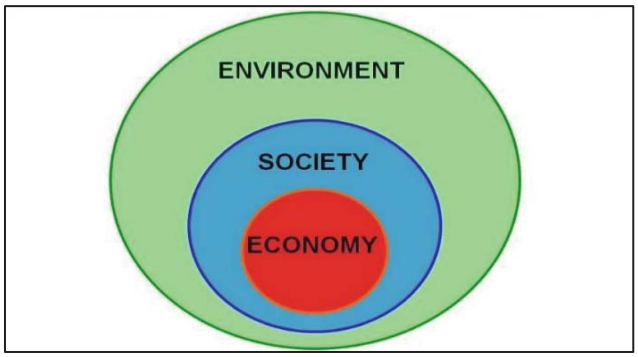

Figure 4: 3-Nested-Dependencies Model of Sustainability (Giannetti, 1993)

Sustainability Assessment Tools

The last couple of decade had seen tremendous growth of building sustainability assessment tools. The first recognized assessment tool emerged in the year 1990 and several others have emerged subsequently from different countries and backgrounds. Sinou and Kyvelou (2006) mentioned that the availability of assessment tool tends to differ from developers due to principles and concept of one tool developed and also it considers the criteria, items evaluation and data. One of the earliest and most profound assessment tools is the UK's Building Research Establishment Environment Assessment Method (BREEAM) developed in the year 1990. The main function of this assessment tools are primary on building specification evaluation including the design, construction and use. According to Ding (2008) the vast experience of BREAAM in building assessment has lead its methodology to be adopted as the foundation of the development of other building assessment tools in Canada, Hong Kong, Australia and many other countries.

The BREEM comprehensive assessment includes all criteria from energy to ecology, the main aspect of management processes, water use, health and wellbeing, transport, pollution and waste. Table 1 shows the rating benchmark of buildings for BREEAM certification. The rating has been identified as outstanding which a building has to obtain a score more than 85% and the lowest rated as unclassified at below 30%. The BREEAM weighting criteria for certification is up to 100 percent (100%) and it consist of nine (9) benchmark points of environmental aspect, energy, health and wellbeing, management, and materials aspects. It has also an additional slot for innovation which gives extra ten percent (10%). Table 2 presents the weighting of the criteria in BREEAM assessment system.

Table 1: BREEAM rating benchmarks

Rating	Score in percentage (%)
Outstanding	Ô 85
Excellent	Ô 70
Very Good	Ô 55
Good	Ô 45
Pass	Ô 30
Unclassified	< 30

Table 2: BREEAM environmental section weightings

Environmental Section	Weighting (%)
Management	12
Health & Wellbeing	15
Energy	19
Transport	8
Water	6
Material	12.5
Waste	7.5
Land Use & Ecology	10
Pollution	10
Total	100
Innovation (additional)	10

Leadership in Energy and Environmental Design (LEED), is the second oldest assessment tool developed, it has been available since the year 1998. This tool was developed by the United States Green Building Council (USGBC). LEED is also one of the earliest assessment tool which has serve as a model that is being adopted and modified according to one's country's environmental, social and economic nature (Reed et al., 2009). LEED is a thirdŽparty certification program and an internationally accepted benchmark for the design, construction and operation of high performance green buildings. LEED promotes a wholeŽbuilding approach to sustainability by recognizing performance in five key areas of human and environmental health (sustainable site development, water efficiency, energy efficiency, materials selection and indoor environmental quality). Certification is based on the total point score achieved, following an independent review. With four possible levels of certification (certified, silver, gold and platinum). LEED is flexible enough to accommodate a wide range of green building strategies that best fit the constraints and goals of particular projects. This tool has a wide range of coverage which include major renovation projects (LEED-NC), existing building operations (LEED-EB), commercial interiors projects (LEED-CI), core and shell projects (LEED-CS), homes (LEED-H) and neighborhood development (LEED-ND) (Sinou & Kyvelou, 2006). The required points for a building to be certified is 40 points and the highest rating is 80 or more to obtain platinum rated.

Table 3: LEED rating system

Rating	Point
Platinum	Ô 80
Gold	79 - 60
Silver	59 - 50
Certified	49 - 40

Table 3 present the rating and points, and Table 4 presents the criteria points for LEED tools.

Table 4: LEED criteria points

Criteria	Points
Sustainable sites	26
Water efficiency	10
Energy & atmosphere	35
Materials & resources	14
Indoor environmental quality credits	15
Innovation in Design	6
Regional Priority	4
Total	110

Japan has one of the most developed assessment tools in Asia, this is known as the Comprehensive Assessment System for Building Environment Efficiency (CASBEE) and it was developed in the year 2001. One of the first tools to emerged in the continent of Asian. The reliability of the tool has gained reputable status as the BREEAM and LEED. The rating tool is mainly focused in green building certification in Japan and Asia. The methodology which is applied during the CASBEE assessment tool usage differs greatly from other tools in existence. It applies the Building environmental efficiency (BEE) model. The Green Star is a sustainable rating tool for an environmental certification scheme. This tool was originally developed by the Green Building Council of Australia (GBCA). Green Star was then adopted by the Green Building Council of South Africa (GBCSA) for use in South Africa (Green Star SA) and has been adopted also by the Ghana Green Building Council (GhGBC) for use in Ghana (Alfris & Braune, 2016). The Green Building Council Australia certifies three levels of green building depending on the points a project achieved during the certification process. The three levels are: 4 Star, 5 Star and 6 Star, indicating “Best Practice”, “Australian excellence” and “World leader” respectively.

METHODOLOGY

The study adopted descriptive design through cross sectional survey. The population consisted of architects, quantity surveyors and construction managers/engineers in the Greater Accra, Central, Ashanti and Brong-Ahafo Regions in Ghana. These construction experts were purposively chosen because of their knowledge and experience in sustainable building practices. Bernard (2002) described purposive sampling as a form of nonprobability sampling in which decisions concerning the individuals to be included in the sample are taken by the researcher, based upon a variety of criteria which may include specialist knowledge of the research issue, or capacity and willingness to participate in the research. The construction professionals were selected to provide useful information on the existing sustainable building rating tools as well as the criteria and weighting points of the proposed rating tool to be used in Ghana. A total of 195 practicing professionals were sampled from across the four regions and data collected. The instruments used for the collection of data were structured questionnaire and a semi-structured interview. A detailed survey questionnaire was designed and developed on the basis of a comprehensive literature review in the research area. To ensure validity, an initial draft of the questionnaire was subjected to critical

review. The relevance of the variables to the purpose of the study was checked, clearly stated and confirmed to be capable of eliciting for the right responses from the respondents. It was shown to experts in the construction industry to review and their comments were used to revise the questionnaire.

The questionnaire consisted of both closed-ended and opened-ended questions. The 4-point Likert scale measuring from 'strongly disagree' to 'strongly agree' was adopted. According to Yin (2003), the Likert scale is easy to use and also decreases doubt, misunderstanding and error. Likert scale also lessens non-response rate and reduces respondents' fatigue. The questionnaire was structured into five main sections, which includes; respondents' background, policy level, application on sustainable construction, challenges that building practitioners face in applying sustainability modules and functionality of sustainable assessment or rating tools in Ghana. The respondents were asked to indicate their degree of agreement or disagreement on the Likert scale as: strongly agree (4); agree (3); disagree (2); and strongly disagree (1). A total of one hundred and forty-six (146) questionnaires were retrieved out of the 195 distributed, making a retrieval rate of seventy-four percent (74%). Data from the field were coded appropriately to make meaning out of them. Coding was done to facilitate data entering and ensure comprehensive analysis. Editing was also done with the aim of detecting and eliminating errors to ensure clean and reliable data. The Statistical Package for Social Science (SPSS) software version 21 was used for the data analysis. Descriptive statistical analysis factors like frequency tables, and percentages were generated to describe the data obtained on the field.

A semi-structured interview was also used to gather information from practicing professionals who are abreast with the sustainability concept or modules. The semi-structured interviews allowed the respondents freedom to express their views in their own terms and this provided reliable and comparative qualitative data (Malhotra & Birks, 2007). An interview guide was used to engage the practicing professionals in a formal interview. The interview guide was prepared based on the main themes that contributed to the developing of a new rating tool. These themes include the categories, the criteria that that makes up each category and comparison of some existing rating tools from literature. To generate the weights for the proposed rating tool, first the categories and criteria have to be decided. In order to do that, existing rating tools were studied and comparison were made and then, the categories and criteria which are suitable for Ghana were short listed. This then formed the basis of the interview with the professionals, the interview was for the professionals to verify the suitability of each category and its criteria. Once criteria have been verified, comparison between these criteria were made to generate weights according to the relative importance. In order to do that, the use the Analytic Hierarchy Process (AHP) technique was employed to make comparison between the criteria to form the basis for the development of a new rating tool for Ghana.

RESULTS AND DISCISSION

Characteristics of Respondents

The characteristics of the respondents were analyzed to ascertain their gender, highest educational level, years of professional practice, the number of works

related to sustainable buildings they have worked on over the years and the region they practice their profession in Ghana. The results are presented in Table 5.

Table 5: Characteristics of Respondents (n=146)

Characteristic	Responses	Frequency	Percent (%)
Gender	Male	113	77.4
	Female	33	22.6
Highest educational qualification	Bachelor's degree	93	63.7
	Master's degree	41	28.1
	Others	12	8.2
Work experience	< 2 years	8	5.5
	2 – 5 years	37	25.3
	6 – 10 years	86	58.9
	> 10 years	15	10.3
Number of works on sustainable building	Never	23	15.8
	1 - 10	62	42.5
	11 - 20	26	17.8
	> 20	35	23.9
Region of practice in Ghana	Greater Accra	67	45.8
	Central	23	15.8
	Ashanti	42	28.8
	Brong-Ahafo	14	9.6

Policy on sustainable development in Ghana

This section deals with the analysis on the policies on sustainable development in Ghana. This section seeks to determine from the respondents the relevance in employing policies and codes to regulate sustainable building practices in Ghana. Successively, respondents were asked to indicate their level of agreement from scale of 1 to 4, the need to have and apply formulated policies from government to guide sustainable building practice. Where 1=strongly disagree, 2=disagree, 3=agree, and 4=strongly agree. A mean value of 2.00 or greater is deemed to be a level of agreement. Table 6 presents the results obtained from the respondents.

Table 6: Policy on sustainable development in Ghana (n = 146)

Sustainable Policy	Frequency				Mean	SD
	SD	D	A	SA		
Sustainable development depends on Government policies	17	23	54	52	2.96	0.99
Policies in Ghana encourages sustainable practice	44	46	54	2	2.09	0.84
Policies are sufficient in building sustainable in Ghana	28	90	23	5	2.03	0.69
Policies should be amended	2	6	52	86	3.52	0.64
Policies should be obligatory	2	17	35	92	3.48	0.75
Policy co-ordination and regulations should be centralized in one body	0	37	71	38	3.00	0.71
Policies should regulate new buildings	7	47	51	41	2.86	0.88
Policies should apply to all kinds of structural development	0	8	53	85	3.52	0.60
Policies should factor in environmental, economic and social issues	2	3	52	89	3.56	0.60
Criteria for professional selection should include demonstrated knowledge of green building practices	6	4	88	48	3.21	0.68

SD=Strongly Disagree, D=Disagree, A=Agree, SA=Strongly Agree

All of the variables or items analyzed had mean values greater than 2.00 as can be seen in Table 6. The respondents rated policies should factor in environmental,

economic and social issues highest with mean value of 3.56. This was followed by policies should apply to all kinds of structural development, policies should be amended, policies should be obligatory, criteria for professional selection should include demonstrated knowledge of green building practices and policy co-ordination and regulations should be centralized in one body with mean values 3.00 and above. Sustainable construction cliché is fast becoming a widespread phenomenon globally and among industry players. Djokoto et al. (2014) identify the lack of policy and codes to regulate the practice as the major barrier to sustainable building practice in Ghana. A sustainable policy seeks to drive forward the sustainable construction by providing clarity around the existing policy framework, signaling the future direction of Government policy and showing what can be done towards making sure they are enforced. The respondents indicated that policies should factor in environmental, economic and social issues of sustainability for the full balance of sustainable principles as also indicated by Ikediashi, Ogunlana and Ujene (2014) and Danso (2015). Schwartz and Raslan (2013) also identified that rating systems are developed to assess the sustainability of a building in accordance with the economic, cultural and ecological environment they are being used in, it was therefore of no surprise when the respondents also indicated that all the dimensions should be factored in the policies. The respondents also believed that policies should apply to all kinds of structural development, be amended, and be obligatory. Also the respondents demonstrated through their responses that professionalism is essential towards suitable sustainable practice so therefore professional selection should include demonstrated knowledge of green building practices as architects educated in green design better serve their clients by designing buildings that cost less to occupy and maintain as Kats (2003) propounded. Factors that determine a building's performance, such as site selection; orientation; foundation, walls, and roof; heating, cooling, and ventilation; and lighting, are either directly or indirectly influenced by the design decisions of the architect (Kats, 2003).

Challenges that building practitioners face in applying building sustainability modules in Ghana

This section analyses the challenges that practitioners face in applying sustainable building modules in Ghana. The respondents were therefore asked to indicate their views by ranking the challenges on a Likert scale of 1 to 4, where 1= strongly disagree, 2= disagree, 3=agree and 4= strongly agree. A mean value of 2.00 or greater is deemed to be a level of agreement. Table 7 presents the results obtained from the respondents.

All of the variables or items analyzed had mean values of 2.00 or greater as can be seen in Table 7. This therefore indicates that respondents largely agreed with the challenges of sustainable development in the construction industry in Ghana. The respondents rated initial and operational cost of sustainable buildings are very high as compare to the conventional buildings first with mean value of 3.19. This was followed by lack of government support and financial incentives in the industry, buildings that attain sustainable certification should be embossed with the certificate to encourage other building owners, learning and skills training on sustainable construction is inadequate in the country, commitment level of stakeholders in the industry is very minimal and not enough research has been carried out on sustainable development to ascertain its viability and practicality all

recording mean values greater than 3.00. Rehm and Ade (2013) emphasis that green building construction costs is higher on average.

Table 7: Challenges of sustainable development in Ghana (n =146)

Challenge	Mean	SD	Rank
Initial and operational cost of sustainable buildings are very high as compare to the conventional buildings	3.19	0.65	1st
Sustainable buildings do not ensure value for money	2.00	0.69	10th
Professionals in the construction industry are not well versed in sustainable building practices	2.35	0.84	9th
Materials and technologies know-how are not readily available in Ghana	2.47	0.89	8th
Commitment level of stakeholders in the industry is very minimal	3.07	0.86	5th
Learning and skills training on sustainable construction is inadequate in the country	3.08	0.79	4th
Buildings that attain sustainable certification should be embossed with the certificate to encourage other building owners	3.10	0.70	3rd
No clear and consistent guidelines or framework for measuring sustainable construction	2.84	0.47	7th
Not enough research has been carried out on sustainable development to ascertain its viability and practicality	3.06	0.74	6th
Lack of Government support and financial incentives in the industry	3.13	0.78	2nd

Most of the respondents perceived sustainable construction to be expensive due to the varied new ideas, systems and components emanating frequently and which are considered expensive to acquire, install and operate. This therefore, leads to the general apathy attached to green building products (Kats, 2003). Governments have important role to promote green building development. Naturally for a developing country like Ghana, the need to have a government ready to lead in the provision of sustainable construction is vital and critical (Ofori, 2006). Physical visual inscription of sustainability status on buildings may serve as an incentive and awareness creation of the subject. According to Dzokoto et al. (2014), the Toronto Green Development Standard (TGDS) indicated that public awareness about green building was the most important component that led to high demand in Canada. Asamoah and Decardi-Nelson (2014) concluded that many of the construction projects in Ghana are becoming larger and more technical in sustainability and will require a higher quality of professional services and better control systems to meet the needs of the growing population. This therefore needs investment in training skills for the survival of the construction industry. Häkkinen and Belloni (2011) posited that sustainable building practice can be hindered by ignorance or a lack of common understanding about sustainability, and this therefore calls for adequate training and continuance skills development which most of the respondents agreed as lacking in the Ghanaian green building industry.

Sustainable assessment tools use in Ghana

In this section, the respondents were asked to indicate their knowledge on the existence and functions of assessment tools in Ghana. The respondents were asked to acknowledge whether or not they know or have heard of any sustainable building assessment tool used in Ghana and name them. Out of the 146 respondents, 83 representing 56.8% said “Yes” indicating they know of sustainability assessment tools use in Ghana, while 63 representing 43.2% said “No” as shown in Table 8. All the 43.2% that answered “No” did not give any name.19.1% of the respondents provided Green Star (Eco Homes) as the tool used

in Ghana and 31.5% wrote "Others" ranging from BREEAM, LEED, Building Code etc. as the building assessment or rating tools they know of being use in Ghana. This implies that the knowledge does not match practice as noted by Nduka and Sotumbo (2014) and Abidin (2010) and perhaps, the Ghana Green Building Council, needs to engage in more of educational programs which will translate the awareness into practice.

Table 8: Sustainable building assessment tools use in Ghana

Responses	Frequencies	Percentage (%)
Yes	83	56.8
No	63	43.2
If "Yes" kindly name them:		
Not sure	9	6.2
Green star (Eco Homes)	28	19.1
Others (BREEAM, LEED, Building Code, etc)	46	31.5

On the functions of assessment tools use in Ghana, the respondents responded to the variables in the Table 9. All of the variables or items analyzed had mean values greater than 2.00. It can be observed that the respondents rated *tool used in assessing the sustainability of buildings in Ghana needs to be updated or changed* highest with mean value of 3.47. This was followed by rating tool for office and commercial buildings should be different from the *rating tool for a residential facility, the assessment tool used in Ghana should be or can be modified to reflect conditions in Ghana, and the rating criteria for office and commercial buildings should be different from the rating of residential facility*. All these variables obtained mean values greater than 3.00.

Table 9: Functional assessment of sustainable tools use in Ghana

Functional assessment	Mean	SD	Rank
Tool used in assessing the sustainability of buildings in Ghana is very efficient and effective	2.18	0.67	10th
Tool used in assessing the sustainability of buildings in Ghana needs to be updated or changed	3.47	0.52	1st
A single tool to rate all kinds of buildings is appropriate	2.38	0.91	9th
Tool used to assess sustainability of buildings in Ghana considers all aspects of sustainability dimensions	2.60	0.61	7th
A rating tool for office and commercial buildings should be different from the rating tool for a residential facility	3.35	0.48	2nd
The rating criteria for office and commercial buildings should be different from the rating of residential facility	3.17	0.48	4th
Measuring sustainability is relatively new in Ghana and so there is a lack of commonly accepted standard	2.95	0.70	5th
The tool used in assessing the sustainability of buildings in Ghana is very easy and simple to understand	2.15	0.65	11th
There is lack of assessment of building performance during operating stage with the current assessment tool used in Ghana	2.56	0.89	8th
The assessment tool focuses on social aspects of sustainability such as stakeholder engagement; health and safety performance	2.66	0.52	6th
The assessment tool used in Ghana should be or can be modified to reflect conditions in Ghana	3.27	0.70	3rd

The respondents were highly of the view that tools used in assessing the sustainability of buildings in Ghana need to be updated or changed, due to the fact that the tools found in the country were not design to meet the existing conditions

in Ghana. This, therefore, suggests the need for the country to develop its own assessment tool which takes into consideration the existing conditions, instead of applying tools that were design for other countries. It is in light of this that the respondents agreed that assessment tool used in Ghana should be or can be modified to reflect conditions in Ghana. Ahmed et al. (2014) agreed with the respondents that, a single tool used to rate the sustainability status of all kinds of buildings is not appropriate, they identified a deficiency in the tools used in Ghana as failing to consider the interaction among different actions towards sustainability. This is in line with the respondents rating that a rating tool for office and commercial buildings should be different from the rating tool for a residential facility. Similarly, clearer building rating systems will result in more sustainable buildings and practices as espouse by Ahmed et al. (2014). Suopajarvi (2011) identified that an effective and efficient rating tool should include sustainability assessment indicators used for providing summaries and to focus and condense the complex surroundings into a form of manageable indicators. Building rating systems were developed as a means for the construction industry to meet the sustainability challenges.

The proposed green building rating tool for Ghana [Green Rating & Measurement System for Ghana (GRMSG)]

The Analytic Hierarchy Process (AHP) method was employed to select a rating tool among the key ones analyzed in order to choose one that best measure indicators similar to the condition of Ghana. This criterion was then modified to suit the prevailing conditions in Ghana. Table 10 presents the AHP analyses in details.

Table 10: Analytic Hierarchy Process (AHP) method for the selection

	BREEAM	LEED	GBCS	GREEN STAR		
BREEAM	1.000	0.200	0.111	3.000		
LEED	5.000	1.000	0.142	5.000		
GBCS	9.000	7.000	1.000	0.111		
GREEN STAR	0.333	0.200	9.000	1.000		
SUM	15.333	8.400	10.253	9.111	WEIGHT	PERCENT
BREEAM	0.065	0.023	0.010	0.329	0.107	10.7%
LEED	0.326	0.119	0.013	0.548	0.251	25.2%
GBCS	0.586	0.833	0.097	0.012	0.382	38.3%
GREEN STAR	0.021	0.023	0.877	0.109	0.257	25.8%

A number building practitioners within the four regions under study were interviewed based on their experience in the construction industry through design to supervision of works. The interview was based on the outcome of the AHP analyses which projected the Green Building Certification System (GBCS) as the rating tool preferably to be modify to suit Ghana's condition. From Table 10, GBCS got the highest percentage (38.3%). The interview focused on the nine (9) main categories which comprises of the following: Land Development with 4 criteria, Transportation having 3 criteria, and Energy Efficiency, Materials Resources Efficiency, Water Efficiency containing 4, 8 and 5 criteria, respectively. The rest are Carbon Emissions reduction with 1 criterion, Maintenance / Innovation /Management having 3 criteria, Environment ecology and Indoor Environmental Quality (IEQ) with 4 and 8 criteria, respectively. The interview with the practitioners resulted in the above mentioned categories as being able to adequately measure sustainability of buildings in Ghana.

Table: 11: Propose "Green Rating & Measurement System for Ghana (GRMSG)"

Categories	Criteria	Benchmark Point (BMP)		
		Weight	TW	Possible Points
Land Development	Ecological Value of Site	1		
	Preservation of Existing Natural Resources	1	4	12
	Interference with Daylight to Adjacent Properties	1		
	Provision of Community Center and/or Facilities	1		
Transportation	Accessibility to Public Transportation	1		
	Installation of Bicycle Racks And Roads	0.5	2	6
	Easy Accessibility to City centers	0.5		
Energy Efficiency	Reduction of Annual Energy Consumption	1.5		
	Use of Alternative renewable Energy Sources such as solar etc.	2	6.5	19.5
	Use of motion and daylight sensors	2		
	Daylight & natural ventilation	1		
Materials Resources Efficiency	Application of Environmentally Friendly Construction Methods/Materials	3		
	Locally sourced materials	2		
	Built-In Furniture	1	14	42
	Installation of Recycling Containers	2		
	Installation of Food Waste Containers	2		
	Reuse-Nonstructural Elements	1		
	Use of Recycled-Content Materials	2		
	Reuse-Structural Elements	1		
Water Efficiency	Water Efficient Landscaping	1		
	Water Use Reduction	1		
	Installation of Storm water Reuse Systems	1	5	15
	Installation of Gray water Reuse Systems	1		
	Rain water harvesting	1		
Atmosphere/ Emissions	Reduction of CO_2 Emissions	3	3	9
Maintenance/ Innovation/ Management	Waste Management and Reduction Planning	1		
	Health and safety management planning	0.5		
	Provision of a Building Manager's Manual	0.5	2.5	7.5
	Provision of an Occupant's Operations and Maintenance Manual	0.5		
Ecological Environment	Consistent Green Space in the Complex	2		
	Application of Planned Landscaping	1		
	Improving the Local Ecological Environment	1.5	5	15
	Topsoil Reuse	0.5		
Indoor Environmental Quality	Use of Low-Emitting Materials	3		
	Installation and Controllability of thermal and cooling System	1		
	Noise Between Floors prevention	0.5	8	24
	Noise Between Walls prevention	0.5		
	Noise from Outside prevention	0.5		
	Accessibility for The Disabled and Elderly	1		
	Increased natural Ventilation	1.5		
Categories = 9	Criteria = 40	50	50	150

These categories and criteria were obtained by shortlisting from the existing rating tool that the AHP suggested as the most suitable for the Ghanaian industry. The weightings are based on the magnitude of the category and criteria's ability to impact on sustainability, it is also based on readily availability and cost of procurement as well as installation of the component. For example, installing bicycle rack is much cheaper than installing renewable source of energy such as

solar systems or wind turbine, so the weight of the two varies in terms of the weighting points. Table 11 throws more highlight on the categories as well as the criteria with it respective weightings and possible points. The total weight (TW) is the sum of all the criteria weights whiles the Possible points of a category is obtained by multiplying the TW by the Benchmark point of three (3) for each category.

As there was an assigned benchmark point (BMP) of three (3) for each category, the weighting value accrued by a project by the BMP will form the accrued points for the proposed assessment tool. The total possible accrued point is one hundred and fifty (150) and a minimum accrued points for a certification is forty (40). Any building is therefore required to earn a minimum point to attain a certification. Buildings earning higher scores will be rewarded with different certification levels depending on the specific thresholds they reach. The proposed GRMSG will have four certification levels which include: Bronze (40-59 points), Silver (60-79 points), Gold (80 -105 points), and Diamond (106 – 150 points) as shown in Table 12.

Table 12: Certification levels

Rating	Score
Diamond	106 - 150
Gold	80 - 105
Silver	60 - 79
Bronze	40 - 59

SUMMARY AND CONCLUSION

The study aimed at analyzing the existing sustainable assessment tools and develop one for the Ghanaian construction industry. It also seeks to assess sustainability policies and challenges for effective delivering of sustainable buildings in Ghana. The study revealed that policies backing sustainable building construction in Ghana are inadequate and existing ones should: factor in environmental, economic and social issues; apply to all kinds of structural development; and be obligatory. The key challenges identified with sustainable buildings include: high initial and operational cost, lack of government support and financial incentives, lack of certification, inadequate skill training, and minimal commitment level and research. The study further revealed that the rating tool most used in Ghana is the Green Star Eco Homes which was adopted from Green Star Australia (GS A-v1) and South Africa (GS SA-v1), and most responded did not know the name of the rating tool used in Ghana. On the functions of assessment tools use in Ghana, it was observed that the rated tool needs to be updated or changed, the rating tool for office all used2.94d iibuildreflng value -eng125 rhe ra

Measurement System for Ghana (GAMS), and therefore, the Ghana Green Building Council (GHGBC) should consider its adoption for use in assessing and certifying green buildings in Ghana.

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The built environment and the sustainable development goals

One of the accents of SDGs was tackling climate change based on human activities in the built environment. It also evolved with a practical guide for reduction in the negative impact of the built environment activities on human health and natural resources. This was targeted among other things, to ensuring that professional build sustainable cities and communities with robust infrastructure that promote sustainable industrialization and foster sustainable innovation. The gains would enhance adaptation to climate change, resilience to disasters, development and implementing sustainable buildings using environmentally friendly materials, (#Envision2030 Goals).

The technology of "green buildings" and ecological balance

A green building is one which has been designed, constructed and is being operated to minimize resource use, reduce waste and negative environmental impacts, maximize the health and productivity of occupants and to decrease life cycle costs. It is a building that makes efficient use of land, materials, energy, and water; generates minimal or no waste; provides a healthy indoor environment for its occupants; and one that restores, improves, or enhances the natural environment, (Linda, 2013). As opined by Farham & Mohammad (2014), green buildings are such that by their design, choice of materials and construction, have been adapted with the environment and have the capacity to conserve land resources. In green buildings, all related subjects such as designing, construction, maintenance and demolishing are considered and consciously made compatible with the environment. Architects, engineers and other built environment professionals, in each step of green construction, spend ample efforts to develop and complete classic designing in order to provide economic and durable residents to live in, by their complimentary activities. Green building helps build environment and provide safety and health for residents by taking cognizance of efficient usage of water energy and other resources; protecting environment and improving the efficiency of users; and deceasing waste, pollution and demolishing environment.

On the other hand, survival of all living organisms is realized as a result of ecological balance. The term ecological balance is used to describe the equilibrium between human being, plants, and animals as it relates to their environment.

Human beings play a key role to maintain ecological balance because they have the highest thinking capacity as compared to other living organisms. Therefore, this balance is very important as it ensures survival, existence and stability of the environment. Harmonious relationships reflect healthy and desirable ecological balance.

As human population increases over time, so does the need to develop more land. Many ecosystems are destroyed in order to clear land for housing developments and roads, agricultural uses and raising livestock, (Tamara, 2018). These activities should be checked to prevent excessive destruction of the forests, this is the role of the built environment professionals, being that deforestation leads to drought. Drought reduces food production resulting to insufficient food. Insufficient food leads to starvation and later death occurs, hence reducing the existence of some species. A major human activity impact worthy of note for ecological balance is the design specification, choice of materials and the construction methods deployed

by the built environment professionals. With consciously planned ecological balance, conducive green environment is maintained therefore, living organisms multiply and thrive.

OVERVIEW OF SOME SELECTED BUILDING MATERIALS AND THEIR APPLICATIONS

In Australia, during the Sustainable Built Environment 2016: International High-Performance Built Environment Conference, both academics, researchers and practitioners gathered and discussed ways to make construction more sustainable. During the proceedings, a number of materials were brought to the fore as innovations and improvements on existing ones, (Rachel, 2016).

Ceramic materials

Ceramics are inorganic, non-metallic and largely polycrystalline materials that may be shaped at room temperature from a selection of raw materials. They obtain their typical properties by sintering at high temperatures (Robert, 2010). Ceramics are used for wall decoration and cladding. Wall cladding could be used internally or externally depending on what purpose they serve, the functions cladding serves ranges from sound proofing, muffing, padding and the likes. The adoption of tiles replaced the advent of wooden floors, concrete floors, polyvinyl carpets and rugs. The main problem with most of the floors before the adoption of tiles was their durability, cost and degree of ease of cleaning. More so, polyvinyl carpets have been discovered to be non-biodegradable and to give off cancerous fumes when ignited. Wall tiles prevent the walls of washrooms, laundries, kitchens, etc., from soaking up water which encourages the growth of algae that could portend health challenges to inhabitants of the built environment. Sanitary wares are ceramic wares often found in bathrooms and toilets, they include water closets, sinks, urinals, bidets, wash hand basins, etc. Their use is employed because of their ease of cleaning and ability to separate man from solid and liquid wastes of the built environment.

Composite materials

Diverse classes of materials can be combined to achieve some other materials with properties and performance that are exceptional. These resultant materials are called composites. In general terms, all materials are composites except elements. A mixture of two elements can be considered to be a composite in structure on an atomic scale, but on a larger scale, composites comprise of crystals, phases and compounds. Therefore, it can be said that steel, which is an alloy of carbon and iron, is a composite. Brass, on the other hand, is a single-phase alloy and not a composite.

In essence, composites are special material brought about by combining materials differing in composition or form on a macro scale for the purpose of obtaining specific characteristics and properties (Brian, 2004). Constituting parts of a composite always retain their identity such that they can be physically identified and they exhibit an interface between one another. A composite has two main parts. The matrix and the reinforcement. The matrix is the body part that gives the composite its bulk form, while reinforcement part is what determines the internal structure of the composite. This could also be referred to as fiber (Schwartz, 1992).

Researchers have tested lightweight materials that are composed of sand, cement, and even the fiber of waste from young coconut and durian for strength and bulk density. Their studies have shown that these materials are good for the construction of walls and roofs, thereby saving energy and reducing waste from the fruit industry, (Anton, 2016). With growing need for stronger but lighter-weight materials in the construction industry today, more and more composite materials are being developed and discovered. Composite materials often matched material strength, flexibility and attractiveness aside cost concerns.

Polymers

Polymer is a compound word which derives from poly, meaning many, and mer, meaning unit. (Reece, 2011). Polymers can be classified either by physical properties, formability, and reactivity; or according to their chain chemistry. Polymers that can be repeatedly shaped and reshaped are called thermoplastics, whereas those that cannot be reshaped at any temperature once they are set are termed thermosets.

Application of polymers in buildings

Environmentally sustainable materials are a major focus of this paper, due to the raising environmental issues of degradation, depletion and pollution (Aihua, et al., 2014). Environmentally friendly polymers include biodegradable and bio based (from renewable resources). In everyday life, polymer applications are as follows: polyethylene are used for electrical insulations; polyvinyl chloride (PVC) is used in pipes, and flooring; polyvinyl acetate is used in adhesives and latex paints; nylon is used in textile and fabrics; bekalite is used for electrical non-conductivity and heat resistant properties in electrical insulators, radio and telephone casing and divers other applications. The main set back with polymers is that most variations of it are non- biodegradable. A disadvantage of the use of polymers, especially (PVC), asbestos and the likes in the built environment.

21ST CENTURY BUILDING DESIGN AND THEIR ENVIRONMENTAL IMPACT

Building materials and their production process are important factors that impact directly on the environment. However, this impact differs from place to place, according to ecological applications of such buildings, (Tulay, 2007). Impact on environment during production of building materials is reduced especially in production of materials at production plants.

In the year 2000, Adalberth Karinin in a research investigation titled: Energy Use and Environmental Impact of New Residential Buildings, where seven (7) authentic buildings built in the 1990s in Sweden were sampled. They were analysed according to energy use and environmental impact during their life cycle, under the following indices: manufacture of building materials, transport of building materials and components to the building site, erection to a building, occupancy, maintenance and renovation, and finally demolition and removal of debris. Results showed that approximately 85 percent of the total estimated energy use during the life cycle was used during the occupation phase. The energy used to manufacture building and installation materials constitutes approximately 15 percent of the total energy use. Between 70 to 90 percent of the total

environmental impact issues arises during the occupation phase, while the manufacture of construction and installation materials constitutes 10 to 20 percent. In conclusion, the energy use and environmental impact during the occupation phase make up a majority of the total, (Adalberth, 2000). This leads to the following 21st century environmental-friendly design applications:

i. Leadership in energy and environmental design (LEED)

Leadership in energy and environmental design is a program that provides a framework for green buildings that can identify and implement measurable design, construction, maintenance and operations solutions. LEED measures nine (9) key areas: regional priority, sustainable sites, innovations in design, materials and resources, energy and atmosphere, water efficiency, indoor and environmental quality, awareness and education and finally, locations and linkages.

There are benefits derivable from LEED. First, it gives projects a positive image. Green building practices can help in significant cost and energy savings. It promotes clean and renewable energy. The indoor air and daylight provide better quality of life to those in the buildings. It indirectly helps to increase the productivity of building occupants and their environs, (Farham & Mohammad, 2014).

ii. Excellence in Design for Greater Efficiencies (EDGE)

Already more than half of all resources consumed globally are used in construction and almost half of all energy generated across the world is used to cool, light, and ventilate our buildings. Meanwhile, buildings account for 15 percent of worldwide greenhouse gas emissions—a number that is expected to climb higher as more people migrate to urban centres for work in coming decades. With this in mind, developing country governments are focusing on the building sector as an area for reform and innovation.

According to International Finance Corporation (IFC, 2015) EDGE encourages sustainable architecture. Building design should at least demonstrate a minimum 20 percent efficiency saving in energy, water and embodied carbon, that is, professionals looking for innovative ways to help adapt and promote more affordable, energy-efficient designs and specifications.

Going green in the building sector, by sustainable materials, can save investors serious money through lower energy and water bills. Until now, going green in the building business seemed a luxury for the wealthy or for select multinational companies looking to make a branding statement. However, as professional are more grounded in these approaches, even the low and medium income buildings can also now adopt this environmentally sustainable designs.

iii. Building Information Modelling (BIM)

Building Information Modeling (BIM) is one of the most promising developments in the built environment (Salman, et al., 2008). It simulates the construction project in a virtual environment such that an accurate virtual model of the building is digitally constructed. When completed, the computer-generated model contains precise geometry and relevant data needed to support the construction, fabrication and procurement activities required to realize the building (Eastman et al., 2008).

At this point it would be easy for environmentally sustainable materials to be selected. It is important to note that a building information model characterizes the geometry, spatial relationships, geographic information, quantities and properties of building elements, cost estimates, material inventories and project schedule. This model can be used to demonstrate the entire building life cycle (Bazjanac, 2006). As a result, quantities and shared properties of materials can be readily extracted with considerations on environmental sustainability concerns.

CONCLUSION

The role of professionals in building environmental sustainability cannot be overemphasized. They work hand in hand from start of any building project to the end at different stages for the one big purpose of creating a conducive built environment. The choice of materials is also a shared responsibility. The choice of materials is often guided by the function to which they are to serve. Apart from cost consideration, other considerations that could determine the selection of materials are heath, aesthetics, environment, etc. With the advent of LEED, EDGE and BIM in this 21st century, innovation has taken centre-stage in the built environment and is still pushing up its frontiers with multiple function sustainable materials and designs for development.

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SUSTAINABLE SOLID WASTE MANAGEMENT IN NIGERIA: REVIEWING THE CONTRIBUTIONS OF SOCIAL NETWORKS IN INFORMAL SOLID WASTE COLLECTION ACTIVITIES

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INTRODUCTION

Research has shown that one of the intractable challenges confronting cities of the global south is how to cope with the challenge of municipal solid waste management and Nigerian cities are no exception. Efforts by city authorities using municipal collection crew, public-private partnerships among other measures to manage solid waste seem inadequate and unsuccessful (Ogbazi, 2009). For instance, estimates suggest that only 30-70 percent of wastes generated in the cities of developing countries were collected for disposal despite spending 30 to 80 percent of operational budget on waste management (Ezeah,, Fazakerley & Roberts, 2013; Medina, 1998). In the midst of this inadequacy, informal collection and disposal seem to be trying to fill the gap. This

authorities often perceive informal solid waste collectors and their activities as social nuisance and aesthetic problem; because they operate outside of government regulations. Of course it is forgotten that because they are outside the

authorities, NGOS and private contractors that are contributing to solid waste management and livelihood challenges (Ezeah et al., 2013). This is yielding positive benefits not only in reducing solid waste but also community liveability. Furthermore, Ezeah et.al (2013) avers that in China the role of itinerant waste buyers and merchants in separation, collection and utilization of reusable solid waste materials collectively increased local demand for secondary raw materials for the local industries. This has influenced solid waste collection activities. The study further highlighted that in Indian cities, partnership exists between local authorities and the recycling workers as well as NGOs and private contractors in Bangalore, Chennai and Delhi for waste collection services. In Madras, one of the cities in India the, nongovernmental organization (NGO) EXNORA created a waste collection programme where residents pay 0.36 dollars per month for refuse collection (Ezeah et.al. 2013). This has reduced littering, increased collection rates and dignifies the activities (Medina, 2000). In Sáo Paulo COOPAMARE cooperatives have 80 members along with 200 independent waste pickers who sell its materials. The report emphasized that in Bogota, a partnership has been formed to operate a waste recycling plant managed by the Bogota Association of waste pickers. In Banbkok, Jakarta, Kanpur, Karachi and Manila recovery activities of recycling collectors saved each city at least 23million dollars per year (Medina, 1998). Gunsillus (2011) reported that in Asian and Latin American countries waste workers have managed to establish organizations, cooperatives and other networks that partners with municipal government and private enterprise in the collection of waste and sale of recycled products. This goes to confirm the assertion by many researchers that the activity is a potent tool for sustainable so

Gunsilllus, 2011). They engage in collection, sorting and marketing of valuable materials of different types disposed of as waste such as plastics, aluminium and bottles among others. Ezeah et.al. (2013) found that many people in the cities of Cairo (Egypt), Cluj (Romania), Pune and Quezon (India) were employed in the sector and earning variously from the activity.

Despite the quantum of extant literature interrogated over time and space in these places, contextual and geographical gaps were observed. There has been no known empirical research on social network and solid waste collection activities in the study area to help engage the attention of city authorities in Nigeria despite growing informal sector activities. For instance Onyebueke (2013) documented that the size of the informal sector activities in Nigeria in 2000 stood at 57.9%. Little or nothing is known on social networks and informal solid waste collection activities in North Central Nigerian cities. Whiteman, Barrat & Westlake (2006) focused on solid waste management as a catalyst for governance reforms: Micro-licencing for private sector participation in Nigeria while Aondoakaa and Akpen (2009) investigated solid waste management in Gboko, Benue state north central Nigeria. Similarly, Magaji & Dakyes (2011) assessed the impact of waste scavenging in Gwagwalada, Abuja while Adeoye, Sadeeq, Musa & Segun (2011) researched on solid waste management in Minna, Niger state, Nigeria. In all of these studies, less attention was paid to examining social networks and the informal recycling activities. Empirical data on social networks and the informal solid waste recycling activities in the study area that might influence policy decision is lacking hence the need for this study.

Merits and demerits of social network

Although most literature upholds social network as an asset some scholars criticize social networks/capital and theories or models especially on the grounds of variation in the definition of the strength of ties (weak or strong) especially outside job seeking circle. Meagher (2005) argued that social capital can sometimes operate as mechanism of conspiracy. Collier (2002) opined that it is not good because the control of institutions like clubs or unions by the powerful can produce "Mafias". It can also act as a means of bribery and opportunism (Gambetta 1996). In his studies Portes (1998) criticize social capital on the account of the drawbacks that may result when groups develop high levels of cohesion and the solidarity is cemented by common experience of adversgrowingl2002a-.000pevhorities36ployedthe

Response of city authorities to social network activities

Studies have shown that in several cities of developing world the attitude and reaction of city authorities tend to neglect the activities of social network in informal solid waste collection despite their contribution to solid waste management. According to Medina (1998) the network and their activities are

agencies responsible for solid waste management. This study therefore seeks to fill this void. The study aim is to examine the contributions of social networks in informal solid waste recycling activities in Makurdi and Lafia cities, with a view to providing empirical data that will guide urban planning decisions. The specific objectives were to: (i) explore the social networks that sustain informal solid waste recycling chain, (ii) examine the ways social network support the activity (iii) determine the implications of the role social networks play in informal solid waste collection on urban development in Makurdi and Lafia cities(iv)determine the response of city authorities to social network activities. The core research problem is how to engage the attention of city authorities' towards social networking as a sustainable solution to solid waste management challenges in Nigerian cities. The central research question is; how is the neglect of social network by city authorities and waste management agencies affecting solid waste management in Nigerian cities.

RESEARCH DESIGN AND METHODS

The research used survey research design approach; it also utilised qualitative research methods. Structured questions which were close and open ended were used to illicit information from waste pickers on their perception of the social networks that support the collection activity, average amount of waste collected by waste pickers per day(in kg). Similarly, key informant interviews with some of them targeted information on how the social networks they identified foster their activities. Qualitative interviews were also conducted with chairmen of waste dealers associations for Makurdi and Lafia. Information elicited here includes, ways the network support members as well as reaction of city authorities to their activities. Furthermore key interviews were conducted with heads of relevant Ministries and Waste Management agencies on their perception of the activities of informal waste pickers, their social networks and whether they engage them.

Data collection

The target population for data collection was 1100 (600 in Makurdi and 500 in Lafia) waste pickers derived from total registered membership population of the dealers association in Makurdi and Lafia cities. Taylor, Sinha & Ghoshal (2006) averred that for a population that is homogenous in characteristics like that of waste pickers any sample used does not make any significant difference. In view of this, 70% was used to sample 770 respondents as indicated in Table 1 and 2.

Relying on preliminary information from the dealers about the number of pickers that supply recyclable waste materials to their shops in the neighbourhoods, the sample sizes in table 1 and 2 were randomly selected across the activity areas in the neighbourhoods. The actual number of respondents per neighbourhood depended on the intensiveness or conc

Table 1: Distribution of questionnaire among sampled residential neighbourhoods in Makurdi

S/N	Name of neighbourhoods	Estimated population	No. of questionnaires administered
1	Wurukum	10,150	120
2	Wadata	8,475	100
3	North Bank	9,222	90
4	High Level	10,640	60
5	Ankpa Ward	7,500	50
	Total	45,987	420

Source: Researcher's field survey (2015).

Table 2: Distribution of questionnaire among sampled residential neighbourhoods in Lafia

S/N	Name of Neighbourhoods	Estimated Population	No. Of Questionnaire Administered
1	Old Town Area	6,301	120
2	Sabon Pegi	5020	100
3	Bukan Sidi	7,660	70
4	Tudun Gwandara	4,920	60
	Total	23,901	350

Source: Researcher's field survey (2015).

A list of statement obtained from literature was made for waste pickers to tick the social network that support their activities most (using the 5 point likert scale) and to state any other not listed. Similarly, information was elicited on average amount of waste collected by waste pickers per day (in kg) every morning. To analyse the data, the questionnaires were coded and entered into the Statistical package for the social sciences (SPSS) computer software to generate the percentages and means. Basle) wa8.4195.3508 T43m.0002e Tc- valuhe questu8(cherTw168definlikste)0 Twrcentag

descriptive statistics response for each variable which was generated from the coded responses of respondents from the SPSS computer software result (or dividing the sum response per variable by total number of respondents; 770)). In this way the mean descriptive statistics was used to rank the networks; any mean statistics value less than the critical value was termed disagree while any value above it (3.0) was termed agree. The likert scale was thus used to identify the main catalogue of social networks that sustain informal solid waste recycling activity in the study area and to rank them as presented in table 3.

Table 3: Distribution of the perception of respondents and descriptive statistics of likert scale variables on social networks that sustains informal solid waste recycling activities in Makurdi and Lafia

Variable	Survey statement	N	Strongly Disagree (SDA)	Disagree (DA)	Neither Disagree Nor Agree (NDA)	Agree (A)	Strongly Agree (SA)	Sum	Mean (Descriptive Statistics)	Rank
Public partnership	Partnership with state institutions	770	0	112	203	452	3	2658	3.45	11
Private partnership	Partnership with private business institutions	770	2	17	129	619	3	2914	3.78	3
Personal ties	Personal ties with house owners	770	0.0	0.0	107	656	7	2980	3.87	1
Family ties	Partnership with family relations	770	0	43	107	617	3	2890	3.75	5
Faith ties	Partnership with religious institutions	770	9	154	207	391	9	2547	3.31	15
Guidelines	Role by guidelines/sanitations	770	10	117	611	27	5	2210	2.87	18
Slogans	Chanting slogans	770	12	252	217	259	30	2353	3.06	17
Association	Membership of recycling association	770	8	337	217	180	28	2193	2.85	19
Tax	Payment of tax/lobby of formal government institution	770	25	312	241	172	20	2160	2.81	20
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
affluence	affluence of community where waste works	[illegible]	16	[illegible]	[illegible]	[illegible]	31	[illegible]	[illegible]	[illegible]
Location	Location of the workplace	[illegible]	38	[illegible]	2b1	[illegible]	10	[illegible]	[illegible]	[illegible]
Distance	Extent/distance covered per day by person	[illegible]	10	109	143	501	7	2b96	3.5	10
Crew link	Link with collection crew	[illegible]	42	146	212	[illegible]	9	[illegible]	[illegible]	[illegible]
Familiarity	Familiarity/regular contact on routes	[illegible]	10	16	129	601	14	[illegible]	[illegible]	4
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Source: Researcher's field Survey (2015).
Scale: Strongly disagree = 1; disagree = 2; neither agree nor disagree = 3; agree = 4; strongly agree = 5, SD= Standard deviation

Table 4: Relationship between waste associations and waste picker activity

Respondent	Excerpts from Interview	Location
Chairman Makurdi Scrap Dealers Association, Makurdi	"We give our members financial assistance through our weekly contribution scheme; we give them security tips on how they can go about their works without hindrance, handle police cases for them and also give them money to go home when they are sick" we also sanction erring members by sending them to the Police or Vigilante for prosecution or reformation or we can send you out of the business here".	Makurdi
Chairman Lafia Scrap Dealers Association – Yan Bola	"We give financial assistance to our members who may be out of money, represent our members even in court if we feel they are innocent and protest against unfair treatment by authorities to our members; we also ensure good working relationship among our members''.	Lafia

Source: Researcher's Interview with chairmen of Waste Dealers Association (2015).

Based on the mean score results as indicated by the waste pickers in table 3, the result shows that the three most important network agreed by waste pickers as facilitating their activities in order of highest rank were; personal ties with house owners(ὼ[= 3.87), ability to communicate in local dialect(ὼ[= 3.81,) and partnership

with private institutions (ώ[=3.78). Findings obtained from the interaction with the

6 has shown that there is significant difference in the mean weight of waste involved in informal solid waste collection activities between Makurdi and Lafia cities ($p = 0.035$, $p < 0.05$). This means that significant difference exists in the mean weight of recyclable waste materials collected between Lafia and Makurdi. It shows more mean daily amount of waste is collected in Lafia than Makurdi per day.

Data was collected from waste pickers, heads of waste association for Makurdi and Lafia and from government agencies to determine the neglect or otherwise of social networks in informal solid waste collection activities in the study area by city authorities. The result is contained in table 7

Table 7: Reaction of City Authorities to Informal Solid Waste Collection Activities

	N	Yes	No
Are you harassed by state authorities in trying to access recyclables?	770	250 (32.5%)	520 (67.5%)
Are your activities regulated by state government?	770	36 (4.7%)	734 (95.3%)
Payment of dues/tax to state government	770	112 (14.5%)	658 (85.5%)
Payment of dues/tax to association	770 (100%)	599 (77.8%)	171 (22.2%)

Source: Field survey (2015).

The percentage response of waste pickers in table 7 indicates that majority 520 respondents representing 67.5% were not harassed by city authorities in the course of accessing recyclable waste materials. Only a negligible number of persons 250 (32.5%) reported that they were harassed. Those who were harassed however reported that this was by security agencies and hoodlums (area boys). Some of these challenges were addressed through dialogue, lobbing by individual waste pickers, junk dealers (their masters) and at worst intervention by the associations leaders.

6.20.2 Interviews with Chairmen of Waste Recycling Associations in Makurdi and Lafia and City Authorities.

The researcher also sought to know from the chairmen of waste dealers association of Makurdi and Lafia whether or not they were assisted by city authorities, all the chairmen in separate response replied:

We do not receive any support (financial or otherwise) and no incentive from the state authorities. According to the Lafia Chairman, “they promised us financial assistance but nothing is given to us”. In the same way, the waste dealers Chairman for Makurdi interjected “even though I often meet the governor on behalf of our members they promise to assist us but fail”. The Makurdi Association Chairman admitted that they do experience conflict with city authorities on issues of sanitation, because some of their members litter the town with filth. In Lafia, however the response was that “we do not have conflict and we are not prevented from doing our work”.

In an interview with the Director of environment in the Ministry of Environment, Makurdi and that of Nasarawa Urban Development Board, the study found that all of them were aware of the activities of the waste pickers and their social networks

in the states. They however opined that the state has not made efforts to assist or engaged them for any purpose.

DISCUSSION OF RESULTS

The findings from the study have unveiled a catalogue of social networks or connections and how they are helping to sustain the activities of waste collection enterprise. Majority of the respondents opined that they got into the enterprise through relations of same state of origin. Most of those interrogated revealed that they migrated mostly from other states such as Kano; Katsina and Jigawa and were of different socio-economic characteristics. According to Medina (1997) immigrants of varying characteristics constitute an important percentage of the population of waste pickers. Some scholars argue that because immigrants struggle with livelihood challenges, they resort to this activity for sustenance. In this case the migrants were brought in deliberately using ethnic, familiar and geo-political connections and represent an asset to the enterprise. Their mutual working relationship helps in guaranteeing regular supply of materials and sustenance of the activity. This is in tandem with findings by Kebede (2015) i Addis Ababa, Ethopia. Social networks (individual and group networks) are playing a critical role in urban waste collection activity because both the connections, contacts or relationship were found to be the basis that were driving the activity in the study area and by implication contributing to solid waste management. This is indicative of the role of social networks in informal enterprise and service delivery. The network structures are helping to carter for welfare of their members because the excerpts of the interview with the chairmen of the dealers association in table 4 affirmed that they work for the welfare of their members by providing financial support, protection and ensuring discipline among members for peaceful working relationship. These support are in tandem with submissions by Granovetter (1973 cited in Williams, 2008) which uphold social networks as an asset in fostering activities or enterprise. The responses from the waste pickers also showed that they work under guidelines from their masters (Ogas) relate with their co-workers as well as interact with house owners who also supply materials for them apart from picking in the open dumps. This usually increases the amount collected by members. Furthermore, they were reportedly guided by operational guidelines handed down to them by their masters (dealers) so they can be defended by their masters. In Vancouver, the code of conduct used by the United We Can (UWC) members (Waste pickers) includes positive behaviour and attitude towards environment while binning as well as relating properly with other binners and maintaining territorial boundaries (Tremblay et al., 2010). This is however in discordance with the situation in the study area where it was found that the workers were not regulatory conscious about the need to keep the environment clean in the course of recovery of materials. The interview with the chairman of Makurdi dealers association indicated that they sometimes experience conflict with city authorities on issues of sanitation, because some of their members litter the town with filth. Findings also showed that the workers have developed a relationship with business owners to access their premises apart from the general picking at garbage dumps, thus they collect materials of different types. For instance, some respondents explained that they collect recyclable materials from the mechanic villages. This may probably explain why some waste pickers indicated that one of

the regular routes they follow to collect recyclables include the Makurdi – Aliade road along which the mechanic village is sited. This is similar with findings by Mamphitta (2011) in a study in Pretoria, South Africa where some waste pickers have developed relationship with generators of particular waste types and collect them for their earnings. The study shows that majority of the waste pickers were not harassed by city authorities in their quest to access recyclables as shown in table 6, only negligible number opined that they experience harassment in the course of their activities. When interrogated the Director, Ministry for Environment, Makurdi and his counterpart, head of Urban and Regional Planning in Lafia all affirmed that they do not restrict or harass the waste pickers in the course of their activities. They opined that they are aware that the activities of waste pickers are useful in the reduction of non-biodegradable waste. The officers however said they have no policies about this activity and do not partner with them nor give them neither incentives nor guidelines for operation in the state. Oklo (2013) in Ghana reported that the workers were constantly threatened with eviction and harassment.

Generally, empirical findings in the study have shown that the activities of social networks in informal solid waste collection in the study area is contributing to urban environmental development in the area by collecting 79.75kg of waste daily or 2.39 tons per month. This suggests that waste pickers contribution to solid waste collection has cost reduction implication for what is left for municipal waste management authorities to collect. This system if harnessed is capable of consistently contributing to reducing the conventional capital intensive approach to city waste management which scholars have argued have produced no better results. This is in concordance with findings in Delhi, India, Rio-dejeneiro, Brazil, China, South Africa and Mexican cities as enunciated in literature. In all of these the association leaders decried their non-inclusion in government welfare packages and other favourable assistance from government that will further spur them to work and contribute to sustainable solid waste management. This suggests that while the waste workers are carrying out what should be the core mandate of the authorities their activities are not supported as in other countries such as Curitiba, Brazil. The already existing associations of waste workers (Scrap Dealers Association and Yan Bola) are playing the role of an arbiter and present a potential platform for harnessing and negotiating partnership for sustained informal collection activities in Nigerian cities. This empirical data portends an opportunity for advancing inclusive measures that would engage the workers for urban solid waste management services. All these thus affirm to the justification of the study.

CONCLUSION AND RECOMMENDATIONS

The study explored the kind of social relations sustaining and pervading the activity. Arising from the empirical findings presented, it can be deduced that social networks and informal solid waste collection activities in the study area has the potential for sustainable solid waste management. It relations been established as a main feature of informal solid waste collection activity just as in other economic enterprise. Generally, the study revealed that the role played by social network in informal collection is a manifestation of the wider contributions to in formalisation which is generally viewed by contemporary scholars as a feature of modern enterprise that has a nexus with the formal institutions. Informal collection activity

is not only contributing to augment solid waste management by municipal authorities but also diversification of sustenance opportunities. It is helping stakeholders in the enterprise to contributing to urban governance in the area. The activity and its structures therefore present a potent asset and platform of engagement for sustainable solid waste management. The network has potentials for urban development challenges, social organization as well as political administration in the study area. The size of the activity and its networks has thus been expanding especially in developing countries based on available evidence in literature. It is thus worth exploiting and expanding as a sustenance opportunity especially in Nigeria and many other developing countries struggling to cope with solid waste management challenges amid economic challenges and failure of city authorities in urban service delivery. Despite the all-important contribution of informal solid waste workers in collection activities, they and their activities are accused of interfering with sanitary operations by authorities in Makurdi. The study represents to a reasonable extent an addition to the current knowledge on the subject matter in the study area and its influence as found avails itself to policy decision. This sector and its ancillaries thus demand the attention of urban planners as well as other development professions to synergies for stronger support for the sector to expand more. The many fronts of cascading ripple effects of social networks in informal solid waste collection and recycling activities calls for inclusive urban planning decisions and regulations or policies by city authorities to harness its potentials.

Policy implications of the study include the fact that in many countries organised social networks are used to engage the state in service provision such as solid waste management. Government in Nigeria could under study, organize, build their capacity and capture the enterprise groups so that they can serve as formal bureaucratic channels for engagement in different ways. The networks and their activities calls for inclusive urban development planning decisions, regulations and policies to expand as well as sustain its contribution to solid waste management as obtained in other cities of the world.

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SUSTAINABLE URBAN DEVELOPMENT AND THE CHALLENGES OF URBAN SPRAWL IN 'ABUJA' THE FEDERAL CAPITAL CITY OF NIGERIA

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The urbanization process in Africa and particularly in Nigeria has resulted in urban sprawl with attendant effects in socio-economic dimensions and environmental degradation. Such effects as loss in biodiversity, decrease in vegetation productivity, uncoordinated waste disposal, generation of heat islands, environmental pollution; and asocial menace are common leading to some socio-physical, mental and health concerns. Undoubtedly, the phenomenon of urban sprawl is having inauspicious effects in city development in Africa; and it is a complex pattern of land use, transportation, and social and economic development due to the rapid expansion of metropolitan areas. However, a sustainable city development process is driven by social, economic and environmental factors in a manner that does not harm or damage the environment, nor exhaust resources utilization for the present and future generations to thrive. To achieve this goal, the city will need to continue its process of transformation, encouraging economic and social regeneration through the new development of opportunities and environmental enhancement. In view of this, this study is undertaken with the aim of seeking ways of accomplishing sustainable urban development in African cities, Abuja in particular. The objective is to examine the current urban sprawling effects on Abuja capital city using textual analyses of the Federal Capital Development Authority's planning/development reports and extant research reports; and thereafter proffer sustainable approaches to its urban planning and development schemes. This is geared towards reducing the liable effects of sprawling such as air pollution, urban heat, automobile-related morbidity and mortality; and encouraging physical activity and promoting mental health and a sense of communal dwelling in the suburbs of the newly growing capital city of Nigeria.

Keywords: Abuja, development, environment, Nigeria, sustainability, urbanization, urban sprawl

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INTRODUCTION

The process of urbanization is often associated with sprawling in both developed and developing countries of the world; and it is considered an ancient time phenomenon which is often characterized by low-density and unplanned residential areas surrounding most cities (Bruegmann, 2005). Urban sprawl is an attendant by-product of urbanization and city growth with socio-economic consequences on metropolitan areas. However, cities are considered as the vehicles for national development and growth as they play significant roles in the national/global economy; and also serve as the power nerve centre of politics, finance, innovation and cultural diversity (Chima, 2012). They are interdependent and are increasingly linked through the flow of global activities; and are in continued growth in population and socio-economic activities (NUDF, 2009). In fact, the urban areas contain half of the world's population as at 2008; and more than a third of world urban population live in large cities (UNFPA, 2011a&b; United Nations, 2011a; World Watch Institute, 2007 cited in Chima, 2012). This urban growth exerts a lot of pressure on the environment in multiple dimensions such as the reduction in the supply of ecosystem services, agricultural production, fresh water availability and waste absorption (Linard, Tatem & Gilbert, 2014). According to Adeponle (2013), rapid urban expansion without recourse to environmental consideration exposes a substantial fraction of the urban population at risk of both natural and human-induced environmental hazards.

Urbanization trends occur in both developed and developing countries but with varied patterns of sprawling. Development of urbanization in developed countries had taken unprecedented rates for many decades which led to the creation of cities with a lot of socio-economic and environmental problems. These include traffic congestion, environmental deterioration/pollution, poverty, crime, racial tension, poor public schools and services, etc. With these problems in sight, the rich people of developed nations, therefore, escaped from the inner cities in order to evade the problems and look forward to the high quality of life leading to a phenomenon of suburbanization. This is because; the suburban areas have access to open space which provides the incoming city dwellers with a chance to enjoy nature and an easy escape from city problems (Brueckner, 2000). However, the scenario in developing countries and particularly sub-Saharan Africa is different. Urbanization in sub-Saharan Africa is characterized by an increasing population of poor people living in urban areas. The number of people living in slum conditions in the urban periphery is prohibitive and has doubled in 15 years to reach nearly 200 million people, about 72% of the urban population in 2005 (Campbell & Campbell, 2007; Dye, 2008; UNPF, 2007 cited in Linard, Tatem & Gilbert, 2014). Ironically, Africa is currently the fastest urbanizing continent in the world, with an annual growth rate of between 4.5% - 5%. This migration influx from rural to urban centres is in response to perceived economic and social opportunities in the cities (Okpala, 2009).

Nigeria is one of the biggest and most populous countries in sub-Saharan Africa, with a population of about 180 million people. It has one of the highest rates of urbanization in Africa (see figure 1). The urbanization pattern in Nigeria takes the form of a central core city with peripheral areas that are suburban; peri-urbanization (Okoye, 2013). Abuja the federal capital city of Nigeria is located in

the geographical centre of the nation and was selected as the new capital in 1975 due to its potentials as an alternative to 'Lagos' which was experiencing heavy population and congestion with enormous environmental problems. Today, Abuja is equally undergoing heavy population growth with associated urban sprawling of a very high degree due to the inadequacies in planning and development strategies evident in the growing suburban slums springing up in almost all directions of the growing capital city. This has given birth to the question of how effectively and efficiently can the issue of the prevailing urban sprawl in Abuja be addressed to attain a sustainable level of city planning and development? To address this question, it becomes imperative to evolve and introduce sustainable urban development strategies as a check to the ongoing malady in the overall physical development pattern of the growing new capital city of Nigeria. Before then, it is helpful to have a look at the theories of urban sprawl as well as the urban sprawl characteristics in an African setting, and as it is currently taking place in Abuja in order to be able to proffer appropriate and sustainable development strategies or models for rectification.

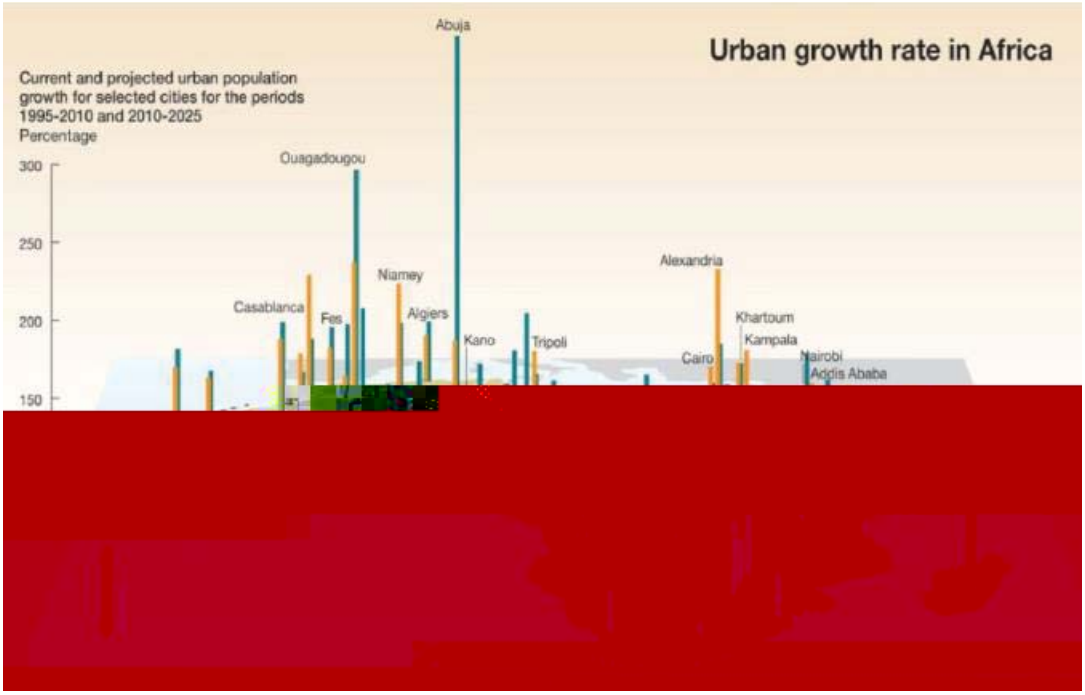

Fig. 1: Urban Growth Rates in Africa
Source: Adapted from Pravettoni, UNEP/GRID-Arendal (2011)

THEORETICAL ANALYSIS OF URBAN SPRAWL

Urban sprawl is a complex phenomenon associated with informal growth and outward expansion of city centres having social and environmental impacts on its setting. It is often characterized by an unplanned and uneven pattern of growth giving birth to situations of inefficient resources utilization. It is an irresponsible and poorly planned development that does not contribute significantly to revenue. It is responsible for the destruction of green spaces and the creation of traffic congestion, and thus has negative impacts on air quality and public health (Chima, 2012; Ewing, 1994). It is a low-density and auto-dependent development on rural land that directly impacts traffic congestion leading to the increased cost of transportation, public infrastructure and of residential and commercial

developments. Urban sprawl adds to the urban divide, pushing social segregation along economic lines that result in a spatial difference in wealth and quality of life across various parts of the cities. In fact, it is referred to as urban decentralization in which the physical outward expansion of cities is characterized by low densities, separated land uses and car-dependent communities (Owusu, 2013). The sprawling nature of cities is evident in the developmental growth associated with increased energy and land consumption. These impacts threaten the natural and rural environments by raising the levels of pollution (air and noise) which often exceed human safety limits, and greenhouse gas emissions that cause climate change. All of these have a telling impact on the quality of lives of people living in the cities (European Environment Agency, 2006).

In the quest for further understanding on the phenomenon of urban sprawling, two schools of thoughts have emerged in the argument for and against the features of urban sprawl (Owusu, 2013) as follows;

i. The opponent school of thought;
   The opponents of urban sprawl have advanced their arguments on the adverse effects of the phenomenon; and have put the responsibility of the control on the government rather than on local devices (Yin & Sun, 2007). They are supported by environmentalists and have agreed that the phenomenon results in increased automobile travel and congestion, high levels of pollution, loss of farmlands, duplicative infrastructure at high costs to society, limited employment accessibility, concentrated poverty and some other undesirable issues within the metropolitan (Owusu, 2013). This is typical of situations in developing countries.

ii. The proponent school of thought.
   The proponents of urban sprawl on the other hand seem to believe more on the positive outcomes of the phenomenon through urban decentralization. The emphasized positive outcomes include improved satisfaction of housing preferences, good quality and serene environment (especially air quality and noise pollution), lower crime rates and better public schools (Glaeser & Kahn, 2003 cited in Owusu, 2013). This argument seems to hold true only for urban sprawling in developed countries as these positive outcomes do not showcase in developing countries.

Though urban sprawl is interlinked with urban growth; urban growth may be observed without the occurrence of sprawl. But sprawl, in reality, induces growth in urban areas from population growth and increase in demand for services; and the lack of strict planning policies (Bhatta, 2009; Bhatta, 2010 cited in Chima, 2012).

In general, it has been noted that city development and growth in developing countries is highly dynamic, diverse and disordered; and increasingly land and space intensive (UNFPA, 2007).

Further studies have identified three main factors responsible for sprawl as follows;

a. The natural phenomenon;
   Jaret et al. (2009) have described urban sprawl as a natural phenomenon, portraying cities as the hub of economic activities with a natural tendency

for its population to expand outwards. This signifies that urban decentralization is an orderly natural growth process and not the result of a market system out of control.

b. Flight from blight;
Wasserman (2008) portends that the phenomenon of urban decentralization goes beyond natural forces. That the phenomenon is partly driven by certain repellant factors of higher tax rates, higher crime rates, crumbling infrastructure, low-performing public institutions, and a greater presence of the poor and lower class in central or inner-city

sprawling and in conjunction with a review of Abuja Urban Development Reports by FCDA is undertaken.

Urban sprawling characteristics in African setting

Though the phenomenon of urban sprawl affects all nations and all periods of

urbanization in the third world is often characterized by a multitude proportion of the poor people living in urban areas (Linard, Tatem & Gilbert, 2014).

The problem of the urban sprawl involving the poor communities of Africa results because of the inability of the Authorities to predict urban growth, and their failure to provide land for the urban poor. The urban poor is being denied land rights prompting them to drift towards the periphery of cities in search of shelter coupled with the fact that little attention is paid to slums, land, services, and transport (Brueckner, 2000). The toll in terms of cost on the government to provide community services in sprawling areas is usually enormous because houses and businesses are spread further apart and local governments could barely provide for the widely spaced services. Vehicular traffic is highly increased causing an increase in air pollution and smog. Sprawled development normally causes an increase in energy consumption per person in urban development (Mieszkowski & Mills, 1993). Today, there is an unprecedented form of urbanization taking place in Africa, putting the future economic and social development of the continent at stake in the face of the looming sprawl (Cartwright, 2015). It is, therefore, crucial to set in place certain sustainable strategies or framework to address it so as to ensure safe, productive and healthy lives of its vast growing cities for sustainable development.

Countries across the world have relocated their capitals for cogent reasons, among which are; ease of accessibility to various regions of the nation, national identity, and overcrowding. The new capital cities are designed to accommodate sustainable urban development and to avert some specific problems (e.g. sprawling) already identified with their predecessor capitals in order to pride the nation amidst comity of nations (Chima, 2012). Regrettably, the case of Abuja today depicts a picture far from this dream as the development plans have been abused through the inadequate implementation of planning policies occasioned by bad governance and wanton corruption in all facets of the city development.

Abuja city growth and development in the context of sustainability

Sustainable city development is the dimension of today's city growth and development, and sustainability in this sense according to Adeponle (2013) is a direction rather than a destination. City of Vancouver (2002) however defines a sustainable city "as one that protects and enhances the immediate and long-term wellbeing of the city and its citizens, while providing the highest quality of life possible." A sustainable society ensures improved public health and a better quality of life for the people in an environment of limited waste generation, devoid of pollution, maximizing conservation of resources and promoting efficiency; and developing local resources to revitalize the local economy. Accomplishing this level of sustainability requires integrated decision-making in the socio-economic, political, ecological and environmental dimensions. The city of Abuja was planned with the expectations of attaining this status.

Abuja officially became the Federal Capital City of Nigeria on 12th December 1991 after Lagos. The relocation from Lagos to Abuja was necessary for many reasons based on the recommendations of the Government Committee Report in 1975 on the need for a new capital city. Prime among the reasons are; that Lagos was incapable of performing a dual role as Federal and State capital due to the

problems of inadequate space for development commensurate with its status; and that a new capital was needed as a symbol of Nigeria's aspirations for unity and greatness; with Abuja being located at the geographical centre of Nigeria (Chima, 2012) as in figure 2.

Figure 2: Map of Nigeria showing Lagos to Abuja
Source: Google map

Based on the commitment for developing Abuja as the new capital city, the Federal Capital Development Authority (FCDA) was established on the 5th February 1976 by Decree Number 6 to be responsible fo

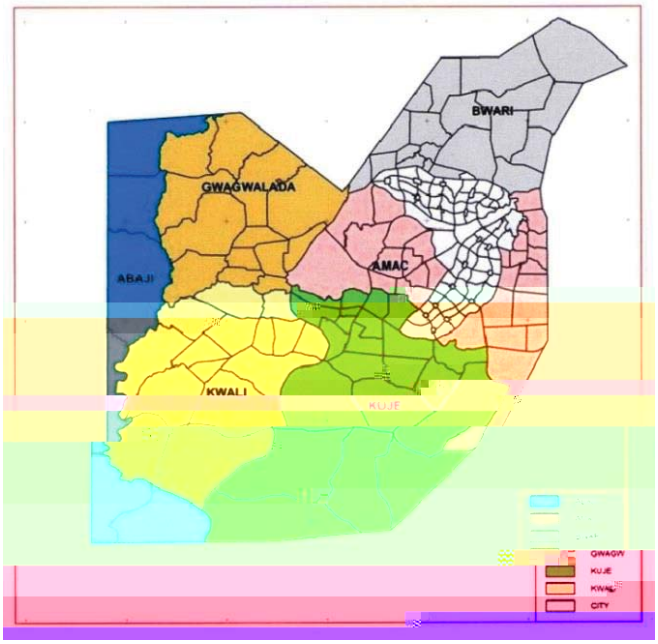

Figure 3: The Core-city Abuja and the Area Councils
Source: Abuja Geographic Information Systems (2011)

The Abuja master plan was prepared to embrace a sustainable outlook in a manner that land use development, infrastructural provision and social services are coordinated and inter-related based on well-articulated objectives that are socio-cultural and environmentally-biased. As such, the new capital city was designed as a national public space to replicate to some extent the forms and structures of existing Nigerian urban centres; and to conserve the natural and cultural environment of the territory (Abba, 2003; Ikoku, 2004; FCDA, 1979). According to FCDA (1979), three major issues that are related to urban form and design were considered as follows;

i. Image-ability: this refers to an observer's perception of the city's purpose, organization and symbolism.
ii. Efficiency: this is the ease with which government decisions are carried out, and
iii. Flexibility: the ease with which growth and change can be accommodated.

The master plan vividly incorporates open space and vital urban restructuring elements, places for recreation and amenity such as the longitudinal parkway system interval to the city, retention of the stream valley and water-course network for both aesthetic and drainage purposes. The preservation of the surrounding escapement of hills and inselbergs in the form of the Gwagwalada plains form the visual back-drop to the city and major focal points within the city. This was accompanied by the provision for the development of recreational facilities like a variety of gardens and parkways. The city was designed to be accomplished in phases as an efficient and attractive environment at every stage of its growth (FCDA, 1979).

The efficiency of the master plan was considered in the context of the city form, and the sites of its natural geography. That is, providing a design form that will help achieve the fastest travel times; and the subsequent use of the physical terrain

to provide efficient services. This culminated into a linear form of transportation with nodes to minimize travel times and to ensure the possibility of incremental growth in the future (see figure 4). By this arrangement or concept, the networks of water, sewage and drainage infrastructures were designed to take advantage of the gravity of the natural environment and as well respect and maintain the natural drainage patterns of the landscape (Chima, 2012). Background studies according to FCDA (1979) on earlier relocated capital cities like Brasilia, Washington and Chandigarh revealed that issues of efficiency and flexibility were compromised for stronger order of symbolic meaning to government functions. This discovery prompted the adoption of the following considerations in order to avert such a compromise.

i. City's location within the geography of its natural environment,
ii. The efficient/effective relationship among public functions, and
iii. Identifiable units within the city's internal organization.

The development of the Abuja capital city was designed to be accomplished in four (4) phases to accommodate an orderly urban growth over an extended period of time (see figure 5). As such, frameworks for growth that can deal with predictable and unpredictable changes were initially put in place (Chima, 2012) for a clearly defined population target of three (3) million inhabitants.

Figure 4: Central Area District Concept Plan
Source: FCDA (1979)

Phase I (one) which constitutes 5 districts as

masterplan with great distortions, resulting from the lack of willingness in governance and acute corruption, the city as at today (2019) is still in a developing trend. Four decades into the city development, work on Phase II (two) is yet to be completed; Phase III (three) has been prepared for development implementation by Federal Housing Authority, and work is yet to commence on Phase IV (four).

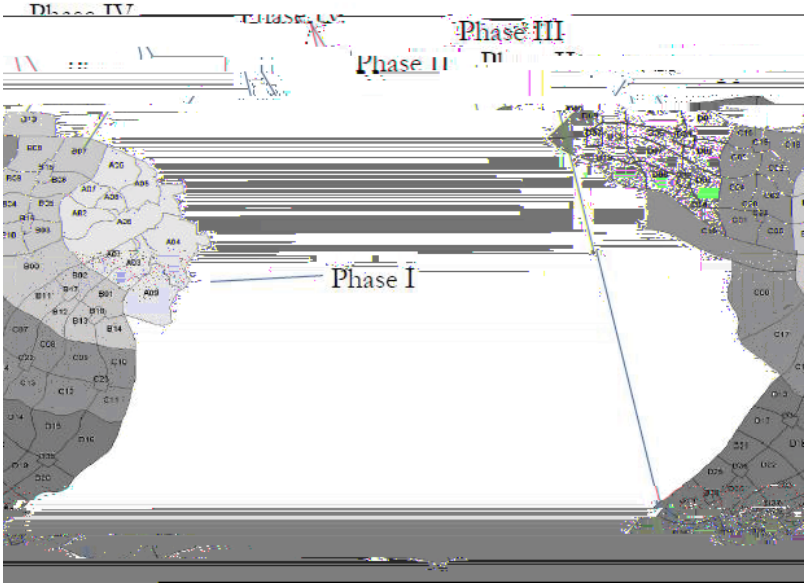

Figure 5: Location of Development Phases in the Federal Capital City, Abuja
Source: Department of Urban and Regional Planning- FCDA (2009)

DISCUSSIONS ON THE OBSTACLES TO SUSTAINABLE URBAN DEVELOPMENT IN ABUJA

The city of Abuja was planned to be a modern sustainable city that is physically developed to ensure well organized urban activities with a consideration for the protection of public interests which include health, safety, convenience, efficiency, energy conservation, environmental quality, social equity, social choice and amenity (Sufiyan et al., 2015). Unfortunately, the reality on ground after decades of city development is far from accomplishing this goal due to the distortion of the master plan. The master plan has been subjected to enormous abuse and distortions arising from a gap between the regulatory framework and enforcement of land and development policies. This is evident in the creation of the Ministry of Federal Capital Territory (FCT) in 1980 by a military regime whose functions were superimposed with those of the already existing Federal Capital Development Authority (FCDA) created in 1976 having a professional bias. This development first created the problem of insufficiency of professional personnel to contain the master plan (Sufiyan et al., 2015).

As a developing city and a new federal capital, there was a great influx of people into the city due to the manner of relocation which created an extreme shortage of serviced land for housing to meet the growing demand. This is occasioned by some anomalies in the noncompliance of government to the policies and regulations of the master plan as early as 1982/83. The relocation of government officials from Lagos to the new capital city in 1982/83 when the stipulated time

iii. There was a massive distortion in the allocation of building plots by the staff of FCDA both in the motive of allocation of the plots and in the distribution of allottees. Meanwhile, building plots allocation according to the master plan is to be based on some equitable biases of federal character.

iv. There was a scheduled time for the construction of the transit-way, and to introduce rapid rail transit system to serve the city. This was deliberately delayed and consequently allowed the right of way reserved for the transit-way to be encroached upon through indiscriminate plot allocation in several of such places. This eventually created a menace for the future development of transit-way for buses and rapid rail system.

v. The abuse of the parkway concept established by the master plan is of great concern. This concept was a major element of the open space system of planning for the city which had given way to other physical developments especially in Phases I & II.

vi.

the public, coupled with the low documented research works on sprawling and its effects on the Abuja city development is a great concern.

Evidence of abuse in the distortion of the Abuja master plan

The Federal Government of Nigeria in 2003 set up a 'Ministerial Committee on Illegal Structures in FCT' to collate a list of illegal structures within the FCT and present a strategy for demolition. Since the exercise which was followed up with actual demolition to some extent, there has not been such effort in addressing the problem of the enormous abuse except for partial and insignificant implementation of the report. In recent times, the little effort has been diffused with further abuse due to political influence by the succeeding government regimes relegating earlier efforts to jeopardy. Some of the distortions as observed by the committee are presented in table 1.

Table 1: Distortions in the Implementation of the Abuja Master Plan

Type of distortion	Number of plots
Encroachment into Green Areas	84 plots subdivided and allocated as residential.
	30 neighbourhood parks converted to corner shops.
Encroachment on sewer lines	70 plots
Encroachment on water pipelines	166 plots
Encroachment on highway corridors	216 plots
Development of residences on plots allocated for educational institutions	22 plots

Source: Ministry of Federal Capital Territory (2003)

According to the Committee Report, the distortions are so enormous that over 500 plots have been contravened in Phase I (one) alone. 22 plots out of 55 plots allocated for educational uses were converted to residential use. In Phase II, changes in land use are equally witnessed. Plots meant for public institutions were converted to residential plots. For example, the Ministers' Quarters in Maitama were not provided in the master plan.

These distortions advertently affected the development of the capital city in multiple dimensions that put the idea of Sustainable City Development in jeopardy. Some of these as observed by Adeponle (2013) are;

i. Inadequate services provision/delivery for the rapidly growing population. The problem of water scarcity as the available dam could no longer cater optimally for the population. The power supply has become inadequate and erratic; with the unsightly overhead power lines instead of the underground cabling proposed by the master plan for both electricity and telecommunication.
ii. Inefficient infrastructural development and uncoordinated service lines as buildings are constructed on services designated lines especially in Phase II.
iii. Uncoordinated developments leading to distortions in the panoramic view of the city landscape as unplanned constructions of residential estates are continuously added thereby exerting more pressure on existing infrastructure.

iv. The de-greening situation of the city and its suburbs, and the lack of concern for the entire landscape and climate change phenomenon.

PROPOSED SUSTAINABLE DEVELOPMENT CONTROL STRATEGIES FOR ABUJA CITY GROWTH AND DEVELOPMENT

The theme, 'Sustainable Development' is a recent call for effective and efficient utilization of all resources for all societies at all times and for all generations – today and beyond. Therefore, all developments, local, regional and global must imbibe the principles of sustainable development for the continuous survival of lives on the planet. In this regard, Bruegmann (2005) declares that an adaptation of sustainable patterns of development is crucial to the advancement of today's infrastructure. Subsequently, the maintenance of balance between human existence and biodiversity is essential to sustainable development. However, the absence of sustainable development practices has generated the phenomenon of urban sprawl in city growth and development around the world, particularly in developing countries. This phenomenon is taking a significant toll in the disappearance of wild forests, meadows, and wet-lands which are being replaced by pavements, buildings and sterile urban landscaping, resulting in an unpleasant, unsustainable and unhealthy/unsafe environment for humans and biodiversity.

In general, Sustainable Development in the context of urban growth and development portends an atmosphere of desired quality of lives for urban and suburban dwellers in all ramifications for all times. But the current situations in

good governance as a feature of sustainability, subsidiary, equity, efficiency, transparency and accountability, civic engagement and citizenship, and security. Thus, the bane to sustainable urban development in FCT is actually corruption in the bureaucracy and all sectors of the economy due to the lack of good governance. However, the willingness and determination of the government to tackle it headlong through good and effective governance is the panacea to overcoming all the prevailing hurdles and obstacles to achieving sustainable city growth and development in Abuja.

The role of public enlightenment and awareness on the objectives of AGIS and the general transformative reforms cannot be undermined. This is necessary so that people do not deviate from or violate the rules and regulations when land allocation is made. The society should be engineered to collaborate at all levels and must learn to work together, at different levels of government, public and private, community or as individuals. This is to foster solidarity, identity, participation and collective actions so as to create and reorganize a more prosperous Federal Capital Territory, Abuja.

There is also the need for regular and periodic review of the master plan for updates/upgrades, and the need to make it available to public institutions and people within the FCT. This should be backed up with adequate machinery to enforce strict adherence to urban development policies by the people and institutions within FCT.

CONCLUSION

The Federal Capital Territory, Abuja was conceived as a modern capital city with great expectations and admirations; and the path to accomplishing this objective borders much on the implementation of the wondrous master plan produced by the International Planning Associates of America. The success of the implementation was anchored on a phase and gradual application of the master plan, which was short-lived even at the initial Phase 1 (one) development stage leading to urban sprawl in and around the city. This can be traced to manifest distortions and deviations from the master plan at various times of the city growth and development. Factors such as rapid population increase and poor implementation of the master plan are grossly responsible for the inefficiencies that ensued particularly in land allocation system. This led to the creation of Abuja Geographic Information System (AGIS) to sanitize and document all land uses in FCT and entrench some level of development and growth control. To further ameliorate the present scenario towards sustainable urban development, the need for good governance which has taken centre stage in development thinking and practice becomes vital. This will improve adherence to development control and land use policies and regulations as a sure way to accomplishing sustainable urban growth and development for the Federal Capital Territory Abuja. Other considerations like the practice of SD principles in all spheres of development, the application of Land Use and Urban Growth Modelling, the re-introduction of Integrated City Planning Approach with a transformative urban national policy, public enlightenment and awareness, and the need for periodic review of the master plan have been suggested.

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SUSTAINABLE URBAN GREEN INFRASTRUCTURES AS A REMEDIATION TOOL FOR ENHANCED ENVIRONMENT AND LOCAL AIR QUALITY FOR METROPOLITAN LAGOS

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Adopting a new paradigm in the urban planning process helps to create a resilient metropolitan city and functional urban open spaces. Lagos State Government is worried about the increasing volume of greenhouse gases emission in the metropolis, hence there is need to remedy the degrading settlements. Mitigation measures traceable to over reliance on hydrocarbon based facilities and equipment call for the redevelopment of the green corridors and wetlands. These green corridors are the existing thin strip of land within Lagos Mainland which are habitats for few wildlife and biodiversity. They include wetlands and canal routes which fall within the setbacks of Agidingbi, Opebi, Oregun, Maryland, Yaba and Iwaya rivers flood plain with a distance of about 17km. Urban development in the past has not articulated these sustainable components in the environmental design but this paper is guided by the use of afforestation and urban greening solutions. The study examine and identified the various land-uses existing in the study area with a view to evaluating their level of compliant to the Global Climate Change policies that addresses low carbon emissions through eco-friendly green infrastructures that enhances the environmental air quality for a more sustainable Lagos City. The study is underpinned by the ecological urbanism dictum. Following the qualitative and descriptive analysis of the on-site data collection, observations and evaluations, the developmental and adaptive strategies were mapped out through GIS based network mapping. The land use data were obtained from various analysis conducted by the use of Geographic Information Systems (GIS), used to take twenty six (26) Points at about 500m intervals along the green corridors and wetlands. The socioeconomic information and details were gotten through various observations, interviews and personal deductions. The wellbeing of a city cannot be separated from the wellbeing of its environment therefore the study recognised the role of a healthy ecosystem and a reduced reliance on fossil fuel, increased green open spaces, restoration of habitats, water and air purity. The study proposed carbon sequestration through restoration, conservation of existing wetlands and other strategic adaptive solutions toward a sustainable and resilient city development in the form of; urban green infrastructures, non-motorized transportation mode, urban agriculture along the wetlands, restoration of the wetlands and water ways, conservation and inclusive landscape regeneration of the open spaces and concludes by stressing the reality of sustainable low carbon philosophy within the landscape and built environment pedagogy.

Keywords: climate change; greenhouse gases; green corridors; landscape regeneration; urban green infrastructures

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INTRODUCTION

Liveable landscapes are designed as public spaces that allow people to get from point A to B, but also support and encourage the activities people pursue in public spaces. Such habitats are resilient, inclusive, multicultural, socially cohesive, economically vibrant, and full of life (UNEP, 2017). The Lagos State Government has commenced some environmental measure to curb the increasing volume of greenhouse gases within the metropolis. An estimate of about 40% of all new vehicle registration in Nigeria are in Lagos and accounts for 40% of the total national petroleum products consumptions (Loricamp, 2007). Loricamp (2007) further states that about 95% of these motorised architecture were manufactured over ten years ago and without catalytic converters to minimize noxious and toxic carbon effluents. Vehicular density is estimated at 220 vehicles per kilometre compare to national average of 1.1 vehicles per kilometre (LSG, 2006). Sustainable Urban Green Infrastructures are needed as remediation and restoration tools for enhancing the environment and the primary local air quality in the Lagos Metropolis (LASEPA, 2001). Commuters need adequate infrastructure in the forms of slow-speed shared walkways, vegetated walls (green walls), roof garden/green roofs, natures walkway, footpaths, cycling routes and green—on which to travel. In accordance to the Lagos state government NMT policies which involves two simple methods; Systematic traffic calming to ensure that smaller streets are safe places for the mixing of pedestrians and other modes -shared lanes; and pedestrian and cycle infrastructure that is physically separated from motor vehicle traffic (by raised medians, vehicle parking lanes, bollards, landscaping, etc.) on larger streets (Lagos NMT Policy, 2017). Streets are public spaces for socialisation and commerce as well as mobility. The slow zone—whether the entire right-of-way of a small street or a separate space on a larger thoroughfare—is space for liveability for people to walk, talk, and interact, for doing business, for children to play. The provision of an adequate slow zone recognizes that street are destinations. It also enables streets to provide safe and uninterrupted mobility for all users regardless of their travelling speed (Lagos NMT Policy, 2017).

The open spaces are for public use. Therefore, their design must not discriminate against users by their age, ability, gender, income, race, ethnicity, or religion. An equity-based approach to NMT policy must ensure that providing services and infrastructure meet the needs of all users. Nigeria's Intended Nationally Dependent Contributions (INDC) as a part of the agreement signed by the federal government of Nigeria in Paris during COP 21 to reduce greenhouse gas emission by 20% conditional and 45% unconditional is key to achieving environment sustainability through low carbon transportation mode (Puncher et al, 2008). Environmental benefits of walking and cycling are achieved through reduced motor vehicle use leading to reduced congestion and vehicle emissions, improved local air quality and reduced carbon emissions into the atmosphere. The urban dwellers are in dire need for safe and pleasing places to walk, cycle, jog and connect to nature within Lagos metropolis, this study proposes the integration of the available green corridors and wetlands with all the inherent ecosystem services and biodiversity to include the stretch of river wetlands and canal routes which fall within the setbacks of Agidingbi, Opebi, Oregun, Maryland, Yaba and Iwaya rivers flood plain from Awolowo Way in Ikeja through Maryland to the Iwaya Community across the

wheelers) and okadas (motorcycle taxis). A smaller number of commuters travel on buses run by Lagos Metropolitan Area Transport Authority (LAMATA) and Lagos Bus Asset Management Limited (LAGBUS). According to recent mode split data, 70 per cent of motorised trips are by paratransit public transport modes (Lagos Urban Transport Master Plan, 2014). Recent data on walking and cycling are not available, but non-motorised modes likely account for upwards of a third of all trips in the city. Walking is a component of almost all public transport trips, so almost all commuters walk as a part of their daily trips. Lagos' concerning transport situation has spurred numerous interventions over the years. In 2002, the Lagos Urban Transport Project (LUTP), a World Bank funded initiative, was launched to revamp and modernise public transport (LUTMP, 2014).

The quality of life for NMT users is much deteriorated; they can never relax when they are at or close to a street. Mobility induced city air pollution is evident in the metropolis where governments annual budgets emphasized road transportation and car ownership at the detriment of ferry, rapid and light rail transit systems (World Bank, 2016). Alternative mobility frame work advocates for circulatory facilities including sidewalks, walkways, paths and bike lanes. These facilities minimally impact cityscape, rely on renewable energy, use less urban space, reduce traffic congestion, improve physical fitness and are cheaper (Adejumo, 2010). Leisure cycling is compatible with non-motorized and car free planning philosophy. Non-motorized modes are either developed along roadways or off road trails along urban natural corridors including parks and urban wilds. Uduma-Olugu et al, (2018) opined that the university's open spaces need to better meet the psychological comfort of the students, staffs and visitors through the use of available spaces to experience plants and trees in a more biophilic manner. She went further to state that open space networks should encourage more active lifestyles by offering a variety of safe and attractive spaces that are well distributed throughout a neighbourhood and are accessible, catering for the sporting, recreational needs of the students within the university's community and preferably public open space should attempt to cater for multiple users (Uduma-Olugu et al, 2018).

There is no single agreed definition of open space nationally or internationally. There is agreement however, that there are many types of urban public open space. Our regions' open space network is not just about playgrounds, parks and reserves, but incorporates diverse aspects of our wider environment, for example, neighbourhood streets, city centres, walkways, greenery, waterways, structures and views. For the purposes of this study we will use a broad understanding of open space. It also includes the open vistas and views that surround the city (RPH, 2010). Open space is also often referred to by the narrower term 'green space'. Green spaces can be defined as 'any vegetated land or water. This includes natural habitats, green corridors such as paths and rivers, parks, gardens, playing fields, children's play areas, cemeteries, and countryside immediately adjoining a town. Open spaces also include contaminated or vacant land, often called "brown fields", which can be developed into green spaces or parks. Undeveloped or poorly developed brown fields are not considered to be quality open spaces and can have a negative impact on health and wellbeing. Under the Local Government Act 2002, local authorities are required to 'promote the social, economic, environmental and cultural wellbeing of communities', commonly called the "four wellbeing". Social,

economic, environmental and cultural factors are the four cornerstones of the sustainability framework. They also represent the four major factors that influence health (Percival, 2017).

The green corridors which serves as a riparian buffer zone in some part of the metropolis is thin and sometimes used as linear parks and converted to recreational use within the urban setting that is substantially longer than it is wide and this area are often described as greenways (Kennedy, 2003). While others uses of the strips of public land next to canal, streams, extended defensive wall, electrical power lines, highway and shorelines in some urbanised cases. Some scholars also often describe this greenways as Riparian Forest or Riparian woodland. It is a forested woodland area of land adjacent to body of water such as river, streams, swamps, pond and lake (Kennedy, 2003). There is a strong incentive to manage and protect riparian land because disproportionally large benefits can be gained by repairing a relatively small tract of land, and because many restoration actions, such as revegetation, are simple and affordable (Wong et al, 2009). The ecological composition predominant here provides critical habitat for different species of butterflies, birds, reptiles and mammals. The forest are natural bodies of water sometimes serve the purpose of a riparian buffer zones for residential neighbourhoods and the forest is important in preserving air and water quality, maintaining stream integrity and purity, acts as filters for the sediments and other toxic pollutants. The buffer zone can be made up through restoration and revitalization of the wetlands which are made up of trees, shrubs and grass plantings (Kennedy, 2003). Sustainability is one the newest degree subjects that attempts to bridge social science with civic engineering and environmental science with the technology of the future. When we hear the word “sustainability” we tend to think of renewable fuel sources, reducing carbon emissions, protecting environments and a way of keeping the delicate ecosystems of our planet in balance (Percival, 2017). Sustainability looks to protect our natural environment, human and ecological health, while driving innovation and not compromising our way of life (Kennedy, 2003).

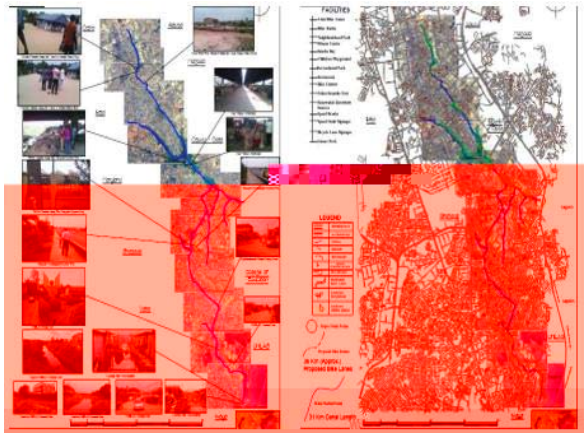
RESEARCH DESIGN / METHODS

The study pursued a descriptive and qualitative analysis of the information gathered during the research and deductive approach, building on the available literature on green city, the authors’ knowledge and experience with the environment, infrastructure, sustainability and green city. Primary data formed the basic source of information used in this study. This was obtained through conduct of reconnaissance survey through direct survey techniques using Global Positioning System (GPS) and Geographic Information System for the both the mapping, database analysis and presentations. Some landmarks, open spaces and commercial hubs were identified and there geospatial locations gotten and the points were taken after every calculated distances of 500m along the wetland/green corridor during the survey. The land use was classified into Administrative, Commercial, Educational, Health, Public, Recreational, Religious and Transportation. The second set of data was gotten from the Physical Planning Development Control Department of the State and through various interviews were conducted with some environmental enthusiasts and stakeholders. Information of statutory setbacks and minimum requirement for greening before building

development approvals. The available descriptive and inferential statistical techniques were used in the collation and analysis of the data. The main hypothesis in this study is that the incorporation of green infrastructure into the urban forms and geospatial configurations will enhance the environment. This study employed descriptive survey design of the existing site conditions in which the existing status of the independent situations were gotten during data collection without any manipulation of the variables.To achieve this, stratified random sampling technique was used to identify and phase the green corridors and the neighboring street roads within the proximate Five Local Government Areas of Lagos State. There are five predominant land use typologies namely; Commercial, Educational, Residential, Public, Recreational and Religious land use which are further categorized into three zones– High, Medium and Low Density.

The Study Area

The study area covers the green corridors and wetlands through a distance of 17km along the Agindingbi-Obafemi Awolowo Road at Ikeja through the Opebi and Oregun link bridges connecting Ojota-Maryland and continuing through Bariga and ending at Iwaya where the University of Lagos is located. The green corridor connects different neighborhoods, communities and districts in Lagos State such as; Yaba, Bariga Gbagada, Anthony, Maryland, Mende, Somolu, Oworonshoki, Ogudu, Ifako, Ojota, and Ikeja. These areas cut across five different central local government area and Local Council Development areas (LCDA) of the Metropolitan Lagos in Nigeria. The site was selected after careful analysis of a set down criteria based on the literature review and the relevant guidelines for the establishment of a 'Biophilic Ecosystem' in the selected wetlands within Lagos metropolis using the following parameters set down as site selection criteria: Location and accessibility to the users; The ease of ingress and egress to and out of the site for vehicles, cyclist and pedestrians. Size of site and possibility for future expansion potentials; enough land to accommodate the various functions as well as give room for future development and expansion. Land use compliance; the site has to be within the land use for recreational development on the States' Master Plan. Environmental features; like land forms, rocks, crops, hills, valleys, stream/river, natural vegetation and any other special character that makes the site unique and can be utilized for the intended project. General study of the site microclimatic conditions and its features considering its potentials and treats in an attempt to utilise the advantages.



Figures 1&2: Location map showing Ikeja - Iwaya Townships (16.6km), the connecting streets and transit hubs. Source: Google Earth Pro 2018.

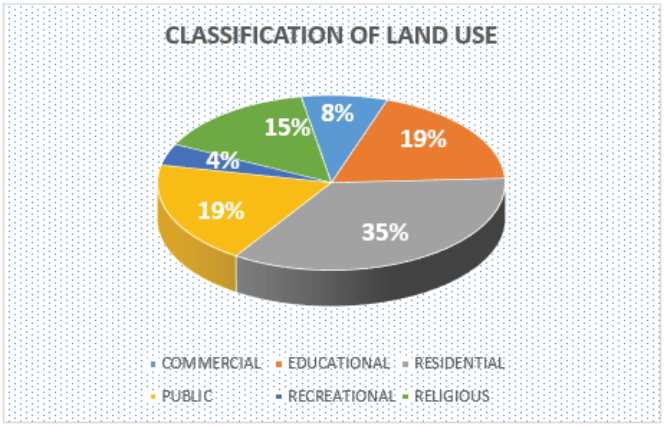


Figure 6: Pie Chart showing the land use analysis. Source: Field survey, 2018.

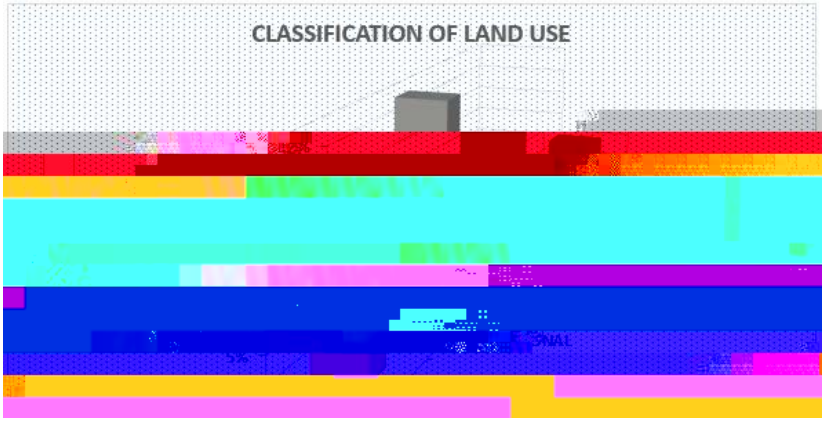


Figure 7: Bar Chart showing the land use analysis. Source: Field survey, 2018.

Table 1&2 above indicates that of the 26 transit hubs location and landmarks selected through random sampling the following analysis were obtainable: commercial (8%), educational (19%), residential (35%), public (19%), recreational (4%) and Religious (15%). This table further shows that most of the land use are for residential use followed by educational and public activities around the Lagos Mainland. Recreation has about 4% of the total land use which means that the study area has limited open spaces that are specifically for greenery. Religious activities occupies about 15% of the area. The studies identifies that there are commercials shops, Churches and Mosques at every streets within the neighbourhood with little or no regard for greenery and open spaces for recreational activities.

FINDINGS AND DISCUSSIONS

The study established that the green corridors and wetlands are vast land of an area of about 30km2 and it is mostly populated by land uses that are not planned hence the high level of abuse, disuse and misuse of the green corridors which have over the years led to the various land/wetlands encroachment, ecosystem degradation through air and water pollution, burning of refuses at the various dump sites, loss of biodiversity, blockages of road drainages. This study confirmed that sustainable urban green infrastructures were not currently in place and use in these areas and therefore suggest the use of green infrastructures as a remediation

tool for enhancing the environment and local air quality for Metropolitan Lagos. It was also observed that the following green infrastructure frameworks should be considered: Urban Ecological Farming, Garden Allotments and Urban Carbon Sequestration.

Introducing urban agricultural practices on wetland as an approach of conserving wetlands in Lagos state offers tangible evidence of Lagos state commitment to urban green initiatives as outlined by Lagos State Park and Garden Agency (LASPARK). Urban agriculture is a growing movement to bring the production, processing, and marketing of food into cities, closer to population centers and communities that often suffer from food insecurity through limited access to healthy food.

Plant life captures and stores carbon found in the environment from sources like automobiles and industries. To achieve a climate resilient Lagos through preservation, restoration and conservation of Lagos wetland, it is therefore paramount to activate and calculate the amount of CO2 that would be sequestered by trees and shrubs over a year on the wetland. In order to populate the value of CO2 captured for environmental benefits, there is need for close enumeration of trees, type of trees, trees area and trees girth in the proposed urban green infrastructure master plan for the metropolis.

Since the wellbeing of a city cannot be separated from the wellbeing of its serene and habitable environments. A re-envisioned local food system restores health to an ecosystem degraded by pollution, contamination, and threats from climate change. Food production, distribution, and consumption now account for one-third of man-made greenhouse gas emissions. A sustainable food system produces food close to the consumers it serves, using renewable resources and avoiding methods and materials that contaminate the environment and the food.

The Integrated Linear Park, Social, Health and Fitness Impact is an off-road bike trail is aim to create connected on-road cycling routes and an off-road trail network across Lagos state. Anthony to Maryland off-road bicycle trail system is seen as a high priority for this feasibility study as it connects to different neighborhoods, communities and districts in Lagos state such includes Gbagada, Anthony, Mende, Somolu, Oworonshoki, Ogudu, Ifako, Ojota, and Ikeja. The plan is also a blueprint for creating a healthy and active environment encouraging people to participate in cycling for healthy living, cycling for low carbon transportation, sports, nature watch, play and relaxing parks. The Linear Park provides bicycle path for transportation, tour and recreation through 16.6 kilometers. A desirable place to live and work includes walking and bicycling among the options for ways to get to work and other destinations.

CONCLUSION

This study summarizes and integrates the main findings which are presented in the urban greening strategies and technological innovations and how the benefits can be articulated in ecological, social and economic terms. Furthermore, the study scrutinized the relationship between green spaces, social cohesion and discussed links between biological and cultural diversity. Hence, UGI is perceived as a

comprehensive landscape approach acknowledging the various ecological services and benefits from a coherent green, grey and blue network at different urban spatial configurations and levels, linking up neighbourhoods, districts and cities.

Securing the full services and benefits of UGI requires both green strategic planning as well as participatory synergies in order to address the variety of challenges associated with local sustainable developments and approaches so as to promoting the social and economic wellbeing of urban residents. Appropriate government authorities and private institutions should recognize the role green infrastructures plays in restoring a healthy ecosystem and in creating a more sustainable city through reduced reliance on fossil fuel, increased green open spaces, restoration of habitats, increased soil, water and air purity.

Ministry of Agriculture and that of Environment should synergize to support the use of sustainable farming practices in urban agricultural settings. Support should be given to the establishment of waste treatment facilities to transform plant waste from gardens and farms into compost to be used in local gardens and farms.

This paper has illustrated that the quality and type of open space provided within communities can have a significant and sustained impact on community health and wellbeing. Adopting the following strategies will help to enhance the air quality:

1. The promotion of health and social benefits, as well as those related to the environment and the economy are important in commending to decision makers the significance of open spaces in shaping our communities now

A. Chiwuzie, D. I. Dabara, T. M. Adenipekun, E. M. Prince and B. O. Ajiboye (2019) Tenant's demand for structural attributes in residential properties: the case of Ede, Nigeria In: Laryea, S. and Essah, E. (Eds) Procs 10th West Africa Built Environment Research (WABER) Conference, 5-7 August 2019, Accra, Ghana, 1063-1076

INTRODUCTION

Residential property comprised several attributes; neighborhood, location and structural (Wilhelmsson, 2000; Aluko, 2011; Anthony, 2012). Each of these attributes exerts influences on the property and hence adds value to the property or otherwise reduces value of the property (Usman, 2016). Structural attributes that have been found to affect demand for residential properties include among others number of living rooms and bedrooms, size of both living and bedrooms, number of toilet and bathrooms, type and quality of floor finishes, level of interior and exterior decorations, perimeter fence and the available space (Odame, 2010; Anthony, 2012; Olayinka, Funsho and Ayotunde, 2013; Nishani, 2016). Okorie (2015) posited that these attributes constitute part of the basic social conditions that can define the quality of life and welfare of the people of residing in a particular property. Consequently, when households want to purchase or rent a residential unit, they have concerns towards the quality of property in terms of functional and live able contexts. Yam and Ismail (2008) found that preferences of housing consumers have changed from basic shelter to quality living environment. This suggests that tenants are becoming increasingly aware that the natures of a property or its structural attributes in terms of how well the property is built and designed have a profound impact on their productivity and general wellbeing. Hence, the need for residential properties to be designed in such a way to achieve convenience of care and enhance family living cannot be overemphasized.

Furthermore, studies have found that the presence of some structural attributes and or the sizes of structural attributes in a property determine the price of such a property. Anthony (2012) posited that if individuals get the amount and size of accommodation they want, they will be willing to pay higher value for it than they would pay for property with more or less the amount of accommodation they require. In fact, Okorie (2015) found that at least 58.65% of residential tenants expressed willingness to pay higher rent to have improved facilities incorporated in residential property. Buys et al. (2005) and Sitar and Krajnc (2008) similarly observed that consumers of residential properties were willing to pay more for properties with quality finishes. The implication is that the absence of quality structural attribute in a property will lead to a reduced rental value. Dabara et al., (2012a) opined that any decrease in rental values negatively affects the viability of landed property investment particularly investment in the residential property market.

The residential property market in Ede, Nigeria has evolved remarkably within the past few years. Thanks to the increased economic activities in the area occasioned by the establishment of higher educational institutions such as the Federal Polytechnic, Redeemers University and Adeleke University. This development has led to influx of people into the area resulting to high demand for residential properties both for owner-occupation and rental holdings. Rental holding as observed by Dabara, Olatoye and Okorie (2012b) is an essential component of a healthy housing system of a nation and predominates in most Nigeria's urban areas including Ede. This may not be unconnected to the fact that renting offers people a more affordable way of gaining access to accommodations (Amenyah and Fletcher, 2013). Furthermore, the diverse ethnic composition of people living in Ede town has impacted on both the types and quality of residential properties available

in the market. The market which was hitherto dominated by tenement buildings is now housing a variety of residential properties types such as self-contained apartments, flats and duplexes with varying structural attributes. This study therefore tends to examine what tenants demand for in terms of structural attributes in residential properties. The term demand in economics connotes desire for a product which is backed with willingness to pay. Hence, understanding the structural attributes that tenants desire for in residential properties as well as their willingness to pay more for the desired attributes will assist the real estate investors in their bid to satisfy the needs of their customers while maximizing return from investments. More so, the knowledge of the demands of real estate consumers as well as their behavior will lead to better understanding of consumer dynamics and aid investment decisions in the real estate market (Gibler and Nelson, 2003).

In view of the above, the aim of the study was to examine tenant's demand for structural attributes in residential property in Ede, Nigeria with a view to providing information that will encourage investor to undertake structural improvements which will meet the expectations of tenants and at the same time attract higher rental values. The research questions include: What are the structural attributes (and /or attribute's size) in residential properties in Ede, Nigeria? What are the structural attributes (and /or attribute's size) that tenants desire for in residential properties in Ede? Are the tenants willing to pay more for the desired attribute(s) in the study area? Furthermore, in order to determine the tenants' responsiveness of willingness to pay more for the desired attributes, the study hypothesized that 90% of the respondent in each property categories would express willingness to pay more for the desired attributes.

LITERATURE REVIEW

Tan (2012) investigated the housing needs and preferences of first-time buyers in Kuala Lumpur with emphasis on certain characteristics of a dwelling such as the number of bathrooms, bedrooms, living rooms, kitchen, among others. Data collected was analyzed by means of regression model. The study revealed that major preference is often given to number of bedrooms.

Opoku and Abdul-Muhmin (2010) also examined housing preferences and attribute importance among low-income consumers in Saudi Arabia. The data was collected through a structured self-administered questionnaire. Relative importance index, chi- square and one-sample t-tests were employed in analyzing the data. The result revealed that number and size of bedrooms, size of living room, bathrooms, kitchen, availability of storage room, type of finishes, were among the important structural attributes that influence house preference among consumers in Saudi Arabia. This finding is consistent with the finding in Hurtubia, Gallay, and Bierlaire (2010). Al-Momani (2000) identified interior design, outdoor space functionality, kitchen size as among the key factors influencing Jordanian housing consumers.

Vahid (2015) on the other hand examined the perception on the priority of structural housing components from the point of view of house consumers in Malaysia. The study adopted the Non-structural fuzzy decision support system (NSFDSS) model as a tool for determining the perceived relative importance of the

set decision criteria. Findings indicated that floor finishing was identified as among major structural housing attributes that influences the preference of house buyer's choice in Johor Bahru, Malaysia.

Table 1: summary of studies on house structural attributes and consumer's preferences

Author (s)	Title	Structural Attributes Investigated	Findings
Vahid Moghimi Mahmud Bin Mohd Jusan (2015)	Priority of Structural Housing Attribute Preferences: identifying Customer Perception	•Type, size and material of doors and windows •Presence and size of green area •Space organization •Space characteristics •Kitchen position •Bathroom position •Size Living of room •Number, size, location of bedrooms •Interior wall tiling •Floor finishes	Space organization of a building, adequacy of ventilation, space characteristics and Floor finishes were the major structural housing attributes that influences the preference of house buyers choice in Joho Bahru, Malaysia.
Tan, T.H. (2012)	Meeting First-time buyers' Housing Needs and Preferences in Greater Kuala Lumpur Cities	•Number of bedrooms •Number of bathroom •Size of living room •Size of Kitchen •Built-up area •Green housing	Number of bedroom is considered very important by first-time homebuyers. There were insignificant relationships in the preference to become a homeowner based on number of bathroom, size of living room, built up area and kitcher area.
Tan, T.H. (2011)	Measuring the Willingness to Pay for Houses in a Sustainable Neighborhood	•Walls •Flooring	There are significant relationships in the willingness to pay based on structural attributes that incorporate environmental sustainability such as floor and wall tiles

Furthermore, Tan (2011) studied the willingness to pay to changes in structural, locational, and neighborhood attributes of housing that incorporate sustainability objectives. A self-administered survey was conducted to collect the required data in Klang Valley, Malaysia. An ordinary least squares method together with a heteroscedasticity consistent covariance matrix estimator was used in analyzing the data. The results revealed significant relationships in the willingness to pay based on structural attributes that incorporate environmental sustainability such as floor and wall tiles. The summary of the different studies and the structural attributes investigated is presented in table 1 below.

From the foregoing structural attributes of residential property indeed impact on consumer's decisions and that the relative importance of various structural attributes in consumer's preferences varies across national contexts. Consumers of residential property are in two folds comprising buyer and renter/tenant. However, previous studies only examined the importance of various structural attributes to residential property consumers from the point of view of home buyers/owners and did not consider the perspective of renters/tenants. The importance of the various structural attributes to consumers may differ between buyers and tenants of residential property. Furthermore, residential property is made up of different

categories; consequently, preferences for structural attributes may also vary across tenants occupying different categories of residential property. The residential properties in Ede town are in categories that are based on the number of rooms and supporting facilities provided in the apartments. This paper therefore intends to contribute to knowledge base by setting forth an understanding on the structural attributes that tenants (of different residential property categories) demand for in Ede, Nigeria with emphasis on the sizes of rooms and availability/sizes of other structural components.

METHODOLOGY

In order to evaluate tenant's demand for structural attributes in the residential properties, a self administered questionnaire survey was conducted to collect the required data directly from tenants. The target population for the study is tenants/renters occupying residential properties in Ede, Nigeria. This means that landlords or owners who occupy their residential properties within the study area were not eligible to participate in the study. Hence, to ensure the eligibility of respondents, stratified sampling was employed. A comprehensive list of the respondents (tenants) is not available to the researchers; therefore, samples were selected from five major areas of the town namely: Okegada, Agip, Allahu lateef, Ya salam and Country home. Furthermore, residential properties in the study area are in different categories. However, Dabara et al. (2018) observed that the dominant categories comprised tenement; one room self-contained, a room and parlour self-contained, two and three bedroom flats respectively. Only these categories were considered in this study. The choice of these categories was based on preliminary investigation which revealed that they are the major rented apartments with their demands being more frequent and stable in the study area. Consequently, other category such as duplex was excluded from this study and this could be one of the limitations of this study.

In line with sample size suggested in Cochran (1977) for infinite population (taking 95% confidence level with ±5% precision), a total of 400 questionnaires were distributed, out of which 278 were returned representing 69.5% response rate. The data requirements for this study include among others the structural attributes available in the residential property and their sizes; the structural attributes (and /or attribute's size) that the tenant desires; and the tenant's willingness to pay more for the desired attribute(s). In order to determine the responsiveness of willingness to pay for desired attributes (or attribute size), the study hypothesized that 90% of the respondents in each property category would express willingness to pay more for the desired attributes or attribute size. This percentage which is based on the acceptable statistical range for a viable analysis would justify tenants' demand and motivate investors to improve the structural attributes in residential properties in the study area. The structural attributes used for the study include: the size of living rooms and bedrooms, size of toilet and bathrooms, size of kitchen, size of dining, size of storage room, type of floor finishes, perimeter fence and private backyard (the selection of these structural attributes among others was based on preliminary investigation which revealed that they are the major consideration in the study area. Hence, other structural attributes such as level of interior and exterior decorations, quality of building materials etc were excluded from this particular study even though they are also important structural attributes).

Data collected were analysed using both descriptive and inferential statistical tools such as percentile, bar charts, weighted mean score and Chi square. A 5-point response scale and weighted mean score were used to determine the importance of each of the selected structural attributes to respondents if they were to make a decision to rent a residential property. Chi square was employed to test the responsiveness of willingness to pay. It specifically tests whether there is significant difference between the observed "willingness to pay" response by the tenants and the hypothesized proportion. Another limitation of this study is it focused on tenant's willingness to pay for desired structural attributes and did not consider how much more the tenants were willing to pay (even though it a very important factor that can justify investors incorporating the desired structural attributes in the property designs).

The various residential property categories and the number sampled are presented in table 2 below. Tenement comprises single rooms with shared toilet and kitchen facilities; a room self-contained is a room which has toilet and kitchen facilities attached; a room and parlour self-contained on the other hand comprised a bedroom and living room attached with kitchen and toilet facilities; two and three bedroom flats have two and three bedrooms respectively attached with kitchen, dining, toilet facilities and in some cases storage room.

Table 2: Types of Residential Properties and the Number Sampled in Ede, Nigeria

Types	No. of Properties	Percentage
Tenement	125	45.0
A room self-contained	14	05.0
A Room and parlour self-contained	23	08.3
Two bedroom flat	28	10.0
Three bedroom flat	88	31.7
Total	278	100

Source: Field survey 2018

DATA ANALYSIS AND DISCUSSION OF RESULT

This section presented the data analysis and discussed the results pertaining to the study objectives starting with the sizes of the various structural attributes in the residential property categories.

Table 3: Average Sizes (in M^2) of Structural Attributes in Residential Properties

Structural Attributes	Tenement	A room self-contained	Room/parlour self-contained	Two bed room flat	Three bed room flat
Living room	N/A*	N/A*	9.50	12.25	14.00
Bedroom	6.25	6.25	6.25	6.25	6.25
Bathroom	1.50	1.50	1.50	1.50	1.50
Dining	N/A*	N/A*	N/A*	3.00	3.00
Kitchen	3.00	1.50	3.00	3.00	3.00
Storage room	N/A*	N/A*	N/A*	1.50	1.50

Source: Field survey 2018
N/A (the design does not incorporate the structural attribute)*

From table 3 above, analysis of the sizes of structural components in the residential properties shows the average size of bedroom and bathroom is approximately 6.25 square meters and 1.50 square meters respectively for all categories of residential

property understudied. Also, the approximate average size of living room is 9.50 square meters in a room and parlour self-contained; 12.25 square meters in two bedroom flats and 14.00 square meters in three bedroom flats. Findings further revealed that the average size of storage room is approximately 1.50 square meters in the flats. The study also found that only about 9.48% of the flats sampled have storage room facility implying that most of the residential properties in the study area were not provided with storage room.

Table 4 shows the types of floor finish in the residential property categories in the study area. The popular floor finishes in the property is either of ceramic tiles or of concrete (generally referred to as cemented floor). In the three bedroom flats category, 3.4% of the properties has fully tiled floor, 38.6% has every other area tiled except the bedrooms (which has concrete floor); 45.5% has only the bathroom tiled while all other area has concrete floor; and 12.5% has fully concrete floor. In the two bedroom flats category, 10.7% of the properties has fully tiled floor; 50% has every other area tiled except the bedrooms (which has concrete floor); and 39.3% has only the bathroom tiled while all other area has concrete floor.

Table 4: Types of Floor Finishes in the Residential Properties (% in parenthesis)

Types	Tenement	A Room self-contained	Room/ parlour self-contained	Two Bed room flat	Three bed room flat
Fully tiled	0 (0.0)	8 (57.1)	4 (17.4)	3 (10.7)	3 (3.4)
Fully tiled except bedrooms	0 (0.0)	0 (0.0)	14 (60.8)	14 (50.0)	34 (38.6)
Fully cemented except bath	7 (5.6)	6 (42.9)	5 (21.7)	11 (39.3)	40 (45.5)
Fully cemented	118 (94.4)	0 (0.0)	0 (0.0)	0 (0.0)	11 (12.5)
Total	125 (100)	14 (100)	23 (100)	28 (100)	88 (100)

Source: Field survey 2018

For a room and parlour self-contained, 17.4% of the properties has fully tiled floor, 60.8% has every other area tiled except the bedrooms (which has concrete floor), 21.7% has only the bathroom tiled while all other area has concrete floor. In a room self-contained category, 57.1% of the properties has fully tiled floor; 42.9% has only the bathroom tiled while all other area has concrete floor. In tenement property category, 94.4% has fully concrete floor while 5.6% has only the bathroom tiled with concrete floor in all other area. The above findings coupled with the tenants' earlier ranking of these attributes bring to mind the question of whether these structural attributes meet the expectations of the tenants. If otherwise, what do tenants actually desire in terms of structural components of residential properties in the study area?

The importance of the various structural attributes to tenants when making decision on renting residential properties is presented in table 5 above. The analysis showed that among the structural attributes listed, the presence of perimeter fence rank highest across four residential property types: a room self-contained (mean score = 4.36); room and parlour self-contained (mean score = 4.21); two bedroom flat (mean score = 4.64); and three bedroom flat (mean score = 4.54). Beyond perimeter fence, other structural attributes such as type of floor finish, all en-suite bedrooms, size of bedrooms, size of living room, size of kitchen and size of storage room ranked among the first six important attributes (although with varying positions) across four categories of residential property. For example, all en-suite bedrooms ranked second in two bedroom flats and third in three

bedroom flats. Size of bedrooms on the other hand ranked first in tenement room (mean score = 4.03); second in one room self-contained (mean score = 4.28); third in room and parlour self-contained (mean score = 3.82); and fourth in two bedroom flats (mean score = 4.21) and three bedroom flats (mean score = 4.21) respectively.

Table 5: Tenants' ranking of Structural Attributes in Residential Properties in Ede

Structural Attributes	Tenement rooms	Weighted Mean Score A room self-contained	A room and parlour self-contained	Two bedroom flat	Three bedroom flat
Size of Living room	N/A*	N/A*	3.74 (5th)	3.82 (5th)	4.18 (5th)
Size of Bedroom	4.03 (1st)	4.28 (2nd)	3.82 (3rd)	4.21 (4th)	4.21 (4th)
Size of Bathroom	2.14 (5th)	3.07 (6th)	2.65 (8th)	3.29 (7th)	3.43 (8th)
Size of Dining	N/A*	N/A*	2.43 (9th)	2.96 (9th)	3.01 (10th)
Size of Kitchen	2.22 (4th)	3.21 (5th)	3.48 (6th)	3.79 (6th)	3.84 (6th)
Size of Storage room	N/A*	3.21 (5th)	3.74 (4th)	3.79 (6th)	3.78 (7th)
Floor finish	2.32 (2nd)	3.78 (3rd)	4.17 (2nd)	4.35 (3rd)	4.41 (2nd)
All en-suite bedrooms	N/A*	N/A**	N/A**	4.54 (2nd)	4.32 (3rd)
Perimeter Fence	2.31 (3rd)	4.36 (1st)	4.21 (1st)	4.64 (1st)	4.45 (1st)
Private backyard	N/A*	3.71 (4th)	3.43 (7th)	3.21 (8th)	3.26 (9th)

Source: Analysis of survey data 2018
N/A (the design does not incorporate the structural attribute)*
*N/A** (the structural attribute is fundamental in the design)*

This finding is in conformity with the findings in Opoku and Abdul-Muhmin (2010). Moreover, size of dining, private backyard and size of bathroom were the three least ranked structural attributes. Although their ranks also differ across the property categories, it generally suggests that these structural attributes were considered less important by tenants in the study area. Furthermore, the tenement category presented a peculiar outcome in the analysis in table 2 above. In this category, the size of bedroom ranked highest with mean score of 4.03 while much lower mean scores were observed for other structural attributes. For example, type of floor finish and perimeter fence that ranked second and third in that category have mean scores of 2.32 and 2.31 respectively. This margin could suggest that tenants in the tenement category considered size of bedroom as very important while other structural attributes such as floor finish, perimeter fence and size of kitchen were considered as less important. The implication of this finding is that the importance of the selected structural attributes varies across tenants of different categories of residential property.

The structural attributes that tenants expressed willingness to more for are presented in table 6. It can be seen from the table 6 that tenants across the five categories of residential properties in the study area expressed willingness to pay more for larger bedrooms. This is suggested by 62.4%, 50.0%, 60.9%, 57.1% and 62.5% in tenement, a room self-contained, room and parlour self-contained, two bedroom flat and three bedroom flat respectively.

Other structural attributes that tenants across all categories expressed willingness to pay more for include fully tiled floor, perimeter fence and larger living room, larger dining, all en-suite bedrooms and private backyard where applicable. Beyond that, respondents in some property categories also expressed willingness

to pay more for other structural attributes such as larger bathroom, larger kitchen and larger storage room. This finding is consistent with Buys et al. (2005); Sitar and Krajnc (2008); Anthony (2012); Okorie (2015).

Table 6: Structural Attributes that Tenant would pay more for (% in parenthesis)

Structural Attributes	Tenement	A room self-contained	A room and parlour self-contained	Two bedroom flat	Three bedroom flat
Larger Living room	N/A*	N/A*	04 (17.4)	08 (28.6)	20 (22.7)
Larger Bedroom	78 (62.4)	07 (50.0)	14 (60.9)	16 (57.1)	55 (62.5)
Larger Bathroom	00 (0.0)	02 (14.3)	06 (26.1)	12 (42.6)	26 (29.5)
Larger Dining	N/A*	N/A*	02 (08.7)	04 (14.3)	21 (23.9)
Larger Kitchen	00 (0.0)	03 (21.4)	05 (21.7)	07 (25.0)	32 (36.4)
Larger Storage room	N/A*	00 (0.0)	09 (39.1)	15 (53.6)	54 (61.4)
Fully Tiled floor	16 (12.8)	10 (71.4)	16 (69.6)	17 (60.7)	56 (63.6)
All en-suite bedrooms	N/A*	N/A**	N/A**	19 (67.9)	57 (64.8)
Perimeter fence	05 (04.0)	09 (64.3)	14 (60.9)	18 (64.3)	58 (65.9)
Private backyard	N/A*	02 (14.3)	05 (21.7)	15 (53.6)	54 (61.4)

Source: Field survey 2018
N/A (the design does not incorporate the structural attribute)*
*N/A** (the structural attribute is fundamental in the design)*

The structural attributes which some tenants did not express willingness to pay for include larger bathroom and kitchen in tenement category as well larger storage room in a room self-contained category. This response may not be unconnected to the design nature of the affected categories. Tenement accommodation is multi-tenanted with shared facilities while a room self-contained is usually occupied by an individual especially students or persons awaiting gainful or better employment hence the occupants give little or no consideration to the amount of space provided for the identified structural attributes in these categories.

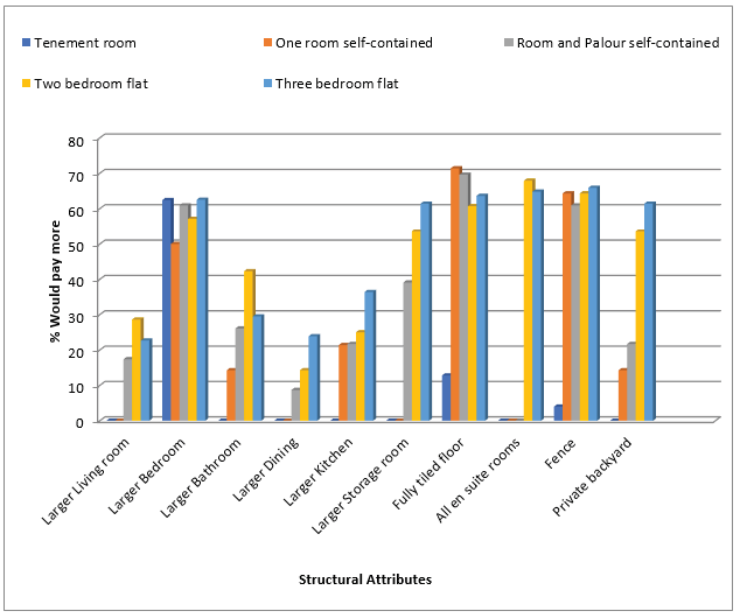


Fig. 1: Structural Attributes that Tenant would pay more for (by Property Categories)

Furthermore, the result of the analysis in table 6 above is represented in figure 1 below. It can be seen that among the selected structural attributes, larger bedroom was ranked very highly in terms of overall “would pay more for” by respondents in

all categories of residential property. Beyond that, other structural attributes that were ranked very highly include fully tiled floor and fence (in a room self contained, room and parlour self contained, two and three bedroom flats); and all en-suite rooms (in two and three bedroom flat). Larger storage room and private backyard were also ranked highly in two and three bedroom flats.

Chi-square was employed to statistically test whether 90% of the tenants expressed willingness to pay more for their desired structural attributes. It specifically tests whether there is significant difference between the observed "willingness to pay" response by the tenants and the 90% hypothesized proportion.

Table 7: Chi-Square Test for 90% of Tenants Would Pay More for Desired Attribute (p-value in parenthesis)

Structural Attributes	Tenement	A room self-contained	A room and parlour self-contained	Two bedroom flat	Three bedroom flat
Larger Living room	N/A*	N/A*	134.73 (.000)	117.39 (.000)	442.51 (.000)
Larger Bedroom	105.79 (.000)	16.79 (.000)	21.69 (.000)	33.59 (.000)	73.94 (.000)
Larger Bathroom	00 (0.0)	88.18 (.000)	104.39 (.000)	69.14 (.000)	357.37 (.000)
Larger Dining	N/A*	N/A*	168.93 (.000)	178.35 (.000)	427.68 (.000)
Larger Kitchen	00 (0.0)	73.14 (.000)	119.08 (.000)	131.44 (.000)	281.29 (.000)
Larger Storage room	N/A*	00 (0.0)	66.13 (.000)	59.06 (.000)	80.18 (.000)
Fully Tiled Floor	827.76 (.000)	5.36 (.021)	10.67 (.001)	80.02 (.000)	67.96 (.000)
Allen-suite B/room	N/A*	N/A**	N/A**	69.14 (.000)	62.23 (.000)
Perimeter fence	1027.22 (.000	10.29(.001)	21.69 (.000)	91.68 (.000)	56.75 (.000)
Private backyard	N/A*	88.18(.000)	119.08 (.000)	59.06 (.000)	3.13 (.077)

Source: Analysis of survey data 2018
N/A (the design does not incorporate the structural attribute)*
*N/A** (the structural attribute is fundamental in the design)*

The chi-square and p values of tenant's responsiveness of willingness to pay more for the desired structural attributes are presented in Table 7. A p-value of < .05 suggests the difference between the observed responses and the expected proportions is statistically significant while p-value of > .05 suggests the difference is not statistically significant. From the analysis, all the structural attributes showed p-values of < .05 suggesting there is significant difference between the observed responses and the 90% expected proportions across all categories of the residential property. These results showed that the observed responses do not march well the expected proportions implying there is sufficient evidence to suggest that 90% of tenants did not express willingness to pay more for the desired structural attributes in the entire categories of residential property understudied.

CONCLUSION

The study examined tenant's demand for structural attributes in residential property in Ede, Nigeria. It specifically analyzed tenant's desire for some selected structural attributes in five residential property categories as well as the tenant's willingness to pay more for the desired attribute(s). The findings of the study suggested that the importance of the selected structural attributes varies across tenants of the various categories of residential property. The study further showed that larger bedroom was ranked very highly in terms of overall "would pay more for" by respondents in all categories of residential property. Other structural

attributes that were ranked very highly include fully tiled floor and fence (in a room self contained, room and parlour self contained, two and three bedroom flats); and all en-suite rooms, larger storage room and private backyard (in two and three bedroom flats). However, the result of the chi square test showed there is significant difference between the observed "would pay more for" responses and the 90% expected proportions (p-values < .05) across all categories of the residential property. Conclusively, 90% of the sampled tenants in all categories of residential property in Ede did not express willingness to pay more for desired structural attributes. This study particularly brings to fore the expectations and behavior of tenants in terms of structural attributes' demand in each on the selected categories of residential property in Ede property market. Consequently, investors in the residential property submarket should take cognizance of these when making decision on house design so as to have a product that appeals to tenant's expectations while ensuring maximization of return from the real estate investment.

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APPENDIX

Fig 2: Tenement Residential Property

Fig 3: A Room Self-contained

Fig 4: A Room and Parlour Self-contained (semi-detached)

Fig. 5: Two Bedroom Flat

Fig. 6: Three Bedroom Flat

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THE INFLUENCE OF GDP ON RENTAL GROWTH OF RESIDENTIAL PROPERTIES IN EDE, NIGERIA

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Changes in rental values may occur in response to changes in economic conditions at all levels of an economy. Against the backdrop of recent unstable GDP growth rates in Nigeria, this study evaluated the influence of GDP on rental growth rates of residential properties in Ede, Nigeria with a view to providing information that will aid better understanding of the dynamics of residential property market for investment decisions. It analyzed the magnitude of growth in rental values of five residential property types comprising tenement room, one room self-contained, room and parlour self-contained, two bedroom flat and three bedroom flat to determine whether significant difference exist in the growth rates across the five property types; the extent of variation in the rental values of the properties types in Ede caused by GDP growth; and also, the relationship between GDP growth rates and rental growth rates of residential properties in the study area. The study utilized both primary and secondary data. Primary data used for the study was collected through structured questionnaire administered on landlords who rented their properties within the study period and comprised rental values of five residential property types between 2002 and 2017. Secondary data for the study comprised Nigeria's GDP figures between 2002 and 2017. Descriptive and inferential statistical techniques such as frequency table, chart, ANOVA and linear regression were used to analyse the data. The results revealed a mean yearly growth rates of 17.03%, 17.01%, 16.57%, 19.86% and 20.83% for tenement room, one room self-contained, room and parlour self-contained, two bedroom flat and three bedroom flat respectively; and the mean rental growth rates across the selected residential property types at 95% confidence level are not significantly different $F(4, 70) = 0.345$ $P = .847 > .05$. Furthermore, during the period under study, GDP values were found to have a strong positive relationship with rental values of residential properties in the study area and accounts for about 73%, 75%, 82%, 76% and 83% of variation in rental values of tenement room, one room self-contained, room and parlour self-contained, two bedroom flat and three bedroom flat respectively. The study however found no statistically significant relationship between GDP growth rates and rental growth rates of residential properties in the study area. Consequently, the study concluded that GDP growth rates do not have significant influence on rental growth rates of selected residential properties in Ede during period understudied.

Keywords: growth, influence of GDP, Nigeria, residential properties, rental value, trend

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INTRODUCTION

Residential properties have continued to attract the interest of real estate investors and developers (Okorie, 2015). Rental value has been observed as the key parameter for measuring the performance of real property investment (Hoesli & MacGregor, 2000; Boon and Higgins, 2007). Changes are likely in rental values and these changes may occur in response to changes in economic conditions at all levels of an economy. According to Born and Pyhrr (1994) and Apergis (2003), macroeconomic policy of national, regional and local economy affects values of property investment and indeed the performance of the property market. Giussani et al. (1993) and Ting (2017) posited that macroeconomic parameter such as money supply, inflation, interest, GDP significantly influence investor's decisions and also determine returns from real property investments. The close link of property investment market to macroeconomic factors is documented in a number of studies conducted at different time. Results from these studies suggested that macroeconomic factors influence property rental movements and return. These studies include Ervi, 2002; Peng and Hudsin-wilson, 2002; Nzalu, 2003; Peng, Tan and Yiu, 2005; Joshi, 2006; Eldelstein & Tsang, 2007; Sinbad & Mhlanga, 2009; Kwangware, 2010; Ojetunde, Popoola and Kemiki 2011; Ojetunde, 2013; Udoekanem, Ighalo and Nuhu, 2014; Lu and Tang, 2014; Udoekanem et al., 2015; Ting, 2017; Wahab et al., 2017. These empirical studies found that GDP is one of the major macroeconomic factors that influence rental values in the property market. Participants in property market such as investors and developers often use rental value as an indicator to appraise the viability of their investment in real property (Udoekanem, Ighalo and Nuhu, 2014). Dabara, et al., (2012) observed that factors that negatively affect the values of real property injure ownership motives and discourage subsequent investment. Besides, one of the important characteristics of real property investments is income (rental) and capital growth (Johnson, Davies and Shapiro, 2000; Karakozova, 2005 and Kivilahti and Vitanen, 2006). Rental growth has remained the major expectation of property investors from 1960 onwards due to the advent of inflation into the property markets worldwide (Crosby, 1983; Crosby, 1984; Baum and Crosby, 1995 and Wyatt, 2007).

The residential property investment market in Ede, Nigeria has become very active in the recent past. This might not be unconnected to the increased economic activities occasioned by the siting of several tertiary educational institutions within the metropolis which has led to the influx of staff, students, businessmen and people providing support services who chose to live close to their employment centers. This development has resulted in increased demand for residential property with the attendant increase in the rental values of residential properties within the area. Consequently, investors and professionals in the real estate industry need to have better understanding of the pattern of rental movements and of the characteristics of the residential property submarket in the city. This becomes necessary as renting remains an essential component of a healthy housing system of a nation (Dabara, Olatoye and Okorie (2012). More so, there has been in recent years a growing interest in modeling the role of macroeconomic factors in property market performance. In fact, Wahab et al., (2017) observed the pressing need for institutional investors to measure the influence of macro economy on the performance of real property investment.

The Nigeria's economy has been characterized by fluctuating macroeconomic statistics which depicts the unstable nature of the economy (Udoekanem, Ighalo and Nuhu, 2014). The GDP growth which measures the overall performance of an economy is not left out. GDP is said to be a monetary price for goods and services produced within a country on a specific time period. An increasing GDP suggests increase in wealth and quality of living for citizens. The improved economic status brings about more people being proper employed, leading to increased demand for suitable accommodation with a corresponding increase in rental value. Jian and Zhang (2012) observed that an increased trend on GDP will strengthen the real estate value. Nigeria's GPD growth rate has been observed to be unstable in the recent past and this could be a source of concern among real estate investors. It is against this background that this study is undertaken with the aim of evaluating the nature of relationship existing between GDP growth rates and the rental growth rates of residential property in Ede, Nigeria with a view to providing information that will aid better understanding of the dynamics of residential property market in the metropolis. The questions this study seeks to find answers to include among other: What were the magnitudes of growth in rental values of residential properties in Ede from 2002 to 2017? Is there any significant difference in rental growth rates across the residential property types from 2002 to 2017? What is the extent of variation in the rental values of the residential properties types in Ede caused by GDP growth? And is there any relationship between GDP growth rates and the rental growth rates of residential properties in the study area?

LITERATURE REVIEW

Results on empirical studies conducted around the world have shown that real property market's growth and Gross Domestic Product (GDP) growth have inseparable relationship and that rental value and rental change in properties is influenced by GDP growth. D'Arcy, McGough and Tsolacos (1994) examined the determinants of office rents in twelve European cities over the period, 1982-1993 and the study concluded that Gross Domestic Product (GDP) and unemployment rates are the most important determinants of office rents across those twelve European cities. This finding is consistent with the result obtained by McGough, Olkkonen and Tsolacos (1998) and D'Arcy, McGough, and Tsolacos (1998).

Similarly, Giussani, Hsia and Tsolacos (1993) examined office rent determinants across European cities. The study also examined the relationship between office rental value and economic activity using cross section and time-series analysis. The study investigated office rental trends for some of the largest cities in Europe and used annual data for the period 1983 - 1991 to test the changes in rental values and fluctuations in economic activity. Their findings suggest that European rental values are determined by particularly gross domestic product (GDP). Hui and Yu (2006) and Keogh (1994) also found that Gross Domestic Product (GDP) is the most significant explanatory variable for rental values.

In the Nigerian scene, Ojetunde (2013) examined the long term relationship between Nigerian residential property market and macro economy using annual data from 1984 to 2011. Multi- equation regression was adopted for data analysis. The result showed the microeconomic variables such as real GDP, inflation, exchange rate and interest rates have long term relationship with residential

property rents in Nigeria. The result further revealed that real GDP and exchange rate forecasted 31.4% of the variation in residential property rent. This result is in conformity with the earlier submission in Ojetunde, Popoola and Kemiki (2011).

Udoekanem et al., (2015) on the other hand examined the determinants of commercial property rental value in Wuse commercial district of Abuja, Nigeria between 2001 and 2012. The study adopted single equation regression. The result also revealed that real GDP and vacancy rate respectively account for 74% and 83% of variation in office rent. The study concluded that GDP and vacancy rate are the major drivers of rental change in Wuse market. This finding is congruent to the findings in Udoekanem, Ighalo and Nuhu, (2014).

Wahab et al., (2017) studied the effect of macroeconomic variables in Abuja residential property market. The study employed Augmented Dicker Fuller (ADF) test and co integration regression to analyze time-series data on annual macroeconomic indices and total property returns index from 2001 to 2015. The result further showed that between 18.2% - 83.6% and 16.2% - 79% variation in 3B/R and 4B/R property returns respectively across the seven out of twelve residential markets were significantly influenced by macroeconomic indicators. The study concluded that real GDP, exchange rate, inflation, interest rate and employment rate were found to have a significant influence on property return across the nine markets.

Broadly speaking, one of the key factors that affect the values of real property is the state of the economy (Nguyen, 2017). GDP is an economic indicator that measures the overall health of the economy. Specifically, GDP measures the total production of goods and services produced in a country and include products for current consumption and the production of capital goods as an investment for future production (National Association of Home Builders, 2001). Housing is a major part of both current consumption and private investment. Output of the housing sector for consumption consists primarily of the services of shelter and security provided by the existing housing stock. The payment of rent by tenants in rental housing is counted as part of consumer spending on services (National Association of Home Builders, 2001). As a country's GDP is increasing, it is more productive which leads to more people being employed. This increases the wealth of the nation, its population and standard of living of the citizens. With improved economic status, citizens are alleviated from low standard of living into proper employment with suitable shelter (Agarwal, 2019). Changes in economic status therefore, can greatly influence a person's ability to rent a particular residential property. This is because the higher the purchasing power, the more the rates of consumption of goods including residential property. This creates a higher demand for residential property which again pushes prices up. Jian and Zhang (2012) further posited that as an economic pointer, an increased trend on GDP will strengthen the real estate value. Conversely, when the GDP is sluggish, so is real estate value.

Most of the literature reviewed particularly from the Nigerian context showed that GDP has an explanatory influence on rental values of real property. These studies aside from been conducted outside the study area currently being examined, the studies only established the relationship between GDP and rental values. No previous empirical study from the literature on the relationship between GDP

growth rates and rental growth rates of residential properties in the study area was found. It is against this background that this study seeks to look beyond rental values to further analyze the relationship between GDP growth rates and rental growth rates of residential property in Ede, Nigeria.

METHODOLOGY AND DATA

The study employed both primary and secondary data. The primary data for the study comprised annual data on rental levels for five residential properties types. The residential property types includes: tenement (single rooms with shared toilet and kitchen facilities); one room 'self-contained' (a room with toilet and kitchen facilities attached); room and parlour 'self-contained' (a bedroom and sitting room with kitchen and toilet facilities attached); two and three bedroom flats respectively. These residential property types were considered for this study because they are predominant in the study area (Dabara et al, 2018). Other category such as duplex was excluded from this study and this could be one of the limitations of this study. The areas covered for this study includes: Agbale, Agip, Allahu Lateef, Country home, Okeresi and Oke-gada, in Ede (these areas covered both prime locations and non prime locations in Ede). The study period is from 2002 to 2017. The population for this study consisted landlords in Ede. The choice of this population was based on preliminary investigations which revealed that data on rental value of residential properties covering the study period were not readily available in estate firms in the study area; hence, the need to request for such information from landlords who rented out their residential properties within the study period. The absence of a well documented rental data is another limitation of this study. In order to obtain rent data directly from the aforementioned respondents, questionnaire survey was conducted. A comprehensive list of the respondents (landlords) is not available to the researchers; therefore, a total of three hundred and eighty five (385) questionnaires in line with sample size suggested in Cochran (1977) for infinite population (taking 95% confidence level with ±5% precision) were administered to the respondents by means of random sampling technique; however, only two hundred and eighty seven (287) questionnaires were retrieved representing 74.5% response rate. The questionnaire was structured to elicit information on the types and location of property, age of property and rental values of the property. The secondary data comprised Nigeria's GDP figures for the period 2002 - 2017 and was sourced from the database of Central Bank of Nigeria (CBN). The study utilized descriptive and inferential statistical techniques for data analysis. Charts were used to describe the pattern of annual growth rates across the five residential property types, ANOVA was used to determine whether significant difference exist in rental growth rates across the residential property types while regression model was used to establish the nature of relationship existing between GDP and rental growth rates in line with previous studies such as Dabara Lawal, Adebowale Ankeli & Gambo (2016), Okorie (2015), Udoekanem et al., (2015) and Dabara, Olatoye & Okorie (2012).

RESULT AND DISCUSSION

This section presents analysis of data collected from the study area and the discussion of results. The analysis was structured to analyze the rental trend in five

residential properties types in Ede between 2002 and 2017, the magnitudes of growth in rental values of the residential properties, the extent of variation in the rental values of the residential properties types caused by GDP growth and the relationship between GDP growth rates and the rental growth rates of residential properties in Ede. The rental values of the residential properties were sourced from landlords who rented their properties between 2002 and 2017, the GDP values for the period 2002 to 2017 were gotten from the Central Bank of Nigeria. These data units were used to determine the relationship between GDP growth rates and the rental growth rates of residential properties in the study area. The average annual rental values of the five dominant residential property types in the study area and the GDP values within the study period are presented in Table 1. The rental value data obtained from the respondents covered both prime and non prime locations of Ede. These rental value data were averaged per annum to give a general picture of the property rental market in the Ede.

Table 1: Average annual rental values of residential properties in ede and gdp values (in naira) from 2002 to 2017

Year	Tenement room	A room self-contained	A room and parlor self-contained	Two bedroom flat	Three bedroom flat	*GDP Values (' 000)
2002	2400.00	3000.00	4800.00	5600.00	7000.00	28957.71
2003	3600.00	4200.00	6500.00	8000.00	10000.00	31701.44
2004	3800.00	4600.00	6800.00	9000.00	12000.00	35020.55
2005	4800.00	5400.00	7000.00	10000.00	14000.00	37474.95
2006	5000.00	5600.00	7500.00	11500.00	18000.00	39995.50
2007	5400.00	6200.00	9600.00	14000.00	22000.00	42922.41
2008	5500.00	6800.00	10500.00	15500.00	25000.00	46012.52
2009	6000.00	7000.00	11500.00	17000.00	28000.00	49856.10
2010	6600.00	7800.00	14000.00	20000.00	34000.00	54612.26
2011	7200.00	8400.00	15000.00	24000.00	38000.00	57511.04
2012	8000.00	10000.00	20500.00	28000.00	48000.00	59929.89
2013	11000.00	15000.00	25000.00	38000.00	65000.00	63218.72
2014	14500.00	18000.00	28000.00	43000.00	78000.00	67152.79
2015	18000.00	23000.00	36000.00	68000.00	90000.00	69023.93
2016	22000.00	27000.00	40000.00	75000.00	108000.00	67931.24
2017	23000.00	28000.00	42000.00	77000.00	115000.00	68496.92

Source: Field survey 2018
*Source: * Central Bank of Nigeria*

The rental values of all the selected residential properties were increasing over the period under study (see Figure 1). Table 1 showed that the rental value of tenement rooms in Ede increased from 2,400 per annum in year 2002 to 23, 000 naira per annum in 2017. Similarly, the rental value for a room self-contained increased from 3,000 naira per annum in year 2002 to 28,000 naira per annum in 2017. Also, rental value of a room and parlour self-contained increased from 4,800 naira per annum in the year 2002 to 42,000 naira per annum 2017. The 2 bedroom flat was also observed to have increased from 5,600 naira per annum in 2002 to 77,000 naira per annum in 2017. The same applies to 3-bedroom flat as the rental value had increased from 7,000 naira per annum in 2002 to 115,000 naira per annum in 2017. This continuous general increase in the rental values of residential properties in the study area is consistent with the observations in Dabara et al., (2018) and could be attributed to the state of the Nigerian economy. The table further revealed steady

increase in the Nigeria's GDP value from 2002 to 2015 (from 28,957,710 naira to 69,023,927 naira approximately). The GDP however declined to 67,931,236 naira in 2006 but slightly improved to 68,496,920 naira in 2017. In order to illustrate the trends in rental values and GDP values, series of index numbers were further computed for both variables as shown in table 2 below. The trends are shown in figure 1 below.

Table 2: Indexes of residential properties' rents in ede and gdp values between 2002 and 2017 (2002=100)

Year	Tenement room	A room self-contained	A room/parlor self-contained	Two bedroom flat	Three bedroom flat	GDP growth rate
2002	100.0	100.0	100.0	100.0	100.0	100.0
2003	150.0	140.0	135.4	142.9	142.9	109.5
2004	158.3	153.3	141.6	160.8	171.4	120.93
2005	200.0	180.0	143.9	178.7	200.0	129.4
2006	208.3	186.7	156.3	205.5	257.1	138.1
2007	225.0	206.7	200.0	250.2	314.2	148.2
2008	229.2	226.7	218.0	277.0	357.0	158.9
2009	250.0	233.3	239.6	303.8	399.9	171.2
2010	275.0	260.0	291.7	357.4	485.6	187.5
2011	300.0	280.0	312.6	428.9	542.8	197.4
2012	333.4	333.3	427.2	500.4	685.6	205.7
2013	458.4	500.0	521.0	679.1	928.4	217.0
2014	604.3	600.0	583.5	768.5	1114.0	230.5
2015	750.1	766.7	750.2	1215.3	1285.5	237.0
2016	916.8	900.0	833.6	1340.4	1542.6	233.2
2017	958.5	933.3	875.2	1376.1	1642.6	235.2

Source: Analysis of surveyed data, 2018

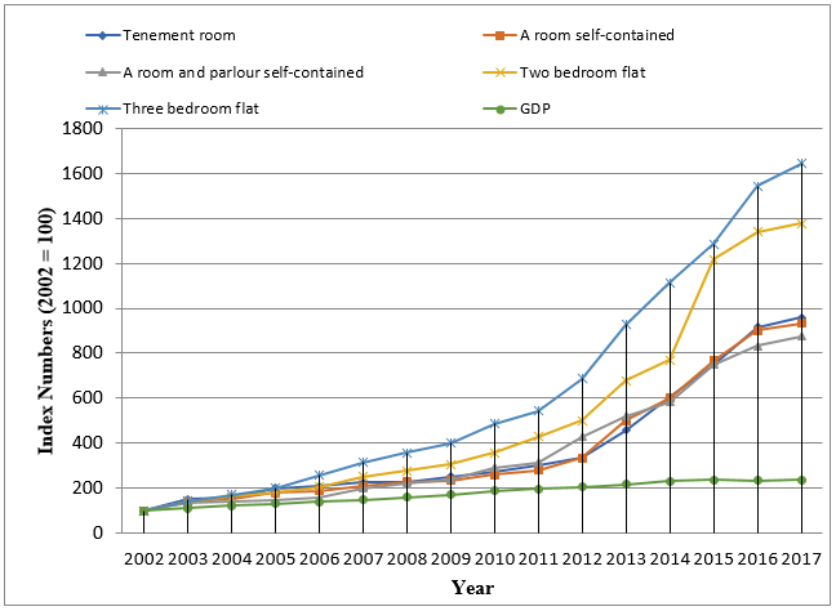

Fig. 1: Graphical Trend of Average Rental Values of Residential Properties in Ede and Nigeria GDP Values from 2002 to 2017

Table 3: Yearly growth rates of residential properties' rents in Ede and GDP between 2002 and 2017

Year	Tenement	A room self-contained	A room and parlor self-contained	Two bedroom flat	Three bedroom flat	GDP growth rate
2002	-	-	-	-	-	-
2003	50.00	40.00	35.42	42.85	42.85	9.5
2004	5.56	9.50	4.62	12.50	20.00	10.44
2005	26.31	17.39	10.29	11.11	16.67	7.0
2006	4.17	3.70	7.14	15.00	28.57	6.7
2007	8.00	10.71	28.00	21.74	22.22	7.3
2008	1.85	9.68	9.38	10.71	13.36	7.2
2009	9.09	2.94	9.52	9.68	12.00	8.4
2010	10.00	11.43	21.74	17.64	21.43	9.5
2011	9.09	7.69	7.14	20.00	11.76	5.3
2012	11.11	19.05	36.67	16.67	26.32	4.2
2013	37.50	50.00	21.95	35.71	35.42	5.5
2014	31.82	20.00	12.00	13.16	20.00	6.2
2015	24.14	27.78	28.57	58.14	15.38	2.8
2016	22.22	21.74	11.11	10.29	20.00	-1.6
2017	4.55	3.57	5.00	2.67	6.48	0.8

Source: Analysis of survey data 2018

Table 3 revealed that rental values of all the selected properties grew on a yearly basis. The growth rates vary from year to year and from one property type to the other ranging from 1.58% to 58.14% during the period under consideration. Tenement recorded its lowest growth rate of 1.58% in 2008 and the highest growth rate of 50% in 2003. Likewise, a room self contained had its lowest growth rate 3.57% in 2007 while its highest growth rate was 50% in 2013. A room and parlour self contained on the other hand, recorded 4.62% in 2004 as its lowest growth rate and had 36.67% in 2012 as its highest growth rate. Similarly, two bedroom flat had its lowest growth rate of 2.67% in 2017 and the highest growth rate of 58.14% in 2015. Finally, the three bedroom recorded 6.48% in 2017 and 42.85% in 2003 as its lowest and highest growth rates respectively. Tables 3 further showed that Nigeria GDP growth rates were unstable during the period and vary from year to year with a lowest rate of -1.6% in 2016 and highest rate of 10.44% in 2004.

Table 4: Descriptive statistics for yearly rental growth rates of residential properties

	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Tenement room	15	17.0273	3.69273	3.69273	1.85	50.00
A room self-contained	15	17.0120	3.51328	3.51328	2.94	50.00
A room/parlour self-contained	15	16.5700	2.87493	2.87493	4.62	36.67
Two bedroom flat	15	19.8580	14.72960	3.80317	2.67	58.14
Three bedroom flat	15	20.8307	9.49105	2.45058	6.48	42.85
Total	75	18.2596	12.58290	1.45295	1.85	58.14

Source: Analysis of survey data 2018

Table 4 presents mean, maximum and minimum of yearly rental growth rates of all the selected residential property types. The table revealed a mean of yearly growth rate of 17.03%, 17.01%, 16.57%. 19.86% and 20.83% for tenement, a room self contained, a room and parlour self contained, two bedroom flat and three bedroom respectively during the period under study. This implies that the mean of

yearly growth rates differ across the five residential property types in the study area within the study period.

Table 5: Result of ANOVA for yearly rental growth rates of residential properties

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	226.425	4	56.606	.345	.847
Within Groups	11489.954	70	164.142		
Total	11716.379	74			

Source: Analysis of survey data 2018

Analysis of variance (ANOVA) test was employed to determine whether the difference that in the mean yearly rental growth rates across the property types were significant. The results show that the mean of yearly rental growth rate across the five selected residential property types at 95% confidence level are not significantly different $F(4, 70) = 0.345$ $p = .847 > .05$.

Table 6: Result of regression analysis on the influence of GDP on rental values

Statistics Property types	R	R2	Std. Error	F	Sig.
Tenement room	.854	.730	.065	37.869	.000
A room self-contained	.864	.746	.080	41.048	.000
Room/parlour self-contained	.908	.824	.101	65.555	.000
Two bedroom flat	.869	.755	.229	43.145	.000
Three bedroom flat	.911	.830	.280	68.324	.000

Source: Analysis of survey data 2018

In line with the findings of earlier studies, Table 6 reveals a strong positive correlation between GDP values and rental values of residential properties. The correlation coefficients between GDP values and tenement room, a room self-contained, a room and parlor self-contained, two bedroom flat and three bedroom flat are 0.854, 0.864, 0.908, 0.869 and 0.911 respectively, and all are significant at 0.000 levels. This therefore implies that as the GDP values increase, the rental values of tenement, a room self-contained, a room and parlor self-contained, two bedroom flat and three bedroom flat also increase translating to increased returns to the investors.

The table also shows that GDP values accounts for about 73%, 75%, 82%, 76% and 83% of variation in rental values of tenement room, one room self-contained, room and parlour self-contained, two bedroom flat and three bedroom flat respectively. The F-statistic shows the significance of the regression models. The F-statistic are 37.869, 41.048, 65.555, 43.145, 68.324 and all are significant at $p = 0.000$. This implies that the model fits the data utilized and consequently can be used as a basis for predicting the rental values of residential properties in the study area.

Table 7 shows there is no statistically significant relationship between GDP growth rates and rental growth rates of residential properties in the study area within the period under consideration. A very weak positive correlation was found between GDP growth rates and rental growth rates of all selected residential properties. It can be seen From Table 7 that the correlation coefficients (R) are 0.004, 0.072, 0.073, 0.045 and 0.308 for tenement room, one room self-contained, room and parlour self-contained, two bedroom flat and three bedroom flat respectively. Although

the correlation between the growth rates of GDP and three bedroom flat (.308) is higher than those of the other four property types, all the correlations however, are not significant (with p values >.05).

Table 7: Result of regression analysis on the influence of GDP on rental growth rates

Statistics Property types	R	R^2	Std. Error	F	Sig.
Tenement room	.004	.000	1.197	.000	.988
A room self-contained	.072	.005	1.136	.068	.798
A room/parlour self-contained	.073	.005	.930	.069	.797
Two bedroom flat	.045	.002	1.232	.027	.873
Three bedroom flat	.308	.095	.756	1.367	.263

Source: Analysis of survey data 2018

These suggest that a unit increase in GDP growth rates resulted in an insignificant increase in rental growth rates of the residential properties in the study area during the period understudied. The presence of very weak positive correlations between GDP growth rates and rental growth rates of residential properties could be attributed to the type of lease structure inherent in the rental submarket. Residential tenants generally have long-term leases that cannot be changed in the middle of economic changes. Furthermore, the F-statistic of .000, .068, .069, .027 and 1.367 (with p values > .05) suggest the regression models are not significant. This implies that GDP growth rates can be used as a basis for predicting the rental growth rates of the selected residential properties in the study area.

CONCLUSION

This study analyzed rental growth rate across the five residential property types in Ede, Nigeria with the aim of determining the relationship between GDP growth rates and rental growth rate of the selected residential property types. It was found that the mean of yearly rental growth rate across the five selected residential property types were not significantly different $F(4, 70) = 0.345$ $p = .847 > .05$. Rental values of all the property types have very significant positive correlation with GDP values. However, there is no statistically significant relationship between GDP growth rates and rental growth rates of the selected residential. Consequently, GDP growth rates have been found to have no significant influence on rental growth rates of selected residential properties. The implication of this absence of a feedback relationship between GDP growth rates and rental growth rates of residential properties is that GDP growth rates can be used as a basis for predicting the rental growth rates of the selected residential properties in the study area and that both variables are not determined contemporaneously.

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THE LEAKY PIPELINE BETWEEN CONSTRUCTION EDUCATION AND WOMEN IN THE CONSTRUCTION INDUSTRY

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For many years, a critical area of concern within South Africa's built environment has been the untransformed nature and the persistent underrepresentation of women within it. At the university level, the number of females registering in the faculty of the Built Environment has experienced a steady increase over the years. This increase, however, is not reflected in the built environment's workplace despite the increase in the graduation of female students. This study investigates the career decisions made by graduating female students based on their perceptions of the built environment, and how their long-term decision affects the underrepresentation of women therein. The study uses an online questionnaire designed from the career construction theory and the leaky bucket theory, which was distributed to female students registered for BSc Honours in Quantity Surveying and Construction Management at a university in South Africa. Interviews with recent graduates in the same field were conducted. The findings from the study report on the factors that motivated female students to study a construction-related degree, the challenges experienced during their studies, and how the experienced challenges influence their long-term career decisions within the construction industry. Graduating female students remain a wasted and an untapped resource within the built environment. If the built environment continuously fails to attract and retain graduating female students, it will face a skills shortage within the industry.

Keywords: barriers, career decisions, construction education, factors, female postgraduates

INTRODUCTION

For many years, a critical area of concern within South Africa's construction industry has been the untransformed nature and the persistent underrepresentation of women within it. This has remained unchanged for decades in many countries (Adogbo, Ibrahim & Ibrahim 2015; Madikizela & Haupt 2010; Del Puerto et al., 2011) even with interventions from the private and public sectors to reduce it. The characteristic of the construction industry is that it is male favoured with the lack of presence of females, especially in top influential positions (Martin & Barnard

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2013). The traditions, organizational cultures and sexist attitudes that exist within the industry play a role when employing females in the industry (Sewalk & Netfield 2013; Madikizela & Haupt 2010). As a result, females currently employed in the construction industry are found more in administrative roles because the industry regards them as not suitable for the technical roles (Agherdien & Smallwood 2013; Sewalk & Netfield 2013).

Over the years, the number of female students registering and graduating from university's construction education programs have been experiencing a steady increase (Fielden et al., 2014; Powell et al., 2005). This increase, however, is not reflected in the industry's workplace (Fernando et al., 2014). This creates an imbalance between the number of female students in university and the number of women in the industry, which suggests that there is a leaky pipeline between universities and the construction industry.

At university, the career decisions of female graduates are influenced by the factors that act as barriers within construction (Ling and Poh, 2004). Decisions of graduating female students in construction-related degree programs are said to be influenced by the limitations found in the industry (Ling and Poh, 2004). Some of the limitations include the perceived unsafe nature of construction, challenging labour requirements and the dangerous work environment when deciding to enter the construction industry (Ling and Poh, 2004). In addition to these limitations, the general environment of the workforce of construction industries is that the majority of the labour force is male (Aulin and Jigmond, 2011), which creates an environment full of gender-based discrimination (Agherdien and Smallwood, 2013).

Studies by Bowen et al., (2013); English & Hay, (2015); and Yokwana, (2015) on the under-representation of females in construction have not sufficiently addressed the issues facing graduating female students from a South African context. The long-term career decisions of graduating female students and the impact the decisions of the graduating female students have on the under-representation of females in the workplace is thus a critical topic that requires thorough investigation. This study explores factors and barriers influencing the career decisions of graduating female students in South Africa's construction education programs, and how these factors and barriers affect their long-term career decisions within the construction industry. The study seeks to provide insight into factors that inspired construction education, barriers faced during construction education and the effect their decision have on the underrepresentation of women in South Africa's construction industry.

LITERATURE REVIEW

Factors motivating construction education

Career paths are usually decided on towards the final years of a person's high school career (Madikizela & Haupt 2010). However, Bigelow et al., (2016) report that the career-decision making process is often complicated for high school students and more than 80% of students in university believe that they made their career decision too early, with some reporting that they would change careers given a chance.

Of the students that choose to study a construction-related degree, the factors that have been identified as influential to female high school students' career decision include the poor image of the construction industry (Bigelow et al., 2017), the impacts of family members, friends, teachers, and counsellors have an influence on female student's perceptions of the construction industry and serve as motivating factors in female students pursuing careers within the industry (OstadaliMakhmalbaf 2014).

More factors that enhance the retention of female students include having a family member in the industry, mentoring, fellowships, scholarships, internships, career opportunities available to them after graduation and industry experience, which are likely to be enhanced if the relationship between universities and the industry is kept alive (Bigelow et al., 2016).

Internal barriers

While females are more likely to finish their degree as compared to males (Del Puerto, Guggemos & Shane 2011), and the increase in female enrolment in construction related degrees (Adogbo et al., 2015; Fielden et al., 2000; Morganson, Jones & Major 2010), underrepresentation of women within the construction industry still perpetuates. However, during their construction-related education, female students are faced with barriers that are regarded as internal barriers in this study.

These barriers have been found to be the lack of networking opportunities for graduating female students to meet and interact with other female professionals in the QS profession (Bigelow et al., 2017; Shane et al., 2012), male-dominated learning environments in the classrooms and dominated male academic staff (Adogbo et al., 2015; Shane et al., 2012). Female students have also reported the male culture that exists in classrooms (Ling & Poh, 2004) which often results in gender-based discrimination and harassment against graduating female students, from their male colleagues (Francis & Prosser 2014; Madikizela & Haupt 2010). This is said to be resulting from the fact that graduating female students are not readily accepted by their male colleagues (Ling & Poh, 2004).

As a result, female students preferred careers in other sectors such as health, commerce and IT over construction because of the barriers they have faced during construction education (Madikizela & Haupt 2010). Since the industry is facing a skills shortage, more effort needs to be made to retain the current pool of female students in construction education (Shane et al., 2012).

External barriers

External barriers are the factors that have been in the industry for many generations which graduating female students have no control over (Ling & Poh, 2004). The nature of the construction industry, working conditions, and sexist attitudes have been identified by (Ling & Poh, 2004) as external barriers graduating female students face in the construction industry. These barriers may be the primary source of the low participation rates we see of women in South Africa's construction industry (Fernando et al., 2014).

The nature of the construction industry is that it has an image that has been built over decades of male dominance (Ginige et al., 2013; Madikizela & Haupt, 2010;

Sewalk & Neitfeld, 2013), with difficult working conditions (Fernando et al., 2014). The construction industry, regarded as an "all-boys club", is a place which expects employees to work long hours, neglecting their family responsibilities in the process (Astor et al., 2017). The consequence of this model is that women who chose to work and have a family are prejudiced against (Astor et al., 2017). These women face sexist attitudes that include gender stereotypes and glass ceiling. Women are further faced with isolation and limited access to mentorship, which may help move up the organisation's ladder, because of the male-dominated organisational culture that exists (Agherdien & Smallwood, 2013).

The Career Construction Theory

The career construction theory addresses how individuals choose their career path based on personal and social constructivism (Savisckas, 2005). It involves career planning, decision making and the exploration of careers, which provides researchers with a way of conceptualizing the way people choose their careers. The career construction theory examines the process of psychosocial adaptation, how individuals cope with vocational development tasks, occupational transitions and work traumas (Savisckas, 2005). The interpretive and interpersonal processes through which people impose meaning and direction is explained, and the factors that impact the career choices of people are explored by the theory. The use of the theory will aid this study in examining the factors that motivated graduating female student to join the construction industry and how their long-term career decision within the industry influences the under-representation of females in South Africa's construction industry.

The Leaky Bucket Theory

The leaky bucket theory was developed by Ehrenberg (1988) to explain the process of customer gain, loss and retention in the marketing field. In the Science, Technology, Engineering and Mathematics (STEM) fields, the term "leaky pipeline" is often used to describe the leaky pipeline that carries female students from high school, through university into the construction industry (Blickenstoff, 2005).

Using the career construction theory, Skorikov (2007) reported that individuals plan for their careers during their adolescent years and develops right through to adulthood. In between the process, people are continuously preparing for and adapting to their careers, and as the adaptation process occurs, it can result in a different career decision than the one chosen during adolescent due to the perceived challenging work environment (Skorikov, 2007). This suggests that the career construction theory comes into play before the leaky bucket theory. The career construction theory explains the pipeline while the leaky bucket theory explains the leak along the pipeline.

Fielden et al., (2014) reported that there has been an increase in the number of female students registering and graduating from universities. However, this increase has not being reflected in the demographics of the industry's workplace. The leaky bucket theory describes this occurrence as a syndrome where universities are constantly graduating an increased number of female students and releasing them into a system that is leaking. As a result, the underrepresentation of women within the construction industry persists despite the increase in the number of graduations of female students.

Ling & Poh, (2004) suggest that graduating female students make their long-term career decisions based on internal barriers faced during construction education and the perceived external barriers found in the construction industry. It can be argued that the leak is caused by the cumulative effect of the barriers graduating female students face, resulting in the imbalance found between female students in university and in the construction industry. This theory will be used to establish the reason for the imbalance in the number of female students in university and the number of females in the construction industry.

PROBLEM STATEMENT

The under-representation of females in South Africa's construction industry is dependent on the experiences of the graduating female students during the course of their construction-related studies, which affects their perceptions of the construction industry and, as a result, their long-term career decisions.

Conceptual Framework

Figure 1 presents the relationship between the early days when female students start deciding on the career path they want to pursue. After high school, female students either register for a construction-related degree or a non construction-related degree. For those that register for a construction-related degree, their decision to pursue a career in the construction industry has been found to be influenced by the media, career opportunities available upon graduation, perceived financial stability, family, friends and mentors. The circle represents female students' duration as undergraduate students at a university in South Africa. During their undergraduate studies, female students have reported being faced with challenges that were identified broadly by Ling & Poh, (2004) as internal and external barriers. Despite having faced barriers during their undergraduate years, some female students decide to continue with their studies by enrolling for a postgraduate degree. Those that decide not to join the industry cause the leaky bucket phenomenon. This leak further perpetuates the underrepresentation of women South Africa's construction industry is facing.

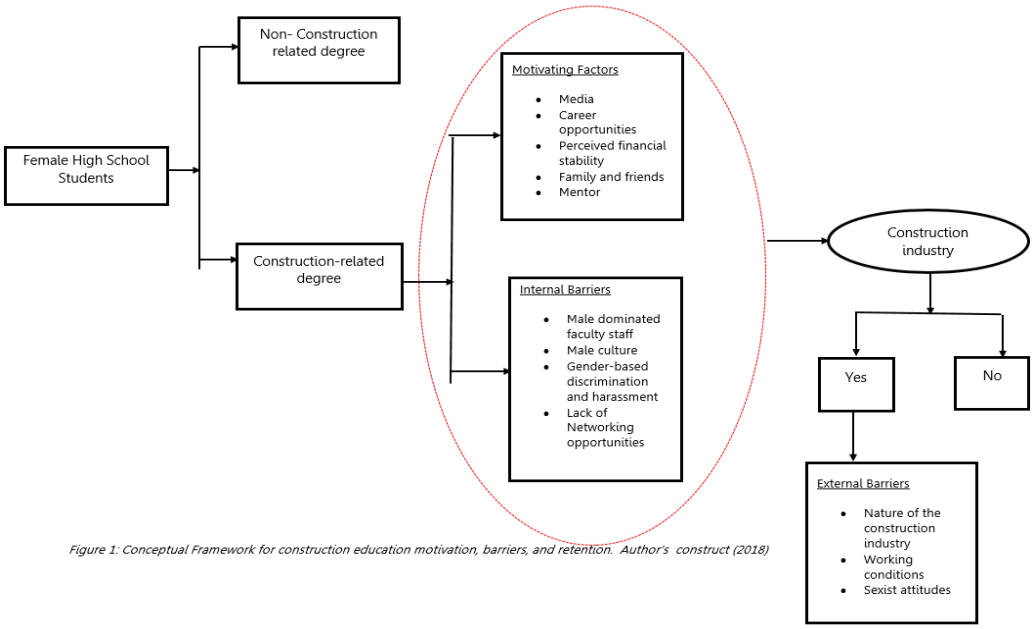

Figure 1: Conceptual Framework for construction education motivation, barriers, and retention. Author's construct (2018)

RESEARCH DESIGN AND METHODS

This study is an extension of a pilot study which used questionnaires to collect data. The pilot study investigated factors that motivated graduating female students to join the construction industry and how their long-term career decision within the industry influences the underrepresentation of women in South Africa's construction industry. The online questionnaire was adapted from previous studies by Ling & Poh, (2004), the career construction theory and the leaky bucket theory. The study used a five-point Likert scale where respondents were asked to rate statements in Table 1.

The questionnaire was distributed to 15 female students registered for BSc Honours (Quantity Surveying) and BSc Honours (Construction Management) at a university in South Africa, and 15 useable questionnaires were returned. The convenience sampling technique was used in this study. The sample was chosen because BSc Honours students have industry experience; thus, they have a better understanding of the scope and nature of construction education, training, and South Africa's construction industry. Furthermore, the Honours year is the exist point for the CM and QS degree thus, the participants are currently at a stage where they are making their long-term career decision. Interviews were conducted with BSc Honours (Quantity Surveying) and BSc Honours (Construction Management) graduates who have recently joined the construction industry. The sampling techniques used for the interviews were the convenience and the snowball sampling techniques. The interview questions were developed using the career construction theory and the leaky bucket theory.

The table below provides a profile of this study's participants. A summary of the results is presented below and will be discussed in the subsequent sections.

careers in the construction industry (Savickas et al., 2005). Factors reported in I1 to I6 report the male dominated nature of the industry, which forms a perception and reality that the industry is of male dominance.

Graduating female students still hold the poor, old image of the construction industry. The nature of the industry is seen as masculine, which requires long working hours. Ling and Poh (2004) suggests that this acts against female graduates' entry into the construction industry. The male culture and gender stereotyping that exists within the industry often subjects women to a slow career progression than their male counterparts. The experience in I1 and I6 contribute in forming the perceptions of the factors reported in E1 to E7. As a result, these external barriers contribute to the leaky bucket phenomenon where the industry cannot retain the increased number of female graduates. This suggests that the leaky point exists in the construction industry and is caused by the reported external barriers. This means that the construction industry cannot retain the

Internal Barriers

Respondent 1: *"The challenge I faced was not having female mentors who occupy executive positions in the industry, which is unfortunate"*

Respondent 2: *"During my undergraduate and post-graduate studies, my class was female dominant. I, therefore, did not experience any gender-based challenges. The only challenges I faced were the regular challenges every student face, regardless of the degree they are enrolled in."*

Respondent 3: *"The only challenge I faced at university is working in groups because I personally don't like working in groups. There was no gender division of activities in class. The girls and boys were treated the same way. However, the academic staff was male-dominated. I guess it reflects the current state of the industry in terms of representation"*

The career construction theory focusses on the role people's experiences play and the social expectations of those experiences play regarding the way people prepare for, enter and participate in the work environment (Savickas et al., 2012). The experiences female graduates experienced during construction education suggest that the leaky point does not lie within the construction education system.

External Barriers

Respondent 1: *"I've only started working 2 years ago but I can already see my ceiling. The industry is very sexist and male-dominant. Women face a lot of challenges and the sexism that exists in the industry can make one resent every moment. For me, this is currently just a job that helps pay my bills. I'm looking to leave and pursue something else in the health field."*

Respondent 2: *"Certain opportunities are afforded to male employees only. It does not matter how good you are at your job as a female. I've been doing admin work such as writing minutes while my male colleagues that I graduated with get to head projects of their own. It's demoralizing because even if you work twice as hard, you are overlooked for promotions and better job prospects as a female."*

Respondent 3: *"I was often judged based on the number of hours I spent at work, and not the quality of work I produced. It is hard and discouraging to work in an industry with a few women in management positions. I could see that my growth would be limited. The glass ceiling is visible in the construction industry."*

The transition from university to the work place is often challenging for graduates. This result in them creating self-regulation capabilities to help them cope with the transition and work traumas (Savickas et al., 2018). When their coping mechanisms do not work, graduates often consider exit strategies (Savickas et al., 2018).

CONCLUSION AND RECOMMENDATION

Graduates have reported that they have experienced external barriers in the industry which cause them to consider leaving the industry. This is after spending at least 6 years of training both in university and in the industry. Although the number of female students registering from and graduating from university's faculty of the built environment have been experiencing an increase, this has not

been reflected in the industry's work environment. This imbalance shows that there is a leaky bucket phenomenon that exists within the construction industry. To solve the problem of underrepresentation of women in the construction industry which has perpetuated over decades, the industry needs to improve on its image to attract more graduating female students. Female mentors need to be established to provide graduating female students with role models. Further, construction companies should establish target initiatives inhouse such as support programmes that challenge the cultural norms and gender stereotypes found in the company. This will allow for internal audits on a large scale. Furthermore, this will ensure that we limit the leaky bucket phenomenon that the industry is currently experiencing. If the industry fails to do this, the skills shortage in the industry will result in a slow economic and infrastructural development of the country. South Africa's construction industry and universities, therefore, need to transform and diversify so that it can sustain its business development and growth.

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THE NEXUS OF THE INFRASTRUCTURE SECTOR, EMPLOYMENT AND ECONOMIC GROWTH

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The world is changing rapidly, in ways that leave many people behind. The discontent with economic growth in recent decades played an important role in the US election of 2016 and the Brexit referendum in the same year. Advances in technology over the recent years have suggested interventions that came with a promise to make everyone better off. Built infrastructure is considered a major sector of the economy throughout the world. Its sheer size and role in economic growth is used to justify its importance. The literature considered revealed that the construction sector is considered an investment sector. The endogenous growth theory is mobilized to explain the relationship of the built infrastructure sector to economic growth and employment. The fundamental dynamics of the built infrastructure sector are studied in relation to economic growth, with a view to ascertaining if there is a basis for national governments to stimulate economic growth and job creation through investment in infrastructure. This will enable policy makers to make better use of the built infrastructure sector. Cointegration analysis of time series total construction output (TCO), construction employment (CE) and GDP data for South Africa reveal that a positive short run relationship does exist between these variables, subject to other factors being equal. However, empirical evidence suggests that there is no obvious link between TCO, CE and GDP. While the endogenous growth theory show that construction influences investment, which is a major factor in determining economic growth, the growth process per se has been shown to be a complex phenomenon.

Keywords: cointegration analysis, economic growth, infrastructure, political economy

INTRODUCTION

The term infrastructure is defined as the basic physical and organizational structures and facilities that are needed for a society or an economy to function (Black et al. 2009). Included under infrastructure is water, sewerage, electricity, gas, communication, air transport, railways, harbours and roads (ONS 2011). Therefore, in construction, the use of the term infrastructure is generally limited to describe fixed assets.

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In the South African statistics, all work that is undertaken by the construction sector such as schools, human settlements, offices, hospitals and transport networks are referred to as infrastructure (Stats SA 2007). While the percentage share of infrastructure related to construction as well as that for R&M can be easily determined from the UK construction statistics, it is not possible to do this from the South African construction statistics. Hence, the terms construction and infrastructure are used interchangeably throughout this research.

There is a great deal of interest in the role of the construction sector in economic growth. Increases in infrastructure spending in South Africa (SA) since 2003 have seen a steady increase in the number of jobs created, as well as skills shortages that accompany such increases. These increases in infrastructure development came as a result of government's increased expenditure, largely driven by large SOEs such as Eskom, Transnet and SANRAL. Infrastructure developments that accompanied the hosting of the 2010 Soccer World Cup also played a significant role in driving up demand in the sector.

According to the CIDB (2007), construction labour refers to all persons involved in physical construction work. It includes both skilled and unskilled labour. As a labour-intensive sector of the economy, construction heavily relies on the skills of its workforce. Skill can be described as the ability to perform particular tasks at a certain level of competence. These competencies include the ability to perform a set of tasks, the ability to understand what others are doing and why, as well as the ability to adapt to changes and unforeseen circumstances. Unskilled labour is more informal and unclearly defined, comprising labourers who lack relevant qualifications and various forms of education and learning (Makhene and Thwala 2009).

A skills shortage can be described as an insufficient supply of suitably qualified workers willing to work under existing market conditions, particularly at prevailing wages (OECD 2016). The impact of skills shortages and how to deal with such skills issues is an important area of study. The OECD identified the cyclic nature of construction work and the poor image of the construction sector as major contributing factors to skills shortage in the sector. This has influenced employment patterns whereby employers try to shield themselves from the fluctuations through the use of sub-contractors (Dlamini 2016). This allows big contractors to shift employment costs from fixed to variable in nature. This in turn results in changes in training and development as employers are not incentivised to train temporary or transient workers for the benefit of competitors.

Economic growth and employment creation in SA have become the preoccupation of every government department over the past two and a half decades since the 1994 dawn of democracy. The challenge has been to create an economic and socio-political environment where citizens would have access to jobs and enterprise opportunities. In the wake of the abolition of apartheid in 1994, it became necessary to build new infrastructure and develop skills to take advantage of the opportunities that were emerging. As an investment sector, infrastructure development became an important factor in the agenda of the ANC government. It set out to rebuild infrastructure that had deteriorated for decades under the apartheid government, especially in rural areas. The reconstruction and

development programme (RDP) that was adopted as a road map was informed by the view that infrastructure is crucial to growth.

While Fedderke et al. found a direct impact for infrastructure investment on economic growth, Du Plessis and Smit (2007) reached a different conclusion. In a study of SA's growth revival after 1994, Du Plessis and Smit used growth accounting to distinguish the relative contributions of capital, labour and total factor productivity to post-apartheid growth at aggregate, sectoral and subsectoral levels. The study investigated infrastructure, as a type of capital financed by the public sector. Du Plessis and Smit found that openness to capital flows and a stable macroeconomic environment had been leading causes of SA's growth recovery after 1994. They also found that an indirect channel via higher private sector investment in productive capital supported the growth recovery.

For much of the first decade of SA's democratic transition, its macroeconomic agenda, conceived in the policy programme of the growth, employment and redistribution (GEAR) strategy of 1996 was defined by neoliberal principles. The neoliberal economic agenda came under attack from the ANC alliance partners (COSATU and the SACP), which from 2003 forced shifts in economic policy in a more developmental direction (Habib 2008). While remarkable transformation has occurred since then, economic growth and employment generation were disappointing.

The SA government's fiscal policy seeks to support structural reforms of the economy consistent with long-run growth, employment creation and an equitable distribution of income. This research aimed to investigate the correlation of construction output, construction employment and economic growth. The problem identified is how the various national plans, policies and strategies impact on the performance of the construction sector.

LITERATURE REVIEW

Construction is considered a major sector of the economy throughout the world. It accounts for about 10% of most countries' gross domestic product (GDP) and 50% of gross fixed capital formation (GFCF). A sector of the economy this big cannot but has an impact on economic growth and employment. Its sheer size and role in economic growth and job creation are used to justify its importance. There should be no conflict between construction output and employment maximisation in the construction sector in the short or long-term. A strategy to increase output through activities consuming more labour and less scarce resources is the only feasible way forward for many developing economies such as SA.

Construction output

Early studies in political economics focused mainly on explaining the role of the construction sector in economic development. Strassmann (1970) studied the role that the construction sector played in economic development and employment creation using regression analysis. He found that the role that the construction sector played varied according to the level of developmental trajectory for each economy. Turin (1978), building on the work of Strassmann, used time series analysis to examine the place of construction in the world economy. He found that

the share of construction in GDP and the value added in construction per capita grew as the economy developed. Building on the work of Turin and Strassmann, Bon (1992) used the input-output analysis to examine the changing role of the construction sector at the various stages of economic development. He suggested that the share of construction spending in GDP first grows, then peaks and declines as economies go through a growth cycle. All these studies emphasized the importance of the role that the construction sector plays in economic growth and job creation.

The construction sector satisfies a wide range of physical, economic and social needs of society (Strassman 1970, Turin 1978 and Bon 1992). Ofori (1988), building on the work of Turin, added the role that the construction sector plays in sustained socioeconomic development. Building on the work of Bon, Myers (2008) as did Tan (2002), argued that construction can be regarded as an engine for economic growth and job creation. Given such significance, it is of interest to understand why developing economies like SA are not utilising the construction sector to transform their economies and create the much needed jobs to curb unemployment.

In a majority of developing economies, construction activity is widely dispersed, as it takes place mainly in the informal sector. This means that construction output figures and labour statistics do not give an accurate picture of the performance of the construction sector as compared to developed economies. The heterogeneity of the construction sector, allied with the immobility, complexity, durability and costliness of its products varies throughout the various stages of growth (Strassman 1970).

Subsequent to Strassmann's seminal work, several studies ensued on the patterns of growth and labour intensity of the construction sector. It became a well-entrenched view in political economics that construction activity plays a dynamic role in the process of economic growth and job creation (Wells 1986). However, the fundamental dynamics of the construction sector that informed such views were less understood.

Using a case study of Sri Lanka, Ganesan (1982) established some concrete strategies necessary to eliminate supply and demand side constraints for the steady growth of construction output and employment. Ganesan took the understanding of the role of the construction sector on the economy and job creation further by focusing on the major activities that constitute construction output. He considered labour and locally available building material as less scarce resources. While this might be the case with most developing countries, the levels and categories of scarce resources remain unclear. It is likely that these will vary significantly from one country to the other.

Major authors on political economics such as Myers (2008), Hillebrandt (2000), Tan (2002), Bon (1992), Wells (1986), Turin (1978) and Strassmann (1970) all emphasized the importance of the role that the construction sector play in economic growth and job creation. However, they seemed to base their work purely on the power of their argument. It would appear that writers in this area, generally, start with the assumption that the construction sector drives economic growth and job creation. An in-depth understanding of the dynamics involved

would enable policy makers in government to make better use of the construction sector.

Construction employment

Skills development in the construction sector remains predominantly complex due to the continued existence of intricate multiple dynamic interrelationships between the education system and the economic system in which skills are utilized as a central input into production and supporting inclusive economic growth. According to Reddy et al. (2016) skills mismatch denotes the types of imbalances that occur between the types of skills developed and those needed in the world of work. Analysis of the imbalances and mismatches provides signals to inform an appropriate skills policy response. In the SA context, Reddy et al. (2016) points out that these mismatches can be categorized into three main types: demand mismatch, educational-supply mismatch and qualifications-job mismatch. This classification is used in trying to understand the skills mismatches that exist in the construction sector.

Despite the efforts of many international organisations to bring consistency in the definition and presentation of national statistics, considerable deviation from the standardised systems remains in the data of many countries. Thus all data relating to the construction sector in developing economies must be interpreted with caution. A discussion of how construction labour statistics covering the informal sector of the SA economy has been factored into the data used in this research is included in the research methods section.

The SA economy has been characterised by low economic growth rates, leading to poor employment growth (National Treasury, 2019). Employment growth in SA has not been sufficient to absorb the large numbers of youth coming onto the labour market for the first time (Reddy et al. 2016). The result of this is an escalating unemployment rate. A key constraint to sustainable job creation in the construction sector of SA is the structural mismatch between labour demand and supply. Under this mismatch the economic growth has favoured high-skilled workers, despite the fact that the majority of the employed and the unemployed have low level skills (Bhorat et al. 2014).

According to Tsele and Agumba (2014), skills shortages in SA are a consequence of the interplay of several complex socio-political and economic factors. Erasmus and Breier (2009) affirmed that skills shortage had been a persistent problem facing the SA construction sector. Three major categories of studies have been undertaken on the subject of skilled labour shortage in the construction sector. First, the identification and discussion of the various factors contributing to skilled labour shortages (Windapo 2016). Second, the impacts and consequences of skilled labour shortages (Rasool and Botha 2011). Third, the methods and means of dealing with the alleviation of skilled labour crisis (Awe 2004). The picture that emerged from these studies is a mixed one. The studies found that, among other things, key factors that influence skills shortage in SA included the construction sector's poor image, the role of government, the quality of the training received by artisans, the ageing workforce, the cyclical nature of construction demand and technological progress.

Technological progress in the construction sector has been shown to entail advances in scientific and technical knowledge such as the construction of energy efficient buildings. It also involves improvements in the methods of organisation and management of the workforce. It is regarded as a key determinant in the growth process. Ofori (1994) observed that in the construction sector, technological progress embraced advances in materials, plant and machinery, organisation, procedures and information systems used in planning, designing, constructing, maintaining, repairing, altering and demolishing buildings and infrastructure. Innovation and invention in the construction sector is achieved through R&D as well as on-the-job-practice.

Economic growth

A lot has been said about the significance of the construction sector in the economy. The United Nations Environment Programme (UNEP) has noted that about one-tenth of the global economy is

According to Hillebrandt (2000), construction products are wanted, not for their own sake, but on account of the goods and services which they can create or help to create. The construction sector also creates, builds and maintains the workplaces in which businesses operate. It builds the homes in which people live. It also builds schools and hospitals that provide the crucial services that society needs. Increased demand for construction inputs such as cement and steel influences investment in the manufacturing sector. Clearly, the provision of infrastructure is vital for any economy to prosper.

Construction activity is part of a unified system of production, consumption and distribution. The contribution of construction products to capital formation cannot be ignored. The endogenous growth theory provides the intellectual framework for much of the debate over public policy aimed at making better use of the construction sector, creating jobs and promoting long run economic growth. Therefore, the endogenous growth theory is considered relevant and appropriate for explaining the economic growth phenomenon as it relates to the construction sector. Thus, it will be applied in the analysis to explain the correlation of construction output, construction employment and economic growth.

RESEARCH DESIGN

The literature considered in the previous section revealed that the construction sector is considered as an investment sector. It is common cause that investment influences economic growth. The paper scrutinizes the trends in total construction output (TCO), construction employment (CE) and GDP growth to establish the correlation of these important variables. A time series statistical analysis is used to carry out this investigation.

Time series TCO, CE and GDP data for SA is reviewed and analyzed to arrive at the conclusion and inferences about the correlations. The sample consists of TCO, CE and GDP data covering the period 2009 to 2018. The secondary data collected mainly from Stats SA is computed into the Stata version 13 software for the cointegration analysis. Created in 1985 by StataCorp, Stata is a data analysis and statistical software package that specialises in econometric analyses (Hansen and Juselius 1995).

Cointegration analysis is used to establish the relationship of TCO, CE and GDP. Economic time series tend to be nonstationary and if they are, the ordinary least squares (OLS) method alone cannot be used to estimate relationships of the series because of autocorrelation and normality assumption (Greene and Misra 2003). According to Greene and Misra, where the OLS method is used in determining long run linear relationships there is the risk of spurious regression, a situation in which a statistically significant relationship between variables may appear to exist when in reality the variables are unrelated. Therefore, the technique of cointegration is used to obtain statistically and economically meaningful regression results.

RESEARCH FINDINGS

This chapter employs the time series statistical method to ascertain the correlation of construction output, construction employment and economic growth. As

reflected in the literature, the construction sector is considered as an investment sector. Investment influences economic growth. Given such arguments, it is of interest to understand how investment in infrastructure affects employment growth in construction.

Patterns of TCO, CE & GDP growth 2009-2018

TCO measures the volume of construction a

Test for Clay and Silt

This test was in accordance with BS 882:1992. Sample of sand was taken to the laboratory for silt and clay test. The following materials and tools were used for the test: sand, salt, water, measuring cylinder-250ml and 500ml, and stirring rod. To start, a saline solution was prepared by taking 2.5g of fine salt and dissolving it into 250ml of water in the 500ml measuring cylinder. The purpose of the saline solution was to accelerate the rate of settling of the various particles of the sand. 50ml of saline solution was poured into the 250ml cylinder (glass). The sand was then added into the same cylinder with the 50ml saline solution till the water level in the same cylinder reached the 100ml reading level. An additional saline solution was added till the water reads 150ml. The additional water was to facilitate the ease of stirring. The stirring rod was used to stir the mixture thoroughly. The cylinder was then placed on a flat surface for three hours for sedimentation. The height of sand and silt were measured and expressed in percentage:

$$\text{Percentage of silt and clay} = \frac{\text{Height of Silt and Clay} \times 100}{\text{Height of Sand}}$$

Test for Particles Distribution of PKSA

To test for particle distribution of PKSA, the sieve analysis method was used for the study which was in accordance with ISO 4406. 150 grams of PKSA was sampled which was made to pass through BS sieve of sizes ranging from 0.045mm to 0.6mm to obtain the various particle sizes. The percentage of PKSA passing through the sieves were recorded and shown in Figure 9.

Batching and Mixing

The materials were batched using weight proportioning method. The mix ratio used was 1: 2: 4 (cement: fine aggregates: coarse aggregates). The palm kernel shell ash was added by weight of the cement in variation from 0% to a maximum of 20% in steps of 5%. A 0.5 water cement ratio was used to determine the amount of water required for mixing each batched of mix. Due to the smaller volume of concrete mixed for each batched of mix, a hand mixing method was adopted. The amount of fine aggregates (sand) required was first measured and placed on the mixing platform. The cement was then measured with its corresponding PKSA percentage and spread on the measured sand. These materials were mixed thoroughly until no distinction could be made between them using shovel. The coarse aggregate was later measured and added to the unified mix of cement, PKSA and sand. Afterwards, the four materials were mixed together to obtain a uniform mix. Per the calculation made, half of the batched water was then poured into the mix and turned several times to obtain a uniform paste before adding the remaining water.

Workability Test

A truncated cone, 300 mm height and 100 mm diameter at the top and 200 mm diameter at the bottom slump cone was filled in three layers. Each layer was given 25 number of blows with tamping rod of length 600mm long and 16mm diameter with a hemispherical tip. The top of the concrete was levelled with a trowel by a screeding motion. Immediately, after screeding off, the cone was slowly lifted up straight.

The slump cone was then set next to the concrete and the difference in height between the slump cone and the specimen was measured using steel tape measure. The test was performed for all samples. The slump test was performed in accordance with BS 1881: Part 102:1983. Find set up for slump test in Figure 4.

Figure 4. Set up for Slump Test

Casting

A total of fifteen concrete cubes of sizes 150mm x150mm x 150mm were cast using varying OPC-PKSA ratio as indicated above. For each percentage replacement, three cubes A metallic moulds having an internal measurement of 150 × 150 × 150mm was in accordance with BS 1881: Part 108: 1983 were used. Before casting, the metallic moulds were oiled to restrain blow holes and other surface defects. The moulds were filled in three layers, with each layer being tamped 35 times with a tamping rod. The casted specimens were left in the moulds for 24 hours before being de-moulded and then cured in water basin until it was time to be tested. Samples of specimen are shown in Figure 5.

Figure 5. PKSA Concrete Cubes

Curing of Specimen

For this research, after twenty four hours of casting the specimen were de-moulded and cured by immersing them in a water basin containing water sample that was used for the mixing. The specimen was tested at 28days of curing for compression. All the cubes were cured in the material laboratory of Sunyani Polytechnic. Figure 6 depicts the curing procedure for cubes.

Figure 6. Curing of Concrete Cubes

Test for Density

To be able to calculate the density of the spacemen, the spacemen were weighed prior to crushing using digital electronic weighing machine and the weight obtained were recorded according to the various replacement levels. The densities of the various blocks were calculated using:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Test for Compressive Strength

This test was carried out at the 28 days of curing. Prior to crushing, the weights of the concrete cubes were recorded to determine their densities. The test was conducted at the Sunyani Polytechnic Building Construction laboratory. A digital compressive strength testing machine produced by Controls Milano, Italy was used. The compressive strength was determined by crushing the concrete cube specimens in the compression machine. The crushing was done with an increasing compressive load which was applied to the specimen until failure occurred. The maximum compressive load was recorded at the point where the cube starts to deform. Figure 7 shows compressive strength testing machine.

Figure 7. Compressive Strength Testing Machine

Test for Correlation between Strength and PKSA Percentage in the Mix

The study used Microsoft Excel 2013 version to test for correlation between the two variables; strength and PKSA percentage in a mix. Here, a scatter diagram was generated as well as correlation coefficient which tell how strong the relationship was. The result of the test is shown in Figure 12.

Test for Water Absorption

Water absorption is one of the durability properties of concrete which determines the water tightness of concrete. The test was conducted according to BS 1881-122:2011 where the concrete cubes were air dry and its weight measured after concrete has been de-moulded. The specimen was then submersed in water for 28 day, it was surface dry and its weight measured again. The differences in weight gives the water absorption rate of the specimen. Here, The lower the absorption, the better the result.

RESULTS AND DISCUSSIONS

Silt and Clay Test Analysis

This test was conducted to ascertain the fitness of the fine aggregate for concrete production. The allowable percentage of silt and clay for concrete should not exceed 16% by standard. The study recorded 7.93% of silt and clay which is within the limits, therefore, the sand is fit for concrete (IS 2386-Part II).

Sieve Analysis of Crushed Granite

Coarse aggregates used in concrete contain aggregates of various sizes. Proper gradation of coarse aggregates is one of the most import factors in producing workable concrete (Neville et al., 2010). Proper gradation ensures that a sample of aggregates contains all standard fractions of aggregate in required proportion such that the sample contains minimum voids so as to influence concrete strength and density. A well-graded aggregate has a gradation of particles size that fairly evenly spans the size from the finest to the coarsest and it is characterized by the S-shaped in gradation curve. From Figure 8, the gradation curve is S-shaped indicating the crushed granite for the study was well graded (Building Research Institute, 2016).

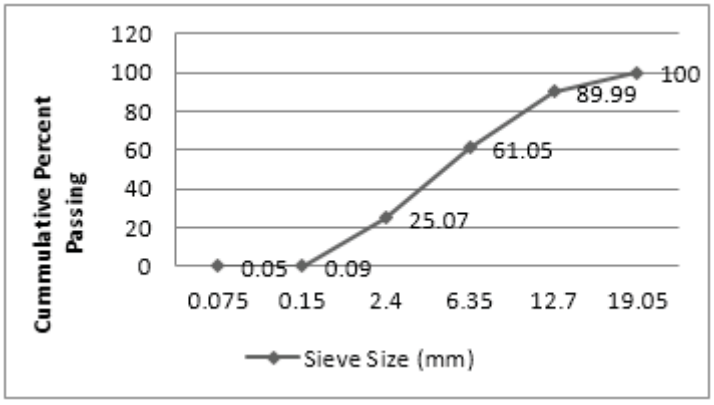

Figure 8. Particles distribution of crushed granite.

Particles Distribution of PKSA

Figure 9 below shows the particle distribution of PKSA. 100% of PKSA passed through the 0.6mm while 99% passed through 0.4mm sieve. The PKSA which passed through the 0.045mm was 31.3% being the least.

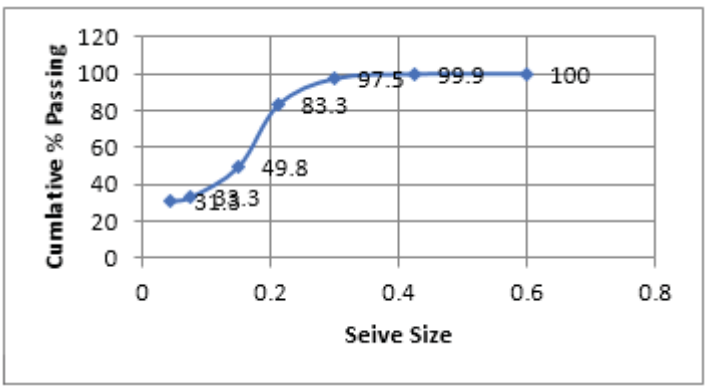

Figure 9. Particle Sieve Analysis of PKSA

Chemical composition of Palm Kernel Shell Ash (PKSA)

The result of the chemical analysis carried out on the palm kernel shell ash is presented on Table 1. According to Neville (2002), the raw materials used in the manufacture of Portland cement, consists mainly of lime, silica, alumina and iron oxide. The chemical analysis of the palm kernel shell ash reveals that it contains some quantities of these elements. The chemical constituents of the PKSA are Silicon (SiO2), Aluminium (Al2O3), and Iron Oxide (Fe2O3). The total amount of SiO2, Al2O3 and Fe2O3 present in the PKSA used for this research is 80.49% which is more than the minimum required 50% specified by the American Society for Testing and Materials (ASTM D5370-14) for type C ashes. Furthermore, this is also in line with ASTM C 618-78 which specifies a minimum requirement of (SiO2+ Al2O3 +Fe2O3 = 70%) for pozzolanas materials. It was seen that PKSA contains all the essential oxides present in OPC and these oxides are important for the properties of concrete. Igarashi et al., (2005) are of the view that when pozzolanic materials are incorporated to concrete, the silica present in these materials reacts with the Ca (OH)2 released during the hydration of cement and forms additional calcium silicate hydrate (C-S-H), which improves durability and the mechanical properties of concrete. Hence, PKSA can be used effectively as a supplementary cementitious material.

The ash produced sometimes varies in tone of colour from whitish grey to darker shade based on the combustion method and the carbon content in it. In other words, the physical characteristic of PKSA is very much influenced by the operating system in the palm oil factory (Utsev and Taku, 2012). The colour of the PKSA was dark grey and this was due to environment the combustion took place. Figure 10 shows the ash of PKSA.

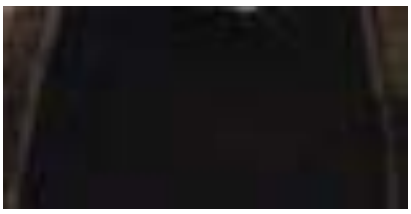

Figure 10. Ash of PKSA

Table 1: Chemical Composition of PKSA

Chemical Composition	OPC	PKSA
SiO2 (silicon)	22.13	63.05
Al2O3 (aluminium)	3.74	13.65
Fe2O3 (iron oxide)	2.97	3.99
CaO (calcium oxide)	63.36	4.27
MgO (magnesium oxide)	2.58	2.79
K2O (potassium oxide)	0.52	6.04

Workability

The result of the workability test is shown in Figure 11. Workability is one of the physical parameters of concrete which affects the strength and durability as well as the cost of labour and appearance of the finished product. Concrete is said to be workable when it is easily placed and compacted homogeneously i.e. without bleeding or segregation. Unworkable concrete needs more work or effort to be compacted in place, also honeycombs and or pockets may also be visible in

finished concrete (Neville et al., 2010). According to Neville et al., (2010), workability is influenced by a number of factors which include: Water content in the concrete mix, Amount of cement & its Properties, Aggregate Grading (Size Distribution), Nature of Aggregate Particles (Shape, Surface Texture, Porosity etc.), Temperature of the concrete mix, Humidity of the environment, Mode of compaction, Method of placement of concrete and Method of transmission of concrete.

The degree of workability ranges from very low to high: 0-25 very low, 25-50 low, 25-100 medium, and 100-172 high (Neville et al., 2010). The slump results from the study were within the range of 50 to 64 which fall within the low range of 25 to 100. The slumps of the samples were seen to be increasing with increase in PKSA percentage. The slump of the concrete increased as the percentage of PKSA increases and decrease in comparison with the conventional concrete, Amu et al., (2011). Neville et al, (2010) reported that grading affects workability of concrete. The differences in the slump of samples was ± one, the differences may be due to operational error such as measuring of the water etc. There were no significant effects of PKSA replacement level on workability (slump).

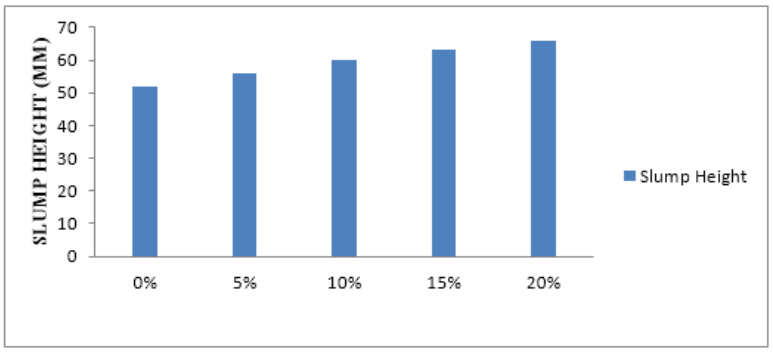

Figure 11: Summary of Workability Test on the Various Mix Ratios

Compressive Strength

Compressive strength test result is shown in Table 2. From the Table 2, the control (0%) yielded the highest compressive strength of 30.08N/mm2 (± 0.42). At 5% replacement of PKSA the strength was 17.29N/mm2 (± 0.34) which was reduced to 15.72 (±0.58) at 10% replacement. With 15% replacement of PKSA, the strength was 14.63N/mm2 (±0.49) which reduced to 12.26N/mm2 (±0.05) at 20% replacement of PKSA.

The targeted strength for the concrete mix design for the study was 30MPa. With the exception of the control, none of the four treated samples exactly hit the targeted strength. It was observed that there was reduction in strength as the percentage of PKSA increases. The reduction in strength was expected because the quantity of the chief compounds in the OPC was not the same with the PKSA. The strength pattern of PKSA concrete in this study was in line with other researchers such as Vignesh et al., (2013) who obtained decrease in compressive strength with increase in the percentage replacement of OPC with CSA Malhotra and Mehta, (2004). They investigated agricultural by-product pozzolans have been used in the manufacture and application of blended cements. Nimityongskul and Daladar (1995) highlighted the potentialities of coconut husk ash, corn cob ash, and peanut shell ash as good pozzolans. Elinwa and Awari (2001) successfully investigated the

potentials of groundnut husk ash concrete by partially replacing Ordinary Portland Cement with groundnut husk ash.

Adesanya (1996) investigated the properties of blended cement mortar, concrete, and stabilized earth made from OPC and corn cob ash and recommended that corn cob ash can serve as replacement for OPC in the production of cement composites. Dwivedia et al. (2006) successfully investigated the pozzolanicity of bamboo leaf ash. Martirena et al., (1998) found that sugar industry solid wastes such as sugar cane straw ash has pozzolanic activity derived from its high content of amorphous silica. Many other researchers have confirmed rice husk ash as pozzolanic material that can be used to partially replace OPC in making cement composites (Cordeiro et al., 2009; Habeeb and Fayyadh, 2009; Rukzo et al., 2009).

Table 2 Compressive Strength of PKSA

Sample	N	Mean (N/mm^2)	Std. Dev.
0%	3	30.08	0.42
5%	3	17.29	0.34
10%	3	15.72	0.58
15%	3	14.63	0.49
20%	3	12.26	0.05

One common characteristic about these studies stated above which is in line with this current study is about the strength development in these agro by-product for partial replacement of OPC, all these studies recorded a reduction in strength with the increasing in the percentage of agro ash. Even though there was a reduction in strength of PKSA concrete, it was evident that 5% PKSA Concrete at 28 days curing age was 17.29N/mm2 meets the minimum required strength of concrete (10 to 40 MPa) at 28 days; it is therefore recommended for normal concrete works.

Strength versus PKSA Proportion in a Mix

Figure 12 shows the relationship between compressive strength and PKSA percentage replacement in concrete mix. It can be observed that there is a negative correlation between the two variables. The R2 = 0.7487 indicates that 74.87% of the variation in compressive strength can be explained by the percentage of PKSA in the concrete. It can also be noticed that the compressive strength of the PKSA $y = -76.6\chi + 25.656$, the value 25.656 is the constant for determining the compressive strength of PKSA concrete. The value -76.6 is the co-efficient of PKSA percentage in a mix which means that if the PKSA (χ) is increased by one unit, the strength will on average decrease by 76.6.

Furthermore, correlation coefficient was computed from the sample data using the Pearson Correlation Coefficient, it was found out to be -0.87 which indicate a strong negative correlation between the variable that is the association between strength and PKSA replacement is inversely proportion – as PKSA replacement percentage increases strength reduces (Bluman, 2004). The result was in line with Vignesh et al., (2014). They utilize coconut ash for partial replacement of OPC. Their study concluded a reduction in strength as the coconut ash in is increased in the mix proportion.

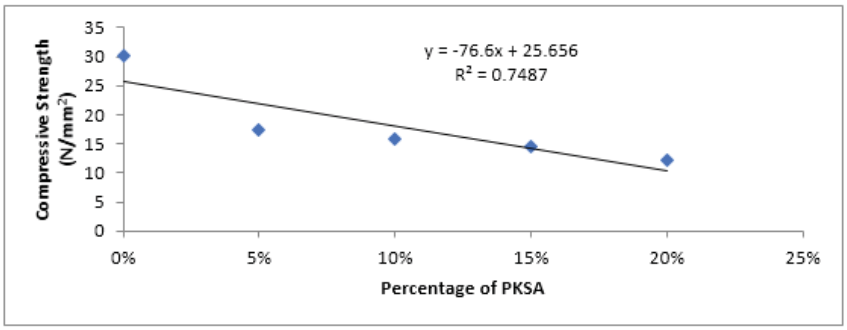

Figure 12: Strength versus PKSA Proportion in a Mix

Water Absorption of PKSA Concrete

From Table 4, it was observed that as the replacement levels of PKSA increases, there was a corresponding increase in water absorption rate. This is because; PKSA concretes retain water for a longer period before it starts to dry up slowly. PKSA concretes do absorb water faster than OPC concretes; thereby retarding hydration processes in the PKSA concrete. Considering the water absorption property of PKSA concrete, it is not recommended for substructure construction which is more likely to be susceptible to moisture.

According to ASTM C1585, water absorption is influenced by a number of factors which include concrete mixture proportions, the presence of chemical admixtures and supplementary cementatious materials, the composition and physical characteristics of the cementatious component and of the aggregate, the entrained air content, the type and duration of curing, the degree of hydration or age, the presence of micro-cracks, the presence of surface treatment such as sealers or form oil and placement method such as consolidation and finishing. This study was in line with Nagalakshmi (2013) who obtained higher water absorption as the percentage of fly ash increases.

Table 4: Water absorption of PKSA

Sample	N	Mean (%)	Std. Dev.
0% (Control)	3	0.047	0.005
5%	3	0.049	0.004
10%	3	0.056	0.001
15%	3	0.058	0.001
20%	3	0.090	0.001

Density of PKSA concrete

The density of concrete is determined largely by the type of aggregate and the cement used in the mixture. Enrique, (1966) reported that since aggregates, cement, water and air have different specific weights, the overall density of any concrete mix depends largely on the relative amount of these materials present. The average density of PKSA concrete cubes ranged between 2167Kg/m3 and 2088Kg/m3as shown in Figure 13. It was observed from the research that, the control obtained the highest of 2167Kg/m3. The density kept reducing as the percentage of PKSA increases. This was expected, since the density of cement is higher than that of the PKSA. This is in line with Vignesh et al., (2014), who had average density decrease with percentage replacement from 2525.5Kg /m3 for OPC to 2314Kg / m3, at 30% replacement.

Figure 13. Density of PKSA Concrete

Relationship between density and compressive strength of PKSA Concrete

The mechanical properties of concrete are highly influenced by its density. A denser concrete generally provides higher strength and fewer amount of voids and porosity (Iffat et al., 2015).

The densities of the various replacement levels of PKSA with their corresponding compressive strength were compared to test if there is a correlation between them using the Pearson correlation coefficient. From Table 4 in the previous chapter, Pearson correlation coefficient was computed to be 0.63 using Excel indicating a correlation between the variables.

From Table 5, it was observed that as the PKSA percentages are increased in the mix, it showed a reduction in strength as well as density. The result was in line Iffat et al., (2015) that there is a relation between concrete strength and density.

Table 5: Relationship between Density and Compressive Strength of PKSA Concrete

Sample	Compressive Strength (N/mm^2)	Density (Kg/m^3)
0%	30.08	2167
5%	17.29	2166
10%	15.72	2165
15%	14.63	2093
20%	12.26	2088

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

Summary of Findings

From the research, the following findings were revealed.

The PKSA has most of the chemical constituent present in OPC cement but in varying quantity. The constituent includes silicon, aluminium, iron oxide, calcium oxide, magnesium oxide and potassium oxide. The colour of the PKSA was dark grey.

The replacement of PKSA in the mix design made concrete workable relatively to the control concrete. The introduction of PKSA in the concrete mix saw a decline in the 28 days compressive strength. The reduction in strength was expected because the quantity of chief components in OPC was not the same with the PKSA.

The relationship between strength and PKSA proportioning in the mix was inversely proportional, that is as PKSA percentage in the mix increases; there was an average reduction of strength by 47.08%. The PKSA concrete absorbed more water than the

control (plain concrete). There was also a reduction in density with the addition of PKSA relative to the control.

Conclusion

The focus of study was to find a replacement for cement in concrete production. From the findings obtained, it is evident that PKSA has some basic parameters that could improve some properties of concrete when used in partial replacement of cement.

Recommendations

These recommendation have been made following the result from the study:

- Since PKSA concrete has high water absorption rate, it is not recommended for moisture prone areas.
- With the addition of the PKSA made concrete relatively workable, it can serve as plasticizer.
- The replacement of PKSA in concrete saw a decline in strength, however, it is recommended that replacement rate of 5% is good for normal concrete works.
- There are various varieties of palm oil fruits such as dura, tunera and pisifera, it is recommended that a further study should be conducted to see the chemical composition of these fruit and in relation to OPC.

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TRANSACTION COSTS CHARACTERISTICS EFFECTS ON CONTRACTING BUSINESS IN NIGERIA

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Various literatures in construction and project management deduced that transaction costs characteristics have impact on contractor's bids evaluation process. Aim of this study is to assess the level of impacts of transaction costs characteristics on contractor's bids evaluation process. Simple random sampling techniques was used in selecting fifty two (52) contractors within some selected states of the North-West zone of Nigeria that are registered in the Bureau of Public Procurement database of contractors, whom are being considered to participate in any federal government tendering process as respondents of the study. The data collected was analyzed using multi-attribute techniques, Relative Importance Index RII and ANOVA. Results of the study indicate that transaction costs characteristics effects among the five categories of factors identified from literature, predictability of owners behavior rank first, followed by project management efficiency (RII=0.698), contractors predictability behavior (RII=0.684), while uncertainty in the transaction environment (RII=0.662) and magnitude of the transaction cost (RII=0.647) rank fourth and fifth with low impacts on contractors' bids evaluation process. No significant difference was found between the effects of TCs characteristics of four factors on contractors' bids evaluation process. While there is a significant different in Uncertainty in the transaction environment factor x^2_{tab} = 17.67 > x^2_{cal} =17.06. Conclusions are that owners' behavior, contractor's behavior, project management efficiency and magnitude of the transaction have an impact on contractor's bids evaluation process in determining a successful tender among the various contractors' bids for a project by the client. The study recommends that contractors should adopt good decision making by reducing the amount of time-spent on disputes/disagreement, unbalance bidding, collusion and cheating that cause uncertainty in the bidding environment. Contractors should adopt experience based type when bidding for construction projects with regards to finance, schedules, manpower, equipment and other documentary evidence in their bidding process.

Keywords: bids evaluation process, contractor, Nigeria, transaction costs characteristics

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INTRODUCTION

In construction projects in Nigeria, clients undergo a procurement process to select a competent consultant and contractor to carry out the construction work using pre-determined selection criteria (Ogunsanmi, 2013; Peter, Love, Davis & Edwards, 2008; McWhirt, Ahn, Jenniffer & Kelly, 2011) or guidelines as stated by the public procurement Act 2007. The Act objectives are to provide the best value for money, economy, transparency, accountability and competition among bidders (PPA 2007).

To ensure aggregate procurement, there is need to obtain economies of scale and reduce procurement costs (PPA 2007). However, it must be quickly noted that the Act has not taken into account the transaction costs incurred with participation in the tender processes due to the varied activities undertaken by clients, consultants and contractors. It is a common fact that contractors devote considerable time and resources in determining the cost of construction and then assessing the price they will quote to the owner (Li, Arditi & Wang 2013). The Client is interested only in the price quoted by contractors.

This price is the rate at which exchange will take place. Price to the contractor becomes a cost to the owner (Hillebrandt & Hughes, 2000). However, the actual cost of a construction project is not the only production cost. The cost of preparing a bidding document, estimating, drawing up a contract condition, advertisements, administrative aspects and dealing with any deviations from construction (Arbitration or Dispute resolution) are also important. In construction these costs are incurred by clients, consultant or contractors as the case may be.

The costs are known as transaction costs in the study of economic organizations (Coase, 1937). In transaction cost economics a transaction occurs when a goods, works or services is transferred across a technologically separable interface (Williamson, 1987). Similarly, in construction using the PPA (2007) a services or goods are supplied to the client in return to a stated amount agreed by client.

However, it is not clear whether transaction costs characteristics were reduced by the use of the PPA since they are not defined systematically (Li et.al 2013). Also, it is not clear or understood whether transaction cost have positive or negative impact on the bidding process phases of a construction project. Various researchers have proven the existence of such cost in the construction industry and other areas of studies. This to include construction-related topics, project organization and governance (Piertoforte, 1997; Turner & Keegan, 2001; Winch, 2001; Muller & Turner, 2005; Jobin, 2008), Agriculture (Huo, 2015; Ferris 2005) and marketing and sub-contracting (Eccles, 1981; Gunarson & Levitt 1982; Reve & Levitt, 1984; Winch, 1989; Constantion, 2001).

Most of the aforementioned researchers on transaction costs indicated how stakeholders are face with challenges due to the costs incurred during transaction by both parties. These leads to higher cost of construction, less economic efficiency in the procurement chain system. For instance, in the United Kingdom UK about 0.57% of the total project value was identified to be spending as the bid costs by the contractors whether they win or lose in a bidding processes (Hughes, 2016).

This is against the fact that, such costs make a significant impact on the retained operating turnover for the construction firm or company.

Worthy of note in the construction transaction in Nigeria is that they offer various transaction costs characteristics (Lingard,Hughes & Chinyio, 1998; Costantino, Pellegrion & Pietroforte, 2011; Enshassi, Mohamed & El-Karriri, 2010; Thomassen, Vassbo, Solheim-Kile & Lohne, 2016; Li, Aridit, & Wang, 2012; Li et.al, 2013) in respects of their Asset specificity, Transaction environment uncertainties, Contractors' behavior, Owners' behavior and Project management efficiency that can have negative impact on bidding process in Nigeria. Objective of this study is to assess the level of impacts of transaction costs characteristics on contractors' bids evaluation process. Bids evaluation process/phases considered in this study are preliminary bids examination (Technical bid phase), detailed evaluation (Financial bid phase), bids comparison, post-qualification verification and bids evaluation report phases.

Thus, the primary research question of this study is:

1. What level of impact does transaction costs characteristics has on contracting business in Nigeria?

The study is important in that it provides the level of impacts of the various transaction costs characteristics in contractors' bids evaluation process for construction project in Nigeria. It also contributes to transaction costs theory literature in assessing the level of impacts of TCs characteristics on contractors' bids evaluation process. Furthermore, financial and technological systems will be improved in the construction industry by increasing the retained operating costs of the contracting firms and more chances of winning contracts by contracting firms in Nigeria.

LITERATURE REVIEW

Transaction costs theory (theoretical review)

Transaction cost economics theory has become a predominant theoretical framework (model) for explaining organizational boundary decision. Like most influential theories, transaction cost theory was not fully developed at the outset. It has been and continues to be retained and reformulated, corrected and expands in response to new theoretical and empirical development (Geyskens, Steenkamp & kumar, 2006).

Transaction cost theory has its origin from Coase (1937), in his article "The nature of the firm" in which he explained market and hierarchies as alternative governance structures. The market is viewed as the dominant model of the logic of economic organization both in manufacturing, construction and overall (Hakansson, Ford, Gadde, Snehato & Waluszewski, 2009). Classic economic theory views the market as an economic system that "work itself" with supply adjusted to demand and production adjusted to consumption (Coase, 1937). According to Coase (1937), firms exist because the cost associated with organizing a transaction within the firm are lower than those associated with organizing it by exchange on the open market. In other word, there are certain costs associated with operating the market and it is necessary to firm an organization to reduce these costs (Coase, 1937).

These associated costs are incurred during such transaction, which are not cost of production. In such situation or condition, they are being considered as the determining factors as to whether a firm manufactures product in-house or buys from the outside market. They arise from the transfer of ownership or property rights (Hughes, Hillebrandt, Greenwood & Kwawu, 2006). The only solution to it is to envisage a Robinson economy; where there are no other parties involved, no concept of ownership or property rights and no need or opportunity. Therefore, to make agreements in this case all cost is production costs.

Transaction costs exist whenever there is economic organization, which means that they are in practice universal. They include the cost of:

a. The drawing up of agreements and contracts;
b. The definition and inspection of goods involved in the transactions;
c. The keeping of records
d. The preparation of bidding documents;
e. Enforcement of the agreements and contract etc.

In construction industry, item (a) and (b) above are very high because of the complexity of the process of producing a building or other works. The Client is purchasing a product which he cannot seen in advance, because it is custom-made and, when he agrees to purchase it, is not in existence. Finding the right contractor to produce the facility and agreeing a price is complex and requires binding contractual arrangement to enforce the agreement made (Hughes et.al, 2006).

Transaction costs characteristics

The majority of studies on transaction costs in construction projects have Lingard et.al (1998), costantino et.al (2011), Li et.al (2012, 2013) indicates various transaction costs characteristics that can have impact on contractors' bids evaluation process. These studies considered various TCs characteristics factors with different area of divergent. According to Lingard et.al (1998) human being inability to predict events, asset specificityand opportunism gives rise to TCs (Coase, 1988), and whereby their co-existence may lead to business failure in general (Ascher, 1987, cited by Lingard et.al, 1998). A study of Costantino et.al (2011) in the U.S analyses the relationship between asset specificity and specialization.

The asset specificity as part of TCs characteristics, which refers it based on Williamson (1991) definition as "the degree to which an asset can be redeployed to alternative use and by alternative users without sacrifices of productive value". He further explained that investments mode for a particular transaction has a higher value only for that transaction. It has little value for other types of transactions (McGuinness, 1994). According to Williamson (1991) cited by Costantino et.al (2011), that asset specificity are of four types, that is site or location specificity, physical specificity, human specificity and temporal asset specificity. Li et.al (2012, 2013) listed out different transaction costs characteristics on construction projects performance as, Uncertainty in the transaction environment, magnitude of the transaction costs, owner's role in the transaction and contractor's role in the transaction.

Furthermore, in their studies on factors affecting TCs in construction projects (Li et.al, 2013) include project management efficiency among transaction costs characteristics with various degree of significance in the design model for each construct. Thomassen et.al (2016) estimate the TCs from both private and public actors, highlight how cost are incurred at the various transaction stages or process such as tender complexity, size of the project, prequalification of bidders and invitation to participate in the tender etc combine to make the transaction prone to high transaction costs at the tender process. Eddy, Maryunani and Ghozalimazkie (2013) also opined that behaviour attributes are among the factor influence TCs in contractors bidding process in construction project.

Therefore, transaction costs characteristics identified from these previous studies are also related to client/owner's behaviour, contractor's behaviour, project management efficiency, transaction environment uncertainties and Asset specificity that are considered in this study. Some of these TCs characteristics factors are in ambit of what has been considered in previous studies and hence they are discussed as follows:

Client's/owner's behaviour

Many studies have listed different client's behaviour that can impact bidding process in construction project. Studies of Walker (1995), Chan and Kumaraswamy (1997), Songer and Moleneer (1997), Dissanayaka and Kumaraswamy (1999) as cited by Li et.al (2013) have pointed that owner's behaviour are characteristics as client type and experience, knowledge of construction team, owner's construction sophistication, well-define scope, owner's risk aversion, and client project management are in practice. However, Li et.al (2012) emphasized that owner's behaviour reduces uncertainty in the transaction environment and increases the efficiency of project management.

Therefore, negative attitudes of the owner's in his behaviour can lead to high impacts towards the bidding process. Owner's (Client's) of construction project dreadful behaviour in terms of relationships with contractor's, consultants, co-workers and colleagues affect contractor's bidding in terms of time, efficiency of the process and poor plans and specifications during and when project implementation. A smooth relationship among parties when bidding may enhance cooperation, reduce disagreements, allow for easy resolution of conflicts and creates stability in the owner's behaviour, hence reducing the uncertainties in the transaction environment.

Kululanga and McCaffer (2001) suggest that an effective organizational learning could be attained as a result of good lesson learned from existing harmony in the project execution. Hence, promoting stability in the owner's behaviour and reducing uncertainties in the transaction environment (i.e negative impact on the contractor's bidding). Walker and Wing (1999) in their studies to explore the relationship between construction project management theory and transaction costs economics argues that owner's behaviour as a human being is characterize by bounded rationality, which made him to act rationally due to the limited analytical and data processing capabilities. By likehood of not choosing the most appropriate organizational structure, procurement method or bidding strategy etc. this is likely to be the case for clients which build regularly (Walker & Wing, 1991).

Contractor's behaviour

The ability of contractors to predict well in relation to behaviour of his client and competitors, the less transaction costs to incurred (Li et.al, 2013). The suspicion of unbalanced bidding, cheating, and collusion may cause uncertainty in the bidding process, may cause the owner's overall project cost to get higher (negative impacts), but it is difficult to detect unbalancing (Arditi & Chotibhongs, 2009) and collusions, and may generate contentious change orders (Manzo, 1997), all contributing to negative impacts. As mention with owner's behaviour, contractors that maintain a good working relationship with sub-contractors may positively and strongly influence general contractors performance (Kale & Arditi, 2001 cited by Li et.al, 2013), and may lower transaction costs of bidding.

Bresnen and Marshall (2000) states that a good harmony between contractors and owners enhance cooporation, trust, and creates stability in the contractor's behaviour, hence lowering TCs. Li et.al (2013), Lingard et.al (1998) identifies some of the elements or variables defining contractor's behaviour as; bidding behaviour, qualifications of the contractor, relationships with sub-contractors, relationships with previous clients, experience in similar type projects, material substitution and frequency claims (Chan & Kumaraswamy, 1997; Dissanayaka & Kumaraswamy, 1999). Similarly, the contractor is affected by bounded rationality issues as a human being, whereby he cannot identify all possible contingencies due to contract incompleteness. Such characteristics may lead to time overrun or costs overrun, due to his refusal to rectify defects found in the bidding documents or project implementation, because he may ask for additional payment due to either of the above item mentions. This can have a negative impact to the project (Chang & Ive, 2007).

Project management efficiency

The ability to provide maximum output given a set of inputs or the ability to minimize input given a set of required output may depends on how efficient the project management team operates. Cooper (1993, 1994) cited by Li et.al (2012) consider quality of project management as a factor that has a large impact on project productivity, quality, and rework. A Study by Li et.al (2012) states that efficient project management lower transaction costs through a good leadership, speedy decision making, efficient communication, fair conflict management and high technical competency. Project managers must develop adequate leadership skills and use appropriate leadership styles during the course of a project. These can only be achieved through speedy decision making process to ensure the best decision is made in the light of existing limitations, to strategically analyze conflict of a competitive nature and understand negotiation as a means of resolving conflicts. Technical competency in terms of knowledge and qualification is a catalyst for speedy decisions, smooth operations, few rework and easy communication, all of which reduce transaction costs impact when bidding by contractors (Carey et.al, 2006). Effective and efficient communication as a variable or indicator of project management ensures that all team members are aware of decision s as soon as they are made, leaving no room for uncertainties in terms of individual responsibilities and goals, hence reducing transaction costs impact (Suva et.al, 2008). It has been revealed that the efforts, resources, focus, determinations

and time management within project team influence a bidder's strategy to contribute in future with similar project or not (Noumba & Dinghem, 2007). Hence, it reduces transaction costs impacts.

A successful project management requires sound team leadership and coordination, diligent project planning and effective oversight of the delivery process (Li et.al, 2012; Walker &Wing 1999; WBDG, 2010). Project management area offers professional guidance, training, collaboration and harmony for the entire team to successfully and effectively carry out a high performance building project, that reduce any negative impacts to the stakeholders. Both contractor's and clients get value for money in construction when project are delivered on time, on budget and to a level of quality that meets those determined criteria or specifications.

Asset specificity

Williamson (1998) mentioned that in "TCE asset specificity is the big locomotive to which transaction costs economics owes much of it predictive content". This declaration has received great support from many other researchers (David & Han, 2004; Shelanski & Klein, 1995). Asset specificity occurs when assets are personalized to a particular transaction and cannot be easily re-assigned to another relationship without a cost. In the construction project bidding contractors are engaged in such similar challenges whereby, those requirements solicit by client are mainly for that bidding, so they cannot be used in subsequent bidding such as; bid security, Court Affidavit, performance bond/Bank guarantee or pre-qualification results. These have a significant impact on contractor's transaction costs. Williamson (1981) opined that asset specificity is the most important element in describing transaction. It is largely an issue of specialization of assets such that buyers cannot easily turn to alternative supplies whereas suppliers on the other hand can easily sell goods to many other buyers. Asset specificity has been classified into three to four classes (Rao, 2003; Rawlence, 2010, Costantino et.al, 2011; Lingard, 1998). This includes location, physical, human and temporal assets specificity. Location specificity refers to the local availability of providers of a given technology, material or labour. Little availability creates a monopolistic situation with consequent "up hold" problem between providers and contractor including higher costs.

Physical asset specificity refers to specialized machinery that can be used for a single purpose. In construction projects typical examples are the boring and lining machines in hard rock tunneling, the paving equipment in road building and the specialized cranes for the steel erection of a high rise building. Human asset specificity refers to the specialized human skill arising in learning by doing. It encompasses the knowledge and experience of personnel that are specific to a firm's line of business and also to long term cooporatives links between general contractor's and subcontractor's. While temporal relates technology with time specific (Costantino et.al, 2011). Lingard et.al (1998) argues that asset specificity has no significant before a contract being let because, except for specialized civil engineering or building services work can simply switch between alternative contractor is high (Winch,1989). Similarly, contractors bidding for a particular

project can change or withdraw before the opening of the document (PPA 2007), but rather have incurred some transaction costs due to printing, traveling, feeding, professional services and other related charges attached to it. This has negative impacts on the contractor's operating or retained costs.

Transaction environment uncertainty

Projects uncertainties in an environment may be both external and internal factors that affect the project execution (Walker & Pryke, 2009; Rawlence, 2010; Jin & Zhang, 2011; Li et.al 2013). These are changes that are normally caused either by nature or by the actions and inactions of other economic actors. Those caused by natural events are called primary uncertainties whereas those caused by other economic actors are referred to as secondary uncertainties. Both of these being unintentional are environmental uncertainties (Williamson, 1985; Rawlence, 2010). Conversely when these factors happen to be strategies and calculated attempts by other actors it is termed behavioral uncertainties (Stucliffe & Zaheer, 1998; Rawlence, 2010).

Li et.al (2013) mention about nine elements related to uncertainty in the transaction environments as project complexity, project uncertainty, completeness of design, early contractor involvement, competition between bidders, integration of design and construction, bonding requirements, incentive/disincentives clauses and fair risk allocation. Project complexity increases uncertainty in the transaction environment, hence increasing the cost of bidding or procurement as a whole (Farajian, 2010). When the scope of a project also is not well defined, initial drawings and specifications are likely to change, promoting many claims and valuations orders that in turn increase transaction costs (negative impact). Bonding requirements may discourage opportunistic behaviour on the part of the contractor (Mysen et.al, 2011) and consequently may reduce transaction costs of the client but increases that of contractors. Similarly, a fair allocation of risks between the parties may reduce transaction costs. An empirical studies by Li et.al (2013) revealed that uncertainty in the transaction environment have a negative impacts and can be minimize by preparing a less complex projects, ensuring that design is complete, secure the contractor's early involvement in the project, encourage healthy competition between bidders and integrate design and construction.

RESEARCH METHOD

Literature review was undertaken to identify transaction costs characteristics as owner's behaviour, contractor's behaviour, asset specificity, project management efficiency, and transaction environment uncertainties on contractor's bidding process. A questionnaire was used to collect factual and perceptive responses and measure impacts or effects regarding the TCs characteristics that affect bid evaluation process in Nigeria. Thus, it has being argued that questionnaire is a widely used approach for descriptive and analytical surveys to find out the facts, opinions and views of respondents (Fellow & Liu, 1997; Naoum, 1998). Two populations were targeted in this research. The first population comprised of contractors that are within some selected states of the North-West geographical zone of Nigeria (i.e Sokoto, Kebbi and Kaduna) who are registered with the Bureau of Public Procurement database of contractors under the civil or building

categorization/classification indicating their IRR (Interim Registration Report) number or ID, (110 Companies).. The objective of this study was to assess the level of transaction costs characteristics impact on contractors bidding process. This was to obtain from the arrangements of the questionnaire structure. To determine the sample size for each population of contract's and client's, the Kish (1995) equation was used. Assaf (1999, 2001) and Abdul-Hadi (1999), Enshassi (2010) among others used this equation:

ڠ سي ح / ٥٨ -- (1)

Where:

n' is the sample size from infinite population, which can be calculated from this formula: ڠ سي ... .

n= sample size from finite population

N= total population (110 contractors)

V2= Standard error of sample population equal to 0.05 for confidence level 95%, t= 1.96

S2= standard error variance of population elements S2= P(1-P), P=0.5

Sample size for the contractors and client population are as follows:

n' = (0.5)2/(0.05)2 = 100

n contractors سي ٥ / ٥٨ = 52 Companies

The calculated sample size was 52. The response rate was 45(73%) for contractors. The respondents were asked to give their experiences based regarding the transaction costs characteristics impact on contractors bidding process using a five point scale (from "1" strongly disagree to "5" strongly agree). The relative importance index (RII) was calculated using the following equation (Naoum, 1998; Assaf, 1999, 2001; Abdul-Hadi, 1999; Wanous, 2003; Enshassi, 2010).

RII = B ـد / إ سي ٣ح٣٨٢ح٢٨١ح١٨٠ح٠٨٥ح٥ / ٣إ ---------------------------- (2)

The level of impact of the TCs characteristics was determined based on the RII computation. The scale was divided into five categories from 0-.2= Very low, 0.21-0.4= Low impact, 0.41-0.6= Small impact, 0.61-0.8 = High impact, and 0.81-1.0= Very high impact.

RESULTS AND DISCUSSIONS

Table 1 Descriptive result of impact of owner's behaviour characteristics on contractor's bid evaluation

Predictability of Owner's Behavior	Relative Importance Index (RII)	Level of Impact (LV)
Relationship with other parties	0.702	High impact
Experience in similar type projects	0.600	Small impact
Payment on time	0.644	High impact
Organizational efficiency	0.627	High impact
Change orders	0.547	Small impact

Table 2 Descriptive result of impact of contractor's behaviour characteristics on contractor's bid evaluation

Predictability of the Contractor's Behaviour	Relative Importance Index (RII)	Level of Impact (LV)
Bidding behaviour	0.684	High impact
Qualifications of the Contractor	0.658	High impact
Relationship with subcontractor	0.578	Small impact
Relationships with previous clients	0.596	Small impact
Experience in similar type projects	0.636	High impact
Material substitution	0.671	High impact
Frequency of claims	0.649	High impact
Location of bidding	0.680	High impact

Table 3 Descriptive result of impact of transaction environment characteristics on contractor's bid evaluation

Uncertainty in the transaction environment	Relative Importance Index (RII)	Level of Impact (LV)
Project complexity	0.662	High impact
Project Uncertainty	0.569	Small impact
Completeness of design	0.636	High impact
Early contractor involvement	0.560	Small impact
Competition between bidders	0.613	High impact
Integration of design and construction	0.582	Small impact
Bonding requirement	0.658	High impact
Incentives/disincentives	0.600	Small impact
Fair risk allocation	0.662	High impact

Table 4 Descriptive result of impact of project management efficiency characteristics on contractor's bid evaluation

Project Management Efficiency	Relative Importance Index (RII)	Level of Impact (LV)
Leadership	0.640	High impact
Quality of decision making	0.618	High impact
Quality of Communication	0.618	High impact
Conflict Management	0.662	High impact
Technical competency	0.698	High impact

Table 5 Descriptive result of impact of magnitude of transaction costs characteristics on contractor's bid evaluation

Magnitude of the Transaction costs	Relative Importance Index (RII)	Level of Impact (LV)
Market research	0.649	High impact
Exploring financing opportunism	0.622	High impact
Conducting feasibility study	0.564	Small impact
Dispute resolution	0.640	High impact
Contract Administration	0.636	High impact
Negotiation	0.636	High impact

Table 6 Descriptive result of impacts of transaction costs among characteristics on contractor's bid evaluation

TCs Characteristics	Relative Importance Index (RII)	Level of Impact (LI	Rank
Predictability of Owner's Behaviour		HI	1
Predictability of the Contractor's Behaviour	0.702	HI	3
Uncertainty in the transaction environment		HI	4
Magnitude of the Transaction costs	0.684	HI	5
Project Management Efficiency		HI	2
	0.662		
	0.649		
	0.698		

Table 7 Inferential result of difference in impact between the transaction costs characteristics on contractor's bids evaluation process

TCs Characteristics	X2Cal	Dif	X2Tab	P-Value	Sig.	Decision
Predictability of Owner's Behaviour	16.85	16	26.29	0.00	S*	Accept Ho
Predictability of the Contractor's Behaviour	23.52	28	41.34	0.00	S*	Accept Ho
Uncertainty in the transaction environment	17.67	32	17.06	0.61	NS	Accept H1
Magnitude of the Transaction costs	14.26	20	31.41	0.00	S*	Accept Ho
Project Management Efficiency	12.74	16	26.30	0.00	S*	Accept Ho

Table 8 ANOVA result of difference in impact between the transaction costs characteristics on contractor's bids evaluation process

Source of Variation	Sum of Square SS	D.F	MS	F-Ratio	Critical Value F	Sig.	P-value	Decision
Between Groups	15130.8	4	3782.7	25.4727	2.78	S*	0.00	Accept H1
Within Groups	3564	24	148.5					
Total	18694.8	28						

Table 1 shows that of the five owners behavior that show some impacts on contractors bidding relationship with other parties rank first (RII=0.702, HI), payment on time (RII=0.644, HI), and organizational efficiency (RII= 0.627, HI) while experience in similar type projects and change order (RII=0.600, 0.547) with small impacts on contractors bidding. These results also reveal that relationships with other parties payment on time and organization efficiency has the highest impacts on contractors bidding while change order and experience on similar projects show some small level of impacts on contractors bidding. Li et.al (2013) findings agrees with these result, which shows that owners should have a good relationship with other parties (such as contractors, designers, suppliers and government agencies) pay the contractors on time and make an effort to improve organizational efficiency. His further emphasis that owner's good character reduces transaction costs effect indirectly through less uncertainty in the transaction environment and project management efficiency (Li et.al 2013).

Table 2 shows that of the eight transaction costs characteristics analyze under the contractors behavior six factors has high impacts while only two indicate small impacts or less effects. Bidding behavior, qualification of contractors, experience, material substitution, frequency of claims and bidding locations has (RII= 0.684, 0.658, 0.636, 0.671, 0.649 and 0.680) while relationship with subcontractors and previous clients has (RII=0.578 and 0.596) which shows small impact on contractors bidding. According to Li et.al (2012) findings reveals that contractor experience, contractor's relationship with client and subcontractor, material substitution,

frequency of claims and qualification of contractors has small effects on contractors.

Table 3 Uncertainty in the transaction environment indicates five factors that has high impacts with project complexity and fair risk allocation first rank (RII=0.662, HI), bonding requirement (RII=0.658, HI), completeness of design (RII=0.636,HI) and competition between bidders (RII=0.613, HI) , while incentive/disincentive (RII=0.600, SI), integration of design and construction (RII=0.582, SI), project uncertainty (RII=0.569, SI), early contractor involvement (RII=0.560, SI) has small impacts on contractors bidding. Li et.al (2012) indicated that uncertainty in the transaction environment has high impact due to factors such as project complexity, complete design, early contractors' involvement, healthy competition between bidders, integrates design and constructions, and fair allocation of risk.

Factors related to project management efficiency table 4 shows that of all the factors analyze has indicated high impacts on contractors bidding with technical competency rank first (RII=0.698, HI), conflict management (RII=0.668, HI), leadership (RII=0.640), Quality of decision making and communication (RII=0.618).

The table 6 shows a comparison of the transaction costs characteristics impacts among the five categories of factors that affect contractor's bidding in the construction industry. Predictability of owners behavior rank first with (RII=0.702), project management efficiency (RII=0.695), predictability of the contractor's behavior (RII=0.684), uncertainty in the transaction environment (RII=0.662), and magnitude of the transaction costs (RII=0.649). As stated by previous researches, that owner's behavior has major effects because the owner is he who regulates all the factors mentioned in the bidding process (Li et.al 2012, 2013). The results also agree with Walker (1995) who considered the contribution of owner and owner's representative as a thermometer or instrument on construction performance.

Table 7 also shows that predictability of owner's behavior, contractor's behaviors, uncertainty in the transaction environment, magnitude of the transaction costs and project management efficiency characteristics have their calculated chi-square values (X2 cal = 16.85, 23.52, 17.67, 14.26 and 12.74) lower than the tabulated values (X2 tab = 26.29, 41.26, 31.41 and 26.30) while X2 tab = 17.06 is higher than the tabulated values. Hence the results is significant for four characteristics and non-significant for only one characteristics (uncertainty in the transaction environment). This implies accepting the null hypothesis. This indicates that owner's behavior, contractors' behavior, magnitude of transaction costs and project management efficiency has impacts on contractors bidding. Similarly, uncertainty in the transaction environment has its calculated chi-square values (X2cal = 17.67) higher than the tabulated value (X2 tab = 17.06) hence the result is not significant. These also accept the alternative hypothesis. This infers that uncertainty in the transaction environment have no impact on contractors bidding. These results disagree with the descriptive result or findings of Li et.al (2012, 2013), Enshassi et.al (2010). In their findings they indicates that uncertainty in the transaction environment increases transaction cost positively as a result of various factors that may emanate, (Diekmann & Girard, 1995; Farajian, 2010; Vrjhoef & Ridder, 2007; Broome & Periy 2002) which will lead to high impacts on the contractors bidding due to more cost to be incurred during the bidding process.

CONCLUSION

In view of the findings of this study the following conclusions are deduced from the study: There are various transaction costs characteristics affecting contractor's bids evaluation process emanating from Predictability of owner's behaviour, Predictability of contractors' behaviour, Uncertainty in the transaction environment, Magnitude of the transaction costs and Project management efficiency. Relationship with other parties, bidding behaviour, project complexity, fair risk allocation, technical competency, market research and contract administration related factors have demonstrated high impacts on contractors' bid and have also influenced the process of bidding evaluation for construction projects. The way a contractors' bid is evaluated for can affect its winning chances. Several stages of evaluation allowing competent contractors', selecting from existing performing vendors and approaches allowing contractors to compete with each other have resulted in successful construction projects. Relationships with other parties (such as contractors', consultants, suppliers and clients) have high impact on bids evaluation process in various ways. It has caused high transaction costs due to less cooperation, increase disagreements, complex dispute resolution and unstable business environment, hence increasing the uncertainty in the transaction environment. Bidding behaviour in the research has indicated high impact on the contractor's bid due to suspicion of unbalanced bidding, cheating and collusion. It may cause uncertainty in the bidding environment, may cause the owner's overall project cost to get higher, but it is hard to detect unbalancing and collusion and they may generate contentious change orders all contributing to higher transaction costs. Unfair risk allocation among parties has demonstrates high impact on contractors' bid during the evaluation process. It leads to increase in their transaction costs and poor performance during execution of the project due to such fair. Recommendations include that clients, stakeholders, practitioners as well as consultants on projects should give careful consideration to the evaluation stages as stated in the PPA 2007 to be adopted when evaluating contractors' bids. Transaction costs should be kept low; by minimizing the uncertainty in the transaction environment also enhances contractor behaviour, indirectly contributing to lower transaction cost; and the party who can reduce the uncertainty in the transaction environment is the construction owner (Client) who can take some or all of the actions described above. Furthermore, contractors should adopt experience based type when bidding for construction projects with regards to finance, schedules (time), manpower, equipment and other documentary evidence so as to lower the transaction costs in their bidding process and have a great chance of winning contracts. Policy makers in government, clients, and contractors into construction projects should give adequate attention on transaction costs characteristics and evaluating process of tenders for better management of future contracting business in Nigeria and other developing countries. These findings were based on perceptions measure, not absolute. Therefore, feature study should consider an absolute type of study in the same area.

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UNDERSTANDING BUILDING PRICE FORECASTING BASED ON ORGANISATIONAL BEHAVIOUR

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Public sector procurement laws require that building price forecast be established in-house at construction project initiation. Thus, building price forecasting is of significant importance within the context of organisational management and performance. Organisation performance is influenced by behaviours inherent in organisations. Hence, attempts at improving building price forecasting in public client organisations would require an understanding of the behaviours therein. Exploring the Robbins & Judge (2013) Organisational Behaviour model, this paper presents and discusses theoretical conceptions for understanding building price forecasting within public sector client organizations with a view to improving the process. The model conceptualises building price forecasting at the three levels of an organisation i.e. individual, group and organisation within the 'input-process-output' framework. The following aspects offer potential influences on building price forecasting: i) at the individual level – motivation, perception, and decision-making (processes); and task performance (outcome); ii) at the group level – structure, and group role (input); communication, leadership, politics and power, and conflict and negotiations (processes); cohesion and functioning (outcome); iii) at the organisation level – structure, and culture (input). The paper concludes by setting out an approach for more in-depth theoretical and empirical exploration to advance the frontier of research perspectives on building price forecasting in construction.

Keywords: building price forecasting, organisational behaviour, public sector client organisation.

INTRODUCTION

Globally, there has been outcry of poor performance of the construction industry in general and the delivery of their projects over budget in particular. Reports still go round that public sector projects are still not satisfactorily delivered. Confirming such report, Kirkham, (2015) laments that, '*Sadly several*

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high profile construction projects in the UK have been plagued with problems over programme and budget. With public sector construction projects, strong emphasis is on meeting the budget; so when the project runs into difficulties, taxpayers and the media become rather unsympathetic.'

The underperformance has been adjudged to have direct link with unrealistic and reliable cost estimates the world over, (Eythorsdottir, 2012; Erdis, 2013). Essa and Fortune (2009) posits that such

Meanwhile, attempts to solve the problem has failed because most of the studies surrounding cost estimating focused mainly on the issue of accuracy and reliability, which are attributable to issues relating to techniques and methods (Jiang, Xu & Liu, 2013; Bayram, 2015; RICS, 2015; Bayram & Al-Jibouri, 2016; Abanda, Kamsu-Foguem & Tah, 2017). Studies by (Olatunji, 2010;

LITERATURE REVIEW

Literature has reveal that organisational theory consists of approaches to analysing social units of people that are structured and managed to meet a

Fig. 1: A Basic OB Model source OB (Robbins and Judge 2013)

Theoretical Framework of the Study

For a relatively long period of time the concepts of the cost advice function of the quantity surveyors (QS) in terms of theories, principles and procedures; have largely revolves around consultancy services whereby the QS assumes an independent and impartial position in providing services to the industry. However, recent developments are challenging this position whereby in-house QS services are once again becoming popular and in demand. Two major support for this changing landscape in QS services is the increasing demand for cost advice in construction firms, Donald (2015) and the second, which is very instructive, is the changes initiated by the RICS to its approaches to the QS's cost advice services particularly the introduction of standards (new rules of measurement – NRM) for providing early stage estimates (RICS, 2011; 2013) i.e. NRM1 – the order of cost estimate (which wasn't a consideration before the coming of the NRMs i.e. 1, 2 & 3 in to the industry), which is the main outcome of any BPF system. The NRM3 also targeted at providing the means of forecasting cost maintenance of building, makes it and the NRM1 more client organisation orientated, hence further promoting and reinforcing the need for in-house QS services.

Having affirmed through literature search that BPF has link with organisation management and the Public Sector Client Organisations do their budgets in-house the study sought to know the process these organisations use in formulating the building price forecasting. This was necessary in order to get the knowledge of how the BPF were produced for client organisations. The essence of the building price forecasting process is to provide uniform guidance and best practices for use by public sector client organisation cost advisers.

DATA COLLECTION

Quantitative data were collected for the research sourced from professionals who participate in building price forecasting in Public Sector Client Organisations. The target population for the study comprised client organisations with their project team members (i.e Architects, Quantity Surveyors, Builders, and services engineers) being the unit of analysis. Sample of the population was drawn based on purposive sampling technique, reason for the choice being that a good BPF technique relies on competent judgement based on construction experience and knowledge. Hence participation is by design and not by chance.

Data analysis

Data on their own have no meaning unless the process of systematical application of statistical and/or logical technique to describe and illustrate, condense and recap, and evaluate the data is done – which is data analysis. Therefore, in pursuant to achieving each of the objectives in this study various analytical tools were used. To establish a theoretical framework for explaining the relationship between client organisation and BPF, two tools were adopted – descriptive statistics using questionnaire survey, and inferential using focus group discussion (FGD).

The descriptive analysis provided mean values, standard deviations and percentages in arriving at the BPF processes and professionals roles as obtained in practice in the NCI. The focus group discussion verified the acceptable processes steps by the academia. Establishing the nature of relationships and the influences between client organisations and BPF variables was achieved by using Spearman correlation coefficient, and Pearson's correlation for the analysis, while to establish the extent of the relationships and the influences multiple regression technique was used. The multiple regression technique was also useful in predicting the forecast outcome.

RESULTS

Table 1: The table comprised perceived steps of BPF process as drawn from textbooks seeing that there were no clear steps in any of the textbooks except the 12 STEPS drawn by Government Accounting Office (GAO, 2010) and adopted for use by Department of Energy (DOE) in 2011in the United State. 17 steps were perceived but 5 imaginary steps were added to test the respondents' knowledge if they are conversant with them. The table shows the respondents accepted all the steps none was rejected completely. Six of the steps were accepted 100% all others got unaccepted figure. These indicated that most of the steps are not known by most of the respondents. Such result shows that there is no common steps use in NCI.

Table 1: Part selection of forecasting steps process (Please note: 'forecast' and 'estimate' are used interchangeably, having the same meaning)

S/N	Perceived Forecasting Steps	N	Yes	No
			1	2
1	Establish level of details required in the forecast	40	100%	0%
2	Make formal request for forecast	40	95%	5%
3	Collect, clean & analyse cost data	40	100%	0%
4	Qualify estimate (in terms of excludes)	40	90%	10%
5	Determine type of estimate required e.g. preliminary, viability etc	40	100%	0%
6	Gather relevant project information	40	100%	0%
7	Determine value for money for the client	40	62.5%	37.5%
8	Prepare the estimate	40	100%	0%
9	Consider project factors (including uncertainties)	40	95%	5%
10	Select, adjust & apply cost data/info	40	97.5%	2.5%
11	Apply necessary skills, expertise and judgment	40	80%	20%
12	Select price estimating methods e.g. functional, superficial etc	40	97.5%	2.5%
13	Identify client's needs & objectives	40	82.5%	17.5%
14	Monitor and review estimate	40	97.5%	2.5%
15	Check governance policies	40	90%	10%
16	Scan and understand available information	40	95%	5%
17	Consider factors affecting accuracy of estimate	40	70%	30%
18	Establish desired accuracy level	40	97.5%	2.5%
19	Communicate the estimate	40	100%	0%
20	Determine purpose of forecast	39	94.9%	5.1%
21	Consider factors affecting selection of estimate methods	40	55%	45%

Table 2: Organisation highest influence on BPF process

S/N	Perceived Forecasting Steps	N	The QS	Group or Team	The Organisation
			1	2	3
1	Establish level of details required in the forecast	40	47.5%	15.0%	37.5%
2	Make formal request for forecast	39	5.1%	7.7%	87.2%
3	Collect, clean & analyse cost data	40	97.5%	0%	2.5%
4	Qualify estimate (in terms of excludes)	40	85%	5%	10%
5	Determine type of estimate required e.g. preliminary, viability etc	40	70%	5%	25.0%
6	Gather relevant project information	39	71.8%	28.2%	0%
7	Determine value for money for the client	31	32.3%	61.2%	6.5%
8	Prepare the estimate	40	97.5%	2.5%	0%
9	Consider project factors (including uncertainties)	39	74.4%	12.8%	12.8%
10	Select, adjust & apply cost data/info	40	100%	0%	0%
11	Apply necessary skills, expertise and judgment	33	81.8%	15.2%	3%
12	Select price estimating methods e.g. functional, superficial etc	40	100%	0%	0%
13	Identify client's needs & objectives	37	13.5%	43.25%	43.25%
14	Monitor and review estimate	40	77.5%	12.5%	10%
15	Check governance policies	39	30.8%	43.6%	25.6%
16	Scan and understand available information	40	72.5%	7.5%	20%
17	Consider factors affecting accuracy of estimate	30	96.7%	3.3%	0%
18	Establish desired accuracy level	40	62.5%	7.5%	30%
19	Communicate the estimate	40	65%	35.0%	0%
20	Determine purpose of forecast	40	35%	17.5%	47.5%
21	Consider factors affecting selection of estimate methods	27	96.3%	0%	3.7%

Table 2:The table sought to find out who the respondents feel is responsible for carrying out each of the steps' function. The result shows the respondents had undivided opinions only on numbers 10 and 12 given the steps' function 100% to the QS. The overall picture gives QS the major participant in the BPF process as the QS got highest percentage ranging from 62.5% – 100% in 15 steps apart from 'establish level of details required in the forecast' which has 47.5%. The grey area is seen in the proportion of responses on the issue of 'identify client's needs & objectives' 43.25% of the respondents were of the opinion that is the 'group or team', and the 'organisation' that influence the step. This perhaps depicts the notion that 'client's needs and objectives' are inclusive in the brief

and not a step on its own since both the group or team and client are involved at the brief stage.

FINDINGS

1. Literature review proves that relationships exist in organisational parameters for building price forecasting.
2. Literature shows that the way building price forecasting are formulated in Nigeria Construction Industry and especially in the Public sector client organisations are not documented. This shows that every organisation does its building price forecasting in the way that is acceptable by their organisation.
3. The ambiguity found in the responses in questionnaire survey proves there is no documented model for building price forecasting in Public sector client organisation in Nigeria construction industry.
4. There is no clear knowledge of how building price forecasting are done in Nigeria construction industry.

CONCLUSION

The study suffices that the conventional theory that BPF is solely dependent on the professional technicalities of the specialized competencies to the exclusion of other influences such as organizational behaviours (parameters) and environmental factors is debunked; and that having proper knowledge of the organisational parameters that also influence the processes and outcome of the BPF system will increase the efficacy of the system. In furtherance to establish the extent of the relationships and the nature of influences, multiple regression technique will be used. The multiple regression technique will also be useful in predicting the forecast outcome.

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