Journal of Construction Project management and Innovation

Volume 4 Supplement 1, 2014 (Special Issue)

ISSN 2223-7852

ABOUT JCPMI

The **Journal of Construction Project Management and Innovation** is published bi-annually (twice per year) through the Centre of Construction Management and Leadership Development (CCMLD) by Sabinet Online - SA ePublications.

Journal of Construction Project Management and Innovation is an open access journal that publish all sorts of researches on Construction project management; Project management; Design and construction management processes; Housing and infrastructure development; Stakeholder management; Project planning and project impact assessments; Design and implementation of labour-intensive projects; Procurement management; Management of construction companies; Industry development; Knowledge management in construction; Empowerment of women; Innovation; Project financing; Current and emerging infrastructure issues in developing countries etc. as well as other issues. The goal of JCPMI is to broaden the knowledge of construction professionals and academicians by promoting free access and providing valuable insight to construction-related information, research and ideas. JCPMI is a bi-annual publication and all articles are peer-reviewed.

Submission of Manuscript

Submit manuscripts as e-mail attachment to the Editorial Office at: caigbavboa@uj.ac.za, didibhukut@uj.ac.za. A manuscript number will be mailed to the corresponding author shortly after submission.

For all other correspondence that cannot be sent by e-mail, please contact the editorial office (caigbavboa@uj.ac.za, didibhukut@uj.ac.za).

The Journal of Construction Project Management and Innovation will only accept manuscripts submitted as e-mail attachments. Please read the Instructions for Authors before submitting your manuscript. The manuscript files should be given the last name of the first author.

Chief Editor

Associate Editor

Editorial Board

Instructions for Author

Electronic submission of manuscripts is strongly encouraged, provided that the text, tables, and figures are included in a single Microsoft Word file (preferably in Arial font).

The **cover letter** should include the corresponding author's full address and telephone/fax numbers and should be in an e-mail message sent to the Editor, with the file, whose name should begin with the first author's surname, as an attachment.

Article Types
Three types of manuscripts may be submitted:

Regular Articles
All portions of the manuscript must be typed 1.5 spacing and all pages numbered starting from the title page. The font size must be 12.

Regular articles: These should describe new and carefully confirmed findings, and experimental procedures should be given in sufficient detail for others to verify the work. The length of a full paper should be the minimum required to describe and interpret the work clearly. The length of a full paper should be between 4000 – 7000 words. .
Review Process

Short Communications: A Short Communication is suitable for recording the results of complete small investigations or giving details of new models or hypotheses, innovative methods, techniques or apparatus. The style of main sections need not conform to that of full-length papers. Short communications are 2 to 4 printed pages (about 6 to 12 manuscript pages) in length.

Reviews: Submissions of reviews and perspectives covering topics of current interest are welcome and encouraged. Reviews should be concise and no longer than 4-6 printed pages (about 12 to 18 manuscript pages). Reviews are also peer-reviewed.

Review Process
All manuscripts are reviewed by an editor and members of the Editorial Board or qualified outside reviewers. Authors cannot nominate reviewers. Only reviewers randomly selected from our database with specialization in the subject area will be contacted to evaluate the manuscripts. The process will be blind review. Decisions will be made as rapidly as possible, and the journal strives to return reviewers' comments to authors as fast as possible. The editorial board will re-review manuscripts that are accepted pending revision. It is the goal of the JCPMI to publish manuscripts within the shortest possible time after submission.

Regular articles

All portions of the manuscript must be typed double spaced and all pages numbered starting from the title page.

The Title should be a brief phrase describing the contents of the paper. The Title Page should include the authors' full names and affiliations, the name of the corresponding author
along with phone, fax and E-mail information. Present addresses of authors should appear as a footnote.

The **Abstract** should be informative and completely self-explanatory briefly present the topic, state the scope of the experiments, indicate significant data, and point out major findings and conclusions. The Abstract should be 100 to 300 words in length. Complete sentences, active verbs, and the third person should be used, and the abstract should be written in the past tense. Standard nomenclature should be used and abbreviations should be avoided. No literature should be cited. Following the abstract, about 3 to 10 key words that will provide indexing references should be listed.

A list of non-standard **Abbreviations** should be added.
In general, non-standard abbreviations should be used only when the full term is very long and used often. Each abbreviation should be spelled out and introduced in parentheses the first time it is used in the text.

The Introduction should provide a clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution. It should be understandable to colleagues from a broad range of scientific disciplines.

Materials and methods should be complete enough to allow experiments to be reproduced. However, only truly new procedures should be described in detail; previously published procedures should be cited, and important modifications of published procedures should be mentioned briefly. Capitalize trade names and include the manufacturer's name and address. Subheadings should be used. Methods in general use need not be described in detail.

Results should be presented with clarity and precision. The results should be written in the past tense when describing findings in the authors' experiments. Previously published findings should be written in the present tense. Results should be explained, but largely without referring to the literature. Discussion, speculation and detailed interpretation of data should not be included in the Results but should be put into the Discussion section

The Discussion should interpret the findings in view of the results obtained in this and in past studies on this topic. State the conclusions in a few sentences at the end of the paper. The Results and Discussion sections can include subheadings, and when appropriate, both sections can be combined.

The Acknowledgments of people, grants, funds, etc. should be brief.

Tables should be kept to a minimum and be designed to be as simple as possible. Tables are to be typed double- spaced throughout, including headings and footnotes. Each table should be on a separate page, numbered consecutively in Arabic numerals and supplied with a heading and a legend. Tables should be self-explanatory without reference to the text. The details of the methods used in the experiments should preferably be described in the legend instead of in the text. The same data should not be presented in both table and graph form or repeated in the text.

Figure legends should be typed in numerical order on a separate sheet. Graphics should be prepared using applications capable of generating high resolution GIF, TIFF, JPEG or Powerpoint before pasting in the Microsoft Word manuscript file. Tables should be prepared in Microsoft Word. Use Arabic numerals to designate figures and upper case letters for their parts (Figure 1). Begin each legend with a title and include sufficient description so that the figure is understandable without reading the text of the manuscript. Information given in legends should not be repeated in the text.

References: In the text, a reference identified by means of an author‘s name should be followed by the date of the reference in parentheses. When there are more than two authors, only the first author‘s name should be mentioned, followed by ’et al‘. In the event that an author cited has had two or more works published during the same year, the reference, both in the text and in the reference list, should be identified by a lower case letter like ’a‘ and ’b‘ after the date to distinguish the works.

Examples:

Aigbavboa (2012), Aigbavboa et al. (2012), (Thwala, 2000), (Aigbavboa and Thwala, 2012), (Aigbavboa, 2008; Lesito, 2007a, b;

Aigbavboa, 2010, 2011), (Thwala et al., 2001)

References should be listed at the end of the paper in alphabetical order. Articles in preparation or articles submitted for publication, unpublished observations, personal communications, etc. should not be included in the reference list but should only be mentioned in the article text (e.g., A. Kingori, University of Nairobi, Kenya, personal communication). Journal names are abbreviated according to Chemical Abstracts. Authors are fully responsible for the accuracy of the references.

Examples:

Aigbavboa CO (2010). Residential satisfaction in low-income housing: a South Africa perspective. Journal of Construction Project Management and Innovation. 1(2): 14 – 20.

Aigbavboa CO, Lesito K (2012). ICT benefit in South Africa Construction Journal of Construction Project Management and Innovation. 2(2): 75 – 81.

Short Communications

Short Communications are limited to a maximum of two figures and one table. They should present a complete study that is more limited in scope than is found in full-length papers. The items of manuscript preparation listed above apply to Short Communications with the following differences: (1) Abstracts are limited to 300 words; (2) instead of a separate Materials and Methods section, experimental procedures may be incorporated into Figure Legends and Table footnotes; (3) Results and Discussion should be combined into a single section.

Proofs and Reprints: Electronic proofs will be sent (e- mail attachment) to the corresponding author as a PDF file. Page proofs are considered to be the final version of the manuscript. With the exception of typographical or minor clerical errors, no changes will be made in the manuscript at the proof stage.

Fees and Charges

No fee is paid for the publication of article(s) in JCPMI. Author's submissions are only required to meet the peer review process.

Submission of a manuscript implies: that the work described has not been published before (except in the form of an abstract or as part of a published lecture, or thesis) that it is not under consideration for publication elsewhere; that if and when the manuscript is accepted for publication, the authors agree to automatic transfer of the copyright to the publisher.

Disclaimer of Warranties

In no event shall the management of the Journal of Construction Project Management and Innovation be liable for any special, incidental, indirect, or consequential damages of any kind arising out of or in connection with the use of the articles or other material derived from the JCPMI, whether or not advised of the possibility of damage, and on any theory of liability.

This publication is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Descriptions of, or references to, products or publications does not imply endorsement of that product or publication. While every effort is made by JCPMI management to see that no inaccurate or misleading data, opinion or statements appear in this publication, they wish to make it clear that the data and opinions appearing in the articles and advertisements herein are the responsibility of the contributor or advertiser concerned. JCPMI management makes no warranty of any kind, either express or implied, regarding the quality, accuracy, availability, or validity of the data or information in this publication or of any other publication to which it may be linked.

TABLE OF CONTENTS

Volume 4 Supplement 1 June, 2014 (Special Issue)

RESEARCH ARTICLES

Journal of Construction Project Management and Innovation Vol. 4 (S1): 882-899, 2014
ISSN 2223-7852

DETERMINANTS OF COMPLIANCE WITH HEALTH AND SAFETY REGULATIONS IN NIGERIA'S CONSTRUCTION INDUSTRY

Nnedinma UMEOKAFOR[1], Boniface UMEADI[2], and David ISAAC[3]

[1,3,]Department of Built Environment, Faculty of Architecture, Computing & Humanities; University of Greenwich. UK. Email: [1]nnedinmaik@hotmail.com; [3]D.isaac@greenwich.ac.uk
[2]NanoMind IDC**,** Communications House, 26 York Street, London W1U 6PZ, UK. Email: B.Umeadi@nanomindidc.com;

ABSTRACT

The accident rate of the construction industry is disproportionate to the number of its workers compared with other industries. Despite this, the Nigerian construction industry lags behind in tackling the health and safety (H&S) challenges posed by the hazardous activities of the industry and contextual issues. Compliance with H&S regulations is one of the pillars to achieving optimum H&S in the workplace; regrettably, its level is low in Nigeria. This low level of compliance with H&S regulations in Nigeria remains one of the major factors blamed for the challenging state of H&S in Nigeria, especially in the construction industry. Hence, this paper examines the determinants of compliance with H&S regulations in Nigeria's construction industry, unearthing the salient issues to compliance with H&S regulations in Nigeria's construction industry. Using compliance theories, it explains the compliance behaviour of the Nigerian construction industry. Although studies on compliance with H&S regulations in developed countries abound, contextual influence prompts a study peculiar to Nigeria. A systematic review of available literature gathered through desk literature search and qualitative content analysis were conducted. The result of this study shows that key determinants to compliance with H&S regulations in the Nigerian construction industry include: culture, client influence, inadequate legislation, activities of the informal construction sector, beliefs, enforcement of H&S regulations, bribery and corruption. It is evident from this study that contextual issues may explain compliance behaviour. This paper goes further to conclude that irrespective of the inadequate regulations and lack of governmental support, stakeholders in the construction industry and trade unions can improve H&S. It also recommends that: building planning departments in local councils be involved in H&S enforcement; in tender selection, preference should be given to construction contractors with good safety records; H&S professionals should exploit the economic benefits of good H&S management system to attract management commitment.

Keywords: Compliance, Construction industry, Health and safety, Nigeria, Regulations.

1. INTRODUCTION

There is consensus that the construction industry understandably holds a poor safety record. On the other hand, it is understandably a major contributor to economies (Kheni et al. 2007; Okeola, 2009). This poor safety record is evident in many studies. According to Odeyinka et al. (2005), construction workers are 6 times more likely to be killed at work than workers in other industries. In the UK, the construction industry accounts for 10% of reported major injuries and 27% of fatal injuries to employees in 2012/2013, irrespective of its 5% contribution to the UK workforce (HSE, 2013). Also, the 2012/2013 record shows that the fatality rate per 100,000 construction workers of the industry in the UK was 1.9 (HSE, 2013). In Hong Kong, the construction industry accounts for an accident rate of 44.3 in 2012, where 3160 accidents were recorded, a 1.5% accident increase (Occupational Safety and Health branch, Labour Department, 2013).

Developing countries are no exceptions; in particular, Kheni et al. (2006) note that in 2000, Ghana's construction industry accounted for 14% of work related fatal injuries. According to a study of 42 construction contractors in Nigeria in 2006 (Idoro 2011a), the best recorded accident per worker rate in Nigeria in 2006 was 2 accidents per 100 construction workers, while the best recorded injury per worker for 2006 was 5 injuries per 100 construction workers. In support, Idoro (2007) demonstrates statistically that the Nigerian construction industry is grossly hazardous. These accidents and fatalities occur due to non-compliance with H&S regulations (Baxendale and Owain, 2000). Although there is dearth of reliable H&S records in developing countries (Idoro, 2011b; Okeola, 2009; Puplampu and Qartey, 2012), the H&S situation in developing countries is worrying (Kheni et al. 2007) and is understandably worse than in developed countries.

Recognising the challenging state of H&S in the construction industry and other industries, international organisations formulate conventions such as ILO convention, while countries formulate national law, standards, policies to protect the safety, health and welfare of people. It is not enough to formulate H&S laws, as compliance is pertinent in realising the aims of the laws. Similarly, adequate regulatory framework and system should be in place to achieve the aforesaid; deplorably, Nigeria is lagging behind in both. In particular, Diugwu et al. (2012) maintain that H&S statuary regulations and provisions are non- functional in Nigeria, simply because the failed H&S system in Nigeria is due to the weak statutory H&S regulations and provisions. It is therefore argued that the evident poor level of compliance with H&S regulations in Nigeria (Diugwu et al., 2013; Idubor & Oisamoje, 2013; Okolie & Okoye, 2012) highly contributes to the demonstrated challenging state of H&S in Nigeria's construction industry (Idoro, 2011a; 2007). In contrast, the continued exclusion of the construction industry in the definition of premises by the factories Act 2004 (Idoro 2008; Diugwu et al. 2012), the inefficiency of the custodian of H&S in Nigeria the Federal Ministry of Labour and Productivity Inspectorate Division (FMLPID) (Umeokafor et al. 2013) may plausibly explain this. Nevertheless, compliance with H&S regulations remains a core instrument for H&S improvement; as a result, understanding its determinants informs development of effective H&S strategies.

Writing about the determinants of compliance with H&S regulations in South Africa, Windapo and Oladapo (2012) found that severity of enforcement penalty, direct and indirect cost of accident, lack of knowledge inter alia determine South Africa's construction contractors compliance with H&S regulations. A review report by HSE in 2008, found that the size of the industry an organisation operates in, the organisational structure, the regulatory environment of the organisation among other factors determine compliance with H&S regulations.

While there is considerable literature on compliance with H&S regulations in the construction industry, contextualising Nigeria's construction industry in relation to determinants of compliance with H&S regulations remains under examined. Studies that consider contextual issues peculiar to Nigeria are vital for effective development of strategies. This view supports Kheni et al. (2007) findings that political, religious, socio-cultural environment influence H&S management hence should be considered when developing effective strategies for H&S. It is against this background that this study, which contextualises Nigeria systematically reviews literature to unearth the factors that determine compliance with H&S regulations in Nigeria's construction industry. It examines issues relating to compliance with H&S regulations in the wider African construction firms and then relates them to the Nigerian construction industry. Furthermore, it seeks to understand the compliance behaviour of Nigeria's construction industry based on compliance theories, considering the factors unearthed by this study.

2. THEORETICAL FRAMEWORK: COMPLIANCE THEORIES

Compliance behaviour is subject to various determinants, which may be complex (HSE, 2008). These determinants help to explain or suggest compliance behaviours of organisations or individuals. Promulgated laws do not guarantee compliance, irrespective of the regulatory efforts (HSE, 2008), rather economic cost (HSE, 2008), quest to maximise profit (HSE, 2008; Windapo & Oladapo, 2012), reputation of firm (HSE, 2008; Jacobi 2012; Nzuve and Lawrence, 2012) sanctions (HSE, 2008; Tombs & Whyte, 2013) inter alia are among the factors theoretically underpinned by compliance theories to explain compliance behaviour. However, some facts remain, some compliance approaches are more effective than others (HSE, 2008) most of which are underpinned by deterrence theories or/and compliance strategies, while some compliance behaviours may not be explained by compliance theories.

Deterrence theories, assume that punitive measures will deter organsations or individuals from breaching the law (Ayres & Braithwaite, 1992; HSE 2005; HSE, 2008). A regulatory authority adopts sanctions such as fines, prosecutions and other punitive measures as its principal technique for ensuring compliance. Indeed, in economic terms (which will mostly attract firms), deterrence embraces this equation $U<pD$, where benefits of non-compliance is U, likelihood of being caught is p and the cost of being apprehended D (Becker 1968 in Fairman & Yapp, 2005). In context of this study, this simply means that if the perceived benefits of non-compliance with H&S regulations are less than the possibility that the construction firms will be caught and the cost/consequence of being caught (image of firm, penalty, competitive level in the market *inter alia*), they will not comply. In other words, compliance is a rational behaviour (Fairman and Yapp, 2005).

In contrast, in relation to H&S, the cost of apprehension is difficult to determine (Fairman and Yapp, 2005) as they are direct and indirect costs (Umeokafor et al., (2013), which are difficult to calculate, making this theory challenging. This is in addition to the point that organisations may not have a perfect knowledge of being caught, (Tombs and Whyte, 2013) based on the point that rationality may be limited.

Consequently, deterrence theories, will adopt measures aimed at ensuring that *p* and *D* are greater than *U* (better still, *p* or *D* is greater than *U*); therefore, it is evident that market behaviours, economic grounds and sanctions are among determinants of compliance in the deterrence theory. This means that compliance depends on the ability of the organisation to understand the implications of all these factors. It is important to note that this theory has not been successful; hence, there has been a shift from deterrence to compliance based approach (Fairman & Yapp, 2005).

Compliance/cooperative/conciliatory strategies (Fairman & Yapp, 2005) seek to achieve compliance by tacking the obstacles (Fairman & Yapp, 2005; Tombs & Whyte, 2013). This may be through adopting approaches such as cooperation and conciliation through educating, persuading and negotiating with organisations (Fairman & Yapp, 2005; HSE, 2008). In the context of this study, this mainly refers to the custodian of H&S in Nigeria the FMLPID achieving compliance by cooperating with construction contactors, educating them on the benefits of H&S and negotiating with them on some strategies to adopt. Deplorably, the FMLPID does not have jurisdiction over the construction industry due to the omission of the industry in the Factories Act 2004 definition of premises. However, as Nigeria rectified the ILO convention on Occupational Safety and Health Convention, 1981 (No. 155), it can be argued that the construction industry is ostensibly bound by article 16 paragraph 1 of the Convention. Despite this, the construction industry remains unregulated by an external party; instead, self-regulation obtains in the industry. This section serves as the theoretical framework for this study, highlighting the underlying philosophical assumption of the factors of compliance discussed below.

3. DETERMINANTS OF COMPLIANCE: H&S IN AFRICA (NIGERIA)

3.1 Beliefs

Smallwood (2002) argues along the general notion that accidents are inevitable in the construction industry because it is believed that the industry is inherently dangerous; therefore, used as an anchor for non-compliance with H&S regulations and also abridge the importance of H&S to secondary issues. In support of this, Kalejaiye (2013) asserts that prior to the enactment of the safety laws in England in 1833, it was believed that accidents were predestined and inevitable, but this was no longer acceptable after the enactment of the above laws. Furthermore, Idubor and Osiamoje (2013) identify religious beliefs to determine compliance with H&S regulations; they opine that some employers resort to fetish rituals to stop accidents instead of taking adequate safety precautions. Idubor and Osiamoje (2013) also posit that some believe accidents are acts of God i.e. accidents occur because God allows them.

This is further emphasised by Sadeq and Ahmad (1996) cited in Smallwood (2002) who note that the Islamic 'Tawhidic' principles of justice & equality, dignity of labour and removal of hardship do not support intervention decisions based on cost benefits. As a result of the above arguments, contractors may do little or nothing to prevent these accidents; they may not take safety guidelines seriously. These therefore suggest that beliefs, be it religious or superstitious often filters into work environments resulting to lack of compliance with H&S regulations in the construction industry Africa wide.

3.2 Tendering process

Compliance with H&S regulations has prompted consumer buyer organisations to list ISO-9000 certification as a requirement for quality standard and a way of complying with H&S regulations (Nzuve & Lawrence, 2012). The literature so far reviewed shows that there is no standard of this nature in the Nigerian construction industry; most contractual documents appear not to highlight the importance of H&S compliance and the impositions of fines (penalties) for non-compliance. The action by consumer buyer organisations stated above can be adopted by the Africa's construction industry and its clients; they can standardise compliance with H&S regulations, not only in tenders as part of contract agreements (Windapo, 2013) but also in the instances where it is possible to that safety records and references from previous clients can be prerequisite for tendering for contracts to indicate the H&S performance of contractors. Therefore, priority should be given to construction firms without injury records; given that, Davies & Tomasin (1990) in Othman (2012) contend that successful projects have a 100% in H&S, time, cost and quality respectively. Relating Davies & Tomasin (1990) argument to section 2, the contention here is that if benefits of compliance/good H&S records are greater than the p and D, the construction contractors will comply with H&S regulations.

3.3 Enforcement of H&S regulations

Nzuve and Lawrence (2012) found that low level of inspection and examination of workplaces might determine the level of compliance with H&S regulations as evident in workplaces in Nairobi. The same can be said of Nigeria, where lack of enforcement characterises regulatory institutions (Idubor & Osiamoje, 2013; Umeokafor et al. 2014), most laws appear to fulfill all righteousness or are used for political or victimisation reasons, and the institutions alleged and proved to be corrupt and arbitrarily exercise its powers (Onyeozili, 2005). These ill characteristics of the regulatory institution in Nigeria also weaken its legal system. The contention being that the efficiency and effectiveness of the H&S enforcement bodies may determine the level of compliance with H&S regulations in workplaces.

In consideration to section 2, this factor of compliance is strongly underpinned by the sanction based deterrence philosophy, where (p) and (D) should be greater than U (better still, p or D should be greater than U) to prompt compliance. Should that be the case, compliance based on punitive measures may not be effective in Nigeria, as the regulatory system in Nigeria is dysfunctional, and as the custodian of H&S in Nigeria (FMLPID) does not comply with basic H&S regulations as Umeokafor et al. (2014) found.

Consequently, construction contractors may take advantage of having perfect knowledge of the low probability of being caught and decide not to comply with H&S. These may explain why researchers posit, that lack of: strict legislation enforcement (Idubor & Oisamoje, 2013; Onyeozili, 2005; Umeokafor et al. 2014); competent professionals i.e. H&S officers (Federal Ministry of Labour and Productivity 2010 in Idubor & Oisamoje, 2013); trained safety officers (Okeola, 2009), all enable non-compliance with H&S regulations in Nigeria. However, although the quality of enforcement may be marginal, enforcement at organisational level perhaps via safety officers should be made mandatory to Nigerian construction contractors (Okeola, 2009), as it will improve H&S enforcement. Equally important, Idubor and Oisamoje (2013) argue that the weak legal structure and absence of law enforcement in Nigeria allow foreign companies to take advantage of the ineffective statutory regulation. The same can be said of the construction industry. That may also suggest that these foreign firms may not have plans to comply fully with the H&S regulations in Nigeria or have a H&S management system similar to those obtained in their countries of origin, as they intend to reduce expenses and added cost to construction outputs.

3.4 Reputation of firms

According to section 2, this factor of compliance is underpinned by the cost of being caught (reputation of organisation) (D) being greater that the perceived benefits of non-compliance with H&S regulations (U). In light of Idubor and Oisamoje's arguments above, it is evident that multinational corporations are able to provide developing countries such as Nigeria with critical financial infrastructure for economic and social development, and at the same time the much-needed H&S regulations. However, these institutions may also bring with them relaxed codes of ethical conduct that serve to dilute the developing nation's regulations rather than to provide the critical support to compliance that ensures improved H&S in organisations. Multinational corporations should promote their reputation through good H&S practices instead of cutting corners in countries where H&S systems are not as rigorous, granted that the images of organisations to the public should contribute to their competitive strength in the market. Indeed, Nzuve and Lawrence (2012) maintain that non-compliance with H&S regulations often reflects the organisation's image and bottom-line, which must be protected; Jacobi (2012) also supports this view by arguing that organisation's image determine the level of their compliance with H&S regulations.

3.5 Higher profit margin

This factor is strongly underpinned by the economic philosophy of deterrence theory, where high cost of production outweighs the cost of being caught; therefore, it can be argued that the cost of being caught may prompt compliance. Indeed, accidents result to injuries, loss of materials and time, payment of compensation and payments to injured staff when off duty, hence increasing the cost of production and affecting the profit margin of the organisation. As such, to reduce the cost of production, improve productivity and maximise profits, many firms seek to improve H&S in their organisations and this includes compliance with H&S regulations (Windapo & Oladapo, 2012).

This explains why Nzuve and Lawrence (2012), Smallwood and Haupt (2007) posit that increased and sustained level of productivity often reflect on the level of compliance with H&S regulations. As such, the question as to why compliance is not at its peak is vital, as compliant organisations will benefit economically. However, ignorance of these benefits of compliance may be the answer the question. Be it as it may, organisations may comply with H&S regulations to save cost thereby increasing their profit margin, but may not comply if the cost of compliance is too much when compared with the profit margin.

3.6 Inadequate funding

Nzuve and Lawrence (2012); Idubor and Oisamoje (2013) contend that capital is required to provide adequate facilities in order to avoid cutting corners. In that lack of facilities such as clamps, safety belts may mean that desperate workforce will risk lives instead of going hungry, hence will not comply with H&S regulations. This explains why Diugwu et al. (2012) argue that lack of resources can hinder H&S management efforts. On the other hand, most enforcement bodies/institutions in the developing world lack the basic tools and amenities, which need funds to promote H&S regulations, educate the society, enforce the regulations, and disseminate information.

3.7 Perception of stakeholders in the industry

It is generally believed that construction industry is one of the most expensive industries; therefore, anything that will increase cost of construction should be avoided. Fairman & Yapp (2005) assert that this compliance behaviour is often based on rationality. This view is echoed by Windapo (2013) that construction contractors in South Africa perceive compliance with construction regulations as costly, time consuming and unnecessary, hence they deem compliance with H&S regulations as unnecessary. The same argument is repeated in Nigeria, where most construction organisations spend little or nothing on H&S management (Diugwu et al., 2012), perhaps because they perceive it as cost. This view simply results to nothing in terms of budget allocated to H&S management; consequently, there is likely to be high level of non-compliance with H&S regulations in these organisations.

3.8 Inadequate training of staff and workplace issues

Technical failure and inadequate training coupled with harsh work environment and unsafe methods of working inter alia are among the causes of non-compliance with H&S regulations in developing countries' construction like South Africa (Othman, 2012). This view is supported by Windapo and Oladapo's study of 2012, which demonstrates that lack of adequate training and unsafe work environment can determine how construction firms handle the issues of compliance with H&S regulations. In concordance, Adenuga, Soyingbe, and Ajayi (2007); Idubor and Osiamoje (2013) highlight that inadequate training is a hindrance to H&S regulations compliance. In correspondence, Idubor and Osiamoje (2013) maintain that the performance and productivity of staff is a function of the level of their expertise and skill, which is a function of the standard of training and education received.

These imply that if adequate H&S training and education are not given to staff, their H&S performance e.g., compliance with H&S regulations will be affected. It can therefore be misunderstood, in simple terms to just result to lack of knowledge and information which in-turn depend on the level of acquired training and education. The facts are that management related issues, individual willingness to participate in self-development, self-determination within a value oriented work environment will encourage compliance to H&S Regulations.

3.9 Management commitment

Argument must be made that the absence of safety consciousness in major construction organisations in Nigeria is common and must be deemed as bad examples. Adenuga et al. (2007) further show that some construction companies do not attach importance to workers' safety. Similarly, Smallwood (2002) agrees that top management should value safety notwithstanding that lack of value for safety may be as a result of the perception that safety is only cost related as argued by Hinze (1997) in Smallwood (2002). Should that be the case, it therefore indicates that the construction industries are not concerned with the safety of their employees as their watchword; it also suggests the absence of management commitment to H&S in the Nigerian construction industry. This explains why, Windapo and Oladipo (2012) contend that management commitment should be seen as the determinant factor to compliance with H&S regulations in the construction industry. This is underpinned theoretically by Fairman and Yapp (2005) assertion that based on deterrence theory; compliance behaviour is determined by rationality.

3.10 Activities of the informal construction sector

Tanko and Anigbogu (2012) pen that the informal construction sector in Nigeria engages in informal construction activities, which constitute about 70% of construction outputs; meanwhile, Kalejaiye (2013) posits that the informal construction sector has little or no access to occupational health. Their main methods of project execution involve employing workforce who do not have ideas of adequate safety practices required, therefore cannot advise the client to comply with H&S regulations. The argument therefore is that if 70% of the construction activities are executed through the informal practice, the construction industry is shooting itself on the foot, as they will never conform to H&S regulations; rather, they contribute to majority of the unsafe construction activities, thus hindering H&S improvement. As such, to improve H&S regulation in Nigeria, greater attention should be given to this sector (Tanko and Anigbogu, 2012) perhaps through adequate regulation. However, It can be argued that the informal sector is difficult to regulate because of the nature of its operations. From the above, it is therefore not misleading to state that this sector contributes hugely to non-compliance with H&S regulations in the Nigerian construction industry.

3.11 Unemployment

Idubor and Oisamoje (2013) identify unemployment as one of the factors that embolden non-compliance with H&S regulations. The level of unemployment in Nigeria is so high and increasing.

According to Trading Economics (2013), unemployment in Nigeria rose from 21.10 % in 2010 to 23.90 % in 2011, this amounts to high volume of men and women given to the employer to pay low wages or impunity to take advantage of workers to work under dehumanising conditions provided they have jobs. Therefore, if construction works being carried out violate H&S regulations at the same time under dangerous conditions, the workers are unable to complain, for they risk losing their jobs.

3.12 Fear of legal sanctions

Nzuve and Lawrence (2012) maintain that orgainsations may also comply with H&S for fear of legal actions. In affirmation, Idubor and Oisamoje (2013) assert that the legal sanctions organisations may face if they do not comply with H&S legislation may result to high financial cost to the organisations, thereby reducing their profit margin, in that they comply with H&S regulations. This implies that fear of legal sanctions may make cooperate organisations comply with H&S regulations. In addition, deterrence theory explains this factor in that for this factor to determine compliance, the likelihood of being caught is (p) and the cost of being apprehended (D) must be higher than the benefits of non-compliance (U). However, given what this study has established so far, it will be the bigger organisations that benefit most either way.

3.13 Bribery and corruption

Onyeozili (2005) states that Nigeria's regulatory institutions and the police force are perceived and have been proved to be corrupt; 'God-fatherism' determines the decisions of the inspectors. This is reinforced by Transparency International (2012) ranking Nigeria 139 out of 176 in terms of corruption perception index. In support, Idubor and Osiamoje (2013) assert that bribery and corruption are the biggest hindrances to proper compliance with H&S regulations in Nigeria; citing an instance where companies would not comply with the standard regulations and still get an 'okay' from the inspectors during inspection as a result of being bribed.

3.14 Neglect of human rights

From the human right perspective, Idubor and Osiamoje (2013); Puplampu and Qartey (2012) debate that human rights are the core elements of H&S. In that human rights are not well rooted in H&S rights of corporations because of lack of strict judicial references in Nigeria (Idubor & Osiamoje, 2013). This suggests that lawmakers neglect human rights, and this may lead to human rights abuse. Also, Puplampu and Qartey (2012) argue that human rights must be accessible to promote H&S. Therefore if inferred, the absence/neglect of human rights may influence H&S and perhaps its compliance.

3.15 Weak legal structures

According to the deterrence theories in section 2, the underlying assumption of this factor is that the likelihood of being caught (p) and the cost of being apprehended (D) are slim and unable to prompt compliance.

Construction contractors often wrongly perceive this slim chance of apprehension as an advantage for non-compliance, believing that the perceived benefits of non-compliance outweigh the benefits of compliance. Indeed, Idubor and Osiamoje (2013) maintain that the legal structure in Nigeria is weak in terms of interpreting and applying the governing laws. In the Nigerian construction industry where different regulations are in use, there is no uniformity in interpretation of regulations, while Idoro (2008) argues that implementation of the regulations are left to personal discretion. With regard to the penalty for non-compliance with H&S regulations, Windapo and Oladapo (2012) found that non-severe penalties for non-compliance with H&S regulations determine compliance with H&S relegations in the South African construction industry. The same can be said of Nigeria, where the penalties for violating some H&S laws are insignificant; often construction contractors take advantage of the law not to comply, or they comply at their discretion. Compliance can be argued to be a rational behaviour (Fairman and Yapp, 2005). However, the Labour, Safety, Health and Welfare Bill of 2012, stipulates stronger punishment for offenders (Idubor & Osiamoje, 2013). A downside of the legal system in Nigeria is the procedure in reality, where court cases take longer than allotted time frame, and H&S regulations are only enforceable upon trial and conviction (Idubor & Osiamoje, 2013). This suggests that majority of causalities may be discouraged from going to court because of the weak legal system in the country and the high cost of seeking justice without legal aid, as such encouraging employers to violate the regulations.

3.16 Client's influence

Famakin and Fawehinmi (2012) acknowledge the influence of clients in improving H&S in the construction industry by citing Huang and Hinze (2006), who assert that clients' involvement is a core requirement for ensuring a zero accident rate in construction projects. This is reinforced by Smallwood and Haupt (2007), who propose that clients should take the lead when it comes to H&S in their projects, as the H&S regulations like the South African Construction Regulations of 2003 place high level of responsibility on the client. These above suggest that low level of compliance with H&S regulations can be traced to the client who should ensure that the regulations are adhered to, hence ensuring optimum H&S in all projects. Lamentably, this is not applicable or evident in the Nigeria, especially in the informal construction practice where violation of H&S is endemic, and some clients have not heard of H&S. Moreover, Okeola (2009) records that one in six of the contractors in the 13 projects studied took an insurance policy. This suggests clients and contractors' neglect, as the client is required by law to ensure that the contractors comply with H&S regulations.

3.17 Lack of awareness and improper medium for information dissemination

The argument that lack of knowledge and understanding of H&S regulations determine the level of compliance within construction regulations is made by Windapo and Oladapo (2012), in that there is lack of awareness in most developing countries (e.g., Nigeria) for H&S regulations and practice, an issue that is also echoed by Idubor and Osiamoje (2013).

Therefore, Diugwu et al. (2012) contend that lack of knowledge for details and implications hinder H&S management in the construction industry. They found that construction workers in Minna, Nigeria (if not the whole country) do not know the enforcer of H&S regulations in Nigeria. If workers do not know or understand the regulations, they will not know when their rights have been violated. Puplampu and Quartey (2012) note a similar issue that lack of adequate Information and statistics hinder the compliance with H&S in Africa; while Diugwu et al. (2012), Idubor and Osiamoje (2013) identify same for Nigeria. The above is explained by Diugwu et al. (2012), whose study argues that H&S information dissemination in Nigeria is ineffective, and has minimal impact to target groups, hence blaming the government for it. This demonstrates that enacting laws without adequate effort to make it available to the public is as a good as not formulating one at all.

3.18 Moral values

Nzuve and Lawrence (2012) believes that managers comply with H&S regulations due to the presumed severity of injury that the workers may suffer if accidents happen, this explains why Okeola (2009) argues that if morally obligatory, compliance should be on humanitarian grounds. In affirmation, Smallwood and Haupt (2007) demonstrate statistically the humanitarian motivation for H&S related regulations and the need for putting construction regulations into law through public announcement; asserting that analyses of severity rates of accident, disabling injury rates to buttress the above must be deemed key and relative to moral values. In contrast, Windapo (2013) shows that the extent of risk and perceived severity of physical hazard that may happen due to non-compliance with H&S regulations are not connected to the standards complied by South African construction contractors. Nevertheless, it can be argued on moral grounds, that employers in construction industry may often consider the H&S of their employees as superficial, therefore convenient to comply with H&S regulations when required.

3.19 Cost of compliance/production

Windapo (2013) found that increase in the cost of compliance with the H&S requirements determines the building constructors' compliance with statutory regulations in South Africa. In that some contractors may weigh the cost of compliance with H&S regulations and the overall cost of production against the profit margin and decide to comply at a convenient level. This is further supported by the deterrence theory in section 2. The implication of the above when factored in is that the cost of compliance (a factor of production) increases the cost of production, in most cases is often high and expensive. This supports Idubor and Osiamoje (2013) who agree that the high cost of production in Nigeria like cost of providing electric power drives organisations to cut corners as per H&S. In contrast, avoiding direct & indirect cost of accidents (a cost of production) can make them comply with H&S regulations as argued elsewhere in this paper. In short, it can be argued that factors of production influence compliance with H&S regulations in the Nigerian construction industry.

3.20 Absence of H&S representatives

The absence of H&S representatives in Nigeria's construction industry has detrimental impact according to Diugwu et al. (2012); who argue this in their study of "construction practices in Minna, Northern Nigeria". They found that 79.5% of most of their respondents do not have H&S representatives in their organisations. Hence, the absence of these representatives is a violation of the H&S regulations, which require organisations to have trade union appointed representatives or employee elected safety representatives. These representatives' main duty are to protect the H&S interest of the workforce. The argument being that these H&S representatives will help in ensuring compliance with H&S. These important factors and the role of safety officers are identified and reverberated by Okeola (2009) in facilitating and encouraging the construction contractors on safety issues, hence recommends mandatory roles for them.

3.21 Lack of adequate regulations

Idubor and Osiamoje (2013) uphold that poor national H&S standards hinder compliance with H&S in Nigeria. This factor of compliance is evident in the Nigerian construction industry, where the local H&S law (Factories Act 2004) does not technically cover it (Diugwu et al., 2012; Idoro, 2008; Idoro, 2011), thus not enforceable in the industry. Consequently, some construction firms adopt regulations from developed countries, and enforcement is at adopter's discretion (Idoro, 2008). The underlying assumption being that construction contractors can make rational decisions in respect to non-compliance on the grounds that they may have a perfect knowledge of the low probability of being caught due to the inadequate regulation. This view is supported by (Diugwu et al. 2012) findings: that lack of adequate regulation, lack of support as some of the constraints to H&S management in the Nigerian construction industry. This is on the grounds that the aforementioned may also determine compliance with H&S regulations.

3.22 Culture

While Kalejaiye (2013) highlights lack of safety culture in the family, education sector as some of the challenges facing the H&S environment in Nigeria's workplace, Idubor and Osiamoje (2013) contend that cultural dimension determines compliance with H&S regulations. They further posit that an organisation with safety culture will have a lower accident rate than one without safety culture. Correspondingly, the collectivist view of cultural dimension of Nigeria may equip Nigerian construction contactors with the potentials to comply with H&S regulations. Indeed, the findings of Kheni et al. (2007) suggest that some owners/managers of construction companies in Ghana comply with H&S because of cultural values and perceptions, highlighting the influence of extended family values. They note that some respondents perceive H&S as cultural and family responsibilities, viewing their employees as family members and themselves as family heads. In contrast, this collectivist view (i.e. cultural dimension) of the developing countries may result to unsound H&S management system in the construction industry (Kheni et al. 2007). This is because construction contractors may assign H&S responsibilities to incompetent family members (Kheni et al. 2007).

Furthermore, Nigeria as a nation has its own cultural norms, social and institutional environments, which include poor enforcement culture and poor implementation culture. As the construction industry like other businesses is susceptible to national culture (Kheni et al. 2007), this may influence their compliance behaviour. This view is supported by Idubor and Osiamoje (2013) who maintain that lack of implementation of plans is a major setback to the compliance with H&S regulations. Okolie and Okoye (2012) corroborate evidence in agreement to the studies above, they posit that national cultural dimension is correlated with safety climate that constantly influence the safety perception and behaviour of construction workers in Nigeria. The findings of their study that the safety perception and attitude of construction workers in Nigeria are influenced by culture, further buttress the view above. Thus, suggesting that compliance with H&S regulations by construction workers is determined by national cultural dimension.

Mention must be made of organisational culture, which Hofstede (1991) describes as the collective programming of the mind in an organisation that differentiates it from another. The argument here is that as organisations exist in a national culture, the institutional and social environment of the nation may influence the organisational culture. This may then determine the perception and attitude of the organisation in relational to H&S. It is argued that cultural environment is a core factor for developing strategies for H&S improvement (Kheni et al. 2007).

4. RESEARCH DESIGN AND METHODS

This study relied on secondary data through desk study. Systematic and extensive searches of databases like (EBSCOHOST, Sciverve Sciencedirect, Swetswise, ASCE Library, EMERALD, inter alia) were done. It used lunch words like 'Occupational health and safety regulations in Nigeria', which yielded only three indirectly related papers to the above topic, so further searches were done with lunch words like 'health and safety management in Nigeria', 'Occupational health and safety regulations in Africa' and some data were found. Those that are directly or indirectly related and relevant to the topic were chosen for the second search strategy. The above methodology was used in order to eliminate bias, ensure transparency and create room for repeatability. Because of the shortage of H&S literature on Nigeria and its construction industry, the citation search approach that is an accepted and widely used search strategy for a paper of this nature was adopted. This strategy requires the use of useful article(s), reference lists of papers and books relevant to the required topic. Content analysis of the data collected was also done and the result presented. This can be done systematically and objectively and/or by inference. In this study, all three techniques and theme-grouping pattern were adopted; inductive and derived explanations of the themes identified were done and the interpretive style used, as this study generates new insight.

5. RESULTS AND DISCUSSION

From the literatures reviewed so far, it is evident that while compliance theories explain some compliance behaviours of construction contractors hence the determinants, contextual issues may also explain their compliance behaviours.

For instance, some construction contractors may comply with H&S regulations because of cultural values and/or family values (Kheni et al. 2007), while national culture can also determine compliance (Okolie and Okoye 2012).

This study was also able to unearth and examine key issues to compliance with H&S regulations in the Nigerian construction industry. These major issues are: socio-cultural, socio-economic, institutional/legal, organisational and industrial issues. Organisational issues identified by this study include: reputation of firms (Jacobi 2012; Nzuve & Lawrence 2012); higher profit margin (Nzuve & Lawrence, 2012; Smallwood & Haupt 2007; Windapo & Oladapo, 2012); inadequate training of staff and workplace issues (Adenuga et al., 2007; Idubor & Osiamoje, 2013; Othman, 2012). Through critical analyses of Adenuga et al. (2007); Smallwood (2002); Windapo and Oladipo (2012); it was inferred that management commitment to H&S would determine compliance with H&S regulations. One of the key arguments being that as long as the Nigerian government do not tackle H&S challenges in the construction industry, organisations should endeavor to champion the improvement of H&S as they would benefit immensely. Literature reviewed so far suggests gross negligence in the part of either the government or enforcement authority. As the government does not take reasonable measures to preventing unsafe practices, then little is expected of the construction industrial operatives; thereof, Smallwood (2002) hypothesises that cultural norms start from the upstream of management to the downstream sector. Therefore, it can be argued that the recorded neglect by the government and industry suggest the absence of safety culture in Nigeria and lack of governmental support.

In terms to institutional/legal issues relating to compliance with H&S regulations, it was evident that the construction industry issue was technically omitted when the Factories Act of 2004 was drafted and during implementation. Enforcement of H&S regulations (Federal Ministry of Labour and Productivity 2010 in Idubor & Osiamoje, 2013; Okeola, 2009; Nzuve & Lawrence, 2012; Onyeozili, 2005; Idubor & Osiamoje, 2013; Umeokafor et al. 2014); weak legal structures (Idubor & Osiamoje 2013); bribery and corruption (Idubor & Osiamoje, 2013; Onyeozili 2005); lack of funding (Idubor & Oisamoje, 2013; Nzuve & Lawrence, 2012); absence of H&S representatives (Diugwu et al., 2012; Okeola, 2009); lack of adequate regulations (Idubor & Osiamoje, 2013) were found to be determinants to compliance with H&S regulations in the Nigerian construction industry. Through critical review of Idubor and Osiamoje (2013); Puplampu and Qartey (2012), it was inferred that neglect of human rights would also determine compliance with H&S regulations in the Nigerian construction industry. Additionally, critical reviews of a conceptual study by Idubor and Oisamoje (2013); an empirical study by Nzuve & Lawrence (2012) highlighted that fear of legal sanctions can also determine compliance with H&S regulations in the said industry.

Furthermore, unemployment (Idubor & Oisamoje, 2013); lack of awareness and improper medium for disseminating information (Diugwu et al., 2012; Idubor & Osiamoje, 2013) were the socio-economic issues recognised by this study that also determine compliance with H&S regulations in the Nigerian construction industry. A popular saying in Nigeria states that “Knowledge is power”; should that be the case, it could be assumed that the Nigerian society is not empowered in terms of H&S due to lack of knowledge in this instance. The studies further show that injury and accident

are common in the construction sites in Nigeria; however, people that suffered from occupational diseases or incidents would not know the necessary steps to take for compensation or to stop the reoccurrence.

In addition, socio-cultural issues were well covered by empirical studies by Othman (2012), Smallwood (2002) and a conceptual study by Kalejaiye (2013). They reported that beliefs determine compliance with H&S regulations in the construction industry. While culture (Idubor & Osiamoje, 2013; Kalejaiye, 2013; Kheni et al. 2007; Okolie and Okoye 2012); client's influence (Famakin & Fawehinmi, 2012; Okeola, 2009; Smallwood & Haupt 2006) were identified as determinants to compliance with H&S regulations, critical review of Nzuve and Lawrence (2012); Okeola (2009), Smallwood and Haupt (2007); Windapo (2013) showed that moral values influence compliance with H&S regulations in Nigeria's construction industry. Also, client's influence on compliance with H&S regulations seems overlooked in the Nigerian construction industry, as has been unearthed by this study.

Industrial issues such as tendering process (Nzuve & Lawrence, 2012; Othman 2012; Windapo, 2013); perception of stakeholders in the industry (Windapo, 2013); cost of compliance/production (Idubor & Oisamoje 2013; Windapo, 2013) were revealed as factors that determine compliance with H&S regulations in the construction industry. Critical analyses of studies (Kalejaiye, 2013; Tanko and Anigbogu, 2012) indicated that activities of the informal sector determine if the said industry would comply with H&S regulations. It should also be noted that the informal sector contributes to about 70% of construction activities in Nigeria (Tanko & Anigbogu, 2012), implying that the informal sector could be a major contributor to the high level of accidents in the construction industry.

6. CONCLUSION AND RECOMMENDATIONS

This study demonstrates that the state of H&S and compliance with H&S regulations in the Nigerian construction industry is poor. It has revealed that the key issues to compliance with H&S regulations in the Nigerian construction industry and perhaps the whole country are mostly related to socio-cultural issues, institutional/legal issues, organizational issues, socio-economic and industrial issues, with the activities of the informal sector as a major contributor. Additionally, using compliance theories, this study explains some compliance behaviours of the construction industry based on the unearthed compliance determinants. It is also evident from this study that contextual issues may explain compliance behaviour. This study goes further to recommend that to sustain the rapid economic growth and infrastructural development in Nigeria and improve H&S in the nation's industry, government's involvement in H&S with adequate enforcement mechanisms, management commitment and support from stakeholders, can help improve compliance with H&S, hence improve productivity, chances of competition in the market inter alia. Most importantly, governments of developing countries like Nigeria should improve H&S awareness and education by using enlightening agencies like the National Orientation Agency of Nigeria; H&S education and training should be mandatory and integrated in the school syllabus right from secondary level. H&S practitioners and promoters should use increase in profit margin inter alia as H&S promotion instruments to attract the public and top management interest. Furthermore, mandatory H&S section in contract documents should be adopted and strictly enforced in the developing countries' construction industry, preferably verified and referenced before payment.

Also, reference as per H&S performance form contractors' previous clients should be a prerequisite for tender selection, hence preference given to those with good H&S records. Meanwhile, naming and shaming organisations of poor and appalling H&S records should be adopted, as they will not like their images with the public and competitive levels in the market to be affected. Government and stakeholders should strictly regulate activities of the informal construction sector in order to promote H&S in developing countries; whereby, the building planning departments in local councils will be used as an H&S enforcer in the grassroots level just as they enforce planning permission.

7. REFERENCES

Adenuga, O.A., Soyingbe, A.A., and Ajayi, M. A. (2007). A study on selected safety measures on construction Companies in Lagos, Nigeria. RICS (Cobra).

Anderson, J. (2007). Health and safety- Matching legislation and enforcement. *Proceedings of the Institution of Civil Engineer. Management, Procurement and Law*, 11-15.

Baxendale, T. and Owain, J. (2000). Construction design and management safety regulations in practice-progress on implementation. International Journal of Project Management, 18 (1), 33-40.

Diugwu, I. A., Baba, D. L., & Egila, A. E. (2012). Effective regulation and level of awareness: An expose of the Nigeria's construction industry. *Open Journal of Safety Science and Technology,* Vol. 2.140-146.

Famakin, I. O., and Fawehinmi, O. S. (2012). Quantity surveyors' perception of construction health and safety regulation in Nigeria. *Journal of Building Performance*, Vol 3 (1).

Fairman, R. & Yapp, C. (2005). Enforced self-regulation, prescription, and conceptions of compliance within small Business: The impact of enforcement. *Law and Policy*, 27 (4).

Federal Republic of Nigeria: *Labour, Safety Health and welfare Bill of 2012*.

Hofstede, G. (1991), *Cultures and organisation: Software of the mind*. McGraw-Hill. London.

HSE (2005) Making an impact on SME compliance behaviour: An evaluation of the effect of interventions upon compliance with health and safety legislation in small and medium sized enterprises. Prepared by Kings College London.

HSE (2008). The determinants of compliance with laws and regulations with special reference to health and safety: A literature review. Retrieved on 14-07-14 from http://www.hse.gov.uk/research/rrpdf/rr638.pdf

HSE (2013) Health and safety in construction in Great Britain, 2013. Retrieved from http://www.hse.gov.uk/statistics/industry/construction/construction.pdf on 12-07-14

Idoro, G. I (2007). A comparative Evaluation of health and safety performance of indigenous and Multinational construction firms in Nigeria. Construction Research Journal, 1(1) 65-75

Idoro, G. I. (2008). Health and safety management efforts as correlates of performance in the Nigerian construction industry. *Journal of Civil Engineering and Management*. Vol 14(4) 277-285.

Idoro, G. I. (2011a). Comparing occupational health and safety (OHS) management efforts and performance of Nigerian construction contractors. Journal of Construction in Developing Countries Vol. 16(2), 151–173.

Idoro, G. I. (2011b) Influence of construction site OHS Fatcilities on OHS performance in Nigeria. In: Laryea, S., Leiringer, R and Hughes, W. (Eds) Procs West Afria Bulit Environment Research (WABER) Conference. 19-21 July 2011, Accra, Ghana, 641-650.

Idubor, E. E., and Oisamoje, M. D. (2013). An exploration of health and safety management issues in Nigeria's efforts to industrialize. *European Scientific Journal*. Vol. 9(12).

International Labour Organisation (ILO) C155 - Occupational Safety and Health Convention, 1981 (No. 155). Retrieved from http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C155

Jacobi, J. (2012). The compliance trap - Too much focus on regulations will shortchange your people & profits. *ASSE Professional Safety Journal*. Pp69-70.

Kalejaiye, P. (2013). Occupational health and safety: Issues, challenges and compensation in Nigeria. *Peak Journal of Public Health and Management,* Vol. 1(2), pp 16-23.

Kheni, N.A., Gibb, A.G.F and Dainty, A.R.J (2006). The management of construction site health and safety by small and medium-sided construction businesses in developing countries: A Ghana case study. In: Boyd, D (Ed.), *Procs 22nd Annual ARCOM Conference*, 4-6 September, 2006, Birmingham, UK. ARCOM, Vol. 1, 273-82

Kheni, N. A., Dainty, A. R. J and Gibb, A. G. F (2007). Influence of Political and Socio-Cultural Environment on Health and Safety Management within SMEs: A Ghana Case Study. *In Boyd, D (Ed) Procs 3rd Annual Conference, 3-5 September 2007, Belfast, UK, Association of Researchers in Construction Management,* 159-168.

Nzuve, S. N. M., and Lawrence, B. A. (2012). The extent of compliance with occupational safety and health regulations at registered workplaces in Nairobi. *International Journal of Business, Humanities and Technology,* Vol. 2 (2) 115-120.

Occupational Safety and Health branch, Labour Department (2013) Occupational safety and health statistics bulletin Issue no 13. Retrieved from http://www.labour.gov.hk/eng/osh/pdf/Bulletin2012.pdf on 12-07-14

Odeyinka, H., Davison, C. and Olomolaiye, P. (2005). An assessment of factors inhibiting designers from complying with health and safety regulations in their design. *Proc. of 21st Annual ARCOM Conference*, 7-9 September, SOAS, University of London, Vol. 2, 905- 913.

Okeola, O. G. (2009). Occupational health and safety (OHS) assessments in the construction industry. *Ist Annual Civil Engineering Conference, 26-28 August 2009, University of IIorin, Nigeri*a.

Okolie, K. C., and Okoye, P. U. (2012). Assessment of national culture and construction health and safety Climate in Nigeria. *Science Journal Publication*, Vol. 2012, 6 pp.

Onyeozili, E. C. (2005) Obstacles to effective policing in Nigeria. *African Journal of Criminology and Justice Studies,* Vol 1 NO (1), 32- 54.

Othman, A. A. E. (2012). A study of the causes and effect of contractors' non-compliance with the health and safety regulations in the South African construction industry. *Architectural Engineering and Design Management,* Vol.8, 180-191.

Puplampu, B. B., and Quartey, S. H. (2012). Key Issues on occupational health and safety practices in Ghana: A Review. *International Journal of Business and Social Science.* Vol. 3(19), 151 -156.

Smallwood, J. J. (2002). The Influence of health and safety (H&S) culture on H&S Performance. In: Greenwood, D (Ed), 18th annual ARCOM conference, 2-4 September 2002, University of Northumbria. *Association of Research in Construction Management,* Vol.1, 217-226.

Smallwood, J.J., and Haupt, T. C. (2007). Impact of South African construction regulations on construction health and safety: Architects' Perceptions. *Journal of Engineering, Design and Technology,* Vol 5(1).

Tanko, B. L., and Anigbogu, N. A. (2012). The use of personal protective equipment (PPE) on construction sites in Nigeria'. In: Laryea, S., Agyepong, S A., Leiringer, R. and Hughes, W. (Eds) *Proc 4th West Africa Built Environment Research (WABER) Conference, 24-26 July 2012, Abuja, Nigeria*, pp 1341-1384.

Tombs, S., and Whyte, D. (2013). The myths and realities of deterrence in workplace safety regulations. *The British Journal of Criminology*, Vol. 53 (5), 746-763.

Trading Economics (2013) *Nigeria unemployment rate.* Retrieved from http://www.tradingeconomics.com/nigeria/unemployment-rate

Transparency International (2012) *Transparency international corruption perceptions index 2012.* Retrieved from http://www.ey.com/Publication/vwLUAssets/2012_TI_CPI/$FILE/2012%20TI%20CPI.pdf

Umeokafor, N., Isaac, D., Jones, K., & Umeadi, B. (2013). Enforcement of occupational safety and health regulations in Nigeria: A exploration. *Proceedings of the 1st International Scientific Forum,* 3, 92-103.

Umeokafor, N.I., Umeadi, B., Jones, K., and Igwegbe, O. (2014). Compliance with occupational safety and health regulations in Nigeria's public regulatory entity: A call for attention. *International Journal of Scientific and Research Publications,* Vol. 4, Issue 5.

Windapo, A., and Oladapo, A. (2012). Determinants of construction firms' compliance with health and safety regulations in South Africa. In Smith, D.D (Ed) Procs 28th Annual ARCOM conference, 3-5 September 2012, Edinburgh, UK. *Association of Research in Construction Management,* 433-444.

Windapo, A. (2013). Relationship between degree of risk, cost and level of compliance to occupational health and safety regulations in construction. *Australasian Journal of Construction Economics and Building,* Vol 13(2), 67- 82.

Journal of Construction Project Management and Innovation Vol. 4 (S1): 900-905, 2014
ISSN 2223-7852

A REVIEW OF CONSTRUCTION MANAGEMENT AND ECONOMICS RESEARCH OUTPUTS IN NIGERIA: TOWARDS A SUSTAINABLE FUTURE

Obuks Augustine EJOHWOMU and Olalekan Shamsideen OSHODI[2]

[1] & [2]Department of Building Technology, Bells University of Technology, Ota, Nigeria; Email: obuksejohwomu@yahoo.co.uk; oshodilekan2002@yahoo.com

ABSTRACT

Construction related research holds the key to a sustainable future. This is because of the potential of research to improve practice. In order to identify the current state of knowledge in construction management and economics research. This article aims to unpack the question by evaluating three (3) decades of longitudinal data into construction management and economics research across seven (7) foremost Nigerian universities. A review of completed PhD studies was done to identify dominant research topics, methods and trends over the study period. It is evident from qualitative analysis that 69.9% of the critical investigation focused on topics related to procurement/project performance, maintenance, cost modelling/construction economics and human resource/productivity. Despite, a moving trend in the topics investigated. There was no evidence of critical research in the area of sustainability. Besides a call for paradigm shift in present day research activities, the concept of sustainability, which has become a dominant policy in the developed world, needs to be enshrined. In other words, there is a need to really examine the extent to which current policies and activities pertaining to sustainability in the construction industry is been integrated into built environment planning and development in Nigeria.

Keywords: Critical research; Nigeria; Paradigm shift; Sustainability

1. INTRODUCTION

The construction industry's output plays a crucial role in the socio-economic growth of any nation. More so, the impact of construction industry on the economy has been a subject of academic debate in several fields. Empirical results and arguments by construction researchers present evidence in support of a positive relationship between construction industry output and economic growth (Ofori et al., 2012; Ofori, 2014; Oladinrin et al., 2014; Ramsaran and Hosein, 2006). The construction industry produces constructed/space for human activity and according to Laryea and Leiringer (2012) the quantity and quality of human life and productivity of humans is dependent on the built environment. Hence, built environment plays a crucial role in driving development.

Currently, Nigeria needs a massive infrastructure overhaul due to several years of neglect and lack of a strategic plan for the economy.

The Nigerian Bureau of Statistics (NBS, 2010) purports that 60.9% of Nigerians are poor (i.e. earn below US$ 1/day). Additionally, the Nigerian construction industry contributed 2.19% to the Gross Domestic Product (GDP) in 2013 which makes it 7th largest sector (NBS, 2013). Despite, the meagre contribution of the construction to the economy, empirical evidence has shown a positive relationship between construction industry output and GDP (Oladinrin et al., 2014). Therefore, development of "capacity, capabilities, knowledge and technologies" through built environment research (Laryea and Leiringer, 2012) can be a driver of economic growth in developing countries like Nigeria.

Construction management and economics is a component of built environment research. Review of top construction management and economics journals as identified by Wing (1997) and Bröchner and Björk (2009) has shown a limited number of contributions by researchers affiliated to Nigerian institutions (Abudayyeh et al., 2004; Al-Sharif & Kaka, 2004; Ke et al., 2009; Laryea, 2011). Thus, a review of a past studies conducted in conducted in department of Building and Quantity in Nigerian Universities (i.e. unpublished PhD research) would assist in identifying current status and gaps that exist in knowledge. Hughes (1994) argues that completed PhDs is a measure vibrancy of a research community. Therefore, this study reviews unpublished PhD research studies in construction management and economics-related disciplines in Nigerian Universities over a twenty-nine year period between 1984 and 2012. This is aimed at addressing the following questions:

1. What is the coverage of construction management and economics topics during the period?
2. What are the dominant research methods during the period?
3. How did the theme/focus/interest of construction management and economics change during the period?

The results of this study would serve as a guide for future directions of built environment reserve which is a prerequisite for improving practice, expertise and extending knowledge.

2. BACKGROUND OF BUILT ENVIRONMENT RESEARCH IN NIGERIA

Tertiary institutions (i.e. polytechnics and universities) conduct research which guide practice. According to Nigerian Universities Commission (2014), there are 128 Universities in Nigeria; the universities comprise of 40 Federal-government owned, 38 State government-owned and 50 Private Universities. This shows that 55% of the Nigerian universities are government funded. This shows that government recognises the importance of universities as a ‘generator’ of new knowledge required to drive policy formation and economic development.

Built environment research is domiciled in universities and research institutes (Laryea & Leiringer, 2012). Academic departments such as architecture, building, engineering, estate management, planning and quantity surveying are responsible for conducting built environment research. However, these tertiary institutions are not able to meet planned vision and objectives due to lack of finance (Laryea & Leiringer, 2012).

This has led to low morale, brain drain, student unrest and labour disputes often reported in the media. Hence, there is a need to develop the capacity of built environment researchers so as to improve their impact on economic growth.

3. METHODOLOGY

This paper reports finding of the investigation of built environment research trends as depicted by the data collected from a sample of 30 unpublished PhD thesis completed in the Department of Building and Quantity Surveying of 7 Nigerian universities between 1984 and 2012 (see Appendix for details). An extensive review of unpublished PhD thesis titles and abstracts was done so as to extract and record data for the study. The study utilised a similar qualitative framework used in a similar study on review published papers presented at West Africa Built Environment Research (WABER) conference (Laryea & Leiringer, 2012). A closer look at the content of the titles and abstracts of the PhD thesis was conducted to:

- Identify the construction management and economics research topics addressed in the thesis.
- Identify the dominant research methods used during the period under consideration.

After the above data items were collected, built environment research trend were identified and analysed over a three arbitrarily selected intervals of ten, ten and nine years intervals respectively (1984-1993, 1994-2003, 2004-2012).

4. FINDINGS AND DISCUSSION

4.1 Topics under investigation

In this paper, for analysis, each PhD thesis was classified based on the main built environment research topic that it investigated. Although, the topic of some of the thesis could fall into several different categories, only the main topic is used to classify each thesis. The topics investigated in the PhD thesis during the study period were categorized into eight categories based on themes. The identified themes are: Cost modelling/construction economics; Project Performance; Maintenance; Human resource/Productivity; Construction materials; Housing; Project Management; and Cost / finance management, as shown in Table 1.

Based on the data presented in Table 1, it is obvious that project performance, cost modelling/construction economics, maintenance, and human resource/productivity were the major topics investigated during the study period. This is in agreement with evidence presented in (Laryea and Leiringer, 2012; Ofori, 2014) which shows that built environment researchers in West Africa conduct a limited amount of research on the following areas namely: Sustainable environment; Building Services; Law and governance systems; Globalisation; public private partnership; and Construction Industry.

Table 1: Major Research Topics of PhD Thesis

Topic	Number	Percentage (%)
Procurement/project performance	7	23.3
Maintenance	6	20.0
Cost modelling/construction economics	4	13.3
Human resource/Productivity	4	13.3
Construction materials	3	10.0
Housing	3	10.0
Risk	1	3.3
Project Management	1	3.3
Cost / finance management	1	3.3
TOTAL	30	100

4.2 Research Design

The classification of research design is based on terminologies adopted from Saunders et al. (2007: 108) and Laryea and Leiringer (2012). Hence, the research design for all the thesis were categorized into experiment, survey, case study, action research, grounded theory, ethnography, and archival research. The classifications are presented in Table 2.

Table 2 shows the frequency of research design used in the PhD thesis. A high reliance on survey research is observed. However, modelling, experiment and case-study was also used. The results generally agree with those obtained in a similar previous study (Laryea and Leiringer, 2012). The similarity with results obtained in Laryea and Leiringer (2012) study might be due to the significant number of paper presented in WABER conference by Nigerian authors.

Table 2: Research Method

Research Method	Number	Percent (%)
Survey	17	56.67
Modelling	9	30.00
Experiment	3	10.00
Case study	1	3.33
Action research	0	0.00
Grounded theory	0	0.00
Ethnography	0	0.00
Archival research	0	0.00

4.3 Trends of Research Topic during the Study Period

To discuss the trends in built environment research as depicted by the completed PhD thesis, the 29-year period under investigation was divided into 2 (10-year) and 1 (9-year) periods. Period one is from 1984-1993, period two is from 1994-2003 and period three is from 2004 to 2012. The frequencies of the topic are presented in Table 3 to identify changes and trend over time.

An increase in the number of completed PhD thesis was noticed. The numbers of completed studies increase from 5 in period one to 18 in period three.

Also, during period one, the greatest topic focused on was maintenance. However, this change in period two, the Cost modelling/construction economics, Procurement/project performance, and Human resource/Productivity received the greatest focus. In the third period, Project performance and maintenance were the major focus of most studies in the third period.

Table 3: Top Construction Research Topics during each Period

Topic	Period 1 1984-1993	Period 2 1994-2003	Period 3 2004-2012	Total	%
Procurement/project performance	0	2	5	7	23.3
Maintenance	2	1	3	6	20.0
Cost modelling/construction economics	1	2	1	4	13.3
Human resource/Productivity	0	2	2	4	13.3
Construction materials	0	0	3	3	10.0
Housing	1	0	2	3	10.0
Risk	0	0	1	1	3.3
Project Management	1	0	0	1	3.3
Cost / finance management	0	0	1	1	3.3

6. CONCLUSION AND RECOMMENDATIONS

There are several limitations to a study of this kind and valid criticisms can be made. The obvious limitation is the sample selected. The PhD thesis selected were those completed in Department of Building and Quantity Surveying. It is worthy to note that other built environment disciplines such as architecture, estate management, engineering and surveying were not included in the sample. Hence, drawing conclusions on the sample selected may be an issue due to the size and characteristics of the sample. However, the consistency with the results of Laryea and Leiringer (2012) study highlights the trends of built environment research in Nigeria. This is due to the quantity of publications authored by researchers affiliated to Nigerian institutions at WABER conference.

Notably, it is found that project performance, cost modelling/construction economics, maintenance, and human resource/productivity were the major topics studied by built environment researcher. In addition, there is an overreliance on survey research method using questionnaires for data collection. The results are similar to the results of Laryea and Leiringer (2012) study, which found an overreliance on survey research. This shows that most studies were targeted at generating generalization which is considered inadequate in proffering solutions to industry problems and developing theories.

Research is needed to improve practice and processes within the built environment. Therefore, there is a need for Nigerian built environment researchers to formulate research problems and chose new research methods which can generate and extend knowledge and theory. Adopting this strategy is important for research to have long term impact. This assertion is supported by earlier studies such as Ofori (2014); Laryea and Leiringer (2012); Fellow (2010); Pollack (2005); Wing et al. (1998). Although, Laryea and Leiringer (2012) study did not recommend the need for a paradigm shift in built environment research.

There is a need for built environment research to re-strategies in order to improve their outputs and impact of such outputs on the Nigerian economy.

7. REFERENCES

Abudayyeh O, Dibert-DeYoung A, Jaselskis, E (2004). Analysis of Trends in Construction Research: 1985–2002. Journal of Construction Engineering and Management. 130(3): 433-439.

Bröchner J, Björk B-C (2008). Where to submit? Journal choice by construction management authors. Construction Management and Economics. 26(7):739-749.

Hughes W (1994). The PhD in construction management. In Skitmore M, Betts M (Ed.), Proceedings of the 10th annual conference of the Association of Researchers in Construction Management [ARCOM], (pp. 76-87). UK.

Laryea S (2011). Built environment education and research in West Africa In: Laryea S, Leiringer R, Hughes W (Eds) Proceedings West Africa Built Environment Research (WABER) Conference, 19-21 July, Accra, Ghana, 203-214.

Laryea S, Leiringer, R (2012). Built environment research in West Africa: current trends and future directions. In: Laryea, S., Agyepong SA, Leiringer R, Hughes W (Eds) Proceedings 4th West Africa Built Environment Research (WABER) Conference, 24-26 July 2012, Abuja, Nigeria, 797-804.

Nigerian Bureau of Statistics. (2010). Annual Abstract of Statistics. Abuja.

Nigerian Bureau of Statistics. (2013). Revised 2011 & Estimates OF Q1 – Q4 2012 Gross Domestic Product for Nigeria.

Ofori G (2014). Nature of construction industry, its needs and its development: A review of four decades of research. In: Ogunlana S, Idoro G, Dada M, Iweka A, Ilechukwu V, Alade W (Eds) Proceedings of the CIB W107 2014 International Conference, 28-30 January, 2014, Lagos, Nigeria, 1-19.

Ofori G, Ai Lin ET, Tjandra IK (2012). Construction Industry Development Initiatives: Lessons for Ghana from some overseas examples. In Badu E, Dinye R, Owusu-Manu D (Ed.), Proceedings of 1st International Conference on Infrastructure Development in Africa. Kumasi.

Oladinrin OT, Ogunsemi, Aje IO (2014). The causal relationship between construction growth and economic growth: a comparative study of Nigeria and South Africa. Ogunlana S, Idoro G, Dada M, Iweka A, Ilechukwu V, Alade W (Eds). Proceedings of the CIB W107 2014 International Conference, Lagos, Nigeria, 83-96.

Pollack J (2007). The changing paradigms of project management. International Journal of Project Management. 25: 266-274

Ramsaran R, Hosein R (2006). Growth, employment and the construction industry in Trinidad and Tobago. Construction Management and Economics. 24(5): 465-474.

Saunders MNK, Lewis P, Thornhill A (2007) Research methods for business students, 5ed., Pearson Education, Harlow.

Wing CK (1997). The ranking of construction management journals. Construction Management and Economics. 15(4): 387-398.

Wing CK, Raftery J, Walker A (1998). The baby and the bathwater: research methods in construction management. Construction Management and Economics, 16(1): 99-104.

Journal of Construction Project Management and Innovation Vol. 4 (S1): 906-911, 2014
ISSN 2223-7852

REMEDIES TO TIMELY DELIVERY OF CONSTRUCTION PROJECTS IN LUSAKA, ZAMBIA – AN EXPLORATORY STUDY

Mulenga MUKUKA[1], Clinton AIGBAVBOA[2], and Wellington THWALA[3]

[1, 2, 3]Department of Construction Management & Quantity Surveying / Faculty of Engineering & the Built Enviornment / University of Johannesburg, South Africa, Email: sirjoze2002@gmail.com;

ABSTRACT

The construction industry is a key sector in the development and economic growth of Zambia, however, the industry has not escaped the challenges facing other countries worldwide in terms of delivering construction projects on time as stipulated in the contracts. This paper assesses the construction professionals' perception on the measures of minimising constuction project delays in Lusaka – Zambia. The data used in this paper were derived from both primary and secondary sources. The secondary data was collected via a detailed review of related literature. The primary data was collected through a well-structured questionnaire which was distributed to construction professionals, which include: Architects, quantity surveyors, builders, civil engineers, land surveyors and project managers. Out of the 50 questionnaires sent out, 32 were received back representing 64% response rate. Data received from the questionnaires was analysed using descriptive statistics procedures. Findings from the study revealed that site management and supervision, effective strategic planning, clear information and communication channels, use proper and modern construction equipment and proper project planning and scheduling were the major measures of minimising construction project delays. The study contributes to the body of knowledge on the subject of minimising construction project delays in Lusaka, Zambia.

Keywords: Construction Industry, Delays, Lusaka, Zambia

1. INTRODUCTION

The construction industry is a key sector in the development and economic growth of Zambia according to the National Council for Construction report (2004). However, the construction industry in Zambia has not escaped the challenges facing other countries worldwide in terms of delivering projects on time as stipulated in contracts. Projects or construction works that are not delivered on time to the client are referred to as delayed projects. Mohamad (2010) defines delay as an act or event that extends the time to complete or perform an act under the contract. Also, Assaf and Al-Hejji (2006), defined delay as the time overrun either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for delivery of a project.

It is basically a project slipping over its planned schedule and is considered as a common problem in construction projects worldwide. Assaf and Al-Hejji (2006) further illustrate that, to the owner, delay means loss of revenue through lack of production facilities and rent-able space or a dependence on present facilities. In some cases, to the contractor, delay means higher overhead costs because of longer work period, higher material costs through inflation, and due to labour cost increases.

Theodore (2009) classifies delays into two, those caused by the client and those caused by the contractor. Delays caused by the client such as late submission of drawings and specifications, frequent change orders, and incorrect site information generates claims from both the main contractors and sub-contractors which many times entail lengthy court battles with huge financial repercussions (Theodore, 2009). Delays caused by contractors can generally be attributed to poor managerial skills. Lack of planning and a poor understanding of accounting and financial principles have led to many a contractor's downfall (Theodore, 2009). Hence, this paper is aimed at identifying the causes and effects of construction project delays in Lusaka, Zambia. This is because the aim of any construction project is to successfully complete the project on time, within budget and with high quality. This study focuses on the completion of projects on time thus overcoming delays. Alkhathami (2004) states that delay can be defined as extra time required to finish a given construction project beyond its original planned duration, whether compensated for or not.

2. CONSTRUCTION PROJECT DELAY – MEASURES OF MINIMISING DELAYS

Aiyetan et al. (2011) show that the principle of Right-First-Time holds great value. Right-first-Time requires accuracy and precision. Accuracy means reflecting the realities (specifications), whereas precision implies meeting the specific dates. The processes of construction demand accuracy and very high precision. Wei (2010) illustrates that when a construction delay occurs, there is no question that the Owner suffers financially. But the extent to which the owner can recover loss of income from the Contractor, and more importantly minimize the risk that such delays will occur, depends largely on how the construction contract was drawn up.

Tabish and Jha (2011) identify five successful criterions that can be used to deliver construction projects on time. The study further revealed that there are independent measures that can be taken in each criteria to reduce delays. These criterions are as follows; Schedule performance criterion, cost performance criterion, quality performance criterion, safety performance criterion and No-dispute performance criterion.

Aiyetan et al. (2011) identified twelve factors that would influence project delivery time, these includes: Construction planning and control techniques; management style; economic policy; the quality of management during construction; site access conditions; site ground conditions; motivation of workers, constructability of designs; socio and political conditions; client understanding of the design; procurement and construction processes; the quality of management during design; and physical environmental conditions. Wei (2010) fifteen ways of minimising delays were identified and ranked them as follows; and hence, this study adopted them, as they were more comprehensive factors that can minimize construction project delays; site management and supervision, effective strategic planning, clear information and communication channels, collaborative working in construction, proper project

planning and scheduling, frequent coordination between the parties involved, complete and proper design at the right time, use appropriate construction methods, accurate initial cost estimates, proper material procurement, proper emphasis on past experience, frequent progress meeting, compressing construction durations, use proper and modern construction equipment and use up-to-date technology.

The above measures of minimising construction delays are in agreement with the study by Majid (2002), where these measures were identified as the most effective ways of reducing construction project delays.

3. RESEARCH METHOD

The data used in this paper were derived from both primary and secondary sources. The primary data was obtained through the survey method, while the secondary data was derived from the review of literature and archival records. The primary data was obtained through the use of a structured questionnaire survey. This was distributed to a total of 50 construction professionals that included; quantity surveyors, civil engineers, architects, builders, land surveyors, and contractors who are currently involved in construction works in Lusaka, Zambia. This yardstick was considered vital for the survey in order to have a true reflection of the measures of minimising construction project delays. All professional and contractors in Lusaka had an equal chance to be drawn and participate in the survey. Out of the 50 questionnaires sent out, 32 were received back representing a 64% response rate. This was considered adequate for the analysis based on the assertion by Moser and Kalton (1971) that the result of a survey could be considered as biased and of little value if the return rate was lower than 30–40%. The data presentation and analysis made use of frequency distributions and percentages of all the respondents. The research was conducted between the months of June to August, 2013.

3.1 Mean Item Score (MIS)

A five point Likert scale was used to determine the measures of minimising construction project delays in Lusaka with regards to the identified factors from the reviewed literature. The adopted scale was as follows:

1 = Extremely unlikely
2 = Unlikely
3 = Neutral
4 = likely
5 = Extremely likely

The five-point scale was transformed to mean item score (MIS) for each of the factors of measures of minimising delays as assessed by the respondents. The indices were then used to determine the rank of each item. The ranking made it possible to cross compare the relative importance of the items as perceived by the respondents. This method was used to analyse the data collected from the questionnaires survey.

The mean item score (MIS) was calculated for each item as follows as in Equation 1.0;

$$MIS = \frac{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{\sum N} \quad \text{.....Equation 1.0}$$

Where;
n1 = Number of respondents for extremely unlikely;
n2 = Number of respondents for unlikely;
n3 = Number of respondents for neutral;
n4 = Number of respondents for likely;
n5 = Number of respondents for extremely likely;
N = Total number of respondents

After mathematical computations, the criteria are then ranked in descending order of their mean item score (from the highest to the lowest).

4. FINDINGS AND DISCUSSION

Findings from the 32 usable questionnaires revealed that 25% of the respondents had diploma degree as their highest qualification while 75% had bachelor's degrees. Further findings revealed that 53% of the respondents, who were all construction professionals, were government employees, 25% were employed by consultants and 22% were employed by contractors. The statistical mode for years of experience of the respondents was in the range of 1-5 years while 31% of the respondents were handling an average of 3-4 construction projects in Lusaka. The following were the results of the methods of minimising construction project delays.

4.1 Measures to minimise construction project delay

When the respondents were asked to rate measures that can be taken to deliver construction projects on time in Lusaka, the following result were obtained; Results as presented in in Table 1 Revealed that site management and supervision was the most effect way of minimising delays in Lusaka. Effective strategic planning, clear information and communication channels and use proper and modern construction equipment were ranked second most effective measures of minimising delays on construction site in Lusaka. These results are in general agreement with the study by wei (2010) where site management and supervision, effective strategic planning and Clear information and communication channels were identified as the most effective measure of minimising construction project delays.

Table 1: Measures to minimise construction project delay.

Methods to minimizing construction delays	MIS	Rank (R)
Site management and supervision.	4.22	1
Effective strategic planning.	4.13	2
Clear information and communication channels.	4.13	2
Use proper and modern construction equipment.	4.13	2
Proper project planning and scheduling.	4.10	3
Adherence to construction specifications.	4.06	4
Frequent coordination between the construction team.	4.03	5
Building according to the construction drawings.	4.03	5
Complete and proper design at the right time.	4.00	6
Up-to-date technology utilization.	3.97	7
Appropriate construction methods.	3.94	8
Collaborative working in construction.	3.91	9
Frequent progress meeting.	3.88	10
Accurate initial cost estimates.	3.84	11
Proper material procurement.	3.84	11
Fast-tracking construction.	3.68	12

5. CONCLUSION AND RECOMMENDATION

Literature review showed that there are many measures that can be employed to minimise construction project delays. The study further identified site management and supervision, effective strategic planning, clear information and communication channels, use proper and modern construction equipment and proper project planning and schedulingas as the major measures of reducing delays. Findings from the study supported work done by previous researchers and scholars that not a singular factor can be employed to minimise delays in Lusaka, Zambia. In recommendation, construction team need to be aware of the factors stated above in order to minimise the construction project delays. Furthermore, the construction team should practice the identified measures of reducing construction project delays such as; Site management and supervision, effective strategic planning, clear information and communication channels, use proper and modern construction equipment, and proper project planning and scheduling among other identified measures.

7. REFERENCES

Aiyetan, A., Smallwood, J. & Shakantu, W. (2011). A systems thinking approach to eliminate delays on building construction projects in South Africa: Acta Structilia, 2011: 18(2).

Alkhathami, M.M. (2004). Examination of the correlation of critical success and delay Factors in construction projects in the kingdom of Saudi Arabia: Doctor of Philosophy Thesis: University of Pittsburgh.

Assaf, S.A. & Al-Hejji, S. (2006). Causes of delay in large construction projects: International Journal of Project Management, 24 (2006): 349–357.

Majid, L.A. (2006). Causes and Effects of Delays in Aceh Construction Industry: Master of Science in Construction Management. Universiti Teknologi: Malaysia.

Mohamad, M.R.B. (2010). The factors and effect of delay in government Construction project, Case study in kuantan: University Malaysia Pahang.

Moser, C.A. & Kalton, G. (1971). Survey methods in social investigation: Heinemann Educational: UK.

National Council for Construction, Zambia. (2004). Development of contractor registration scheme with a focus on small scale civil works contractors: final report.

Tabish, S. Z. S. & Jha, K. N. (2011). Important Factors for Success of Public Construction Projects: 2011 2nd International Conference on Construction and Project Management: vol.15 (2011) IACSIT Press, Singapore.

Theodore, T. (2009). Types of Construction Delays. Understanding them clearly, analysing them correctly. 2nd Edition. Oxford: Elsevier Inc. Pages 25-36.

Wei, S.K. (2010). Causes, effects and methods of minimizing delays in construction projects: Universiti Teknologi Malaysia.

Journal of Construction Project Management and Innovation Vol. 4 (S1): 912-932, 2014
ISSN 2223-7852

AN ASSESSMENT OF PROFESSIONALS' PERCEPTION OF THE SUSTAINABILITY PERFORMANCE OF INFRASTRUCTURE PROJECTS IN NIGERIA

Amadosi-Jesse EMMANUEL[1], Ahmed Doko IBRAHIM[2] and Kulomri Jipato ADOGBO[3]

[1, 2 & 3]Department of Quantity Surveying, Ahmadu Bello University, Zaria, Kaduna State Nigeria (+234) 803 583 6544, E-mail: talk2amadosi@yahoo.com; adibrahim2@yahoo.com; kjadogbo@yahoo.com

ABSTRACT

Construction activities lead to the provision of infrastructure. However, these activities have undesirable impact on the environment. Various management approaches have evolved to guide construction participants in achieving better sustainability performance of infrastructure project. However, methods for evaluating the sustainability performance of infrastructure projects across economic, social and environmental aspects are not covered in literature. This paper aimed to assess professionals' perception of sustainability performance of infrastructure projects in Nigeria. The research adopted a questionnaire survey of professionals in the Nigerian Construction industry. 100 questionnaires were distributed and a total of 72 valid responses were obtained and used in the analysis. The research found that sustainability performance of infrastructure projects in Nigeria fall between moderate performances to high performance. Some factors whose performance falls below a set standard and adversely affect sustainability performance include ozone protection, modular and standardised design, discharge of water. The study recommends that government policies which incorporate the assessment of proposed infrastructure across social, economic and environmental impacts should be formulated to improve sustainability performance of infrastructure projects.

Keywords: Built environment, Infrastructure projects, Sustainable development, Sustainability performance, Nigeria

1. INTRODUCTION

Sustainable development is commonly defined as a development that meets the needs of the present without compromising the ability of future generation to meet their own needs (World Commission on Environment and Development (WCED), 1987). According to the World Bank Group (2008), infrastructure assets are the most critical components for the sustainable development of emerging countries, as they provide their communities with the necessary conditions to reach their economic, social, and environmental goals. It is considered that the proper development and operation of infrastructure projects can contribute significantly to the mission of sustainable development (Hong, 2008).

Infrastructure project is a kind of public goods in which government policy has an important role to influence the impacts of project on economic development and social needs (Shen, Wu, & Zhang, 2011). They include a wide range of construction works such as power plant, highways, railways, rural and urban electrification, transport, telecommunication facilities, the provision of water and sanitation, and safe disposal of waste, housing, education and health facilities. The development and progress of human society subsist on physical infrastructure for distributing resources and services to the public (Organization for Economic Cooperation and Development (OECD), 2006; Akintayo et al, 2011). Thus, Infrastructure facilities provide foundation and play an essential role in contributing to economic growth, raising the quality of life and poverty reduction (World Bank, 1994; OECD, 2006).

While infrastructure projects make significant contribution to economic and social development, they cause less desirable consequence to the environment if they are not properly implemented (Hong, 2008). In the same vein, Miyatake (1996) observed that the mission of the construction industry is that of creating built environment better for humans, he however warned that in pursuing this mission, we should now seriously pay attention to the fact that, should we continue the practice of conventional construction through which the prosperity as well as the fate of our days has been built, this missions of ours would not be pursued sustainable into the next century and beyond. Meanwhile, literature is replete with proofs that the construction industry and its activities have significant impact on the environment (Kibert, 1994; Roodman and Lenssen, 1995; Hill and Bowen, 1997; Ofori, 2000; Du Plessis, 2002; Dania et al., 2007; and Ameh et al., 2010). For example, the use of water for construction purpose damage soil and reduce the amount of portable water available for industrial and household use (World Bank, 1994; OECD, 2001a; OECD, 2006).

Appreciation of this has led to several studies from different perspectives. For example, Choguill (1996) proposed principles for policy formulation in order to improve infrastructure sustainability through serving and cooperating with communities. Rackwitz et al (2005) introduced maintenance strategy for improving infrastructure effectiveness based on cost benefit analysis with focus on project performance during operation stage. Ugwu and Haupt (2007) proposed an indicator system for assessing infrastructure sustainability with focusing on project operation stage. Shen et al. (2004) noted that since project performance traditionally refers to the outcomes of construction cost, time, and quality; the identification of dynamic factors in the existing studies mainly concerns these three aspects. When the contents of project performance are extended to incorporating project sustainable performance, factors affecting project performance need to be reviewed. Hence, it therefore becomes a pressing issue to find ways for gaining better sustainability performance for implementing infrastructure work in developing countries (Hong, 2008).

2. THE CONCEPT OF SUSTAINABLE DEVELOPMENT

2.1. The Definition of Sustainable Development

The concept of sustainable development was contextually defined by the World Commission on Environment and Development as 'development which meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987), and this concept has been widely accepted by many firms, institutions and governments across the globe (Hong, 2008).

Since the 'Brundtland Report' on the World Commission on Environment, numerous definitions of sustainable development have been proposed. Research efforts made to define the concept of sustainable development can also be found extensively in other publications. For example, Liddle (1994) defines sustainable development as a 'constraint on present consumption to ensure that future generations will inherit a resource base no less than the previous generation inherited'. Lozar (1993) defines it as 'maximizing the use of natural resources for permanent construction and minimising environmental degradation over the life-cycle of the construction application'. Although a single and unique definition of sustainable development does not exist among these various studies, a clear understanding of the key features and principles of sustainable development is important.

2.1.2 The Principles of Sustainable Development

The terms "sustainability" and "sustainable development" are sources of confusion. They are sometimes used interchangeably. However, Du Plesis (2002) noted that if one considers the motivation behind the concept of sustainable development, these interpretations are misleading and incorrect. He however noted that the objective is to sustain the species homo sapiens (that is to support it and keep it alive) and put forward the relationship between the terms as follows; Sustainability is the condition or state which would allow the continued existence of homo sapiens, and provide a safe, healthy and productive life in harmony with nature and local cultural and spiritual values. It is the goal to be achieved. Sustainable development is then the kind of development we need to pursue in order to achieve the state of sustainability. It is a continuous process of maintaining a dynamic balance between the demands of people for equity, prosperity and quality of life, and what is ecologically possible. It is what needs to be done. According to Du Plesis (2002) to get this, it become necessary to achieve a measure of social and economic equity between individuals, as well as between communities, nations and generations. We have to find a way to equitably distribute wealth (in the form of access to resources and opportunities) and increase prosperity for all. This line of reasoning leads to the so-called three pillars of sustainable development – people (social development), the planet (ecological protection) and prosperity (economic development).

Sustainability has been conveniently divided into three constituent parts: economic, environmental and social sustainability. There has generally been recognition of the three dimensions of sustainable development (Harris, 2000; OECD, 2001a; WB, 2003).

3. AGENDA 21 FOR SUSTAINABLE CONSTRUCTION

The Agenda 21 (UNCED, 1992) endorsed in Rio in 1992 presents a comprehensive blueprint of action related to sustainable development, and puts forward the need to integrate environment and development at the policy, planning and management levels. As there is a growing interest in sustainable construction, many researchers have dedicated themselves to it. The Agenda 21 on Sustainable Construction is intended to be a global intermediary between those general Agendas in existence, i.e. the Brundtland Report and the Habitat Agenda, and the required national and regional Agendas for the built environment and the construction sector currently or in the course of development. The three principal objectives for this Agenda 21 for Sustainable Construction are:

- to create a global framework and terminology that will add value to all national or regional, and sub-sectorial agendas;
- to create an agenda for CIB activities in the field, and for coordinating CIB with its specialized partner organizations, and
- to provide a source document for definition of R&D activities.

4. EXISTING APPROACHES FOR PROJECT EVALUATION

4.1 Economic Analysis

Economic analysis or economic appraisal is an effective approach to evaluate the costs and benefits of projects, from society's viewpoint, in order to select the most beneficial investment from a range of options (Langston, 1999). It is commonly used in the public sector and generally applied to large-scale infrastructure projects. The costs and benefits include 'intangibles' that cannot easily be measured in monetary terms and 'externalities' that affect society as a whole. It seeks to assess the net benefits of alternative projects to society as whole rather than to a particular client or providing authority. It takes account of the preferences of individuals in the community by calculation of a single overall figure to indicate the net social benefits of the project. Economic analysis proceeds in four essential steps: (a) identifying relevant costs and benefits; (b) valuing costs and benefits; (c) comparing costs and benefits; and (d) selecting the project.

4.2 Financial Analysis

Financial analysis or financial appraisal is a technique for assessing the financial viability of projects from the perspective of an individual organisation. Financial analysis of competing project options will indicate the extent to which each project affects the financial objectives of the organisation. The financial viability of a project is essentially indicated by the extent to which the financial benefits associated with the project exceed financial costs over the useful life of the project.

The analysis procedures of financial evaluation include (1) identifying relevant costs and benefits; (2) valuing costs and benefits at market prices; (3) measuring the financial viability of a project; and (4) conducting uncertainty and risk analysis.

4.3 Life-Cycle Assessment

A life-cycle assessment (LCA, also known as life-cycle analysis, eco-balance or cradle-to-grave analysis) is the investigation and valuation of a project's multiple aspects, including cost and environmental performance, from the perspective of a project life-cycle. It is a variant input-out analysis focusing on physical rather than just monetary flows (Hong, 2008).Life-cycle assessment of project's environmental effect investigates the impact on the environment from raw materials acquisition through the manufacturing, use/reuse, maintenance, recycling and waste management activities, i.e. from cradle to grave (White et al, 1993, 1995). It addresses all environmental factors and their inputs at any stage (primarily energy and raw materials) and all outputs at any stage (release to air, water and land). These inputs and outputs are considered as burdens on the environment. These burdens are then assessed as environmental impacts. Conducting LCAs for alternative products or projects provides for comparison of overall and relative environmental impacts, the intention being to allow for the trade-offs associated with each option to be assessed, rather than merely identifying the best option.

4.4 Environmental Impact Assessment (EIA)

Environmental impact assessment (EIA) in developing a construction project is a process by which information about the likely effects of a development on the environment is assessed (Council on Environment Quality, 1978). The process includes predicting and evaluating the project's impact on the environment, with the conclusions being used for decision-making. EIA aims to prevent environmental degradation by giving decision-makers better information about the consequences that development actions could have on the environment (Thompson et al, 1997). EIA is an important tool, providing decision-makers with both quantitative and qualitative information and value judgments about the environment and therefore a better understanding of the consequences of their actions (Brookes and Pollard, 2001). The three stages of the Environmental Impact Assessment include screening, scoping and consideration of alternatives. The consideration of alternative solutions for improvements should be an essential element of the EIA process and has been described as 'the heart of the environmental impact statement (EIS) in the USA' (Council on Environment Quality, 1978).

Alternatives are usually identified by reference to the type and scale of the project, location and processes will be influenced by economic, technical or regulatory considerations, and EIA should ensure that environmental criteria are added to the list. The decision on the project thus take place in a true decision-making framework, rather than involving relatively minor decisions about the mitigation of a particular action on an ad-hoc basis. An effective approach to analysing alternative solutions in developing a construction project is provided by the World Bank (1996). A table or matrix can be used to summarise the information for each alternative, incorporating systematic approaches involving scaling, rating or ranking. If environmental and social impacts are broadly similar then technical or economic factors can be used for further analysis. More complex analysis may be required if a choice cannot be made using the matrix: for example, multi-attribute decision-making techniques, which incorporate the values of the key interested parties.

Various steps are involved, including identification of the entities to be evaluated (e.g. alternatives) and then the identification and structuring of environmental attributes (e.g. noise level) to be measured.

4.5 Social Impact Assessment (SIA)

Social impact assessment (SIA) for a project used to be considered a component of a broader Environmental Impact Assessment, but has increasingly become a separate exercise, either in parallel with EIA or on its own. SIA is a process that promotes openness and accountability, fairness and equity, and which defends human rights in the whole process of implementing an infrastructure project (Hong, 2008).

Whilst there are many different models for conducting the SIA process, particularly for large infrastructure projects e.g. (Finsterbusch 1980; Branch et al. 1984; Burdge 1994; Inter-organisational Committee, 1994), there are commonly considered to be basic elements, summarised as ten steps (Inter-organisational Committee, 1994). They include Public involvement; Identification of alternatives; Profile baseline conditions; Scoping; Projection of estimated effects; Prediction of responses to impacts; Estimate indirect and cumulative impacts;

Changes in alternatives; Mitigation and monitoring.

5. CURRENT DEVELOPMENT

Many countries have introduced new instruments/tools over the past few years in order to improve the knowledge about the level of sustainability in each country's building stock. On one hand, it can be argued that the individual characteristics of each country, such as the climate and type of building stock, necessitate an individual sustainability rating tool for that country. The downside is that to varying degrees the rating tools for different countries are constructed on different parameters (Reed et al. 2009).

5.1 Environmental Assessment Tools

The past few years have seen a significant increase in interest and research activity in the development of building environmental assessment methods. Existing assessment models consist of two types: (a) specific models that are focused on one particular aspect, e.g. energy performance; and (b) general models that aim to obtain an overall assessment of the environmental performance of buildings or building components (Hong, 2008).

Current researches in developed countries have focused on evaluation of project performance through the development of assessment tools, such as the Building Research Establishment Environmental Assessment Method (BREEAM) (BRE, 1998), Leadership in Energy and Environmental Design (LEED) which was introduced by the U.S Green Building Council (USGBC, 2001), Building for Environment and Economic Sustainability (BEES) tool and so on. Equally, in Nigeria, studies evaluating construction projects have been carried out, for example Owabukeruyele (1999); Ibrahim et al. (2010); Bala et al.(2008b); Nwafor (2006); Abelson (2005) and Essa and Fortune (2005). The methods include economic appraisal, environmental impact assessment, social impact assessment and life cycle analysis.

While they have proved to assess the performance of construction projects in individual dimensions including social, economic and environmental aspects, these approaches are often used in isolation (Hong, 2008).Hence, the typical weakness in these applications is that the method is often used in separation and distinctively. Emphasis on sustainable development is placed in the balance together with the project performance of social, economic and environmental sustainability (Shen et al. 2007; Ibrahim and Price, 2005). This implies that human activities for development must balance different objectives and seek synergies from different aspect (Hong, 2008).

The purpose of assessing sustainability performance is to provide sustainability information that facilitates adequate decision making toward sustainable development (Munda, 2003; Oscar et al, 2011). The absence of an integrative approach has led to multiple consequences. For instance, the implementation of some infrastructure projects leading to serious environmental pollution as a result of over-emphasis to meeting social needs and economic growth. Ugwu and Haupt (2007) in their study emphasize the need for developing countries to be able to assess the sustainability performance of their infrastructure project using economic, societal and environmental matrix. Against this backdrop, this study assessed sustainability performance of infrastructure project in Nigeria with a view to tackle sustainable development issues in a comprehensive manner within the context of construction.

6. CURRENT INTEGRATED SUSTAINABILITY FRAMEWORK

6.1 Use of a Multiple-Criteria Approach for Evaluating the Sustainability Performance of Construction Projects

Ding (2005) developed a multi-criteria decision analysis approach for the measurement of project sustainable performance. A model of a sustainability index as an evaluation tool that combines economic, social and environmental criteria into an indexing algorithm has been developed. The sustainability index uses monetary and non-monetary measures to rank construction projects in terms of their contribution to sustainability. This process enables the application of the principle of trade-offs to operate in the decision-making process and thereby allows environmental values to be considered when selecting a development option. Ugwu et al. (2006) used a multiple-criteria approach to evaluating the sustainability performance of infrastructure projects. In many countries, such as Austria, Belgium, Greece and Netherlands in the European Union, it is a requirement to integrate the objects of economic, social and environmental development into a multiple-criteria decision analysis approach when evaluating transport projects (OECD, 2001).The multi-criteria approach provides a structured way of taking into account large amounts of both quantitative and qualitative information required for the comparison of options. The approach has proved valuable in providing help and guidance to the decision-maker in discovering the most desirable solution to a decision problem where several, often conflicting, criteria must be taken into consideration (Belton and Stewart, 2002).

6.2 Difficulties in the Application of Evaluation Approaches for Assessing Project Sustainability

The above discussion present typical existing methods for evaluating project performance, including economic, analysis, financial analysis, environmental impact assessment and life cycle analysis. Whist these methods can help to assess the performance of construction projects in multiple dimensions such as social, economic and environmental aspects, the typical weakness in these applications is that the method is often used in separation. Emphasis on sustainable development is placed in the balance together with the project performance of social development, economic development and environmental sustainability. However, fragmentation in using these evaluation principles cannot bring cohesive result. Fragmentation in assessing a project can entail consequence whereby the implementation of projects, particularly infrastructure types such as highway, will cause serious environmental pollution due to the over emphasis given to meeting the needs of economic and social development. On the other hand, if the implementation of a highway infrastructure projects only aims at environmental goals, it may lead to loses of economic benefits. In other cases, a highway infrastructure project may aim only at improving economic efficiency in a particular region and may then run counter to objectives related with social equity and cohesion.

Keeping the evaluation techniques of economic, social and environmental performance brings about the independence of each aspect of the project appraisal, which is aimed only at one particular aspect. Separate appraisals may no doubt be preferred by decision makers who opt for more discretion in one aspect when making decision. However preferences for individual aspect often assumed without proper justification and thus mistaken decisions can result.

Separate evaluation of a project's economic, social and environmental performances is often conducted at different stages in time by different groups or specialist without sufficient exchange of information. Different project participant often practice their management activities and emphasize their individual viewpoints in isolation. Lack of coordination and less consideration of the relationships between these aspect increase the risk of omission or overlap, and often result in adversarial relationships among various construction and management participants when the project is implemented, making it difficult for the different project stakeholders to act in unity to improve project performance in practice. This is echoed in previous studies (Scholten and Post, 2002).

In conclusion, the discussion that relates to the use of multi-criteria approach for evaluating sustainability performance of infrastructure projects(in Section 2.7.1) of this chapter has also pointed out that the use of a multi-criteria approach can give cohesive consideration between environmental, social and economic dimensions when project performance is evaluated. And there are several methods available for this purpose. However, as Hong (2008) pointed out, one major weakness in applying such methods is that they do not consider the impact of dynamic interactions between various factors which affect the project performance over time. There are various uncertainties in the whole process of implementing a project, such as a highway infrastructure, and it is important to consider these dynamic factors in appraising the project performance.

The identification of the critical issues affecting performance and the understanding of their relationships is most important in conducting proper performance evaluation. Therefore there is a need for an appropriate measure in conducting infrastructure project assessment by taking into account various issues. The use of this evaluation approach is particularly important for large-scale infrastructure projects involving very substantial investment and a long period of construction and operation. Perhaps the contribution that that this work offer through the use of this approach can not only consider collectively all project performance dimensions - economic, social and environmental concerns - but also identify the sustainability issues that affects infrastructure across its life cycle.

7. RESEARCH METHOD

The research adopted a quantitative approach using a project sustainability performance checklist that was developed by Shen et al (2007) to assess sustainability performance of infrastructure in Nigeria. The framework set out in form of a checklist provides one with a means of assessing sustainability performance against identified Economic sustainability factors (ESF), Social sustainability factors (SSF) and Environmental sustainability factors (EnSF) and is meant to comprehensively capture project throughout a complete life cycle. Given each phase of completed infrastructure project, each sustainability dimension (economic, social and environmental) on the checklist has a number of indicators which were required to be measured on a five point scale. Using a structured questionnaire, respondents were asked to indicate on a 5-point likert scale, their assessment of sustainability performance of the infrastructure projects they have been involved with.

Using a simple random sampling procedure, the questionnaires were administered to construction industry professionals in Federal Capital Territory, Abuja, Nigeria.. Following the examples of Xiao (2002) and Nwokoro and Onukwube (2011), the sample frame is the total number of practicing professionals in the built industry in Abuja. The region was selected on the premise that it is one of the fastest growing capital and cosmopolitan city with vast construction activity and construction professional as established by Dada (2005) and Oladapo (2006). The influx of people has also brought about increased infrastructure demand.

7.1 Determination of Sample Size

To ensure adequate representation of information collected, the sample used in this survey was drawn primarily from the directories of professional organisations in the federal capital territory-Abuja. A total of 5740 practicing professionals registered with their respective professional bodies were however obtained. Because it was impractical to collect data from all these professionals in the population, sampling was necessary to make the survey possible. In order to determine a suitable size for the sample, the following formula from Czaja and Blair (1996) and Creative Research Systems (2003) was applied:

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

Where: N = sample size, Z = standardised variable, P = percentage picking a choice, expressed as a decimal, C = confidence interval, expressed as a decimal.

As with most other research, a confidence level of 95% was assumed (Munn and Drever, 1990; Creative Research Systems, 2003). For 95% confidence level (i.e. significance level of $\alpha = 0.05$), $z = 1.96$. Based on the need to find a balance between the level of precision, resources available and usefulness of the findings (Maisel and Persell, 1996), a confidence interval (c) of ±10% was also assumed for this research. According to Czaja and Blair (1996), when determining the sample size for a given level of accuracy, the worst case percentage picking a choice (p) should be assumed. This is given as 50% or 0.5. Based on these assumptions, the sample size was computed as follows:

$$N = \frac{1.96^2 \times 0.5\,(1 - 0.5)}{0.1^2} \qquad N = 96.04$$

The sample size is now approximately 94. To make a round figure and ensure optimal result from the professionals identified, 100 questionnaires were administered.

7.2 Method of Analysis

Each of the sustainability factors (economic, social and environmental) is measured by a number of performance indicators. One consideration in selecting a proper method for analysis is that it should not give rise to rather heavy computations and complex algorithms in the assessment exercise. For this purpose, a 'Weighted Summation or mean' method, which is one of the simplest multi-criteria evaluation methods, is adopted to calculate the values of sustainability performance (Hong, 2008).Weighted mean represent the statistical technique used to determine the average responses of the different options provided in the various parts of the survey questionnaire used. The method is used in conjunction with the Likert Scale.

The following were used as the basis for interpretations of the computed weighted mean.1.00 – 1.50 Poor performance; 1.51 – 2.50 Low performance; 2.51 – 3.50 Moderate performance; 3.51 - 4.50 High performance; 4.51 - 5.00 Very high performance.The responses from experts enabled the calculation of average responses (weighted mean) of the different options provided. Furthermore, both the reliability and validity of the survey data were checked. The test for reliability is important because they form the basis of the adequacy of the information from the questionnaire survey. In general, reliability is estimated by examining the consistency with which the respondents express their rating(Shen, Wu, & Zhang, 2011). The inter-rater reliability (IRR) test became necessary as it provided a way of quantifying the degree of agreement between the respondents who make independent rating of the factors. In this study, the Cronbach's alpha coefficient method was used to test the reliability of the classification the factors presented for assessment. A previous study suggests that a value of Cronbach's alpha of 0.7 or higher normally indicate a reliable classification (Ceng and Huang, 2005).

8. RESULTS AND DISCUSSIONS

8.1 Characteristics of Respondents

A total of 100 questionnaires were administered to respondents in government establishments, contracting organisations, consultancies and professionals in private practice. The questionnaire is divided into two sections; the first section of the questionnaire relates to the demographic background of the respondents while in the second section respondents were required to indicate their perception of the sustainability performance of the infrastructure projects that they have been involved in the pastby ticking any of the scale of 1-5, 1 being poor performance and 5being very high performance. Table 1 shows the breakdown of the respondents by profession and responses received from respondents.

Table 1: Response to survey by profession

Respondents	Distribution	Responses	Percent
Architects	20	16	22.22
Builders	20	14	19.44
Quantity Surveyors	20	20	27.78
Engineers	20	12	16.67
Others	20	10	13.89
Total	**100**	**72**	**100.00**

Table 2: Qualification of Respondents

Qualification	Number	Percentage
HND/B.Sc only	12	16.67
HND/B.Sc plus relevant professional qualification	41	56.94
Postgraduate Qualification	19	26.39
Total	**72**	**100.00**

From table 2, at least 56% of the respondents had a first degree and professional qualification while about 26% had post graduate qualifications. About 36% (26) of the respondents have had over 21years of work experience in the construction industry and about 52% have work between 11 to 20 years. This lends credibility to the response generated in this survey.

8.2 Respondents' Response on the Infrastructure they have specialised in

The different range of infrastructure on which respondents based their assessment include power supply, highways, railways, rural and urban electrification, telecommunication, housing and urban development, education, health care facilities, airports/ports, water supply resources, integrated infrastructure and others. The result shows 44 (61%) have been engaged in connection with housing and urban development, 9 (12.5%) respondents linked their assessment to integrated infrastructure project the rest 26.5% were spread across other infrastructure. Though the study is carried out to assess infrastructure projects, the result here indicate that more implication can be drawn with reference to housing and urban development.

8.3 Respondents' assessment of sustainability performance of infrastructure projects

The study covers majorly knowledge acquired by professionals on completed infrastructure project with respect to their sustainability performance in Nigeria. Built industry professionals‟ perception is assessed in order to make an empirical judgment on sustainability performance of infrastructure.

Respondents‟ indicated their perception on the sustainability performance of the infrastructure projects that they have been involved with in the past forms the basis for analysis and these were collated and harmonised (Table 3). Furthermore, the responses on housing and urban development were considered being the most prevalent sector that the respondents were engaged in.

The table shows the weighted mean (W.M), standard deviation (S.D), ranking(R) and the performance of the factors. The table shows that the weighted means of the respondents‟ perception of the degree of sustainability performance of infrastructure projects falls between 3.86 and 2.85. From the categorisation of the weighted mean given in chapter three, this indicates that all the factors of sustainability performance of infrastructure have been adjudged to perform either moderately or high. The dispersion of values about a central value, i.e., the weighted mean, permits an assessment of the strength of the collective respondents‟ perceptions, thus, as indicated by Tastle et al. (2005) a collective set of ordinal scale values that yield a narrow dispersion can logically be viewed as possessing a greater agreement. The low values for standard deviation indicate a high degree of consistency in respondents‟ opinion.

Table 3: Assessment of sustainability performance of infrastructure projects (Inception Phase)

Project Inception Phase					
ESF – I		.M	.D	nk	Performance
Supply and demand	Evaluating local, regional, national, and even global market supply and demand of similar products/projects and in the future current	.58	835	2	High
Marketing forecast	Predicting market size, pricing, marketing strategies, and marketing targets	3.43	.932	1	Moderate
Scale and business scope	Project scale and the business scope during project operation are essential attributes to the project profitability	3.67	.787		High
Effects on local economy	A project should serve both the local economy and take advantage of the infrastructure in the local economy to generate economic benefits	3.78	1.01		High
Life cycle cost analysis	Analysis should not be given to elementary but total cost for building-up, operating, maintaining, and disposing a construction project over its life	3.60	1.00	1	High
Life cycle profit analysis	Analysis should not be focused on stage or sectional profits but the total profit from operating a construction project across its life cycle	3.72	.923		High
Capital budget	Capital budget should be defined to planning and controlling project total cost	3.61	.943	0	High
Finance plan	Defining and planning project finance schedule, for example, when, how, and how much to finance	3.60	1.04	1	High
Investment plan	Arrangement of fixed and liquid capital for investment, and a cash flow plan at project inception stage	3.69	.922		High
SSF – I					
Land use	Considering that the land selection for project site should protect cropland and natural resources	3.51	.872	6	High
Conserving cultural heritage	Avoiding negative impacts from project development on any cultural heritage	3.49	.919	8	Moderate
Employment	Project implementation should be able to provide local employment opportunities	3.74	.964		High
Infrastructure capacity-building	The project improves local infrastructure capacity, such as drainage, sewage, power, road, and communication, transportation, dining, recreation, shopping, education, financing, and medical	3.44	1.01	0	Moderate
Community amenities	Provision of community amenities for the harmonization of new settlements and local communities	3.42	1.03	2	Moderate
Safety assessment	Assessment should be conducted to identify any future safety risks to the public and project users	3.64	.997		High
EnSF-I					

Eco-environmental sensitivity	Avoiding as much as possible the irretrievable impacts on the surroundings from implementing a project	3.22	.04	7	Moderate
Ecological assessment	Examining potential ecological risks and benefits associated with the proposed project	3.28	.02	2	Moderate
Air assessment	Examining potential air pollution from the proposed project and its impact on the local climate.	3.12	.09	4	Moderate
Water assessment	Examining potential water pollution from the proposed project, including both surface and ground water, and project's consumption on water resources	3.39	.943	4	Moderate
Noise assessment	Examining potential noise pollution during both project construction and operation stages	3.03	.02	0	Moderate
Waste assessment	Examining waste generation at both project construction and operation stages	3.29	.926	1	Moderate

Table 4: Assessment of sustainability performance of infrastructure projects (Design Phase)

Project Design Phase					
ESF – II		.M	.D	nk	Performance
Consideration of life cycle cost	Consider the total cost involved in project life cycle, including site formation, construction, operation, maintenance cost and demolition cost	.69	.944		High
project layout	Consideration being given to standard dimension in design specifications	.86	.969		High
Materials choice	Consideration being given to economy, durability and availability for material selection	.51	.934	6	High
SSF – II					
Safety design	Considerations are given in designing process for emergencies such as fire, earthquake, flood, radiation, and eco-environmental accidents	.33	.04	8	Moderate
Security consideration	Installation of security alarm and security screen	.25	.96	5	Moderate
EnSF – II					
Designer	Knowledgeable of energy savings and environmental issues	.33	.993	8	Moderate
Life cycle design	Effective communications among designers, clients, environmental professionals, and relevant governmental staff to ensure all environmental requirements are incorporated into the design process	.36	.924	6	Moderate
Environmentally conscious design	Incorporation of all environmental considerations into project design for construction, operation, demolition, recycling, and disposal	.12	.992	4	Moderate
Modular and standardised design	Use of modular and standardised components to enhance buildability and to reduce waste generation	.93	.998	6	Moderate

Table 5: Assessment of sustainability performance of infrastructure projects (Construction Phase)

Project Construction Stage					
ESF – III		.M	.D	nk	Performance
Loan interests	Consideration given to the interests for the capital cost paid for both a fixed loan and liquid capital	.31	.988	0	Moderate
Opportunity cost	Fixed and liquid capital tied up to project will loose opportunities of investing in other projects	.6	.833	1	High
Labour cost	Salaries paid to human resources, such as general construction workers, plumbers, carpenters, masons, etc.	.47	.888	9	Moderate
Professional fees	Fees paid to various professionals and consultants such as engineers, environmental, ecological, geological, and legal experts	.56	.933	4	High
Materials cost	Costs for all types of materials such as concrete, lime, steel, timber and brick	.65	.842		High
Energy cost	Costs for consuming various types of energy such as electricity, oil, gas, coal	.43	.869	1	Moderate
Water cost	Costs for using water resources and for dealing with surface & ground water	.5	.822	7	Moderate
Equipment cost	Costs for using various tools, vehicles, and tower cranes	.51	.919	6	Moderate

Equipment purchase cost	Costs for purchasing various equipment such as plants, elevators, escalators, and HVAC systems	.51	.993	6	High
Installation cost	Costs for the installation of all kinds of equipment and facilities	.39	1.00	6	Moderate
Site security	Various types of measures for protecting the site safety	.35	.937	4	Moderate
SSF – III					
Direct employment	Provisions of working opportunities from implementing the project to local labour market, including construction workers, professionals, & engineers	3.75	.868		High
Indirect employment	Employment generated by up-&-downstream industries & services to construction	3.51	.839	6	High
Construction safety	Safety measures, facilities, & insurance for working staff	3.56	1.01	4	High
Public safety	Provision of warning boards and signal systems, safety measures and facilities for the public	3.65	.966		High
Improvement of infrastructure	Provisions of better drainage, sewage, road, message, heating, and electrical systems	3.57	.917	3	High
Infrastructure burden	Demand for water, road, energy, services and space for implementing the project	3.53	.804	5	High
EnSF – III					
Land use pollution	Utilising land effectively and the measures taken to avoiding land pollution	.32	.853	9	Moderate
Natural habitat destruction	Protection of living environment for both human being and animals	.26	.872	4	Moderate
Air pollution	Generation of CO2, CO, SO2, NO2, and NO	.19	.799	0	Moderate
Noise pollution	Noise and vibration induced from project operation	3.21	.948	8	Moderate
Discharges/pollution	Release of chemical waste and organic pollutants to water ways	2.96	.911	5	Moderate
Waste generation	Waste produced from project operation	3.26	.964	4	Moderate
Comfort disturbance	Effects on people's living environment and the balance on eco-systems	3.08	.931	7	Moderate
Energy and resource consumption	Saving energy & resources consumption including electrical, water & resources	3.10	.906	6	Moderate
Health and safety risks	Ensure on-site health and safety by reducing the number of accidents, providing on-site supervision, and providing training programs to employees	3.35	1.04	7	Moderate
Using renewable materials	Using typical renewable materials such as bamboo, cork, fast-growing poplar, and wheat straw cabinetry, which are reproducible	3.01	.796	1	Moderate
Ozone protection	Reducing the release of chlorofluorocarbons and hydro-chlorofluorocarbons thus protecting the ozone layer	2.85	.867	7	Moderate
Off-site fabrication	Reducing on-site waste by using off-site fabrication	3.24	.927	6	Moderate
Material reuse	Reuse of building components, rubble, earth, concrete, steel and timber	3.07	.861	8	Moderate
Structural operations	Consideration being given to the reduction of earthwork and excavation, reinforcement, concreting and waste treatment during structural operation	3.07	.793	8	Moderate
Project Construction Stage					
EnSF – III		M	.D	nk	Performn
External & internal operations	Controlling environmental impacts from walling, roofing, insulation, component installation, plumbing and drainage, painting, landscaping, and waste treatment	2.97	.919	4	Moderate
Health & Safety	Emphasising on site hygiene, provision of health care	3.42	.915	2	Moderate
Project organisation	Environmental management task force, resource coordination, supervision and cooperation culture	3.33	.993	8	Moderate
Envirn'tal mgt. resources	Resource inputs for implementing environmental management, including labour, plant, materials and finance	3.11	.943	5	Moderate
Organisational policy	Establishment of environment management system, application of envrn'talmgt standards, project manuals, programs, progress control reports	3.24	.682	6	Moderate
Communication of environmental mgt information	Managing project environmental information through information management expertise and information management facilities	3.17	.888	1	Moderate
Environmental mgt technology	Environmental experts, environmental management facilities, energy and resource saving technology, pollution and waste reduction technology	3.12	.903	4	Moderate

Environmental regulations	Environmental protection law and regulations on Construction activities	3.17	.993	1	Moderate

Table 6: Assessment of sustainability performance of infrastructure projects (Operation Phase)

Project Operation Phase					
ESF – IV		.M	.D	nk	Performanc
Distribution of project income	Reinvestment, dividends, and paybacks	.26	.904	4	Moderate
Balance sheet from project	Develop a balance sheet to continuously check with the project cost and time	.22	.953	7	Moderate
Labour cost	Salaries for managerial staff, workers, professionals & Engineers	.6	.899	1	High
General expenses	Daily water, electricity, gas, and consumables	.49	.872	8	Moderate
Materials cost	Various materials for project operation and maintenance	.42	.868	2	Moderate
Logistics costs	Materials procurement, stock costs, and transportation	.58	.835	2	High
Marketing costs	Resource investment for market analysis, advertising, promotion	.06	.854	9	Moderate
Training costs	Training employees for improving the quality of human resources	.99	1.13	3	Moderate
Improvement of local econ. environment	Consideration being given to benefit economically to the local society	.22	1.08	7	Moderate
SSF – IV					
Direct employment	Costs for employing workers, managers, and professionals in project operation	3.44	.803	0	Moderate
Indirect employment	Employment associated with project operation along up-and-down stream industries	3.21	.838	8	Moderate
Provision of services	Benefits of improving living standard to local communities	3.29	.971	1	Moderate
Provision of facilities	Provision of spaces and facilities beneficial to the development of local communities	3.21	1.05	8	Moderate
EnSF – IV					
Land contamination	Release of chemical wastes through dumping and landfills	3.13	.948	4	Moderate
Air pollution	Generation of various chemicals such as CO2, CO, SO2,	3.24	1.03	6	Moderate
Water pollution	Release of chemical wastes & organic pollutants to water ways	3.25	.946	5	Moderate
Noise pollution	Noise and vibration induced from project operation	3.33	.888	8	Moderate
Waste generation	Wastes produced from project operations	3.26	.877	6	Moderate
Ecological impacts	Negative impacts from project operations to flora, fauna, and ecosystems	3.22	.843	7	Moderate
Energy consumption	Energy consumption on electrical, lighting and other energy appliances	3.38	.971	5	Moderate
Water consumption	Water usage for production of hygiene, cooling & heating	3.31	.929	0	Moderate
Raw material consumption	Use of both renewable and non-renewable raw materials	3.08	.884	7	Moderate
Training to employees	Providing various environmental education and training programs to different levels of employees	3.00	.949	2	Moderate
Envirt'l friendly operation of f	Improving productivity, reducing the generation of pollution, & reducing resource consumption facilities	.08	.96	7	Moderate

Table 7: Assessment of sustainability performance of infrastructure projects (Demolition Phase)

Project Demolition Phase					
ESF – V		.M	.D	nk	Performance
Labour cost	Human resources provided for planning, managing and operating project demolition	.41	.950	3	Moderate

Energy used for demolition	Crushing, transporting and relocating	.44	.712	0	Moderate
Waste disposal costs	Costs for waste loading and unloading, transportation, charges for disposals	.58	.839	2	High
Compensation to project stakeholders	Compensating to affected parties during demolition process	.31	.950	0	Moderate
Dissolve/deploy project staff	Provision of pensions, unemployment compensation	.11	.979	5	Moderate
Compensation to the polluted environment	Compensation made for the damaged environment to the local residents, land, water, and ecosystem	.06	1.05	9	Moderate
Land value for redevelopment	The value of the land after demolition for re-development	.21	1.01	8	Moderate
Residual value	Valuable residues, such as steel, brick, timber, glass, equipment for reuse and recycle	.03	1.03	0	Moderate
SSF – V					
Land for new development	Provision of land upon the completion of demolition to allow new project in line with the demands of local community	.2	.839	9	Moderate
Job opportunity	Provision of jobs during project demolition for site work, transportation and disposal	.27	.844	3	Moderate
Operational safety	Presence of safety risks to labours and the public during project demolition from explosion, dismantling, toxic materials, and radioactive materials	.21	.844	8	Moderate
Communication to the public	Promotion on the public awareness of the project demolition and the possible impacts to the public	.2	.995	9	Moderate
EnSF – V					
Demolition plan	Adequate demolition plan on hazard materials and waste reduction or recycle	3.10	.06	6	Moderate
Demolition control	Supervision and control on the demolition activities to protect the environment	3.31	.965	0	Moderate
Environment-friendly demolition method	Adoption of technologies to alleviate the disturbance on eco-environment systems and neighbourhood, and to maximise waste reusing and recycling	3.15	.09	2	Moderate
Environmental information & policy	Communication of Knowledge about environmental policies, regulations, legislations, and environmental techniques	3.11	.05	5	Moderate
Waste classification	Classification of demolition wastes for enabling effective treatment and disposal	3.14	.15	3	Moderate
Special waste treatment	Special treatment given to toxic materials, heavy metals, radioactive chemicals released from demolition	3.15	.1	2	Moderate
Waste recycling and reuse	Recycling and reclaiming of useful materials such as steel, brick, glass, timber, and some equipment	3.01	.1	1	Moderate

9. RELIABILITY ANALYSIS

The Cronbach's alpha coefficient method was used to test the data reliability. Cronbach's alpha is helping to determine whether it is justifiable to interpret scores that has been aggregated together. The calculation results show that the Cronbach's alpha coefficients are between 0.971 and 0.972. This value is considered optimally sufficient to make interpretation since they are more than 0.7.

10. DISCUSSIONS

The analysis of the survey response produced the weighted mean performance values for 112 factors for economic, social and environmental sustainability cut across five phases of project life cycle. The values of the weighted mean (weighted sustainability score) range from 2.85 to 3.86.

This can be interpreted as saying the sustainability performance of infrastructure project is satisfactory in Nigeria as practically all the values from respondents' data indicate moderate performance to high performance. This assessment applying generally to infrastructure projects can assist project clients, decision makers in evaluating the total sustainability performance of infrastructure and diagnosing the performance of key factors.

From the analysis above, while the application of the tool has identified within each sustainability aspect at least two factors with highest weighted performance value, it has also identified factors with the least weighted performance value. Within the economic dimension, they include "Project layout, i.e. the consideration being given to standard dimension in design specifications. The performance of this particular requirement is considered crucial as a recent finding by Shen et al. (2007) show that design process affects largely the project sustainability performance. For example, the design specifications affect functional performance of building components such as air conditioners, ventilation, lighting, electrical, heating, fire and water systems. The study by Ibrahim and Price (2005) also demonstrate that the aspect of building layout also has potential impact on the sustainability of infrastructure. It is therefore apparent that good adherence is given to translating dimensions in design specification to what is constructed. The second high ranking factor: effect on local economy (3.78), illustrates that the implementation of infrastructure projects ought to serve both the local economy and at the same time take advantage of the infrastructure in the local economy to generate economic benefits, this is deemed to be doing well.

The implementation of infrastructure projects has social impact in many regard. For example Kessides (1993) and Hong (2008) clearly noted that the provision of infrastructure affect labour productivity and access to employment, and thus the capacity to earn future income and increasing consumer demands. The result of the analysis within sustainability dimension supports this assertion as the factors with the highest value ranked to by respondents related to employment; at the construction phase is the 'direct employment' with a weighted performance score of 3.75 and at the inception phase is 'employment' factor with 3.74 score. While the first relate to the employment opportunities gained from implementing the project to the local labour market, including construction workers, professionals, and engineers. The second is connected with the ability of providing local employment opportunities arising from project implementation. Hong (2008) has therefore put forward that more employment opportunities will be provided directly or indirectly with the implementation of infrastructure projects especially in Nigeria which records high unemployment rate (Zuofa et al, 2012).

From the 50 environmental sustainability factors which form the basis for respondents' assessment, health and safety is ranked most performed. That is to say emphasis on site hygiene, provision of health care is given adequate attention in the implementation of infrastructure project, this finding contrast the studies of Fang et al. (2001) and Shen et al.(2011) who advocate for measure for poor safety management. The weighted performance value 3.42 though is indicative of the need for concerted towards improving health and safety. The other factor also ranked high is 'water assessment' at the inception stage. This relates to the examination of potential water pollution from the proposed project, including both surface and ground water, and project's consumption on water resources.

Shen and Tam (2002) observed that the control of environmental impacts from construction has become a major issue to the public. From this, it is obvious that the implementation of infrastructure projects take into account environmental protection through proper water assessment.

The identification of factors that positively affect sustainability performance of infrastructure projects though important for several reasons, equally important is those factors that have adverse effect on sustainability performance of infrastructure. The use of the tool has also identified factors that respondents' assessments have shown to moderately perform and thus will require action/improvement. The factors include ozone protection (2.85); modular and standardised design (2.93); discharge of water (2.96); external and internal operations (2.97) i.e. the control of environmental impacts from building elements, component installation, waste treatment etc., and training cost (2.99).

By examining performance across the three sustainability dimensions, it can be found that the economic factors show better performance than the social and environmental factors. The average weighted performance value for all the economic, social and environmental factors stand as 3.45, 3.43 and 3.18 respectively. It can therefore be said that considering the impact of sustainability performance from dynamic interaction between the factors economic, social and environmental standpoint, the performance level of economic factors is higher while that of the environmental sustainability factor is viewed least, This is not entirely a surprise given that scores of reports on environmental related problems have been widely identified and reported.

11. CONCLUSION

Infrastructure projects play major role in economic, social and environmental activities particularly in developing countries like Nigeria. The assessment of their sustainability performance deserves to be properly addressed. However, due to lack of effective assessment indicators in practice and failure to integrate the three major themes of sustainability, infrastructure projects are not assessed effectively vis-à-vis their sustainability performance. Using a well-captured integrated and holistic approach found in literature, this study revealed that sustainability performance of infrastructure projects in Nigeria fall within moderate performances to high performance. In assessing the sustainability performance of infrastructure projects in Nigeria, this study has also identified factors that affect the performance of sustainability performance. It is acknowledged that effective sustainability performance can only be achieved when there is a common basis of information and knowledge of project sustainability. This work is therefore presented in a way that would assist project participants with the following; (i) understand major factors affecting project sustainability performance in a consistent and holistic way, (ii) contribute to sustainability performance of infrastructure projects and (iii) provide sustainability information that facilitates adequate decision making toward sustainable development.

The following recommendations are proffered based on the findings in this study:

i. The Nigerian construction industry should propose principles for policy formulation in order to improve sustainability performance of infrastructure projects.
ii. The approach presented in this research would enable professionals, decision-makers to analyse and evaluate in a holistic manner factors that affect sustainability performance.

12. REFERENCES

Abelson, P (1995) Cost benefit analysis of proposed major rail development in Lagos, Nigeria Transport reviews: a Transnational Trans-disciplinary Journal Vol. 15, No. 3, 265-289

Akintayo, O., Onajite, J.G. and Olusola, B.S. (2011) An evaluation of the trend of budgetary allocations for infrastructural development in Osun state, south-western, Nigeria In: Laryea, S., Leiringer, R. and Hughes, W. (Eds.) Proc. West Africa Built Environment Research (WABER) Conference, 19-21 July 2011, Accra, Ghana, 105-117.

Ameh, S. Dania, A. Zubairu I. and Bustani, S. (2010) Sustainable Construction Education: Assessing the Adequacy of Built Environment Professional‟s Training In: Laryea, S., Leiringer, R. and Hughes, W. (Eds) Procs. West Africa Built Environment Research (WABER) Conference, 27-28 July 2010, Accra, Ghana, 509-23.

Bala, K., Ibrahim, A.M., Ibrahim, Y.M.(2008b) Whole Life-Cycle Costing of Proposed Building Projects in the Nigerian Construction Industry, Journal of Engineering and Applied Sciences, Medwell Journals, 3(9): pp 676-683.

BRE (British Research Establishment Limited) (1998), The Building Research Establishment Environmental Assessment Method, British Research Establishment Limited, London

Calderon C. and Serven, L. (2004) The Effect of Infrastructure development on growth and income distribution.www.urbaninfrastructureindia.org/pdf/1-urban&goverance_web.pdf. Assessed 12/01/2013.

Creative Research Systems (2003) The survey system, http://www.surveysystem.com/sscalc.htm (accessed December 12, 2012)

Czaja, R. and Blair, J. (1996) Designing surveys: a guide to decisions and procedures, Thousand Oaks, California; London, Pine Forge Press.

Dada J.O. (2005) An Assessment of Risk Factors in the Procurement of Building Projects in Lagos and Abuja. Unpublished MSc. thesis, Department of Quantity Surveying, ObafemiAwolowo University, Ile-Ife, Nigeria.

Dania, A.A. Kehinde, J. O. and Bala, K. (2007) A study of construction Material Waste Management Practices by Construction Firms in Nigeria. PRoBE 07 Glasgow Caledonian University, Glasgow, UK 20th-22nd November, 2007. Pp. 121-129.

Du Plessis, C. (2002) Agenda 21 for Sustainable Construction in Developing Countries –A discussion document.CIB Information Bulletin Nr.2/01.

Essa, R and Fortune, C (2005) Project price forecasting and the evaluation of housing association projects for sustainable benefit.In Proc. of Postgraduate Researchers of the Built and Natural Environment (PRoBE) (Eds) Egbu O.C. and Tong M.K.L. Glasgow Caledonian University, Scotland, UK.

Fang D.P., Huang X. Y., and John C.W. (2001).Review of the Researches of Construction Safety Management. Journal of Safety & Environment, 1(2), 25-32.

Hill, R.C. and Bowen, P. A. (1997), "Sustainable construction: principles and framework for attainment", Construction Management and Economics (1997) 15, 223-239.

Hong, Y. (2008) A dynamic approach for evaluating the sustainability performance of infrastructure projects. Unpublished thesis submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy. Dept. of Building and real estate, the Hong Kong Polytechnic University.

Ibrahim A.D. and Price A.D.F. (2005) Impacts of social and environmental factors in the procurement of healthcare infrastructure.In Proceeding of Postgraduate Researchers of the Built and Natural Environment (Eds) Egbu O.C. and Tong M.K.L. Glasgow Calendonian University, Glasgow Scotland, UK. 15

Ibrahim, A. M., Bala, K., Ibrahim, Y.M. and Ibrahim A.D. (2010) Evaluating the characteristics of whole life-cycle cost data in the Nigerian construction industry. In: Laryea, S., Leiringer, R. and Hughes, W. (Eds) Procs. West Africa Built Environment Research (WABER) Conference, 27-28 July 2010, Accra, Ghana, 321-30

Kessides, C. (1993) "The contributions of infrastructure to economic development: a review of experience and policy implications", World Bank Discussion Papers, available at http//www-wds.worldbank.org/servlet.

Kibert, C. J. (1994) Establishing principles and a model for sustainable construction.In Proc of First International Conference of CIB TG 16 on sustainable Construction. Tampa, Florida, USA, 6-9 November, pp.3-12, Pp. 3–12.

Maisel, R. and Persell, C. H. (1996) How sampling works, Thousand Oaks, California, Pine Forge Press.

Miyatake, Y. (1996) Technology development and sustainable construction, Journal of Management in Engineering, July/August. Vol. 12, No. 4, pp. 23 – 27.

Munde, G. (2003) "Measuring sustainability" A multi-criterion framework.Manuscript in Environment, Development and Sustainability Journal.

Munn, P. and Drever, E. (1990) Using questionnaires in small-scale research: A teachers' guide, SCRE, Edinburgh.

Nwafor, J.C. (2006) Environmental Impact Assessment for Sustainable Development. Enugu: Eldermark Publishers.

Nwokoro, I. and Onukwube, .H (2011) Sustainable or Green Construction in Lagos, Nigeria: Principles, Attributes and Framework. Journal of Sustainable Development, Vol. 4 No. 4

OECD (Organisation for Economic Economic Co-oeration and Development) (2006), infrastructure to 2030: telecom, land transport, water and electricity, organization for economic Co-operation and development, Paris.

OECD (Organization for Economic Co-operation and Development) (2001a), Sustainable development: Critical issues, Organization for Economic Co-operation and Development, Paris.

Ofori G. (2000) Greening the construction supply chain in Singapore. European Journal of Purchasing & Supply Management 6 (2000) 195}206

Oladapo, A.A (2006) the impact of ICT on professional practice in the Nigerian construction industry.The Electronic Journal on Infromation Systems in Developing Countries.Vol 24(2) 1-19

Oscar, O. Francesc, C and Guido, S (2011) Sustainability assessment within the residential building sector based on LCA and MFA: the experience in a developed (Spain) and a developing country (Colombia). http://www.lcm2011.org/papers.html?...Sustainability_assessment_within_t... Accessed 12/12/2012

Owabukeruyele, W.S. (1999) "The cost benefit analysis of a low income residential housing in a mangrove and wetland forest reserve. Unpublished research submitted to graduate school of environmental studies. University of Strathclyde, Glasgow, Scotland.

Prasad, D. and Hall, M. (2005). The Construction Challenge: Sustainability in Developing Countries.

Roodman, D. M. and Lenssen, N. (1995) World Watch Report 124, A building revolution: how ecology and health Concerns are transforming construction. World Watch Institute, March. 16

Shen, L. Y. and Tam, W. Y. V. (2002) Implementing of environ- mental management in the Hong Kong construction industry. International Journal of Project Management, 20(7), p. 535–543

Shen, L. Y., Wu, Y. Z., Chan, E. H. W., and Hao, J. L. (2005), "Application of system dynamics for assessment of sustainable performance of construction projects", Journal of Zhejiang University Science, 2005 6A (4): 339-349

Shen, L.Y, Hao, J.L., Tam V.W.,and Yao, H. (2007) A checklist for assessing sustainability performance of construction Projects. Journal of civil engineering and management Vol. XIII,No 4, 273–281http:/www.jcem.vgtu.lt.

Shen, L.Y., Wu, Y., and Zang, X. (2011) Key Assessment Indicators for the Sustainability of Infrastructure Projects.Journal of Construction Engineering and Management.

Tastle, W.J. Russell, J and Wierman, M.J. (2005) A New Measure to Analyze Student Performance Using the Likert Scale. Proc. of Information Systems Education Conference ISECON 2005, v22 (Columbus Ohio): ISSN: 1542-7382 (refereed)

Ugwu, O.O and Haupt, T.C. (2007) "Key performance indicators and assessment methods for infrastructure sustainability- A South African construction industry perspective", Building and Environment, Vol. 42, No. 2.

USGBC (US Green Building Council) (2001), Leadership in Energy and Environmental Design-rating System, US Green Building Council, Washington, DC.

WCED (World Commission on Environment and Development) (1987), Our Common Future, Oxford University Press, Oxford.

World Bank (1994) World development report 1994 –infrastructure for development, Oxford University Press for the World Bank, Washington, DC.

World Bank Group. (2008). Sustainable infrastructure action plan, FY 2009-2011. The International Bank for Reconstruction and Development, the World Bank Group, World Bank, July 2008.

Xiao, H. (2002) A comparative study of contractor performance based on Japanese, UK and US construction practice, PhD thesis, SEBE, University of Wolverhampton, Wolverhampton.

Zuofa, T., Ochieng, E.G. and Awuzie, B.O. (2012) Stakeholder perception of risks and risk factors in infrastructural projects: The case of the Niger Delta In: Laryea, S., Leiringer, R. and Hughes, W. (Eds) Procs (WABER) Conference, 19-21 July 2011, Accra, Ghana.

Journal of Construction Project Management and Innovation Vol. 4 (S1): 934-948, 2014
ISSN 2223-7852

IMPACTS OF CONSTRUCTION ACTIVITIES ON THE ENVIRONMENT: THE CASE OF GHANA

Simon Ofori AMETEPEY[1] and Samuel Kwame ANSAH[2]

[1]Faculty of Technical Education, University of Education, Winneba, P. O. Box 1277, Kumasi, Ghana, PH (+233) 0244975790, E-mail: oforipmp@gmail.com

[2]Department of Building Technology, Cape Coast Polytechnic, P. O. Box AD 50, Cape Coast, Ghana, PH (+233) 0246769673 E-mail: skansah@hotmail.co.uk

ABSTRACT

Construction activities impact on the environment throughout the life cycle of development. These impacts occur from initial work on-site through the construction period, operational period and to the final demolition when a building comes to an end of its life. Even though the construction period is comparatively shorter in relation to the other stages of a building's life, it has diverse significant impacts on the environment. This study investigates the major impacts of construction activities on the environment in Ghana. Thirty-three possible impacts of construction activities on the environment were identified from literature. These impacts were further categorized into nine major groups and were subjected to a cross-sectional survey. Questionnaire and interview were used to elicit the views of respondents. Questionnaires were distributed to 100 randomly selected construction practitioners made up of 58 architects, 37 quantity surveyors and 5 structural engineers registered with their professional bodies. Semi-structured interview was conducted amongst purposively selected contractors and consultants. The respondents were asked to identify the most important environmental impacts. The relative importance of the impacts identified were calculated and ranked by the relative importance index. According to the results of the study, the respondents agreed that resource consumption group impacts ranked highest among the major impacts of construction activities on the environment in Ghana. The resource consumption group impacts were raw materials consumption, electricity consumption, water consumption and fuel consumption. Biodiversity impact was second followed by local issues impacts. The paper recommends that stakeholders in the construction industry should come up with special legislations, codes or standards relating to sustainable construction practices specific to Ghana's construction environment and ensure proper and effective implementation.

Keywords: Construction Activities, Construction industry, Environment, Ghana, Impact

1. INTRODUCTION

Environmental deterioration has captured the world's attention and has been one of the most discussed subjects locally, nationally and globally (Bentivegna et al., 2002). Langston and Ding (2001) posited that the world is in crucial environmental catastrophe.

The increase in population and the quest for development such as the built environment has resulted to ozone layer depletion, global warming, resource depletion and ecosystem destruction (ibid). This has put the built environment and the construction industry under the spotlight since its activities significantly impact on the environment.

Construction activities affect the environment throughout the life cycle of development. These impacts occur from initial work on-site through the construction period, operational period and to the final demolition when a building comes to an end of its life. Even though the construction period is comparatively shorter in relation to the other stages of a building's life, it has diverse significant effects on the environment. For that matter, there is progressively growing concern about the impact of construction activities on human and environmental health. Even though, construction project development potentially contributes to the economic and social development, and enhancing both the standard of living and the quality of life, it is also associated with deterioration of the environment (Azqueta, 1992).

The state of affairs of the construction industry in Ghana is not quite different from other developing countries. The focus of the Ghanaian construction industry is largely on economic growth and improving the quality of life of the people whilst environmental protection is utterly downgraded. The GDP released for the third quarter of 2012 by the Ghana Statistical Service, indicates that the construction industry contributed 19.2% to the economy. Accordingly, the construction industry was the second largest sector in the Ghanaian economy illustrating its contribution to the social and economic gains whilst its negative contribution to the environment is absolutely neglected. In spite of the social and economic gains, construction activities extend beyond the erection of houses, hospitals, schools, offices and factories to civil engineering works such as roads, bridges and communication infrastructure which support the economy. In meeting these demands, the Ghanaian construction industry exerts enormous pressures on global natural resources. The environmental significance of such pressures comes into play when some of these resources are depletable and non-renewable, bringing the construction industry in direct conflict with the physical environment. Moreover, in spite of the benefits of the construction industry, unsustainable design and construction processes as well as constant degradation of the environment for construction purposes exist in Ghana (Dadzie & Dzokoto, 2013). It is against this backdrop that investigating the major impacts of construction activities on the environment in Ghana and recommending measures to minimize the impacts assume great importance. The main objective of this study is to identify the major impacts of construction activities on the environment in Ghana. The study sought to identify the perceptions of practitioners (Architects, Quantity Surveyors and Structural Engineers), consultants and contractors regarding the impacts of construction activities on the environment in Ghana and to suggest possible ways of minimizing the impacts.

2. LITERATURE REVIEW

The construction industry has a significant irreversible impact on the environment across a broad spectrum of its activities during the off-site, on site and operational activities, which alter ecological integrity (Uher, 1999).

According to Levin (1997), buildings are very large contributors to environmental deterioration. It is clear that actions are needed to make the built environment and construction activities more sustainable (Hill & Bowen, 1997; Barret et al., 1999; Cole, 1999; Holmes & Hudson, 2000; Morel et al., 2001; Scheuer et al., 2003). Therefore the analysis of the impact of the construction activities on the environment may need to look at a "cradle to grave" view point (Ofori et al., 2000).

The construction industry is one of the largest exploiters of both renewable and non-renewable natural resources (Spence &Mulligan, 1995; Curwell & Cooper, 1998; Uher, 1999). It relies heavily on the natural environment for the supply of raw materials such as timber, sand and aggregates for the building process. According to World watch institute (2003), building construction consumes 40 percent of the world's raw stones, gravel and sand and 25 percent of the virgin wood per year. It also consumes 40 percent of the energy and 16 percent of water annually. In Europe, the Austrian construction industry has about 50 percent of material turnover induced by the society as a whole per year (Rohracher, 2001) and 44 percent in Sweden (Sterner, 2002). The extraction of natural resources causes irreversible changes to the natural environment of the countryside and coastal areas, both from an ecological and a scenic point of view (Curwell & Cooper, 1998; Ofori & Chan, 1998; Langford et al., 1999). The subsequent transfer of these areas into geographically dispersed sites not only leads to further consumption of energy, but also increases the amount of particulate matter in the atmosphere.

Raw materials extraction and construction activities also contribute to the accumulation of pollutants in the atmosphere. According to Levin (1997), in the USA construction is responsible for 40 percent of atmospheric emissions, 20 percent of water effluents and 13 percent of other releases. Dust and other emission include some toxic substances such as nitrogen and sulphur oxides. They are released during the production and transportation of materials as well as from site activities and have caused serious threat to the natural environment (Spence & Mulligan, 1995; Ofori & Chan, 1998; Rohracher, 2001). Other harmful materials, such as chlorofluorocarbons (CFCs), are used in insulation, air conditioning, refrigeration plants and fire-fighting systems and have seriously depleted the ozone layer (Clough, 1994; Langford et al., 1999). Pollutants have also been released into the biosphere causing serious land and water contamination, frequently due to on-site negligence resulting in toxic spillages which are then washed into underground aquatic systems and reservoirs (Kein et al., 1999). According to Langford et al (1999), about one third of the world's land is being degraded and pollutants are depleting environmental quality, interfering with the environment's capacity to provide a naturally balanced ecosystem.

A large volume of waste results from the production, transportation and use of materials (Ofori & Chan, 1998; Kein et al., 1999). It should be noted that construction activities contribute approximately 29 percent of waste in the USA, more than 50 percent in the UK and 20-30 percent in Australia (Teo & Loosemore, 2001). According to Levin (1997), in the USA construction contributes 25 percent of solid waste generation. In the European Union, the construction industry contributes about 40-50 percent of wastes on per year (Sjostrom & Bakens, 1999; Sterner, 2002). Most construction waste is unnecessary (Sterner, 2002). He added that many construction and demolition materials have a high potential for recycle and reuse.

Nevertheless, screening, checking and handling construction waste for recycling are time consuming activities and the lack of environmental awareness amongst building professionals may create significant barriers to the usefulness of recycling (Langston & Ding, 1997). The depletion of natural resources by the building industry is a topic of serious discussion as most of the recyclable material from building sites ends up in landfill sites. Sterner (2002) stated that implementing a waste management plan during the planning and design stages can reduce waste on-site by 15 percent, and delivers cost savings of up to 50 percent on waste handling.

Besides generating waste, building activities also irreversibly transforms arable lands into physical assets such as buildings, roads, dams or other civil engineering projects (Spence & Mulligan, 1995; Langford et al., 1999; Uher, 1999). According to Langford et al. (1999), about 7 percent of the world's cropland was lost between 1980 and 1990. Arable land is also lost through quarrying and mining the raw materials used in construction. Construction also contributes to the loss of forests through the timber used in building and in providing energy for manufacturing building materials. Both deforestation and the burning of fossil fuels contribute directly to global warming and air pollution. In addition, building industry considered to be a major consumer of energy and the use of finite fossil fuel resources for this purpose have contributed significantly to carbon dioxide emissions (Clough, 1994; Spence & Mulligan, 1995; Ofori & Chan, 1998; Langford et al., Uher, 1999). In Europe, construction activities have consumed about 40 percent of total energy production (Sjostrom & Bakens, 1999; Rohracher, 2001; Sterner, 2002).

2.1 Identification of Environmental Impacts of Construction Activities

According to Chen et al. (2000), sources of pollution and hazards from construction activities can be divided into seven major types: dust, harmful gases, noises, solid and liquid wastes, fallen objects, ground movements and others. Chen et al. (2005) considered construction impacts under eight categories: soil and ground contamination, underground water contamination, construction and demolition waste, noise and vibration, dust, hazardous emissions and odours, wildlife and natural features impacts and archaeology impacts. On the other hand, Cole (2000) stated that the environmental impacts of the construction process embrace resource uses, ecological loadings and human health issues. March (1992) observed the construction industry's environmental impacts under the categories of ecology, landscape, traffic, water, energy, timber consumption, noise, dust, sewage, and health and safety hazards. Shen and Tam (2002) classified construction environmental impacts as the extraction of environmental resources such as fossil fuels and minerals; extending consumption of generic resources namely: land, water, air, and energy; the production of waste that require the consumption of land for disposal; and pollution of the living environment with noise, odours, dust, vibrations, chemical and particulate emissions, and solid and sanitary waste. According to Cardoso (2005), typical negative impacts of the construction activities include waste production, mud, dust, soil and water contamination and damage to public drainage systems, destruction of plants, visual impact, noise, traffic increase and parking space shortage and damage to public space.

From the review above, it is apparent that there is no single approach regarding the environmental impacts associated with the construction process in the literature.

Eco-Management and Audit Scheme (EMAS) regulation (Gangollels, n.d.) provides a standardized and comprehensive list of environmental aspects covering almost all the previous mentioned environmental aspects. So finally, guidance provided in EMAS regulation was used to initially identify generic environmental impacts: (1) emissions to air, (2) releases to water, (3) avoidance, recycling, reuse, transportation and disposal of solid and other wastes, particularly hazardous wastes, (4) use and contamination of land, (5) use of natural resources and raw materials (including energy), (6) local issues (noise, vibration, odour, dust, visual appearance, etc.), (7) transport issues, (8) risks of environmental accidents and impacts arising, or likely to arise, as consequences of incidents, accidents and potential emergency situations and (9) effects on biodiversity. However, environmental impacts coming from EMAS regulation had to be customized to the construction processes and for this reason an exhaustive preliminary analysis with a process-oriented approach (Zobel & Burman, 2004) was carried out. Environmental impacts provided in EMAS regulation were analysed for the entire construction process.

3. RESEARCH APPROACH

The study adopted the concurrent mixed study design (Quantitative and Qualitative). Quantitative research investigates facts and tries to establish relationships between these facts. While qualitative research is a subjective assessment of a situation or problem, and takes the form of an opinion, view, perception or attitude towards objects. A combination of quantitative and qualitative approach is advocated because it takes advantage of the strengths in the two approaches while limiting the weaknesses. Quantitative study of human phenomena can only give frequencies of occurrences of certain observable manifestations of the phenomena without explaining why they occur. Therefore it is important to also adopt a qualitative research paradigm to compensate for the limitations of using quantitative approach for a study.

3.1 Sample Selection

Three categories of practitioners within the construction industry were chosen for the quantitative study which included architects, quantity surveyors and structural engineers. The study design led to a choice of only practitioners who are members of their various professional bodies thereby giving a research population of Architects, Quantity surveyors and Structural engineers who are members of their respective professional bodies i.e. Ghana institution of architects, Ghana institution of surveyors and Ghana institution of engineers. Stratified sampling procedure was applied to generate the sample for the study. Simple random sampling was further used to select practitioners from the various professional groups. A sample size of 100 practitioners from the total population of 413 practitioners registered with their professional bodies was determined for the questionnaire survey using the formula proposed by Yamane (1967) as follows: $n= N/1+N (e)^2$, Where N = the total population size; e = the standard error of sampling distribution assumed to be 0.013 and n is the sample size. Purposive sampling was used to select 18 contractors and 16 consultants for the qualitative study.

3.2 Data Collection

The data collection process involved two stages. The first stage consisted of literature search for information on the impacts of construction activities on the environment in other countries and interview of some experts involved in the implementation process. The purpose of interviewing the experts was essentially to validate a preliminary set of impacts of construction activities on the environment gleaned from the literature and to determine from their experience other impacts of construction activities on the environment in Ghana.

The first phase resulted in the identification of thirty-three (33) impacts of construction activities on the environment. The second stage involved the development of questionnaire incorporating the 33 impacts of construction activities on the environment identified in the literature reviewed. The questionnaire was organised in the form of an importance scale (i.e. 4 = 'highly important', 3 = 'very important', 2 = 'important', 1 = 'not important'). Respondents were then asked to indicate by ticking a column, the relative importance of each of the impacts of construction activities on the environment. A total of 100 questionnaires were personally distributed by the researchers to respondents in the Greater Accra Region of Ghana where the concentration of practitioners is highest. Fifty-eight (58) of the total questionnaires were dispensed to Architects, thirty-seven (37) to Quantity surveyors and five (5) to Structural engineers. In total, 83 questionnaires (83%) were retrieved from the respondents for analysis as presented in table 1.

In the same second stage, semi-structured interviews were also conducted amongst some contractors and consultants for the qualitative study. The interviews adopted an attitudinal approach which is used to subjectively evaluate the opinion of a person or a group of people towards a particular attribute, variable, factor or a question.

Table 1. Field Data - Questionnaires distributed and responses received

Respondents	Questionnaires Distributed	Questionnaires Returned	Percentage of Responses
Architects	58	48	83%
Quantity Surveyors	37	30	81%
Structural Engineers	5	5	100%
Total	100	83	83%

3.3 Data Analysis Technique

The quantitative data were analysed using the Statistical Package for Social Sciences (SPSS) and Microsoft excel software. Two forms of statistical analysis were undertaken: Descriptive statistics such as percentages were used to summarize information from respondents. Also inferential statistics such as relative importance index method (RII) was used herein to determine architects, quantity surveyors, and structural engineers' perceptions of the relative importance of the identified environmental impacts of construction activities. Kendall's coefficient of concordance was used to determine whether there is a significant degree of agreement among the 3 groups of respondents (Architects, Quantity Surveyors and Structural Engineers). Kendall's coefficient of concordance is used as a measure of agreement among raters.

It indicates the degree of agreement on a zero to one scale. Kruskal-wallis test was also used to validate the results of Kendall's coefficient of concordance. The interview data was analysed using conceptual content analysis which takes into account the appearance of a concept or the numbers of times (frequency) a particular concept appears in a text. Bordens and Abbott (2008) noted that content analysis is a useful technique to help in understanding behaviour adopting a purely descriptive approach.

4. RESULTS

Out of 83 total respondents in the survey, 57.8% were architects, 36.2% of them were quantity surveyors while 6.0% of the respondents were Structural engineers. It was also found that 15.66% of the total respondents work with contractors, 48.19% work with consultants whilst 28.92% work with clients.

The survey data consisting of the 33 causes of environmental deterioration were analysed and grouped into nine major areas: Atmospheric emissions, water emissions, waste generation, soil alteration, resource consumption, local issues, and transport issues, effects on biodiversity, and accidents and incidents. The results of the study provide an indication of the relative importance index and rank of impacts of construction activities on the environment in Ghana as presented in table 2.

Table 2. The relative importance index (RII) and rank of impacts of construction activities on the environment in Ghana according to the three groups

Environmental Impacts	Architects		Quantity Surveyors		Structural Engineers		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
1. atmospheric emissions								
greenhouse gas emissions	0.766	27	0.825	25	0.850	12	0.814	24
emission of vocs and cfcs	0.776	26	0.833	24	0.900	5	0.836	22
2. water emissions								
water from excavation	0.750	28	0.758	32	0.750	23	0.753	28
water from cleaning tools	0.677	30	0.767	31	0.700	26	0.715	29
sanitary water	0.693	29	0.750	33	0.650	28	0.698	30
3. waste generation								
excavated waste material	0.891	16	0.892	17	0.850	12	0.877	17
municipal waste	0.880	21	0.875	20	0.850	12	0.868	18
inert waste	0.885	19	0.908	10	0.850	12	0.881	16
ordinary waste	0.901	15	0.900	15	0.900	5	0.900	9
toxic waste	0.880	21	0.875	20	0.800	20	0.852	21
4. soil alteration								
land occupancy	0.849	25	0.867	22	0.750	23	0.822	23
concrete relase agent	0.656	32	0.792	29	0.500	32	0.649	32
cleaning agents	0.651	33	0.817	28	0.450	33	0.639	33
construction machinery waste	0.677	30	0.783	30	0.550	31	0.670	31
5. resource consumption								
water consumption	0.948	5	0.942	3	0.900	5	0.930	5

electricity consumption	0.932	7	0.933	6	0.900	5	0.922	6
fuel consumption	0.953	2	0.942	3	0.800	20	0.898	10
raw materials consumption	0.979	1	0.967	1	1.000	1	0.982	1
6. local issues								
dust generation from machinery	0.917	13	0.908	10	0.900	5	0.908	8
dust generation in earthworks	0.906	14	0.892	17	0.800	20	0.866	19
dust generation in cutting operations	0.891	16	0.925	7	0.850	12	0.889	15
noise and vibration generation	0.948	5	0.950	2	0.950	2	0.949	2
landscape alteration	0.922	9	0.900	15	0.850	12	0.891	14
7. transport issues								
road traffic	0.922	9	0.908	10	0.850	12	0.893	13
interference in road traffic	0.922	9	0.908	10	0.750	23	0.860	20
8. effects on biodiversity								
vegetation removal	0.953	2	0.942	3	0.950	2	0.948	3
loss of edaphic soil	0.922	9	0.917	9	0.900	5	0.913	7
potential soil erosion	0.932	7	0.908	10	0.850	12	0.897	11
interception of water bodies	0.891	16	0.892	17	0.900	5	0.894	12
interference with the ecosystems	0.953	2	0.925	7	0.950	2	0.943	4
9. accidents and incidents								
fire outbreaks	0.885	19	0.850	23	0.650	28	0.795	26
breakage of service pipes	0.865	23	0.825	25	0.700	26	0.797	25
breakage of receptacles	0.865	23	0.825	25	0.600	30	0.763	27

5. DISCUSSION

The relative importance index and ranks of environmental impacts by all the respondents are presented in Table 2. Table 2 also illustrates the average relative importance index and ranks of environmental impacts by all respondents.

Generally, all major stakeholders agreed that the top ten most important environmental impacts of construction activities in Ghana are:

- raw materials consumption
- noise and vibration generation
- vegetation removal
- interference with the ecosystem
- water consumption
- electricity consumption
- loss of edaphic soil
- dust generation from machinery
- ordinary waste
- fuel consumption

Based on the different groups of environmental impacts, the respondents generally agreed that the top three groups of impacts are:

- resource consumption
- effects on biodiversity
- local issues

The following discussion is focused on the nine groups of environmental impacts in descending order of their ranking.

5.1 Resource consumption

The resource consumption group of environmental impacts was ranked highest by all the respondents put together. Raw materials consumption was determined by all respondents under the resource consumption group of environmental impacts as the first major environmental impact of construction activities in Ghana. It is encouraging to note that contractors and consultants interviewed also admitted that raw materials consumption is the most important environmental impact. The world watch institute (2003) opined that building construction consumes 40 percent of the world's raw stones, gravel and sand and 25 percent of the virgin wood per year. It also consumes 40 percent of the energy and 16 percent of water annually. Water, electricity and fuel consumption which are all under the resource consumption group of environmental impacts were ranked within the top ten most important environmental impacts of construction activities in Ghana.

5.2 Effects on Biodiversity

The effects on biodiversity group were ranked the second most important environmental impact of construction activities by the three groups of respondents. Vegetation removal, interference with the ecosystem and loss of edaphic soil which are all under the effects on biodiversity group of environmental impacts were also ranked within the top ten most important environmental impacts of construction activities in Ghana. This was also corroborated by the contractors and consultants interviewed.

5.3 Local Issues

Architects, Quantity surveyors, and Structural engineers together ranked local issues group as the third most crucial environmental impact of construction activities with the relative importance index of 0.932, 0.933, and 0.800 respectively. Within this group, Architects ranked noise and vibration generation as the most important environmental impact of construction activities. Quantity surveyors as well as Structural engineers also ranked noise and vibration generation as the most important. There is also abundant evidence to support the assertion that construction activities generate dust, noise and vibration.

5.4 Transport issues

Transport issues as an environmental impact group was ranked the fourth most important environmental impact of construction activities by the three groups of respondents. Within this group, architects and quantity surveyors agreed that interference in road traffic was the most important environmental impact of construction activities. On the other hand, Structural engineers ranked road traffic the most important factor. It is imperative to also note that contractors and consultants interviewed raised the issue of road traffic but attributed it by and large to road construction.

5.5 Waste generation

Architects, quantity surveyors, and structural engineers together ranked waste generation as the fifth most essential environmental impact of construction activities with relative importance index of 0.896, 0.883, and 0.850 respectively. Within this group, architects and Structural engineers ranked ordinary waste as the most important environmental impact of construction activities. Quantity surveyors on the other hand ranked inert waste as the most important. According to Ofori and Chan (1998) majority of the wastes generated from construction activities resulted from the production, transportation and the use of materials. A study conducted by Teo and Loosemore (2001) also posited that construction activities contributes approximately 29 percent of waste in the USA, more than 50 percent in the UK and 20-30 percent in Australia to the overall landfill volume. However, Sterner (2002) stated that implementing a waste management plan during the planning and design stages can reduce waste on-site by 15 percent, with 43 percent less waste going to the landfill through recycling, and it delivers cost savings of up to 50 percent on waste handling.

5.6 Atmospheric emissions

The atmospheric emissions group of environmental impacts was ranked sixth by all the respondents. Architects, Quantity Surveyors and Structural Engineers all agreed that within the atmospheric emissions group of environmental impact of construction activities, emissions of volatile organic compounds (VOCs) and chlorofluorocarbons (CFCs) was a major environmental impact. According to Levin (1997), in the USA construction is responsible for 40 percent of atmospheric emissions. The emissions include some toxic substances such as nitrogen and sulphur oxides. They are released during the production and transportation of materials as well as from site activities and have caused serious threat to the natural environment (Spence & Mulligan, 1995; Ofori & Chan, 1998; Rohracher, 2001). Other harmful materials, such as chlorofluorocarbons (CFCs), are used in insulation, air conditioning, refrigeration plants and fire-fighting systems and have seriously depleted the ozone layer (Clough, 1994; Langford et al., 1999).

5.7 Accidents and incidents

Accidents and incidents as an environmental impact group was ranked the seventh most important environmental impact of construction activities by the three parties put together.

Within this group, architects and quantity surveyors agreed that fire outbreak was the most important environmental impact of construction activities. On the other hand, Structural engineers' ranked breakage of service pipes as the most important factor. Some contractors and consultants interviewed also raised the issue of building collapse in the course of construction as part of accidents and incidents.

5.8 Soil alteration

The three groups of respondents together ranked soil alteration as the eighth most essential environmental impact of construction activities. Soil alteration as an environmental impact group was ranked relatively low. All parties agreed that land occupancy was the most important factor in this category.

5.9 Water emissions

The water emissions group was ranked the lowest by the three groups of respondents. Regarding all the factors in the group, all the three parties ranked water from excavation high. As indicated by the respondents, water emissions from construction activities do not impact the environment so much in Ghana.

5.10 Degree of agreement

To determine whether there is a significant degree of agreement among the 3 groups (architects, quantity surveyors, and structural engineers) Kendall's coefficient of concordance is used as a measure of agreement among raters. The results are presented in table 3.

H0: There is no significant degree of agreement among Architects, Quantity surveyors and Structural engineers.

H1: There is a significant degree of agreement among Architects, Quantity surveyors and Structural engineers.

Table 3. Kendall's Coefficient of Concordance

Group/ Category	W	Chi-Square	P-Value (Sig.)	Decision
Atmospheric emissions	0.791	24.143	0.000	Reject H0
Water emissions	0.675	14.516	0.000	Reject H0
Waste generation	0.645	53.554	0.000	Reject H0
Soil alteration	0.711	25.806	0.000	Reject H0
Resource consumption	0.940	78.000	0.000	Reject H0
Local issues	0.693	57.522	0.000	Reject H0
Transport issues	0.540	44.800	0.000	Reject H0
Effects on biodiversity	0.810	67.213	0.000	Reject H0
Accidents and incidents	0.621	43.215	0.000	Reject H0

***** The agreement is significant at level of $\alpha = 0.05$

For all the environmental impact groups as presented in table 3, the p-values (Sig.) are less than ά = 0.05 (ά is the level of significance), the null hypothesis, H0, is rejected. Thus, it can be said that there is a sufficient evidence to support the alternative hypothesis, H1. Therefore, there is a significant degree of agreement among the Architects, Quantity Surveyors and Structural Engineers regarding the environmental impacts of construction activities in Ghana.

The Kruskal-Wallis (KW) test was used to validate the result of the Kendall's coefficient of concordance test. KW test is a statistical test that is used to compare the ranks means between two or more samples. This test is used in order to check out if there are any significant differences in the point of view of the respondents (Architects, Quantity Surveyors and Structural Engineers) regarding the levels of each of the environmental impacts of construction activities. The results are presented in table 4.

Table 4: Kruskal-Wallis test for environmental impacts of construction activities

Group/ Category	KW Value	DF	P-Value (Sig.)
Atmospheric emissions	0.779	2	0.677
Water emissions	0.994	2	0.608
Waste generation	0.298	2	0.862
Soil alteration	0.885	2	0.642
Resource consumption	0.571	2	0.752
Local issues	0.073	2	0.964
Transport issues	2.812	2	0.245
Effects on biodiversity	1.795	2	0.407
Accidents and incidents	0.985	2	0.611

DF: Degree of Freedom

H0: There is no significant difference between the responses of the Architects, Quantity surveyors and Structural engineers.

H1: There is a significant difference between the responses of the Architects, Quantity surveyors and Structural engineers.

For all the environmental impact groups as presented in table 4, the p-value (sig.) for each group is greater than ά = 0.05 (ά is the level of significance), so the null hypothesis is not rejected. Hence it can be concluded that there is no significant difference between the three groups of practitioners' responses regarding the environmental impacts of construction activities. This result validates the previous result (Kendall's Coefficient of Concordance test). Therefore, it can be reliably stated that the three groups of respondents' agree with each other in terms of their perception towards environmental impacts of construction activities in Ghana.

6. CONCLUSION AND RECOMMENDATION

This study focused on impacts of construction activities on the environment in Ghana. The study sought the views of Architects, Quantity Surveyors and Structural Engineers on the relative importance of the environmental impacts of construction activities in Ghana. The study showed that, out of a total of 33 environmental impacts identified, the top ten most important environmental impacts factors agreed by all the respondents are as follows: raw materials consumption, noise and vibration generation, vegetation removal, interference with the ecosystems, water consumption, electricity consumption, loss of edaphic soil, dust generation from machinery, ordinary waste and fuel consumption. The 33 environmental impacts identified in the study were grouped into nine categories and ranked accordingly. The results also indicated that, all the respondents agreed that the resource consumption group of environmental impacts was the most influential impact. Effects on biodiversity impacts were considered the second most important causing environmental deterioration followed by local issues impacts.

Finally, there is a pressing need for government to intervene in order that the use of sustainable construction designs and construction strategies that is environmentally friendly becomes the custom in Ghana. The paper therefore recommends that government with the support of stakeholders in the construction industry should come up with special legislations, codes or standards relating to sustainable construction practices specific to Ghana's construction environment to ensure its proper and effective implementation. Specifically, the national building regulations should be reviewed to take account of environmental regulations. Besides, all forms of construction activities should be subjected to an environmental impact assessment to determine the potential impacts and also come up with some mitigation measures before they are executed.

7. REFERENCES

Azqueta, D. (1992). 'Social project appraisal and environmental impact assessment: a necessary but complicated theoretical bridge', in *Development Policy Review*, Vol. 10, pp. 255–270.

Barrett, P. S., Sexton, M.G. & Green, L. (1999). 'Integrated delivery systems for sustainable construction', in *Building Research and Information*, Vol. 27, No. 6, pp. 397–404.

Bentivegna, V., Curwell, S., Deakin, M., Lombardi, P., Mitchell, G. & Nijkamp, P. (2002). 'A vision and methodology for integrated sustainable urban development: BEQUEST', in *Building Research and Information*, Vol. 30, No. 2, pp. 83–94.

Cardoso J.M. (2005). Construction site environmental impact in civil engineering education. European *Journal of Engineering Education*, 30(1), pp. 51-58.

Chen Z., Li H. & Wong C.T.C. (2005). Environmental Planning: Analytic network process model for environmentally conscious construction planning. *Journal of Construction Engineering and Management*, 131(1), pp. 92-101.

Chen Z., Li H. & Wong C.T.C. (2000). Environmental management of urban construction projects in China. *Journal of Construction Engineering and Management*, 126(4), pp. 320-324.

Clough, R. (1994). 'Environmental impacts of building construction', in *Proceedings of First International Conference: Building and the Environ*ment, BRE, Watford, UK, May.

Cole R.J. (2000). Building environmental assessment methods: Assessing construction practices. *Construction Management and Economics,* 18(8), pp. 949-957.

Cole, R.J. (1999). 'Building environmental assessment methods: clarifying intentions', in *Building Research and Information,* Vol. 27, No. 4/5, pp. 230–246.

Curwell, S. & Cooper, I. (1998). 'The implications of urban sustainability' in *Building Research and Information,* Vol. 26, No. 1, pp. 17–28.

Djokoto S.D., & Dadzie, J. (2013). Barriers to sustainable construction in the Ghanaian construction industry: consultants perspectives *In:* Laryea, S. and Agyepong, S. (Eds) *Procs 5th West Africa Built Environment Research (WABER) Conference,* 12-14 August 2013, Accra, Ghana, 223-234.

Gangolells, M., Casals, M., Gasso, S., Forcada, N., Fuertes, A. & Roca, X. (n. d.). Identifying potential environmental impacts at the pre-construction stage. Group of Construction Research and Innovation, Department of Construction Engineering, Technical University of Catalonia, Terrassa, Spain.

Hill, R.C. & Bowen, P.A. (1997). 'Sustainable construction: principles and a framework for attainment', in *Construction Management and Economics,* Vol. 15, pp. 223–239.

Holmes, J. & Hudson, G. (2000). 'An evaluation of the objectives of the BREEAM scheme for offices: a local case study', in *Proceedings of Cutting Edge 2000,* RICS Research Foundation, RICS, London.

Kein, A.T.T., Ofori, G. & Briffett, C. (1999). 'ISO 14000: its relevance to the construction industry of Singapore and its potential as the next industry milestone', in *Construction Management and Economics*, Vol. 17, pp. 449–461.

Langford, D.A., Zhang, X.Q., Maver, T., MacLeod, I. & Dimitrijeic, B. (1999). 'Design and managing for sustainable buildings in the UK', in *Profitable partnering in construction procurement, CIB W92 (Procurement Systems) and CIB23 (Culture in Construction), Joint Symposium*, S.O. Ogunlana, (Ed.), E & FN Spon, London, pp. 373–382.

Langston, C. & Ding, G.K.C. (2001). *Sustainable practices in the built environment*, 2nd Edn., Butterworth Heinemann, Oxford.

Langston, C. & Ding, G.K.C. (1997). 'The Planet in Crisis', in *Sustainable practices: ESD and the construction industry*, C. Langston, (Ed.), Envirobook, NSW, pp. 13–20.

Levin, H. (1997). 'Systematic evaluation and assessment of building environmental performance (SEABEP)', in *Proceedings of Second International Conference, Building and the Environment,* June, Paris, pp. 3–10.

March M.C. (1992), Construction and environment: a management matrix. Chartered Builder, 4,pp.11-12.

Morel, J.C., Mesbah, A., Oggero, M. & Walker, P. (2001). 'Building houses with local materials: means to drastically reduce the environmental impact of construction', in *Building and Environment,* Vol. 36, Issue 10, December, pp. 1119–1126.

Ofori, G., Briffett, C., Gang, G. & Ranasinghe, M. (2000). 'Impact of ISO 14000 on construction enterprises in Singapore', in *Construction Management and Economics*, Vol. 18, pp. 935–947.

Ofori, G. & Chan, P. (1998). 'Procurement methods and contractual provisions for sustainability in construction', in *Proceedings of Construction and the Environment: CIB World Building Congress*, Gävle, 7–12 June, pp. c296.

Rohracher, H. (2001). 'Managing the technological transition to sustainable construction of buildings: a socio-technical perspective', in *Technology Analysis and Strategic Management*, Vol. 13, No. 1, pp. 137–150.

Scheuer, C., Keoleian, G.A. & Reppe, P. (2003). 'Life cycle energy and environmental
performance of a new university building: modelling challenges and design implications', in *Energy and Buildings*, Vol. 35, pp. 1049–1064.

Shen L.Y. & Tam V.W.Y. (2002). Implementation of environmental management in the Hong Kong construction industry. *International Journal of Project Management*, 20(7), pp. 535-543.

Sjöström, C. & Bakens, W. (1999). 'CIB Agenda 21 for sustainable construction: why how and what', in *Building Research and Information*, Vol. 27, No. 6, pp. 347–353.

Spence, R. & Mulligan, H. (1995). 'Sustainable development and the construction industry', in *Habitat International*, Vol. 19, No. 3, pp. 279–292.

Sterner, E. (2002). 'Green procurement of buildings: A study of Swedish clients' considerations', in *Construction Management and Economics*, Vol. 20, pp. 21–30.

Teo, M.M.M. & Loosemore, M. (2001). 'A theory of waste behaviour in the construction industry', in *Construction Management and Economics*, Vol. 19, pp. 741–751.

Uher, T.E. (1999). 'Absolute indicator of sustainable construction', in *Proceedings of COBRA 1999*, RICS Research Foundation, RICS, London, pp. 243–253.

Worldwatch Institute (2003). Sustainable facilities: building material selection,West Michigan sustainable Business Forum retrieved from http://www.sustainablebusforum.org/bldgmat.html: last accessed April 2013).

Yamane, T. (1967). "Statistics, An introductory analysis", 2nd Ed., New York: Harper and Row.

Zobel T. & Burman J. O. (2004). Factors of importance in identification and assessment of environmental aspects in an EMS context: Experiences in Swedish organizations. *Journal of Cleaner Production,* 12 (1), pp. 13-27.