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Submitted: 13 August 2018

Published online in 'accepted manuscript' format: 16 January 2019

Manuscript title: Determinants of Non-compliance with Structural Building Code Standards in Nigeria

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Abstract

This paper examines the determinants of non-compliance with structural building code standards and regulations within residential development projects in Nigeria. The study targets all stakeholders in development projects and data were collected using stratified sampling and through the administration of 600 paper-based questionnaires to construction professionals and other stakeholders. A total of 378 valid questionnaires were utilised, representing a valid response rate of 63%. The following indicators were identified and investigated through quantitative analysis: corruption, capacity building, employment/financial strength, professional rivalry, professional vested interests, technological expertise, professional involvement in decision-making, human rights and public opinion from the earlier research in Nigeria. Using SPSS software with an AMOS add-on, factor analysis and SEM were employed to investigate the data, which revealed that corruption, professional rivalry, professional vested interest, and professional involvement in decision-making as a combined administrative factor were the most influential in leading to non-compliance with building code standards in residential development projects in Nigeria, followed by training and to a lesser extent, sociological factors. In response to the findings, this study develops credible and acceptable enforcement control policy framework practices to improve the administrative and technical failure aspects of building standards and regulatory compliance in residential development projects.

1. Introduction

The construction industry in Nigeria suffers from persistent non-compliance with standards and regulations. Unlike developed nations, which regularly review and update their building standards in order to replicate best practice, developing countries have little regard for regulatory compliance, despite continuous growth in the construction rates of residential buildings (Windapo and Rotimi, 2012; Dahiru et al., 2011; NBS, 2015).

Mbamali and Okotie (2012) argue that industry and government stakeholders should stabilise the construction sector by increasing adherence to regulations, which in turn would attract investors, create employment, and increase the industry's contribution to gross domestic product (GDP) so it matches the levels in developed nations.

Currently, the compliance process for High-Rise Residential Building (HRRB) development projects in Nigeria includes design planning approval and inspections, both during and after construction. Non-compliance with building code (BC) standards has contributed to several cases of structural collapse (Mbamali and Okotie, 2012; Dahiru et al., 2012). Dahiru et al. (2012) posited that non-compliance with BC standards in Nigeria is due to corruption during the approval process, and that construction professionals and government officials are at fault. They emphasised that HRRB projects in Nigeria are characterised by non-compliance with structural building code standards and regulations (BCSR). The Sarbanes-Oxley Act 2002 (cited in Windapo and Rotimi, 2012), describes compliance as conforming or being in the process of conforming to rules or established guidelines, such as specifications, policy, legislation, standard or law. Laubscher (2011, p. 29) stated that 'building

standards is an official technical reference document, that sets standards for building and construction works through quality, performance, size, measurement criteria and the methodology of operations.' Abdullahi et al. (2013) argued that industries and manufacturers in developing countries have little regard for compliance with standards, even well-known standards such as ISO 14001 (environmental management system) and ISO 9000 (quality management system). In Nigeria, standards and regulations are not enforced by an established institution, but rather through societal class and individual personalities, which tend to be more influential than institutions, standards and regulations, and the law (Okpala, 1984 cited in Yakubu, 2017). Furthermore, rules and regulations may be broken by approaching a well-placed individual within society (Yakubu, 2017).

Oyinola (2011) and Ayedun et al. (2012) attributed such practice to corruption at different levels of Nigerian leadership, in the form of nepotism and systemic disorder that favour the chosen few and affect the degree of compliance with standards and regulations in high-rise residential construction projects in Nigeria (Windapo & Rotimi, 2012).

Casa (2012) established that a BC consists of administrative, legislative, technical and social components that work together to ensure building safety, benefits and welfare, and to provide convenience to all persons related to the building process. Al-Fahad (2012) explained that the legislative aspect involves building rules and regulations, the social aspect deals with relationships between people with respect to the code and the built environment, the administrative aspect deals with BC administration and the discharge of BC functions, and finally, the technical aspect deals with the technical requirements for pre-design, design,

construction and the post-construction stages of building.

All the research cited so far on this topic indicates that building development projects in Nigeria seldom comply fully with structural BCSR. However, these studies could identify only to a limited extent which aspect of the building standards and regulations (administrative, technical, legal or social) suffered most from non-compliance. There was therefore a gap in the literature, and an opportunity to identify and examine the component of the standards and regulations that is most often breached, leading to building collapse in Nigeria. This study investigates this point and relies in part on contextual analysis, international experience, the evidence of corruption presented by Ayedun et al. (2012) and Oyinola (2011) and the contributions of Omeife and Windapo (2013).

This paper reports on an empirical study, prompted by evidence of non-compliance with building standards and regulations in building projects that aims to examine determinants of non-compliance with structural BCSR for development projects in Nigeria. The outcome of this study will assist in the development of a practical policy development framework for standards and regulatory requirements for a structural BC for Nigerian high-rise residential building projects.

2. Literature review

2.1 Non-compliance with building standards and regulations in residential building projects

The causes and effects of non-compliance with building regulations vary between countries, and from state to state. For example in Kuwait, Al-Fahad (2012) established that the administrative system and technical and social factors, are the major contributors to

non-compliance faced by the building industry, which is plagued by unauthorised buildings, the illegal conversion of buildings, street conversions to refuse dumps and sub-standard houses, especially for middle and low-income earners. Sharkheyli et al. (2012) argue that non-compliance varies according to the general context of the social, economic, cultural, and legal framework, and the quality of the urban and environmental conditions of the affected areas. Although the constructors of high, medium and low quality buildings may exhibit a significant response with regard to awareness, this does not translate into compliance in terms of air-space, occupancy ratio, zoning and the over-development of plots resulting in poor circulation, inadequate space, and overcrowding in low and medium income areas. Non-compliance, according to Arimah and Adeagbo (2000) and Alnsour and Meaton (2009), is mostly by poor and illiterate people. Arimah and Adeagbo (2000) further opined that factors affecting non-compliance can be categorised as institutional (regulations and standards), administrative and public. The content and intent of the applicable regulations and standards do not match the socioeconomic characteristics, culture and values of the public, and are outdated, foreign, rigid and restrictive. With regard to the administrative factor, inter-agency co-ordination for effective implementation is lacking within the relevant agencies. There are other plausible reasons provided for non-compliance with structural BCSR in Nigeria, including ignorance of the law. Windapo and Rotimi (2012) argue that the majority of low and medium income earners undertaking developments within satellite communities are ignorant of the requirements of the building regulations in Nigeria. Corruption, due to systemic and leadership disorders, is another significant contributing factor to non-compliance (Ayedun et al.,

2012), together with a lack of professional participation in the development of building projects in Nigeria (Omeife and Windapo, 2013), professional rivalry and mutual suspicion, a lack of technical knowledge, and an inadequate capacity to train construction site workers (Agapiou, 1998 cited in Yakubu, 2017). Training has been shown to enhance skills in new technology and change practices within the profession (Dixit, 2008).

2.2 Evidence of non-compliance with building standards and regulations in Nigeria

It is obvious that non-compliance with building standards and regulations is not limited to Nigeria—the literature reports non-compliance in countries including Scotland, Canada, Kenya, South Africa and Ghana.

Laubscher (2011, p. 40) noted that in South Africa there were problems of code 'uniformity' and failed promises by the government to review the code every five years (no reviews were undertaken in 2000 or 2005 following the publication of the revisions in 1991). However, in 2008, Notice No. R.574 was published in the government Gazette No: 31084 on council recommendations. Laubscher (2011, p. 40) noted that '1st October, 2008 (Government Gazette No. 31084, 30 May, 2008:45–68) marks the operational of the National Building Regulations (NBR) and Building Standards Act (103, 1977), which was declared by the honourable minister of trade & industry' (see also Wafula and Talukhaba, 2011).

Sanewu et al. (2011) explained that the short-comings of Kenyan building regulations originate in colonial-era irregularities, a lack of modern requirements within the BC, and the absence of accountable parties when a building collapses. These factors compelled the country to review the existing code in 2009 and update it to meet modern and sustainable requirements,

provide for accountability in the event of structural failures, and help identify professionals who did not comply with building standards (see also Kimani and Musungu, 2010).

The CASA Association (2012) affirmed that Ghana, on 22nd May 2012, initiated a forum for construction professionals to review their BC with respect to climate change, disaster risk reduction, and sustainable growth development. Having discovered that the BC did not comply with international best practice in terms of green architecture, environmental quality, energy efficiency and disaster risk reduction, the forum aimed to incorporate these into Ghana's BC (GBC). This was followed by the provision of administrative guidelines that would foster a prudent governance process and efficient management of the guidelines for compliance, in addition to providing a communication roadmap for public ownership of the GBC (CASA Association, 2012).

Baiche et al. (2006) described how in 1990 and 2000, the Canada Mortgage and Housing Corporation and the Ontario Home Warranty Program undertook a survey to evaluate the cause of 44 building failures and to document the extent of these failures in order to identify the key underlying factors. The case observation approach adopted by Baiche et al. helped provide for administrative guidelines for prudent governance, efficient management of the guidelines for compliance, and to produce a communication roadmap for owners of the public buildings.

In Scotland, the Building Standard System, which is administered and enforced by local authorities, is responsible for some limitations aimed at protecting the public interest and the discharge of duties, such as preparing building regulations and associated guidelines, providing views on compliance to assist verifiers (currently local authorities) in decision-making,

granting the relaxation of regulations in exceptional cases, maintaining a register of Approved Certifiers, monitoring and auditing the certification system and the performance of verifiers, and verifying Crown building work. This has led to the establishment of the Scottish Building Standards Agency (SBSA), which was created in June 2004 as part of an implementation approach, and then in April 2008 as a directorate for the Built Environment, with responsibility for architecture policy, building standards and planning. The Scotland Building Standards division, which acts on behalf of Scottish Ministers, helps to facilitate Scotland's building standards through compliance with building regulations (see the Building (Scotland) Act, 2003). Granting independent regulators authority to monitor compliance and enforce rules and regulations is a very good approach in developed nations where there is respect for the rule of law. However, in Nigeria, where some persons act outside the set standards; the leadership of such an agency must be a person of integrity, who does not engage in nepotism or corruption, whether on a petty or grand scale.

In Nigeria the problem of non-compliance is ostensibly due to obvious contributing factors such as the lack of legislative backing for building standards and regulations, inadequate awareness, corrupt leadership and poor implementation and enforcement processes (Dahiru, et al., 2012; Olagunju et al., 2013; Olusola et al., 2011; Omeife and Windapo, 2013). For example, Olaitan and Yakubu (2013) observed regulatory enforcement failure and non-compliance with the BC in Nigeria after assessing 167 building projects, only 28 of which (16%) had obtained approval, only 10 of which utilised the services of at least one professional (0.59%), and none of which were subject to recorded site visits, indicating a total failure of

regulatory enforcement.

Further evidence of enforcement and compliance failure is the overwhelming number of recorded cases of building collapse across major cities in Nigeria. In total, there have been 63 structural building collapses: three cases from 1976 to 1978, 19 from 1982 to 1995, and 42 from 2000 to 16 September 2014; resulting in 742 recorded deaths and 96 injuries (Tanko et al., 2013, citing Ayedun et al., 2012; Bayo, 1995; Olagunju et al., 2013; Windapo and Rotimi, 2012, all cited in Yakubu and Agapiou, 2016). Fagbenle and Oluwunmi (2010) argued that these failures were the result of professionals and non-professionals undermining the regulation of the BC for structural building development projects due to inadequate legislation and a lack of accountability within the industry.

2.3 Potential solutions to the problem

Various authors have made useful suggestions for solving the problem of non-compliance with building standards and regulations in Nigeria. For example, Fagbenle and Oluwunmi (2010) suggested life imprisonment of any professionals or non-professionals found guilty. In the opinion of this researcher, life imprisonment may still not solve the problem of non-compliance, instead adequate machinery and the engagement of relevant stakeholders should be encouraged in finding lasting solutions to the problem. This study agreed with other relevant stakeholders who suggested legislative enactment of the BC, monitoring and evaluation of building development projects by professional bodies, empowerment of enforcement agencies, the introduction of an independent regulatory body, the insurance of building projects, the introduction of forensic analysis to aid in assessing the actual causes of failure, skills training,

and continuous professional development (Ayedun et al., 2012; Dahiru et al., 2012; Olagunju et al., 2013; Tanko et al., 2013).

3. Research objective

This study explores the determinants of non-compliance with structural BCSRs in building development projects in Nigeria. Non-compliance indicators identified through research and from professionals and other relevant stakeholders within the building construction industry were investigated, including corruption (Ayedun et al., 2012; Civil Society Organisations, 2008; Oyinola, 2011; Transparency International, 2013), capacity building (Dixit, 2008), employment and financial strength (financial capacity) (Berrisford, 2010), professional rivalry, professional vested interests, technological expertise (specialisation and technical know-how), professional involvement in decision-making (Omeife and Windapo, 2013), human rights, and public opinion (Berrisford, 2010).

The individual indicators or groups of factors relating to a particular aspect of BCSR identified from the literature that generally lead to non-compliance were assessed using exploratory factor analysis to remove data redundancy and to reveal the underlying pattern of the causal relationship. The study will also examines the strength of the associations of the causes to non-compliance indicators, and the relative effects of each indicator within and across other factors. Finally, one factor and structural equation modelling is performed to predict direct and indirect outcomes of non-compliance.

4. Research methodology

4.1 Questionnaire design

A questionnaire was the main instrument used for data collection and included respondents' demographic data, including their age, sex, educational qualifications, professional discipline and the number of years they have worked in the building construction industry in Nigeria. Nine primary variables indicators were assessed, namely corruption, technological expertise, capacity building, professional vested interest and professional rivalry, together with other indicators, including professional participation in industry decision-making, employment and financial strength, human rights, and respect for public opinion, by a confirmatory factor analysis statistical test from the conceptual model, all of which were rated on a five-point frequency scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Likert-point frequency scale measured these variables as they impede implementation and enforcement of, and compliance with structural aspects of BCSR among residential building development projects. An additional section was added in which respondents were asked to suggest potential solutions to these problems. The approach used for managing the self-administered questionnaires was a drop-and-pick method, where respondents were allowed a week to complete the questionnaire at their own convenience. The researcher pilot-tested the questionnaire among six professionals, aged 50–60, with more than 30 years' practical experience. The pilot test allowed the researcher to assess the questionnaire's effectiveness, the coverage of the research themes, the wording of the questions, and to collect general feedback. The experts' observations were noted, and where required the questions were re-framed to

produce the final version of the questionnaire which was used in this research.

4.2 Data collection

This study employed stratified random sampling, which was used to distribute a questionnaire to individuals who differed in terms of their professional discipline, gender, years of experience, professional position, and academic qualifications. This was to ensure that a wide range of views were represented and avoided any potential selection bias, as argued by Randolph and Myers (2013). Other research, for example by Migosi et al. (2013), has also used this approach to investigate similar issues. In total, 600 paper-based structured questionnaires were self-administered in the study, targeting stakeholders involved in residential development projects in Nigeria. The dataset of respondents included architects (55), builders[1] (65), engineers (structural & civil) (60), urban planners (70), quantity surveyors (20), land/GI surveyors (15), academics (35), development control professionals (75), legislators[2] (10), contractors[3] (65), industry participants (20), artisans (25), estate valuers (20), insurance brokers (10), members of professional bodies (20), members of standard organisations of Nigeria (10), union/NGO members (10) and facility/construction managers (25). Of the 600 questionnaires distributed, 426 were returned, representing a 70% response rate; 48 were deemed to be invalid for not providing complete information for appropriate categorisation into

[1] Academically trained and professionally certified person(s) responsible for the erection, execution and supervision of the work of artisans and tradesmen in the construction of buildings in accordance with building drawings in Nigeria.

[2] Responsible for the enactment of BC standards and regulations in Nigeria.

[3] An individual or company that provides materials or labour to the government, an individual or another company as part of a contract in building construction practice in Nigeria.

professional disciplines, and some did not report their academic qualification, years of experience, or gender, which meant that the number of valid responses for the analysis was 378.

4.3 Data analysis

The data were processed into numerical codes and entered into a pre-designed data entry spreadsheet, in SPSS 23 with an AMOS add-on for Confirmatory Factor Analysis and Structural Equation Modelling. **Confirmatory factor analysis (CFA)** is a multivariate statistical procedure that is used to test how well the measured variables represent the number of constructs (Brown, 2014). Structural equation modelling (SEM) is a multivariate statistical analysis technique that is used to analyze structural relationships (Hox and Bechger, 1998). This technique is the combination of factor analysis and multiple regression analysis, and it was used to analyze the structural relationship between measured variables and latent constructs.

The missing values were managed by exclusion from the cases, pairwise. The data analysis, also carried out using SPSS 23, generated descriptive statistics, such as frequencies for categorical variables to determine how many people provided each response (e.g. number of males or females) and the mean, median and standard deviation for continuous variables, to provide a basic summary of descriptive statistics**.** Exploratory factor analysis was then employed to extract the most influential factors after rotation and removal of redundant variables by looking for groups among the inter-correlations of a set of variables after which confirmatory factor analysis was deployed for SEM analysis of the factors. The

Kaiser-Meyer-Olkin (KMO) measure for sampling adequacy recommends a value of 0.5 and above in order for a data set to be suitable for factor analysis, and Bartlett's test of sphericity value has to be significant at 0.05 or less for suitability (Williams et al., 2010; Pallant, 2013, cited in Kaiser, 1970, 1974; Bartlett, 1954). The factors were reduced using the maximum likelihood extraction (MLE) method with an initial eigenvalue of 1 and more. Many checks were employed for the reduction in addition to the eigenvalues, including a total variance explained table, a scree plot, a correlation matrix (structure) for coefficients of 0.3 and more, and a factor matrix table for the un-rotated loadings of each of the items reduced. The rotation method for the extracted variables was maximum likelihood with oblimin rotation. The correlation matrix was generated through factor analysis to determine the strength and associations of the causal factors, and regression factor score analysis was employed to determine the relative cause and effects across other factors, assuming a constant variance regression line and an underlying linear relationship between the observed and unobserved (latent trait) variable factors.

This study is based on the following null-hypothesis:

H_0: Non-compliance with building standards and regulations in residential building projects occurs in Nigeria because of the systemic failure of technical, social, and administrative governance.

H_1: Adequate compliance with building standards and regulations in residential building projects occurs in Nigeria because of the systemic success of technical, social, and administrative governance.

5. Results

5.1 Sample

This section describes the characteristics of the sample before presenting the results of the analysis. The questionnaire survey was conducted from June 2015 to May 2016 and stratified sampling was adopted because the total population is divided into strata and in order to reduce the error estimation of the group strata. Table 2 shows the demographic characteristics of the sample respondents' non- parametric descriptive statistics of dispersion. Pallant (2013) advises the use of non-parametric descriptive statistics (median) for the indication of the spread or dispersion of the scores using an inter-quartile range (IQR) which does not assume a normal distribution to report the 25th percentile and the 75th percentile values and the percentile 50 as actual median (Md) when the data is skewed. In Table 1, the age variable indicates a Md=4.0 (IQR:3,4), sex indicates a Md=1 (IQR:1,1), educational qualification shows a Md=5 (IQR:3,5), professional discipline indicates a Md=1 (IQR:1,2) and years of experience indicates a Md=3 (IQR:2,3) for the sample characteristics respectively.

5.1.1 Variable Indicators

To understand how the measurements of the indicators are spread out from the average (mean) or expected value, Table 2 describes and summarises the characteristics of the indicators in the descriptive statistics. The results show high standard deviations of 0.63 to 0.97 and mean values of 2.68 to 4.30 for the factor indicators.

5.2 Most influential factor leading to non-compliance

To determine the most influential factor, indicators leading to non-compliance with building regulations in HRRB projects, data sampling adequacy were assessed, and Bartlett's test of significance was conducted. For this research data the KMO value is 0.632 and the Bartlett's test result is significant (P=0.000), indicating that factor analysis is appropriate to help explore and determine the most influential factors leading to non-compliance with building regulations. Communalities explained high values of variance at 0.99, 0.98 and 0.96 for human rights, capacity building and professional involvement in decision-making, respectively, with the lowest communalities observed at 0.83 for corruption.

Three factor indicators meet the Kaiser criterion with initial eigenvalues of 1 or more and were extracted as explained with the total variance shown in Table 3. Before rotation, 100% is explored using 9 factors, after rotation, 91.31% is explored using 3 factors.

Further checks for factor indicator extraction, as required in exploratory factor analysis to determine the most influential factors leading to non-compliance, included the use of a scree plot. The scree plot indicates a clear break from extracted components 1 to 3, indicating that these components capture much more information than the remainder.

Another check leading to the determination of the most influential factor indicators of non-compliance was factor loading of the pattern matrix by MLE methods and oblimin with the Kaiser normalisation rotation method as shown in Table 4. The factor loadings of each variable indicate strong (highest) loading of the following items: component 1, capacity building at 1.01, technological expertise at 0.88, and employment and financial strength at 0.66;

component 2, human rights at -0.96 and respect for public opinion at 0.73; and component 3, professional rivalry at 0.92, professional involvement in decision-making building at professional vested interest at 0.88, 0.75, and corruption at 0.72. Referring to the items for each component, component 1 can be labelled as the technical factor of BC standards, component 2 as the sociological factor, and component 3 as the administrative governance factor.

The structure matrix presented in Table 5 shows the correlation between variables and factors. The variable item of capacity building indicates the highest component 1 factor correlation of 0.99, followed by professional involvement in decision making at 0.97. The component 3 factor indicates 0.96 for professional rivalry followed by professional vested interest at 0.91. Both factor component 1 (technical factor) and factor component 3 (administrative factor) show a negative correlation impact on all variables for factor component 2 (sociological factor).

5.2.1 One factor measurement model confirmatory analysis

A dependent variable (DV) non-compliance to structural BC standards in residential projects is manifested (predicted) by nine directly observed variables (IVs) using one factor confirmatory factor analysis (CFA). This indicates standardised high factor loading as the best indicator values and poor factor loading as a suggestion indicating other factors within the group. Professional rivalry indicates the best loading at 0.94, professional involvement in decision-making follows at 0.93, and corruption has the lowest factor loading of 0.83 in the one factor confirmatory analysis, together with capacity building at 0.92 and technological expertise at 0.89.

5.2.2 Underlying pattern and the strength and association of most influential factors

To address the research hypothesis, the pattern of the most influential factor indicator relationships leading to non-compliance after rotation was investigated and Table 6 summarises the strength of the relationships between the three factors. This is positively and negatively high, at r = +1, r = –0.74 or r = 0.74 between the technical, sociological and administrative aspects of the structural BC standards, revealing a strong positive and negative correlation relationship between the three factors. The relationship between these factors is strong enough to exclude the possibility of sampling error. Therefore this study concludes with the finding that there is a significant linear relationship between many of the factors of non-compliance with structural BCSRs in residential building in Nigeria. For example, any increase in capacity building and technical know-how means an increase in human rights and public engagement and a very perfect systemic services (administration) free from corruption, professional rivalry, and vested interest and a decrease in technical factors (capacity building and technical experience), all others will follow in tandem, leading to non-compliance with standards and regulations.

5.2.3 Development of a theoretical model for the SEM analysis

To test the hypothesis, a model was developed from theory and is shown in Figure 1. The test is to establish consistency with the observed data for direct and indirect predictions.

SEM Diagram explanation: Squares represent observed variables; Circles represent errors; Ovals represent latent variables

Accepted manuscript
doi: 10.1680/jmapl.18.00033

The Independent variables (IV) are CB – capacity building, TE – technological expertise, EFS – employment and financial strength, HR – human rights, RPO – respect for public opinion, CPTN –corruption, PR – professional rivalry, PIDM – professional involvement in decision making, PVI – professional vested interest and non-compliance is the dependent variable (DV). The arrows with single heads represent linear dependencies. For instance, the arrow leading from independent variable capacity building (CB) to dependent variable (DV) shows that DV scores depend, in part, on IV of CB on so on. The variable error (e1–e10) is enclosed in a circle because it is not directly observed. Error represents unobserved variables and no specified measurement unit.

Model Parameters

Regression Weights: (Group number 1—default model)					
	Estimate	S.E.	C.R.	P	Label
CB< -------Technical factor	.81	.53	-.16.15	***	
TE<---------Technical factor	.78	.42	14.20	***	
EFS<-------- Technical factor	.70	.73	12.3	***	
HR< ----------Sociological factor	.58	.43	-.132	***	
RPO<---------Sociological factor	.80	.52	12.50	***	
PR<---------Administrative governance	1.00000				
PIDM<-----Administrative governance	.90	1.12	-10.3	.003	
PVI<----Administrative governance	.89	.76	.60	***	
CPTN<----administrative governance	.76	.223	.54	***	
Non-compliance<---Technical factor	.82	.62	16.53	***	
Non-compliance<---sociological factor	.94	.53	17.57	***	
Non-compliance<----Administrative governance	.81	.79	15.58	***	
Covariance: (Group number 1—default model)					

	Estimate	S.E.	C.R.	P	Label
Technical<----> Sociological	-9.2	4.56	1.75	***	
Sociological<----> Administrative governance	4.72	2.26	.91	***	
Technical <----> Administrative governance	.45	.11	.82	***	

All the parameters estimates are significantly different from 0 (highly significant).

Standardised Regression Weights: (Group number 1—default model)	
	Estimate
CB< -------Technical factor	.872
TE<---------Technical factor	.702
EFS<-------- Technical factor	.425
HR< ----------Sociological factor	.662
RPO<---------Sociological factor	.058
PR<---------Administrative governance	.901
PIDM<-----Administrative governance	.762
PVI<----Administrative governance	.801
CPTN<----administrative governance	.625
Non-compliance<---Technical factor	.802
Non-compliance<---sociological factor	1.875
Non-compliance<----Administrative governance	.642

RMSEA (Root mean square error of approximation) = 0.043. This is less than 0.05 indicating good fit. The correlations between technical and sociological, sociological and administrative, and technical and administrative estimate with Amos are significant. GFI (Goodness of fit index) and AGFI (Adjustable Goodness of fit Index) also indicate good fit of 0.97 and .0.98 respectively.

Model	*RMSEA*	*LO 90*	*HI 90*	*PCLOSE*
Default model	.0425	.00000	.07432	.622
Independence model	.4501	.2667	.30145	.00000

RMR GFI

Model	*RMR*	*GFI*	*AGFI*	*PGFI*
Default model	.07042	.97223	.9844	.16335
Saturated model	.00000	1.00000		
Independence model	4.43590	.58116	.57303	.433320

5.3 Contribution of each indicator to non-compliance

Multiple regression analysis was conducted assuming the factor score 1 to 3 as predictors (constant) to examine the relative effects of group contributions to non-compliance. Using the following factor scores, factor score 1 (technical factor), factor score 2 (sociological factor), and factor score 3 (administrative governance), the most influential factors leading to non-compliance were established.

5.3.1 Capacity building

The results show capacity building accounts for 78% of the variation in non-compliance with BCSR. The model returns: (F=3,365), $p<0.01$, $R^2=0.78$ (78%), standardised coefficients (Beta value (B)=0.33, p = 0.01).

5.3.2 Corruption

Corruption was predicted with the factor score and the results in Table 7 show that corruption has

an R^2=0.68, (F=1,956), p<0.01, B=0.76, sociological factor at B=0.05, and that the contribution of the technical aspect is B=0.32.

5.3.3 Professional involvement in decision-making

Using the factor score variables, the results indicate a $R^{2=}$0.67 variance, (F=1891, p<0.01), the standardised coefficients results indicate the following unique contributions to non-compliance: administrative factor B=0.73, while all others are below 0.3.

5.3.4 Technological expertise

R^2=0.79, (F=3482, p<0.01), and the standardised coefficients results show that the individual contribution of technical aspect B=0.89, while other components have Beta values below 0.03.

5.3.5 Human rights

R^2=0.79 variance contribution, (F=351.892, p<0.01). The standardised coefficients results show social aspect B=0.22, administrative governance B=- 0.83, and technical aspect at B=0.23,

5.3.6 SEM measurement analysis

Figure 3 below represents standardised estimates of variables. The figure indicates the standardised regression coefficients and factor loading (SR) estimates of capacity building at 0.81, squared multiple correlations (SMC) at 0.772 and technological expertise (SR=0.70, SMC=0.652), although employment/financial strength is low (SR=0.43, SMC=0.38), suggesting an unreliable indicator of the technical factor. The sociological factor indicates (SR=0.67, SMC=0.501) for human rights and respect for public opinion at (SR=0.58,

SMC=0.467), while for the administrative governance factor the results are professional rivalry (SR=0.90, SMC=0.671), professional involvement in decision-making (SR=0.76, SMC=0.601), professional vested interest (SR=0.80, SMC=0.731) and corruption (SR=0.63, SMC=468). The correlation between the technical and sociological factors indicates 4.75 and –1.30 between the administrative governance factor and the sociological factor and the covariance is significant at (1.68 $p< 0.05$).

The square multiple correlations provide information about how much variance of an observed variable the factor can account for. Similarly, the unobserved variable technical factor's standardised weight is 0.64 in relation to non-compliance. For the sociological factor the result is (SR=0.45) and for the administrative governance factor (SR=0.80), with the overall effect of a 0.72 weighting for the three unobserved factors to non-compliance.

CPTN – corruption, PR – professional rivalry, PIDM – professional involvement in decision making, PVI – professional vested interest, HR – human rights, RPO – respect for public opinion, CB – capacity building, TE – technological expertise, EFS – employment and financial strength

The overall model test for goodness appears to fit with the Chi-square X^2 test and yields statistics of 10.616 and df=11 and a corresponding P-value of 0.564. The hypothesis that the systemic failure of technical, social, and administrative governance causes non-compliance is correct and can be accepted since the p-value is too high to reject the model.

6. Discussion

The analysis of the data provides a clear view of the main causes of non-compliance with BCSR

in Nigerian residential development projects. It is worth noting that similar studies have been conducted which investigated the control of physical planning between 1963 and 1980 (Okpala, 1984 cited in Yakubu, 2017) and the compliance in developing areas to building regulations (Olaitan and Yakubu, 2013). In these studies the results indicated that 20–40% of the total building developments within the Ibadan metropolis submitted an application to seek approval, while 60% of the developers did not attempt to seek building approval or permission to build. Similarly, in Lokoja, Nigeria, 167 buildings were assessed with 16% approval, 0.6% professional representation and 0.0% visitation for enforcement to compliance. In this study, lack of capacity building, professional rivalry, lack of monitoring for standard enforcement, systemic corruption, and lack of relevant stakeholder engagement contributed between 68% and 80% to building standards and regulations compliance failure in Nigeria.

Standards and regulations are a central part of any governmental approach to maintaining and improving the quality and performance of building projects (Baiche et al., 2006). Non-compliance with regulations is a function of several different factors, as described by Ayedun et al. (2012). This study has presented nine indicators as determinants of non-compliance. Using descriptive statistics, the indicators show significant participation, where the lowest mean value was 2.68 (technological expertise) and the highest was 4.30 (corruption); the lowest value of standard deviation was 0.63 (professional vested interest) and the highest was 0.85 (corruption). Three aspects of BCSR have been identified as influential to non-compliance: the administrative aspect (relating to administrative governance) is the most influential, followed by the technical aspect (relating to training and development). The least influential is the

sociological aspect, which is traceable from EFA variable reduction and extraction to CFA one factor path analysis and SEM analysis.

6.1 Administrative issues within regulations and compliance

It has been established in this study from the SEM analysis that the direction of the parameter estimates indicates the effects on non-compliance. Professional rivalry, professional involvement in decision-making, professional vested interest and corruption relating to administrative governance are the most influential factors leading to non-compliance with BC standards in building development projects in Nigeria. The reason for this can be traced to the study by Nijsen et al. (2009) on the concept of compliance by Adam Smith (Smith, 1966), which is due to the administrative burden problem created and imposed on the industry or on practitioners. Administrative decisions in the regulatory implementation process should be supportive, proactive, vigorous, and enthusiastic, with attention to reducing barriers and creating administrative enabling environments for practitioners. Administrators should regularly ask for feedback from all levels of practitioners, and should pay particular attention to satisfaction and the fidelity (performance assessment) of the outcome, instead of being a routine source of nuisance to the industry (National Implementation Research Network, 2015).

Building development projects in Nigeria lack the characteristics of support, proactivity and vigour. For example, the BC standards for the industry have not been enacted since they were drafted in 2006. This helps explain the continual collapse of buildings over the past 15 years, the many on-going building development projects that are ignored by the government and enforcement agencies, and administrative agencies' failure to arrest or sanction those

responsible (to serve as a deterrent to others). This is exemplified by the results of this study, where poor administration was found to be the leading cause of non-compliance with standards and regulations in the development of building projects.

Nijsen et al. (2009) stressed that policy makers and regulatory inspectors should clearly illustrate how administrative systems can be responsible for promoting quality and compliance. Their study further stresses that reporting and monitoring compliance makes the administrative process easier and more efficient for both professionals and the industry, and consequently should be introduced. This implies that in order to achieve success, direct and frequent communication from the practice level to policy makers and administrators (the practice-policy communication loop) should be implemented. This would allow for data collection, descriptions of experiences, and constraints to be recorded to ensure full and effective compliance at the practical stage, with the help of professional teams who possess the skills and abilities to help practitioners and staff make full and effective use of the innovations and enabled policy (NIRN, 2015).

6.2 Training and development issues

The results of this study show the significant effect of technical factors on non-compliance. Capacity building and technological expertise are issues related to the training and development of professionals and relevant stakeholders. Increased capacity building indicates improvement on the technical front and less non-compliance, while technological expertise also indicates better technical performance and less non-compliance. This result supports the advocacy for building construction skills training in developing countries, where advanced technology for the

production process is scarce (Muya et al., 2004). Skills training and development differs, and there is the possibility of confusing the terms and their meanings. In this study the focus is on skills, which are activities that influence employment and earning regarding the structural aspects of building projects for both professionals and artisans. The construction industry in this digital age is characterised by advanced technology, modern construction methodology, and high-tech materials that require consistent improvements to training and development in order to meet industry needs (Agapiou, Price and McCaffer, 1995).

Human rights and respect for public opinion to a lesser extent have a direct relative cause and effect on non-compliance. The direction of the parameter estimates indicates the effects on non-compliance. Increased human rights awareness indicates a better outcome in terms of sociological factors and less non-compliance and greater respect for public opinion also indicates a better outcome in terms of sociological factors, as well as less non-compliance. The more people are aware of standards and regulations, the more likely they are to adhere to them (Dahiru et al., 2012).

Van Dyke (2015) presented the purpose of administrators as facilitating the work of compliance with standards and regulations through training, coaching, and the selection of administrative staff who have the technical expertise to align policies and procedures for the implementation of administrative policies. These individuals should also take the lead on systems interventions and create enabling places and time to make the work of practitioners and supervisors easier. The results of the theoretical model for the SEM analysis are consistent with the observed data for direct and indirect predictions of factors of non-compliance with

structural BC standards in building through the systemic failure of technical, sociological and administrative governance. Hence, the theoretical null-hypothesis can be accepted as the research conclusion, as argued by Migosi et al. (2013). The findings are in line with previous research and support the claim that the administrative system, technical process and social effects are among the major causes of non-compliance with building standards and regulations, for example, the administrative factor (Al-Fahad, 2012), public financial strength (poverty) (Sarhhelyli et al., 2012), the political-cultural factor (Alsour and Meaton, 2009), and institutional context, administrative machinery, public poverty and illiteracy (Arimah and Adeagbo, 2000). However, in this study the CFA analysis indicates another factor for non-compliance with structural building standards and regulations in the Nigerian context, namely training and development in relation to the implementation process as the contribution of this research to the body of knowledge.

6.3 Policy development framework design

The conceptual building control enforcement policy framework for this study advocates the adoption of the modern commitment theory of regulation. The proposed development is based on this study's contextual analysis and from international experience, together with input from professionals and relevant stakeholders in the Nigerian building construction industry and from the general public on potential solutions to the problems concerning structural aspects of building standards and regulations.

This study has identified the need to establish an independent building regulation authority, to be called the Independent Building Regulation Commission (IBRC), which should

be enacted through a Building Regulation Act. The commission should be equipped with adequate resources (materials and individuals) in order to drive the credible process of consultations on building design and regulation requirements, to assess proposed plans for compliance, and to inspect construction sites at different critical stages. Continuous capacity building for the established commission should be a priority, and monitoring and evaluation of activities for performance assessment (fidelity) should be clearly defined. The fidelity findings should be followed by an insurance plan and strategic plan for improvements, with consideration paid to quality management and complaint procedures. Jorgen (2010), Johan (1999), and Stiggler (1971) all advocate the adoption of a similar policy framework for the enforcement of standards and regulations.

The framework emphasises the continuous sequence of stages related to the central idea of an IBRC, rather than the connecting arrows within the circle.

7. Conclusions

The aim of this study was to identify and examine the main factors leading to non-compliance with structural BCSR in building development projects in Nigeria. It also revealed the underlying pattern of the causal factors' strengths and associations, and examined the relative effects of the main influential causal factor on other factors. Specifically, this study aimed to determine whether there is a relationship between the determinant factors and their influences on non-compliance with standards and regulations. The results suggest that decision making, corruption and professional rivalry (administrative factors), training and development (technical factors), human rights and respect for public opinion (social factors), all statistically

contribute to non-compliance. However, a critical study of the transformation results indicates the stronger influences of corruption, rivalry and decision making (administrative factors) compared to the other factors in the association. When examining the broad research aspects of building standards and regulations, it is worth noting that corruption, decision making and rivalry relate more to the administrative aspect of building standards and regulations, which influences the policy framework for other factors. For example, there is a strong administrative effect on training and development (technical factors) with regard to compliance issues. However, training and development which relates to the technical aspect of the regulations was ranked after administration and shows a stronger influence on employment and interest, which means that enhancing training and development may create employment and increase individual empowerment. Public engagement rights connect directly with the social aspect of the building standards and regulations, as can be observed from the results. The administrative aspect also influences the social aspect (public engagement) and has a strong relationship with empowerment (employment and interest). The implication is that if compliance is to be achieved, the public must be engaged and empowered, professionals and relevant stakeholders have to be technically trained in new technological developments. Most importantly, the greatest influence, namely administration, must be stripped of the influences of corruption, rivalry and decision making, in order to reduce the impact on other factors for compliance with building standards and regulations in building development projects.

This study has revealed that lack of training and development (capacity building) also causes non-compliance with standards and regulations apart from the administrative and social

factors identified in other studies. In view of these findings, a building enforcement control policy framework is advanced by this study as a possible solution for mitigating the administrative and technical failure aspects of building standards and regulatory compliance in residential development projects. Such a framework should encompass monitoring, the continual review of compliance, and training for capacity development in Nigeria and other developing countries.

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Table 1. Non-parametric descriptive statistics of dispersion

		Age	Sex	Educational qualification	Profession (Occupation)	Years of Experience
N	Valid	378	378	378	378	378
	Missing					
Median		4.0000	1.0000	5.0000	1.0000	3.0000
Range		5.00	1.00	6.00	1.00	5.00
Sum		1375.00	465.00	1704.00	496.00	1242.00
Percentiles	25	3.0000	1.0000	3.0000	1.0000	2.0000
	50	4.0000	1.0000	5.0000	1.0000	3.0000
	75	4.0000	1.0000	5.0000	2.0000	4.0000

Table 2. Characteristics of the indicators

	Count	Mean	Std. Deviation
Corruption	378	4.3016	0.84881
Capacity building	378	3.5186	0.67699
Professional involvement in decision-making	378	3.5238	0.72888
Employment and financial strength	378	3.4587	0.81613
Technological expertise	378	2.6765	0.97424
Professional rivalry	378	3.6746	0.71174
Professional vested interest	378	3.7931	0.62710
Human rights	378	3.1930	0.73708
Respect for public opinion	378	3.2169	0.81141
Valid N (listwise)	378		

Table 3. Total variance explained

Factor	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	7.532	83.694	83.694	7.359	81.763	81.763	6.784
2	0.565	6.278	89.972	0.391	4.340	86.102	6.272
3	0.347	3.851	93.823	0.469	5.211	91.313	5.890
4	0.208	2.313	96.136				
5	0.125	1.389	97.525				
6	0.083	0.923	98.449				
7	0.063	0.700	99.149				
8	0.044	0.488	99.636				
9	0.033	0.364	100.000				

Extraction method: maximum likelihood.

a. When factors are correlated, the sums of squared loadings cannot be added to obtain the total variance.

Table 4. Pattern matrix[a]

	Factor		
	1	2	3
Corruption	0.306		0.715
Capacity building	1.006		
Professional involvement in decision-making			0.880
Employment and financial strength	0.657		
Technological expertise	0.867		
Professional rivalry			0.916
Professional vested interest			0.752
Human rights		-0.956	
Respect for public opinion		-0.734	

Extraction method: maximum likelihood.

Rotation method: oblimin with Kaiser normalisation.

a. Rotation converged in 9 iterations.

Table 5. Structure matrix

	Factor		
	1	2	3
Corruption	0.831	-0.825	0.841
Capacity building	0.986	-0.782	0.744
Professional involvement in decision-making	0.970	-0.791	0.797
Employment & financial strength	0.930	-0.842	0.788
Technological expertise	0.926	-0.805	0.642
Professional rivalry	0.722	-0.746	0.961
Professional vested interest	0.757	-0.738	0.908
Human rights	0.813	-0.993	0.757
Respect for public opinion	0.838	-0.954	0.799

Extraction method: maximum likelihood.

Rotation method: oblimin with Kaiser normalisation.

Table 6. Factor Correlation Matrix

Factor	1	2	3
1	1.000	-0.811	0.741
2	-0.811	1.000	-0.742
3	0.741	-0.742	1.000

Extraction method: maximum likelihood.
Rotation method: oblimin with Kaiser normalisation.

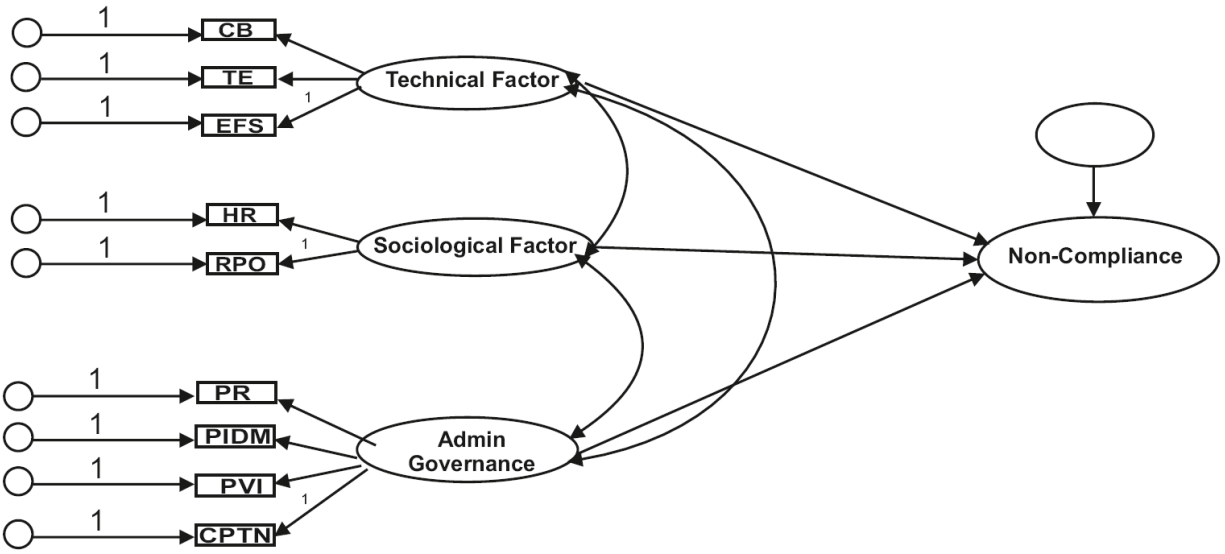
Table 7. Summary of the regression analysis of the contribution of each indicator to non-compliance with structural building standards and regulations

Independent Variables	Factor score 3 (CPTN, PR, PIDM, PVI)	Factor score 2 (HR, RPO)	Factor score 1 (CB, TE, EFS)	R Squared change	F Value	P Value
Capacity building	0.115	0.327	0.793	0.783 (78%)	336.537	0.000
Professional decision-making	0.731	-0.111	0.242	67%	189.111	0.000
Technological expertise	0.005	0.007	0.887	0.789 (79%)	34.175	0.000
Human rights	-0.222	0.833	0.217	0.79.1	351.892	0.000
Corruption	0.759	0.319	0.005	0.677 (68%)	195.658	0.000
Professional rivalry	0.720	-0.205	-0.055	0.652	174.725	0.000
Professional vested interest	0.337	-0.011	0.117	0.729 (73%)	251.271	0.000
Respect for public opinion	-0.163	-0.859	0.050	0.756	310.353	0.000
Employment/ financial strength	0.418	-0.062	-0.002	0.798	369.392	0.000

CPTN – corruption, PR – professional rivalry, PIDM – professional involvement in decision making, PVI – professional vested interest, HR – human rights, RPO – respect for public opinion, CB – capacity building, TE – technological expertise, EFS – employment and financial strength

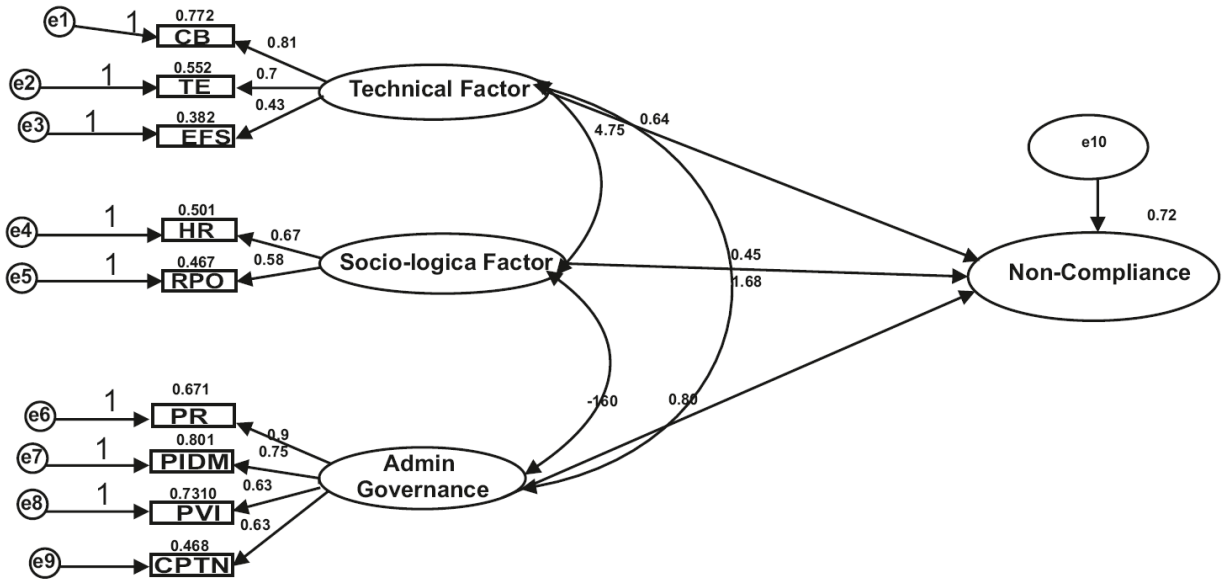
Accepted manuscript
doi: 10.1680/jmapl.18.00033

Figure 1. Theoretical model for SEM hypothesis testing



Accepted manuscript
doi: 10.1680/jmapl.18.00033

Figure 2. SEM with standardised estimates-non-compliance



Accepted manuscript
doi: 10.1680/jmapl.18.00033

Figure 3. Conceptual building control enforcement policy framework