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# PRINCIPAL COMPONENT ANALYSIS (PCA) OF THE ACTIVITIES OF INFORMAL CONSTRUCTION WORKERS/ARTISANS IN NIGERIA

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## ABSTRACT

Every employment has deposit of activities to be performed by her employees. These activities vary with industries and who performs each of these activities is determined by how significance they are to the employment operation. Construction is one of such industries whose activities necessitate the growth and development of infrastructure needs of the societies. The activities in the construction industry are performed by different trades' artisans refer to as informal workers/artisans in this paper. Hence, this paper examines the activities of informal construction workers/artisans in Nigeria with a view to classify these activities according to various trades in the industry. A comprehensive list of construction activities was made and informal workers/artisans were asked to rank these activities based on the frequency of how they are being performed on construction projects. Data collected were analyzed using factor analysis which classified these activities into principal components that described construction trades. The result of the study shows that the most frequent activities are associated with demolition & reconstruction and woodwork while the least frequent activities associated with electrical works. The result also classifies activities in the industry into various trades including plumbing installations, mansory & blockwork, steelworks, woodworks, electrical installations, painting & decoration; and demolition & reconstruction. The finding of this study provides information on the activities of the informal workers/artisans in the construction industry for the professionals, employers and policy makers to provide enabling and friendly environment for efficient service delivery in the construction industry.

**Keywords:** Construction Workers/Artisans, Informal Activities, Informal Construction, Informal Sector, Nigeria

## 1. INTRODUCTION

The value added of construction ranges between 7% to 10% for highly developed economies and around 3% to 6% for underdeveloped economies (Lowe, 2003). In the developing countries, the value added could be higher because figures on the informal sector are mostly not included which could generate a significant casual employment in urban and rural areas (Ganesan 2000). In United Kingdom, construction industry contributes about 8 to 10 per cent of the GDP (BTEC's Own Resources, n.d.). In Nigeria, Aganga (2010) established that the construction industry contributes about 3 percent to the nation's Gross Domestic Product (GDP). In 2011, it was accounted to have contributed about 1.3% of Gross Domestic Product (GDP) (AEO 2012). Awodele et al (2010) noted that the contribution of the Nigerian construction industry to the GDP of Nigeria has reduced considerably from about 7% in 1980s to 1.3% in 2011. This contribution is below a range of 5 to 10 percent of GDP as envisaged by the United Nation and in developed nations like UK and America. Therefore, the construction industry in Nigeria is seen to be underperforming and performance in the industry retarding. Therefore, there is a need to investigate the activities and nature of operations of the informal workers/artisans who play significant roles in the construction industry in Nigeria.

Construction industry has been described in many ways. Construction activities play a vital role in the process of economic growth and development; and are of paramount importance for employment and economic growth (Mitullah and Wachira, 2003; Ogunsemi and Jagboro, 2006). It is further described to comprise of a regulated formal part and unregulated informal part (United Nations Centre for Human Settlement (UNCHS), 1996; Mlinga and Wells, 2001; Oladapo, 2006). Jewell et al. (2005) also stated that most construction sectors around the world have a high percentage of output being produced informally.

Mitullah and Wachira (2003) also reported that in some low-income countries the vast majority of construction labourers have always been employed informally. Output from the construction industry is a major and integral part of the national output, accounting for a sizeable proportion in the Gross Domestic Product (GDP) of both developed and underdeveloped countries (Ganesan 1997; Crosthwaite, 2000). Mlinga and Wells (2002) described informal construction sector as comprising "unregistered and unprotected individuals and small enterprises that supply labour and contribute in other ways to the output of the construction sector. Rogerson (1988) also describes construction industry as one of the largest employers of the informal sector workforce. Well (2007) stated that there is absence of regulation in the terms and conditions of employment as well as in the construction process of informal sector.

Jinadu (2004) cited in Sanni and Alabi (2008) stated that availability of manpower in both qualitative and quantitative terms is very crucial and constitutes the second largest single component of resource input required by the construction industry.

Manpower required for construction varies from professionals like Architects, Builders, Engineers, Quantity Surveyors, Urban and Regional Planners, Estate Managers to building artisans like bricklayers/masons, carpenters, welders/iron-benders, house painters, plumbers, electricians and the allied professions, and labour. Agbola (1985) established that manpower costs constitute about 40% of the total housing construction costs. In most cases, the types of manpower usually needed in large quantity for housing construction in Nigeria are artisans and labour (Sanni and Alabi, 2008) and this is equally applicable globally. This shows that there are two major classes of players/workers to the success of any construction industry; and both the professionals and informal worker/artisans ensure qualitative and quantitative performance of any construction activities respectively. Studies have also indicated that there are shortages in supply of skilled artisans in the construction industry globally.

In Mlinga and Wells (2001) opinion, the informal workers/artisans of the construction industry are generally ignored and receive little support from the government. They further argued that policies to develop the construction industries of developing countries should address the needs of the informal sector, where the bulk of the labour force is found (Mlinga and Wells, 2001). Meagher and Yunusa (1996) also stated that Nigeria has the largest, and arguably the most dynamic informal sector in sub-Saharan Africa and ILO (2002) has also described informal sector in sub-Saharan Africa as the largest concentration of informality globally. This invariably means that informal construction sector in Nigeria is significant both in Africa and developing countries thereby necessitate a need for its investigation. Consequently, the deficiencies, inadequacies and weaknesses of informal workers to construction sector have greatly affected the output of the industry with poor impact on nation Gross Domestic Products (GDP). Against this background, the paper assessed the activities of informal construction workers/artisans in the Nigerian construction industry with a view to provide information for policy formation to improving performance the informal construction sector in Nigeria.

## 2. LITERATURE REVIEW

### *2.1 Activities of Informal Workers/Artisans on Construction Projects*

Construction industry has a strong connection with other sectors of the economy and the increase in the construction activities will have positive impact on the wealth of the country (Ogunsemi and Aje, 2005). Availability of manpower in both qualitative and quantitative terms is very crucial and constitutes the second largest single component of resource input required by the construction industry (Jinadu, 2004; cited in Sanni and Alabi, 2008). Manpower required for construction varies from professionals like Architects/ Planners, Quantity Surveyors, Builders, Engineers to building artisans like bricklayers/masons, carpenters, welders/iron-benders, painters, plumbers, electricians and the allied professionals and trades.

The former could be described as formal manpower requirement because their operations are regulated by the government in terms of level of operations/activities to carry out, forms/conditions of engagement and remuneration while the later is described as the informal players or workers whose activities are not regulated by the government although very crucial and form the core of construction works. The functions of each of the players are sets of activities to be performed at different stages of any construction projects. The formal players (professionals) activities are knowledge-based or knowledge-driven (less labour intensive) while the informal players (artisans) activities are labour intensive which requires forms of physical efforts/energies to be carried out. The extent of activities to be carried out by various informal players is imperative, hence the need for it assessment. The informal construction workers/artisans considered under this study include bricklayers/masons, carpenters, iron benders, painters, plumbers and electricians.

In construction projects/works, bricklayers/masons construct walls, partitions, fireplaces, chimneys, and other structures from brick, block, and other masonry materials such as structural tile, concrete cinder, glass, gypsum and terra cotta (AGCNH, 2011). According to Occupational Outlook Handbook (2011) brickmasons, blockmasons, and stonemasons are often called bricklayers. They create, build and repair walls, floors, partitions, fireplaces, chimneys, and other structures with brick, precast masonry panels, concrete block, and other masonry materials. In Nigeria, they are often called bricklayers or masons whose works include blocklaying, concreting, plastering, flooring and other works made from cement, sand and aggregates.

Carpenters, on the other hands erect wood framework in buildings; build forms for concrete; and erect partitions, studs, joints, drywalls, and rafters (AGCNH, 2011). Some carpenters construct docks, work with large timbers, and drive piles to support the foundations of buildings and bridges. According to Occupational Outlook Handbook (2011) carpenters construct, erect, install, and repair structures and fixtures made from wood and other materials. Carpenters are involved in many different kinds of construction, from the building of highways and bridges to the installation of kitchen cabinets. They then join the materials with nails, screws, staples, or adhesives. Depending on the employer, carpenters install partitions, doors, and windows; change locks; and repair broken furniture. In Nigeria, carpenters are trained skilled artisans that deal with wood works and the allied products such as plywood et al. Carpenters make formworks to concrete at foundation and superstructure levels. They construct roof, doors and windows with their frames, wardrobes, kitchen cabinets, ceiling noggins, and other furniture works.

Electricians lay out, install, and test electrical service and electrical wire systems used to provide heat, light, power, air conditioning, and refrigeration in homes, office building, factories, hospitals, and schools. They also install conduit and other materials, and connect electrical machinery, equipment, and controls and transmission systems (AGCNH, 2011). Electricians install and maintain all of the electrical and power systems for our homes, businesses, and factories.

They install and maintain the wiring and control equipment through which electricity flows. They also install and maintain electrical equipment and machines in factories and a wide range of other businesses. Electricians specializing in construction primarily install wiring systems into factories, businesses, and new home (Occupational Outlook Handbook, 2011). In Nigeria, electricians are skilled artisans trained to carry out wiring of building structure. They lay cable either surface or conduit; lay pipes for conduit, fix electrical fittings and accessories, build and repair electrical appliances. They also construct, generate and distribute power within a community (rural electrification).

According to AGCNH (2011) structural iron workers erect the steel framework for large industrial, commercial, or residential buildings, bridges, and metal tanks. They erect, bolt, rivet, or weld the fabricated structural metal members that support the structure during and after construction. Some iron workers, called rodmen, set steel bars (rebar) or steel mesh in forms to strengthen concrete buildings, bridges, and highways. Other ironworkers called Ornamental Iron Workers install and assemble grills, canopies, stairways, iron ladders, decorative iron railings, posts, and gates. Occupational Outlook Handbook (2011) also confirmed that structural and reinforcing iron and metal workers place and install iron or steel girders, columns, and other construction materials to form buildings, bridges, and other structures. They also position and secure steel bars or mesh in concrete forms in order to reinforce the concrete used in highways, buildings, bridges, tunnels, and other structures. Ironworkers also structural metal, steel frames and assemble the cranes and derricks that move structural steel, reinforcing bars, buckets of concrete, lumber, and other materials and equipment around the construction site. Iron workers also connect steel columns, beams, and girders. In Nigeria, iron workers are called iron benders whose works include cutting, erecting and assembling iron works such as iron rods in construction of lintels, upper floor beams, steel roof trusses, burglary proof et al.

According to Occupational Outlook Handbook (2011), painters prepare the surfaces to be coated, so that the paint will adhere properly. This may require removing the old coat of paint by sanding, wire brushing, burning, or water and abrasive blasting. Painters also fill nail holes and cracks, sandpaper rough spots, and wash walls and trim to remove dirt, grease, and dust. Painters apply paint, stain, varnish, and other finishes to buildings and other structures. They select the right paint or finish for the surface to be covered, taking into account durability, ease of handling, method of application, and customers' wishes. In Nigeria, painter on a new works ensure that surface to be painted are smooth for paint application while on the old work remove all existing paints, stains and materials to the surface before paint application. They select the best type, colour and quality of paint to be used by their client on any job.

Plumbers are skilled craftsmen who install, repair and alter pipe systems that carry gases, water and other liquids required for sanitation, storm water, industrial production, and other uses.

They install plumbing fixtures, appliances, bathtubs, basins, sinks, showers, and grease line systems. They work from blueprints and working drawings to determine materials required for installation. They cut and thread pipe using pipe cutters, cutting torches, and pipe threading machines. Plumbers may have to work indoors or outdoors on a ladder or scaffold, underground in a trench, a crawl space under a building, or in the unfinished basement of a new building (AGCNH, 2011). Plumbers, pipelayers, pipefitters, and steamfitters install, maintain, and repair many different types of pipe systems. Plumbers install and repair the water, waste disposal, drainage, and gas systems in homes and commercial and industrial buildings. Plumbers also install plumbing fixtures—bathtubs, showers, sinks, and toilets—and appliances such as dishwashers, waste disposers, and water heaters (Occupational Outlook Handbook, 2011). In Nigeria, they are called plumbers whose works include laying of pipes for waste and water supply into the building. They fix all appliances such as water closet, wash hand basin, water heater (cold/hot), bath, shower tray, etc.

### *2.2 Related Studies on Informal Construction Workers/Artisans*

A major concern of stakeholders in the Nigerian Construction industry is how to improve service delivery. Mitullah and Wachira (2003) also reported that the development of an efficient construction industry is an objective of policy in most countries. In recent years, the informal construction sector has grown in size and importance in many African countries (Mlinga, 1998; Ngare, 1998; Wells, 2001). While small, unregistered construction enterprises were previously involved in the building, maintenance and repair of individual residential houses, they are now increasingly involved in the construction of complex and much larger commercial buildings (Wells, 2001). At the same time, due to unpredictable workloads in the construction industry and high costs involved in keeping idle labour, formal registered enterprises are resorting to subcontracting to the informal sector (Wells, 2001). This affirmed the level of significance and relevance of informal sector to the construction industry in African continent.

Extant literature has revealed challenges of skilled labour shortage in the construction industry. A study by the Construction User Round Table (CURT, 2001) in United States showed that owner companies considered the shortage of skilled labor as the most critical problem the construction industry today is facing. Statistics published by the Bureau of Labor Statistics of United States (BLS, 2004) indicated that by 2010, there will be a need to replace 1,469,000 construction trade worker jobs. A study on infrastructure in South Africa revealed a shortage of individuals to build and maintain infrastructure in underdeveloped areas (Philips et al., 1995). A study of railways in Japan linked the reduction in maintenance of the existing lines to the problem of labor shortages (Tarumi, 1994). The skilled labour shortage is due to the fact that people are no longer interested in going to these construction trades because of the nature of the activities in the industry. Hence, there is a need to appraise the activities of the informal workers/artisans in the construction industry because this will help in providing information to the policy makers to understand better conditions of activities of the players and the need for policy to address the challenges of informal workers/artisans in the construction industry.

Related studies on informal construction workers/artisans include researches on the occupational conditions of informal construction workers; a study by Mackenzie et al. (2000) in UK confirmed the provision of education, skill acquisition & development for informal construction workers in developed nations. But studies in developing countries by Vaid (1999) and Anand (2000) in India, Zylberstajn (1992) in Brazil showed that the education of construction workers were low and poor. Review of literature on the level of employment of construction workers show that in both the developed and developing countries, unemployment is very high to workers on temporary contracts than those on permanent contracts (Harvey, 2000; Vaid, 1999; Yuson, 2001), also those on permanent or formal contracts earn far more than their counterparts on temporary or informal contracts (Yuson, 2001; Lux & Fox, 2000; Connolly, 2001; Allen, 1994; Muteta, 1998; Vaid, 1999; Saboia, 1997; Harvey, 2000).

On social security, occupation safety and living conditions, most construction workers on temporary or informal contracts were not covered by social security benefits while very few on permanent contracts receive such (Abdul-Aziz, 2001; Muteta, 1998; Vaid, 1999) and situation on safety, health conditions, unemployment and retirement (pension) do not differ (Wall Street Journals, 2006; ICI, 2001; Harvey, 2000; ILO, 1998 & 1999; Gyi et al., 1999). Health records and rate of accidents were reported very much worse in developing countries by Abdul-Aziz (1995), Yuson (2001) and Lux & Fox (2001). Moreover, the performance of construction workers can only be improved through continuous training and skill development, studies in developing countries revealed that most construction workers received their skill through apprenticeship/traditional or informal processes and have not received any further training and certification (Lux & Fox, 2001; Abdul-Aziz, 2001; Yuson, 2001; Assad, 1993) while training and skill development had been in record in developed countries like United Kingdom (UK) (Bowen, 1996) and funding for sustainability has been the major problem.

In Nigeria, related studies on informal construction sector such as Oladapo (2006) undoubtedly confirmed the existence of informal construction sector. Fagbenle and Olawunmi (2010) and Oladapo (2001) emphasized the poor impact of informal sector on construction output. Adeyemi et al. (2006) also established that the vast majority of labourers of the informal sector in the Nigerian construction industry are female who act either as labourers or unskilled labour force. Wahab (2010) established that the stress factors attributed to artisans in the Nigerian construction industry include qualitative and quantitative workloads, tight-time frame of works and unstable working hour. Nwaka (2009) emphasized on the need for the government (formal sector) to support informal sector and not allow the sector to content with self-help and fending for themselves. Hence, Mitullah and Wachira (2003) submitted that the focus of research and technical assistance to date has largely been upon the enterprises that comprise the sector – the contractors, subcontractors and consultants.

Little attention has been paid to the labour force, about which often very little is known.

None of these studies on informal construction sector in Nigeria has examined and explored the informal workers/artisans' activities. Although, ILO (2002) had stated that statistics on informal sector are needed as a tool for evidence-based policy-making and advocacy. Therefore, in Nigeria such statistics are not available and where exist there are little research works that provide such statistics about informal sector workers/artisans in the construction industry. The paper therefore aims to fill this gap by examining the activities of informal workers/artisans in Nigeria.

## 3. RESEARCH METHODOLOGY

The study area was for this research was Osun state in the southwestern Nigeria. Ọṣun State is an inland state in Southwestern Nigeria. Its capital is Osogbo. It is bounded in the north by Kwara State, in the east partly by Ekiti State and partly by Ondo State, in the south by Ogun State and in the west by Oyo State (Wikipedia, 2012). The state consists of 30 Local Government Areas, the primary (third tier) unit of government in Nigeria (Wikipedia, 2012). The 30 Local Government Areas are listed below with their headquarters in parentheses including Aiyedaade (Gbongan), Aiyedire (Ile Ogbo), Atakunmosa East (Iperindo), Atakunmosa West (Osu), Boluwaduro (Otan-Ayegbaju), Boripe (Iragbiji), Ede North (Oja Timi), Ede South (Ede), Egbedore (Awo), Ejigbo (Ejigbo) and Ife Central (Ile-Ife). Others include Ife East (Oke-Ogbo), Ife North (Ipetumodu), Ife South (Ifetedo), Ifedayo (Oke-Ila Orangun), Ifelodun (Ikirun), Ila (Ila Orangun), Ilesa East (Ilesa), Ilesa West (Ereja Square), Irepodun (Ilobu), Irewole (Ikire), Isokan (Apomu), Iwo (Iwo), Obokun (Ibokun), Odo Otin (Okuku), Ola Oluwa (Bode Osi), Olorunda (Igbonna, Osogbo), Oriade (Ijebu-Jesa), Orolu (Ifon-Osun), Osogbo (Osogbo) and Ife East Area Office (Modakeke).

Osun State is divided into three federal senatorial districts including Osun Central, Osun West and Osun East. Each senatorial district is made of 10 local government areas. Osun Central has 10 LGAs including Osogbo, Olorunda, Odo-Otin, Ila, Boluwaduro, Boripe, Ifedayo, Ifelodun, Ifon Osun and Ejigbo. Osun West has 10 LGAs consist of Aiyedade, Aiyedire, Ede North, Ede South, Egbedore, Irepodun, Irewole, Isokan, Iwo and Olaoluwa. Osun East (Ife/Ijesha) comprises of Ife Central, Ife East, Ife North, Ife South, Atakumosa West, Atakumosa East, Obokun, Oriade, Ilesha East and Ilesha West. The study population for this study was obtained from the result of preliminary survey conducted on informal workers/artisans of the construction industry in the Osun State. Preliminary survey was conducted because there was no statistics or official data of informal workers/artisans in the study area. The informal workers/artisans surveyed include masons, carpenters, iron benders, painters, plumbers and electricians. The statistics on the informal workers/artisans were obtained by contacting the leaders of their various associations.

The leaders provided us with the registers of their associations, where we got the number of registered members for each trade. Due to accuracy and reliability of the registers collected, the figures obtained were harmonized and factored for the purpose of this study.

Since the state has three senatorial districts comprising Osun West, Osun East (Ife/Ijesha) and Osun Central; and each district has 10 local government areas. Two local government areas were selected from each senatorial district which gave a total of 6 local governments representing 20% of the study area. The study population obtained comprised 1190 masons/bricklayers, 2185 carpenters, 455 iron benders, 291 painters, 375 plumbers and 705 electricians from the study area. This gave a total 5201 informal construction workers/artisans. 5% of informal workers/artisans from the 6 local government areas were selected for this study given a sample of 60 masons, 109 carpenters, 23 iron benders, 15 painters, 19 plumbers and 15 electricians. This gave a sample size of 261 out of total 5201 informal workers/artisans of the construction industry in the study area. Purposive sampling technique was adopted in the selection of the sample size from the study population and administration of questionnaire to the informal workers/artisans.

Purposive sampling technique was adopted because of the demographic characteristics of the study population in terms of their level of education, skills status and accessibility. Secondly, the purposive sampling was also used so as to collect valid information from right set of workers. In other to collect an organized and closed data for this study, a list of questions was made on a well structured and closed multiple choice questionnaire which was administered on informal workers/artisans. Most of these informal workers/artisans were contacted through site visits and attending their association meetings; and the questionnaire was administered to them by the survey crew in form of interview. 3 Likert rating scale was used in rating their responses and the usual 5 Likert scale was not used because the survey crews were responsible in making sound judgement of the opinion of the informal workers/artisans based on their views on every research question raised. The questionnaire was divided into four sections. The first section identified the characteristics of the informal sector players. These include their sex, age group, marital status, no of wife and children among others. The other sections of the questionnaire addressed the specific objectives of this study. A total of 165 copies of questionnaire out those gotten back were found suitable and used for analysis. The data obtained were imported into Statistical Packages for Social Sciences (SPSS) for analysis. Since the data collected are closed ended, both descriptive and inferential statistics were employed in analyzing the data collected. These include percentage, mean score, factor analysis and analysis of variance (ANOVA) as applicable to this paper. The percentage shows the proportion of their demographic information while mean score shows the ratio of the responses among the informal workers/artisans.

Factor analysis KMO and Bartlett's Test appraised the level of adequacy of the data collected and reduces long list of activities to minima groups for easy description of data while ANOVA establishes the level of significance of the activities of the informal construction workers/artisans. The mean scores (MS) were calculated using the mathematical model below:

$$MS = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{(n_5 + n_4 + n_3 + n_2 + n_1)}$$

Where $n_5$ = number of respondents who picked 5
$n_4$ = number of respondents who picked 4
$n_3$ = number of respondents who picked 3
$n_2$ = number of respondents who picked 2
$n_1$ = number of respondents who picked 1

## 4. FINDINGS AND DISCUSSION

### *4.1 Respondents' Demographic Information*

This paper examined the activities of the informal workers/artisans in the construction industry in Osun state Nigeria. Information on the personal characteristics of the informal workers/artisans such their sex, age group and academic qualification were examined. The results obtained show that all the respondents were male. The study also revealed the age group of the informal workers/artisans in the construction industry and found that 8.5% are less than 20 years of age while 63.6%, 26.1% and 1.8% are of 21-40, 41-60 and above 60 years respectively. The highest academic qualifications of the respondents shows that 29.7% are holders of primary school certificate, 14.0% hold junior secondary certificate, 37.0%, 12.7%, 4.2%, 1.2% and 1.2% hold senior secondary certificate, NABTEB Certificate/Trade test, OND/NCE, HND and other academic qualifications respectively.

### *4.2 Frequency of the Activities of Informal Construction Workers/Artisans*

From the review of literature, a comprehensive list of the activities of informal workers/artisans in the construction industry was made as shown in the key to Table 1. The mean score values of informal workers/artisans' responses are described in Table 1. From Table 1, 14 out of 29 representing 48% of the activities has mean score values above 1.5 (1.5-2.06) from highest mean score value of 3.00 which indicates that less than half of the activities identified are the most frequently activities carried out by the informal players. Out of 29 activities identified, from the perspective of mason, the most frequent activities carry out include remove old materials in preparation for new works; plaster, level, smooth and shape surfaces;

construct walls and partitions; break existing structures such as walls, stone; mix concrete and mortar for laying block and plastering walls. Carpenters also ranked remove old materials in preparation for new works; build formwork for concrete; erect wood works; erect partitions, studs, joints and rafters; install floor covering, ceiling, paneling and interior design; smooth, chisel, cutting and fixing frames as the most frequent activities carry out on construction works.

The highest ranked activities by iron benders are to set steel bars; erect the steel framework for commercial, residential buildings; erect bolts and rivets; install and assemble grills, canopies, stairways, iron ladders; weld fabricated structural metal members and steel roof members; smooth, chisel, cutting and fixing frames. Painters also ranked preparation of surface for paint application; mix pigments, oils and other ingredients to obtain the required color as their most frequent activities. Plumbers also ranked read and interprets drawings to determine materials required for installation; measure, bend, cut and thread pipe using pipe cutters, cutting torches; join sections together as necessary using elbows, "T' Joints or other couplings; install plumbing fixtures, appliances, bathtubs, basins, sinks and showers; check leaks by forcing liquid steam or air through it under pressure; install and repair high pressure pipe system for industrial and commercial; install, repair and alter pipe system that carries gasses, water and other liquids as the most frequent activities perform on construction works. The electricians most frequent activities include lay out, install and test electrical services and electrical wiring; install conduits and other electrical materials; connect electrical machinery, equipments and control; read and interprets drawings to determine materials required for installation; measure, bend, cut and thread pipe using pipe cutters, cutting torches.

The overall assessment of these activities shows that the most frequent activities include; remove old materials in preparation for new works (2.06), read and interprets drawings to determine materials required for installation (2.03), build formwork for concrete (1.93), erect wood works (1.90), erect partitions, studs, joints and rafters (1.85), install floor covering, ceiling, paneling and interior design (1.82), smooth, chisel, cutting and fixing frames, et al. (1.81) and construct walls, partitions e.t.c. (1.79). It was noted the most frequent activities are most are associated with woodwork applicable in formwork and mansory. The less frequent activities include connect electrical machinery, equipments and controls (1.24), install conduits and other electrical materials (1.25), lay out, install and test electrical service and electrical wiring (1.29), Mix pigments, oils and other ingredients to obtain the required color (1.35) and install and high pressure pipe system for industrial and commercial. This shows that the least frequent activities of informal workers/artisans are associated with electrical works. The ANOVA test conducted on the result (at 5% significance) shows that all the activities of informal workers identified by this study were very significant eventhough 14 out of 29 representing 48% were ranked high by the informal workers/artisans. It was observed that the most frequently carried out by an artisan could be the least carried out by other artisans.

They are all considered gamine to the construction contract execution and equally important to construction industry. Table 2 further shows the list of the most frequent activities carried out by each of the informal construction workers/artisans in the industry.

### *4.3 Classification of the Activities of Informal Construction Workers/Artisans*

The list of the activities highlighted in the Key to Table 1 were subjected to factor analysis with each item treated as a variable with the aim of reducing them to few significant activities which will be used in the description of closely related activities and those sharing the same features or perform by the same informal workers/artisans on construction sites. The appropriateness of those activities was tested using factor extraction, Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (MSA) and the Bartlett's test of sphericity. The result was presented in Table 3 and from the Table, KMO value was 0.724. Field (2005) established that the KMO value of a set of scores should be close to 1 for factor analysis to yield distinct and reliable factors and Wiki (2007) also stated that Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (MSA) should be greater than 0.5 for satisfactory factor analysis to proceed. Hence, from these propositions, it could be concluded that factors analysis is appropriate for the data collected for this study. Also, Bartlett's test of sphericity showed that the result was highly significant ($\chi^2 = 4.839E3$, $p< 0.05$). The result agreed with Field (2005) recommendation and therefore confirmed the suitability of factor analysis for this study.

**Key to Table 1**

| S/N | ACTIVITIES |
|---|---|
| 1 | Remove old materials in preparation for new works |
| 2 | Read and interprets drawings to determine materials required for installation |
| 3 | Build formwork for concrete |
| 4 | Erect wood works |
| 5 | Erect partitions, studs, joints and rafters |
| 6 | Install floor covering, ceiling, paneling and interior design |
| 7 | Smooth, chisel, cutting and fixing frames, e.t.c |
| 8 | Plaster, level, smooth and shape surfaces |
| 9 | Construct walls, partitions and etc |
| 10 | Break existing structures such as walls, stone, etc |
| 11 | Mix concrete and mortar for laying block and plastering walls |
| 12 | Measure, bend, cut and thread pipe using pipe cutters, cutting torches et al. |
| 13 | Join sections together as necessary using elbows, "T' Joints or other couplings |

| | |
|---|---|
| 14 | Install plumbing fixtures, appliances, bathtubs, basins, sinks and showers |
| 15 | Set steel bars or steel mesh in forms |
| 16 | Install and assemble grills, canopies, stairways, iron ladders, et al |
| 17 | Erect the steel framework for commercial, residential buildings etc, |
| 18 | Erect bolts and rivets |
| 19 | Weld fabricated structural metal members and steel roof members |
| 20 | Mould blocks and bricks |
| 21 | Prepare surface and apply paint, varnish, enamel, etc |
| 22 | Check leaks by forcing liquid steam or air through it under pressure |
| 23 | Install, repair and alter pipe system that carries gasses, water and other liquids |
| 24 | Install and repair high pressure pipe system for industrial and commercial |
| 25 | Mix pigments, oils and other ingredients to obtain the required color |
| 26 | Lay out, install and test electrical service and electrical wiring |
| 27 | Install conduits and other electrical materials |
| 28 | Connect electrical machinery, equipments and control etc |
| 29 | Prepare surface for paint application |

Source: (Odediran, 2012)

**Table 1: Activities of Informal Sector Workers/Artisans in the Construction Industry**

| Key | Mason | | Carpenter | | Bender | | Painter | | Plumber | | Electrician | | Overall | | F | Sig. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Rk | Mean | Rk | Mean | Rk | Mean | Rk | Mean | Rk | Mean | Rk | Mean | Rk | | |
| 1 | 2.35 | 5 | 2.14 | 6 | 2.27 | 9 | 1.17 | 9 | 1.69 | 9 | 1.60 | 9 | 2.06 | 1 | 6.149 | .000* |
| 2 | 1.88 | 7 | 1.84 | 7 | 2.33 | 11 | 1.36 | 4 | 3.00 | 1 | 2.67 | 4 | 2.03 | 2 | 8.056 | .000* |
| 3 | 1.77 | 8 | 2.88 | 1 | 1.43 | 16 | 1.14 | 10 | 1.00 | 21 | 1.27 | 22 | 1.93 | 3 | 37.950 | .000* |
| 4 | 1.73 | 9 | 2.82 | 2 | 1.50 | 15 | 1.00 | 19 | 1.00 | 21 | 1.33 | 21 | 1.90 | 4 | 41.519 | .000* |
| 5 | 1.67 | 11 | 2.74 | 3 | 1.57 | 14 | 1.21 | 7 | 1.00 | 21 | 1.07 | 29 | 1.85 | 5 | 33.270 | .000* |
| 6 | 1.71 | 10 | 2.58 | 4 | 1.29 | 21 | 1.36 | 4 | 1.08 | 15 | 1.14 | 26 | 1.82 | 6 | 19.010 | .000* |
| 7 | 1.58 | 15 | 2.22 | 5 | 2.86 | 6 | 1.18 | 8 | 1.08 | 15 | 1.40 | 18 | 1.81 | 7 | 14.933 | .000* |
| 8 | 2.91 | 1 | 1.18 | 15 | 1.36 | 18 | 1.00 | 19 | 1.15 | 12 | 1.40 | 18 | 1.78 | 9 | 79.942 | .000* |
| 9 | 2.89 | 2 | 1.28 | 11 | 1.00 | 27 | 1.07 | 16 | 1.15 | 12 | 1.43 | 16 | 1.79 | 8 | 65.288 | .000* |
| 10 | 2.61 | 3 | 1.24 | 13 | 1.43 | 16 | 1.00 | 19 | 1.77 | 8 | 1.60 | 8 | 1.78 | 10 | 12.522 | .000* |
| 11 | 2.41 | 4 | 1.30 | 9 | 1.20 | 22 | 1.07 | 16 | 1.08 | 15 | 1.40 | 18 | 1.63 | 11 | 29.027 | .000* |
| 12 | 1.35 | 19 | 1.02 | 27 | 2.40 | 8 | 1.14 | 10 | 2.92 | 2 | 2.20 | 5 | 1.53 | 12 | 42.439 | .000* |
| 13 | 1.29 | 24 | 1.20 | 14 | 2.27 | 9 | 1.14 | 10 | 2.92 | 2 | 1.67 | 7 | 1.51 | 13 | 21.944 | .000* |
| 14 | 1.62 | 14 | 1.06 | 22 | 1.67 | 13 | 1.14 | 10 | 2.92 | 2 | 1.53 | 10 | 1.50 | 14 | 15.914 | .000* |
| 15 | 1.42 | 20 | 1.16 | 16 | 3.00 | 1 | 1.00 | 19 | 1.08 | 15 | 1.47 | 12 | 1.43 | 21 | 28.551 | .000* |
| 16 | 1.65 | 12 | 1.06 | 20 | 2.87 | 4 | 1.00 | 19 | 1.38 | 10 | 1.47 | 12 | 1.48 | 17 | 22.033 | .000* |
| 17 | 1.56 | 16 | 1.25 | 12 | 2.93 | 2 | 1.00 | 19 | 1.15 | 12 | 1.20 | 24 | 1.49 | 15 | 21.605 | .000* |
| 18 | 1.35 | 18 | 1.41 | 8 | 2.93 | 2 | 1.00 | 19 | 1.38 | 10 | 1.20 | 24 | 1.47 | 18 | 22.887 | .000* |
| 19 | 1.37 | 17 | 1.16 | 16 | 2.87 | 4 | 1.07 | 16 | 1.08 | 15 | 1.47 | 12 | 1.40 | 22 | 24.268 | .000* |
| 20 | 1.94 | 6 | 1.30 | 9 | 1.00 | 27 | 1.00 | 19 | 1.00 | 21 | 1.27 | 22 | 1.44 | 20 | 11.075 | .000* |
| 21 | 1.42 | 20 | 1.06 | 20 | 2.60 | 7 | 2.64 | 2 | 1.00 | 21 | 1.13 | 27 | 1.47 | 18 | 31.480 | .000* |
| 22 | 1.31 | 23 | 1.04 | 23 | 1.07 | 24 | 1.14 | 10 | 2.92 | 2 | 1.93 | 6 | 1.38 | 23 | 30.851 | .000* |
| 23 | 1.33 | 22 | 1.08 | 19 | 1.00 | 27 | 1.36 | 4 | 2.85 | 7 | 1.47 | 12 | 1.36 | 24 | 22.298 | .000* |
| 24 | 1.27 | 25 | 1.04 | 23 | 1.33 | 19 | 1.14 | 10 | 2.92 | 2 | 1.53 | 10 | 1.35 | 25 | 25.640 | .000* |
| 25 | 1.25 | 26 | 1.04 | 24 | 1.93 | 12 | 2.43 | 3 | 1.00 | 21 | 1.40 | 16 | 1.35 | 25 | 25.788 | .000* |
| 26 | 1.23 | 27 | 1.04 | 24 | 1.33 | 19 | 1.00 | 19 | 1.00 | 21 | 2.80 | 1 | 1.29 | 27 | 39.442 | .000* |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | 1.15 | 28 | 1.02 | 27 | 1.13 | 23 | 1.00 | 19 | 1.00 | 21 | 2.87 | 1 | 1.25 | 28 | 88.925 | .000* |
| 28 | 1.15 | 28 | 1.02 | 27 | 1.07 | 24 | 1.00 | 19 | 1.00 | 21 | 2.87 | 1 | 1.24 | 29 | 109.680 | .000* |
| 29 | 1.65 | 12 | 1.10 | 18 | 1.07 | 24 | 2.86 | 1 | 1.08 | 15 | 1.13 | 27 | 1.49 | 15 | 20.988 | .000* |

Source: (Odediran, 2012) *: significant at 5% level

**Table 2: The Critical Activities of the Informal Workers/Artisans on Construction Sites**

| IDENTIFIED ACTIVITES ON CONSTRUCTION WORKS | INFORMAL WORKERS/ARTISANS | MOST FREQUENT ACTIVITES | NO |
|---|---|---|---|
| Remove old materials in preparation for new works; Read and interprets drawings to determine materials required for installation; Build formwork for concrete; Erect wood works; Erect partitions, studs, joints and rafters; Install floor covering, ceiling, paneling and interior design; Smooth, chisel, cutting and fixing frames; Plaster, level, smooth and shape surfaces; Construct walls and partitions; Break existing structures such as walls, stone; Mix concrete and mortar for laying block and plastering walls; Measure, bend, cut and thread pipe using pipe cutters, cutting torches; Join sections together as necessary using elbows, "T' Joints or other couplings; Install plumbing fixtures, appliances, bathtubs, basins, sinks and showers; Set steel bars or steel mesh in forms; Install and assemble grills, canopies, stairways, iron ladders; Erect the steel framework for commercial, residential buildings; Erect bolts and rivets; Weld fabricated structural metal members and steel roof members; Mould blocks and bricks; Prepare surface and apply paint, varnish, enamel; Check leaks by forcing liquid steam or air through it under pressure; Install, repair and alter pipe system that carries gasses, water and other liquids; Install and repair high pressure pipe system for industrial and commercial; Mix pigments, oils and other ingredients to obtain the required color; Lay out, install and test electrical service and electrical wiring; Install conduits and other electrical materials; Connect electrical machinery, equipments and control; Prepare surface for paint application, Remove old materials in preparation for new works; Read and interprets drawings to determine materials required for installation; Build formwork for concrete | MASONS | Remove old materials in preparation for new works; Plaster, level, smooth and shape surfaces; Construct walls, partitions and etc; Break existing structures such as walls, stone, etc; Mix concrete and mortar for laying block and plastering walls | 5 |
| | CARPENTERS | Remove old materials in preparation for new works; Build formwork for concrete; Erect wood works; Erect partitions, studs, joints and rafters; Install floor covering, ceiling, paneling and interior design; Smooth, chisel, cutting and fixing frames, e.t.c | |
| | BENDERS | Set steel bars etc; Erect the steel framework for commercial, residential buildings; Erect bolts and rivets; Install and assemble grills, canopies, stairways, iron ladders; Weld fabricated structural metal members and steel roof members; Smooth, chisel, cutting and fixing frames; | 6 |
| | PAINTERS | Prepare surface for paint application; Prepare surface and apply paint, varnish, enamel; Mix pigments, oils and other ingredients to obtain the required color | 3 |
| | PLUMBERS | Read and interprets drawings to determine materials required for installation; Measure, bend, cut and thread pipe using pipe cutters, cutting torches; Join sections together as necessary using elbows, "T' Joints or other couplings; Install plumbing fixtures, appliances, bathtubs, basins, sinks and showers; Check leaks by forcing liquid steam or air through it under pressure; Install and repair high pressure pipe system for industrial and commercial; Install, repair and alter pipe system that carries gasses, water and other liquids | 7 |
| | ELECTRICIANS | Lay out, install and test electrical service and electrical wiring; Install conduits and other electrical materials; Connect electrical machinery, equipments and control; Read and interprets drawings to determine materials required for installation; Measure, bend, cut and thread pipe using pipe cutters, cutting torches | 5 |

Source: (Odediran, 2012)

**Table 3: KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | 0.724 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 4.839E3 |
| | Df | 406 |
| | Sig. | 0.000 |

Source: (Odediran, 2012)

Table 4 illustrates the outcome of the factor loading which classified activities into various trades sharing equal and relevant features; and/or performs by an informal construction worker/artisan. Factor analysis reduces a large number of activities to a smaller number of trades for modeling purposes. This gave seven major activities of the informal workers/artisans in the construction industry which represent various trades in the industry. Each of these activities was grouped as sub-activities under the seven trades identified from factor loadings as shown in Table 4. The trades include plumbing and associated works, mansory & blockwork, steelworks, woodworks, electrical works, painting and decoration and demolition and reconstruction. The latter is not really a trade but a preliminary works common to most of the trades in the construction industry. Table 5 shows the classification of these activities to various trades based on the outcome of the factor analysis.

From Table 4 and based on result of rotated factor matrix (factors loading), the component 1 was named *plumbing and associated work*; the activities under the component comprises of install, repair and alter pipe system that carries gasses, water and other liquids; install plumbing fixtures, appliances, bathtubs, basins, sinks and showers; measure, bend, cut and thread pipe using pipe cutters; join sections together as necessary using elbows, "T' Joints or other couplings; install and repair high pressure pipe system; and check leaks by forcing liquid steam or air through it under pressure; install and repair high pressure pipe system for industrial. Component 2 was also named *mansory and blockwork* and the activities under this trade include construct walls and partitions; plaster, level, smooth and shape surfaces; break existing structures such as walls, stone; mould blocks and bricks; mix concrete and mortar for laying block and plastering walls. Component 3 was named *steelworks* with activities including smooth, chisel, cutting and fixing frames; erect the steel framework for commercial and residential buildings; erect bolts and rivets; weld fabricated structural metal members and steel roof members; install and assemble grills, canopies, stairways, iron ladders; and set steel bars or steel mesh in forms.

Component 4 was equally named *woodwork* with the activities to include erect wood works; build formwork for concrete; erect partitions, studs, joints and rafters; and install floor covering, ceiling, paneling and interior design. The 5$^{th}$ Component was *electrical works* having activities such as lay out, install and test electrical services and electrical wiring; install conduits and other electrical materials and connect electrical machineries, equipments and controls. The 6$^{th}$ Component was *painting and decoration* activities such as prepare surface and apply paint, varnish, enamel; mix pigments, oils and other ingredients to obtain the required color and prepare surface for paint application. The 7$^{th}$ Component was named *demolition and reconstruction* having activities such as remove old materials in preparation for new works and read and interprets drawings to determine materials required for installation. All these activities carried out by the informal construction workers/artisans agreed with the construction trades activities as highlighted by Associated General Contractors of New Hampshire (2011) and described by Occupational Outlook Handbook (2011).

## 5. CONCLUSION AND RECOMMENDATION

Based on the explorative survey of informal sector players in the Nigerian construction industry, this paper presents the findings of the activities of informal construction workers/artisans in Osun State Nigeria. The overall assessment of twenty nine (29) activities by the study shows that the most frequent activities of informal workers/artisans on construction works in the Nigerian include to remove old materials in preparation for new works, read and interprets drawings to determine materials required for installation, build formwork for concrete, erect wood works, erect partitions, studs, joints and rafters, install floor covering, ceiling, paneling and interior design, smooth, chisel, cutting and fixing frames; and construct walls and partitions. While the less frequent activities on the other hand include connect electrical machinery, equipments and controls, install conduits and other electrical materials, lay out, install and test electrical services and electrical wiring, mix pigments, oils and other ingredients to obtain the required color and install and high pressure pipe system for industrial and commercial. The study also classified the activities in the construction industry into various trades including plumbing and associated works, mansory & blockwork, steelworks, woodworks, electrical works, painting and decoration and demolition and reconstruction.

From the outcome of this study, the paper recommends that stakeholders in the execution of construction works and policy makers on informal sector should take a closer examination of the activities of informal workers/artisans in the industry. This will assist in providing enabling environment for operation of informal workers/artisans and for combating the challenges inhibiting the poor performance of the construction industry in general.

**Table 4: Rotated Factor Matrix (Loading) of the Activities of the Informal Players on Construction Sites**

| | **FACTORS** | **COMPONENTS** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 1 | Construct wall, partition etc | | 0.921 | | | | | |
| 2 | Plaster, level, smooth etc | | 0.921 | | | | | |
| 3 | Break existing structure such as walls, stone etc | | 0.843 | | | | | |
| 4 | Mould block and bricks | | 0.780 | | | | | |
| 5 | Mix concrete and mortar etc | | 0.866 | | | | | |
| 6 | Remove old materials in preparation for new one | | | | | | | 0.553 |
| 7 | Erect wood work | | | | 0.897 | | | |
| 8 | Build formwork | | | | 0.909 | | | |
| 9 | Erect partitions, studs etc | | | | 0.840 | | | |
| 10 | Install floor covering, ceiling etc | | | | 0.666 | | | |
| 11 | Smooth, chisel etc | | | 0.437 | | | | |
| 12 | Erect the steel framework for large industrial etc | | | 0.860 | | | | |
| 13 | Erect bolts and rivets | | | 0.835 | | | | |
| 14 | Weld fabricated structural metal member | | | 0.699 | | | | |
| 15 | Set steel bars etc | | | 0.676 | | | | |
| 16 | Install and assemble grills etc | | | 0.746 | | | | |
| 17 | Prepare surface and apply paints etc | | | | | | 0.761 | |
| 18 | Mix pigments, oil etc | | | | | | 0.646 | |
| 19 | Prepare surface for paint application | | | | | | 0.866 | |
| 20 | Install, repair and alter pipe system | 0.859 | | | | | | |
| 21 | Install plumbing fixtures etc | 0.776 | | | | | | |
| 22 | Read and interpret drawings etc | | | | | | | 0.613 |
| 23 | Measure, bend, cut and thread pipe etc | 0.727 | | | | | | |
| 24 | Join sections together | 0.821 | | | | | | |
| 25 | Install and repair high pressure pipe system etc | 0.944 | | | | | | |
| 26 | Check leaks by forcing liquid steam or air etc | 0.854 | | | | | | |
| 27 | Lay out, install and test electrical services etc | | | | | 0.910 | | |
| 28 | Install conduit and other electrical materials | | | | | 0.971 | | |
| 29 | Connect electrical machinery, equipment etc | | | | | 0.974 | | |

**Table 5: Extracted Activities through Principal Components Analysis with the loaded items**

| S/N | Component factors (Trade) | Loaded Items |
|---|---|---|
| 1 | Plumbing and Associated works | Install, repair and alter pipe system that carries gasses, water and other liquids |
| | | Install plumbing fixtures, appliances, bathtubs, basins, sinks and showers |
| | | Measure, bend, cut and thread pipe using pipe cutters et al. |
| | | Join sections together as necessary using elbows, "T' Joints or other couplings |
| | | Install and repair high pressure pipe system etc |
| | | Check leaks by forcing liquid steam or air through it under pressure |
| | | Install and repair high pressure pipe system for industrial and comer |
| 2 | Mansory and Blockwork | Construct walls, partitions and etc |
| | | Plaster, level, smooth and shape surfaces |
| | | Break existing structures such as walls, stone, etc |
| | | Mould blocks and bricks |
| | | Mix concrete and mortar for laying block and plastering walls |
| 3 | Steelworks | Smooth, chisel, cutting and fixing frames, e.t.c |
| | | Erect the steel framework for commercial, residential buildings etc |
| | | Erect bolts and rivets |
| | | Weld fabricated structural metal members and steel roof members |
| | | Install and assemble grills, canopies, stairways, iron ladders, et al |
| | | Set steel bars or steel mesh in forms |
| 4 | Woodwork | Erect wood works |
| | | Build formwork for concrete |
| | | Erect partitions, studs, joints and rafters |
| | | Install floor covering, ceiling, paneling and interior design |
| 5 | Electrical works | Lay out, install and test electrical service and electrical wiring |
| | | Install conduits and other electrical materials |
| | | Connect electrical machinery, equipments and control etc |
| 6 | Painting and Decoration | Prepare surface and apply paint, varnish, enamel, etc |
| | | Mix pigments, oils and other ingredients to obtain the required color |
| | | Prepare surface for paint application |
| 7 | Demolition and Reconstruction | Remove old materials in preparation for new works |
| | | Read and interprets drawings to determine materials required for installation |

Source: (Odediran, 2012)

## 6. ACKNOWLEDGEMENT

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# EXPLORING THE IMPORTANCE OF EMOTIONAL QUOTIENT IN CONSTRUCTION: PERSPECTIVES FROM HEALTH AND SAFETY PROFESSIONALS IN SOUTH AFRICA

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## ABSTRACT

Self-regard, emotional self-awareness, flexibility, problem solving, and stress tolerance, inter alia, constitute attributes that affect how well activities are carried out by individuals. Thus, construction activities that are people intensive require a measure of emotional quotient (EQ) to enhance project performance, especially with regard to health and safety (H&S). EQ is important due to: intrapersonal EQ; relationship with one self; interpersonal EQ; stress management; adaptability, and general mood of employees. The aforesaid in due course impact on performance related to the project parameters in the sector, inter alia, cost, H&S, time, quality, and productivity. The purpose of the paper is to present the findings of an exploratory study that was conducted to determine the perceived importance of EQ in terms of managing construction H&S and the extent to which EQ contributes to optimising H&S performance on projects in South Africa. This is aimed at contributing to the enhancement of H&S performance in construction.

**Keywords:** Construction, Emotional Quotient, Health and Safety (H&S), Performance, Project, South Africa

## 1. INTRODUCTION

The South African literature has noted construction health and safety (H&S) related underperformance (Construction Industry Development Board, 2009: 37; 2010: 4; Emuze and Smallwood, 2012: 33).

This persistent underperformance, that is not limited to construction H&S, has necessitated a paradigm shift in the industry in terms of construction management. A shift from the dominant operations paradigm to one that addresses organisational behaviour is now being promoted in the discipline of construction management (Love, Edwards and Wood, 2011: 52). This particular study engages with this shift and contributes to the emotional quotient (EQ) discussion from the South African perspective. EQ, which measures emotional competence, embraces managerial and leadership qualities that are essential for managing projects (Muller, Geraldi and Turner, 2012: 77). EQ is being promoted based on the premise that organisational behaviour can be used for improving performance in construction. Organisational behaviour is concerned with examining the impact that individuals, groups, and structure have on the behaviours within a firm for the purpose of applying such knowledge towards enhancing effectiveness and efficiency in the firm (Roberts, Ziedner and Mathews, 2001: 198)

Love et al. (2011: 59) recently contend that an in-depth investigation and appreciation of how individuals and teams influence organisational behaviour would lead to improvement in construction project performance. Muller et al. (2012: 86) also show that EQ and managerial leadership training should be incorporated into the education and training of project managers since EQ and managerial competence impact projects positively and directly. As an illustration, the value of EQ extends to H&S management. The findings of a study indicate that project personnel can use emotional intelligence (EI), interpersonal skills, and transformational leadership, to implement H&S management tasks and develop safe climate in work environments (Sunindijo and Zou, 2011: 10). Sunindijo and Zou (2011: 8) and by extension Salovey and Mayer (1990: 187) observe that EI, particularly self-awareness, is a core factor that contributes to improvement of individual performance and the evolution of effective relationships with others. They further note that project personnel can show their EI in interpersonal relationships by communicating effectively, motivating others, resolving conflicts, and building teams. In effect, effective interpersonal relationships are needed so that employees can become transformational leaders that inspire their teams to generate superior performance (Sunindijo and Zou, 2011: 10).

The overall aim of this discourse is to argue that EQ and its contributions to project H&S performance optimisation may be useful in the construction management domain. The premise adopted indicates that management lies in the recognition that people engage in both repetitive and non-repetitive operations. Going forward, a synopsis of the value of EQ in construction is provided before the main data that emanate from the South African study is presented. Final remarks that conclude the paper re-echo the usefulness of EQ in the construction industry.

## 2. LITERATURE REVIEW

EI is defined as “the ability to monitor one’s own and others’ feelings and emotions, to discriminate among them and to use this information to guide one’s thinking and actions" (Salovey and Mayer, 1990: 189).



This 1990 definition by Salovey and Mayer shows that emotions can be used to guide logical thinking and goal-oriented actions that are important in construction project environments. In other words, emotions can enhance rationality when this definition is taken into consideration.

Several authors from the management and humanity disciplines have shown how working with emotions can enhance certain skills. Within a project context, Carmeli (2003: 807) confirms that managers who are considered to be 'emotionally intelligent' outperform their peers; and EI can be said to be the "ability to perceive emotions, to access and generate emotions so as to assist thought, to understand emotions and emotional wisdom, and to reflectively regulate emotions in order to enhance emotional and intellectual growth." (Ashkanasy and Daus, 2005: 450) Love et al. (2011: 56) recently contextualised EI to construction. Love and his co-authors suggest that although psychologists have pointed to the benefits associated with EI, the concept still remains largely unexplored in a construction context. The study observed that this notable absence could be due to a similar lack of psychological research in construction, but also a general unwillingness of the industry to pay attention to individual psychology because the industry seems rooted in process efficiency under the banner of the operations management paradigm. They then conclude that if construction organisations focus on selecting managers who are highly emotionally intelligent, and provide training to employees on how to become aware and utilise emotions appropriately in their role, the industry may see a significant improvement of effectiveness over and above that offered by the renowned operational initiative alone.

In particular, Caruso et al. (2001: 56) contend that EI is a vital catalyst of leadership, either the charismatic or the transformational style, as it enables leaders to: articulate team goals and objectives; engender enthusiasm in teams; empathise with team members; establish cooperation and trust, and identify and then encourage flexibility. For instance, citations by Love et al. (2011: 58) indicate that assessing individuals and a team's EI before the start of a project can provide managers with a vital psychological description, and enable them to identify strategies that would improve project performance in terms of effectiveness. Love et al. (2011: 59) deduce that members of a project team, particularly site management, need to be aware of their emotions and understand how their feelings can affect other people. In other words, members of the project team need to make an effort to determine why they are experiencing certain emotions, and should be made aware of how these emotions can be controlled.

Before the contextualisation of EI into the construction domain by Love et al. (2011: 59), an EI related study was conducted among project managers and engineers in Thailand in a bid to determine the benefits of EI to project management in terms of leadership style. The study that was conducted in Thailand was intended to extend the usefulness of EI to the construction industry.

The findings of the study indicate that project managers and engineers with higher EI scores tend to use more open communication and proactive leadership styles than their counterparts with lower EI scores (Sunindijo et al., 2007: 169). Sunindijo et al. (2007: 170) also note that there were positive correlations between leadership behaviours and EI dimensions. The study discovered that EI generates delegating, open communication, and proactive behaviours, that are essential for the achievement of zero accidents on sites and other objectives.

According to Sunindijo et al. (2007: 170), open communication is a key factor in organisational success as it is the catalyst for getting the best from people, construction workers and site management alike; and proactivity is essential to tackle problems at the early stages of the construction process. Hence, a project manager or engineer with high EI can stimulate team performance and innovation (Sunindijo et al., 2007: 170). This argument was reinforced by the Thai study, which indicates that the project managers and engineers with high EI scores used stimulating, rewarding, delegating, leading by example, open communication, listening, participating, and proactive behaviours more than the project managers and engineers with low EI scores. In addition, Sunindijo et al. (2007: 169) note significant positive correlations between delegating and self-awareness, sharing and open communication with social-awareness, and pro-activeness with self-management.

Another study that was conducted in the United States of America (USA) among construction executives examined the EI profiles of construction leaders and the relationship between construction leader EQ and transformational leadership behaviour (Butler and Chinowsky, 2006: 121). Evidence from the study shows that stress tolerance, independence, and optimism constituted EI strengths among the respondents. As indicated in Table 1, stress tolerance falls under the stress management area of EI, independence is categorised under intrapersonal skills, and optimism is a component of general mood.

In addition, interpersonal skills were found to be the most important of the major components of EQ in explaining transformational behaviour, while empathy, a subscale of interpersonal skills, was found to be the most important variable of the 15 subscales in explaining transformation leadership behaviour variance. As a result, Butler and Chinowsky (2006: 125) argue that the findings of the study have indeed proven that a relationship exists between construction leader EQ and transformational leadership behaviour. Because the study of competencies opens the door to insights relative to humans and talent, and adults appear to be able to develop competencies that are vital to outstanding performance in management, leadership, and many other occupations and professions (Boyatzis, 2009: 765), a study that explores how EQ can be used to the benefit of construction H&S is arguably a timely endeavor.

Table 1 Bar-On's model of Emotional Intelligence

| **Component Measured by EQ-I Subscales** | **Area** |
|---|---|
| Self-regard | Interpersonal skills |
| Emotional self-awareness | |
| Assertiveness | |
| Independence | |
| Self-actualisation | |
| Empathy | Intrapersonal skills |
| Social responsibility | |
| Interpersonal relationship | |
| Reality testing | Adaptability |
| Flexibility | |
| Problem solving | |
| Stress tolerance | Stress management |
| Impulse control | |
| Optimism | General moods |
| Happiness | |

Extracted from Butler and Chinowsky (2006: 120)

## 3. RESEARCH METHODOLOGY

Given that the exploratory study was intended to provide insights that will be useful for a future in-depth study, a pilot survey was conducted among H&S professionals in South African construction. The purposive sampling method was adopted as the H&S professionals were selected on the basis of their likely understanding and appreciation of EI and its role in managing construction H&S and achieving optimum performance. The self-administered questionnaire was sent per e-mail to professionals within the with the intention of achieving at least 30 responses before the initial analysis was undertaken. 38 responses were recorded during the compilation of this paper, and constitute the basis of the presented findings. The data was captured in and analysed using MS Excel. Because of the limited responses only descriptive statistics in the form of frequencies and a measure of central tendency, namely a mean score (MS), were used for presenting the findings in the next section. The questions that were posed to the respondents entailed five-point Likert scale formats and were formulated to elicit responses to the importance of fifteen attributes / states according to Bar-On's model of EI (Butler and Chinowsky, 2006: 120) in terms of managing construction H&S, and the contributions of these attributes / states to optimising (best possible) H&S performance. The questionnaire included the definitions of the fifteen attributes / states to prevent misunderstanding and to assure congruence when responding to questions. These definitions include:

- Self-regard: The ability to look at and understand, respect and accept oneself;



- Emotional self-awareness: Ability to understand ones thoughts, feelings and emotions;
- Independence: Be self-reliant, do not need anyone to tell them what to do, can stand and work alone, lead;
- Assertiveness: Express feelings, beliefs, thoughts in a non-destructive way, not using anger and temper;
- Self-actualisation: Realize ones potential, strive to reach what one wants to, in the right career, being fulfilled;
- Empathy: To emotionally read others, feel for them as if in their shoes (different from sympathy);
- Social responsibility: Co-operate, contribute to one's social group, being involved, caring for the team, society;
- Interpersonal relationships: Maintain satisfying relationships, getting along with others;
- Stress tolerance: The ability to withstand adverse and stressful situations without falling apart;
- Impulse control: Ability to resist or delay an impulse, drive or temptation to act (e.g. anger, eating, drugs, shopping);
- Reality testing: Ability to assess the correspondence between what is experienced (subjective) and what in reality exists (having accurate assumptions);
- Flexibility: Ability to adjust ones emotions, thoughts and behaviours to changing situations, manage change and new ways of doing things;
- Problem solving: Ability to identify, define problems and implement effective solutions;
- Optimism: Ability to look at the brighter side of life, maintain a positive attitude, and
- Happiness: To feel satisfied with one’s life, enjoy one self, have fun, study, which was quantitative in nature addressed H&S management in terms of: knowledge of legislation (its existence); perceptions relative to H&S; aspects of H&S culture, and management practices / interventions.

## 4. FINDINGS AND DISCUSSION

Table 2 indicates the importance of attributes / states in terms of managing construction H&S in terms of percentage responses to a scale of 1 (not) to 5 (very), and a MS ranging between 1.00 and 5.00. Given that all the MSs are > 3.00, all the attributes / states can be deemed to be important.

However, nine of the fifteen (60%) MSs > 4.20 ≤ 5.00, and thus the attributes / states can be deemed to be between more than important to very important / very important. Problem solving predominates with a MS of 4.74. This attribute is critical, as during the process of construction and when managing H&S, problems are frequently encountered.



Second ranked assertiveness is important due to the challenging nature of construction and that H&S is a 'life or death' issue. Third ranked stress tolerance is also a critical attribute as stress is frequently experienced by all levels of construction management and production workers. Furthermore, the inability to tolerate stress could result in poor decision making or impulsive action(s), which in turn could be the trigger for a series of events that culminates in an accident. Reality testing, ranked fourth, is particularly important in terms of managing H&S as a manager must be able to differentiate between reality and perception.

The remaining six (40%) MSs are > 3.40 ≤ 4.20, and thus the attributes / states can be deemed to be between important to more than important / more than important. Self-regard, ranked tenth, is important as within the context of managing H&S, managers and others need to reflect and respect themselves in order to respect others. Given that H&S is a corporate social responsibility (CSR) issue, eleventh ranked social responsibility is important. Construction is a dynamic and ever changing process, in that on many projects the work level changes with time and it is not static as a production line. Therefore, twelfth ranked flexibility is important to enable management to absorb and process the realities of construction without compromising H&S.

Thirteenth ranked self-actualisation is important as within the context of managing H&S, achievers and the achievement of optimum or better practice in terms of importance has benefits. Fourteenth ranked happiness is a state that assists managers to face the challenges of construction and managing H&S. Independence, ranked fifteenth is important as managers in construction must be leaders and 'do the right thing' as opposed to 'doing things right', and often act decisively with respect to managing H&S.

For example the perception that all stakeholders and workers are committed to H&S is just that, the commitment should be tested. Due to the pressure experienced and the stressful nature of construction, fifth ranked impulse control is important. Furthermore, in terms of managing H&S, acting on impulse can have fatal consequences. Due to the number of stakeholders, the team nature of construction, construction is people intensive, and that H&S requires a multi-stakeholder effort, the ability to optimise sixth ranked interpersonal relationships is important. Seventh ranked empathy is important as managers should consider the H&S of individuals as if they were personally undertaking the activity themselves. Emotional self-awareness, ranked eighth, is important as managers must understand their thoughts and feelings and the reasons for their decisions, and be conscious and mindful of the H&S implications of such decisions. Managing construction and H&S is challenging and therefore optimism, ranked ninth, is important.

Table 2 Importance of attributes / states in terms of managing construction H&S

| Attribute / State | Response (%) | | | | | | MS | Rank |
|---|---|---|---|---|---|---|---|---|
| | U | Not ..............................Very | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | | |
| Problem solving | 0.0 | 0.0 | 0.0 | 2.6 | 21.1 | 76.3 | 4.74 | 1 |
| Assertiveness | 0.0 | 0.0 | 0.0 | 5.3 | 34.2 | 60.5 | 4.55 | 2 |
| Stress tolerance | 0.0 | 0.0 | 0.0 | 10.5 | 28.9 | 60.5 | 4.50 | 3 |
| Reality testing | 0.0 | 2.6 | 0.0 | 7.9 | 31.6 | 57.9 | 4.42 | 4 |
| Impulse control | 0.0 | 0.0 | 0.0 | 7.9 | 44.7 | 47.4 | 4.39 | 5 |
| Interpersonal relationship | 0.0 | 0.0 | 0.0 | 10.5 | 39.5 | 50.0 | 4.39 | 6 |
| Empathy | 0.0 | 0.0 | 2.6 | 10.5 | 42.1 | 44.7 | 4.29 | 7 |
| Emotional self-awareness | 0.0 | 2.6 | 2.6 | 7.9 | 36.8 | 50.0 | 4.29 | 8 |
| Optimism | 0.0 | 2.6 | 2.6 | 10.5 | 31.6 | 52.6 | 4.29 | 9 |
| Self-regard | 0.0 | 2.6 | 0.0 | 18.4 | 39.5 | 39.5 | 4.13 | 10 |
| Social responsibility | 2.6 | 2.6 | 2.6 | 7.9 | 42.1 | 42.1 | 4.11 | 11 |
| Flexibility | 0.0 | 2.6 | 0.0 | 23.7 | 31.6 | 42.1 | 4.11 | 12 |
| Self-actualisation | 0.0 | 0.0 | 0.0 | 28.9 | 34.2 | 36.8 | 4.08 | 13 |
| Happiness | 2.6 | 2.6 | 7.9 | 13.2 | 34.2 | 39.5 | 3.92 | 14 |
| Independence | 0.0 | 5.3 | 5.3 | 26.3 | 26.3 | 36.8 | 3.84 | 15 |

Table 3 indicates the extent to which attributes / states contribute to optimising (best possible) H&S performance on construction projects in terms of percentage responses to a scale of 1 (minor) to 5 (major), and a MS ranging between 1.00 and 5.00. Given that all the MSs are > 3.00, all the attributes / states can be deemed to contribute more of a major than a minor extent to optimising (best possible) H&S performance on construction projects. However, five of the fifteen (33.3%) achieved MSs > 4.20 ≤ 5.00, and thus the attributes / states can be deemed to contribute between a near major to major / major extent. As with the importance of attributes / states, problem solving predominates. It is followed by a cluster consisting of assertiveness, stress tolerance, impulse control, and self-actualisation. The remaining ten (66.7%) MSs are > 3.40 ≤ 4.20, and thus the attributes / states can be deemed to contribute between some extent to a near major / near major extent. These are interpersonal relationship, optimism, self-regard, flexibility, social responsibility, reality testing, emotional self-awareness, empathy, happiness, and independence.

Table 3 Extent to which attributes / states contribute to optimising (best possible) H&S performance on construction projects

| Attribute / State | Response (%) | | | | | | MS | Rank |
|---|---|---|---|---|---|---|---|---|
| | U | Minor ……………………Major | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | | |
| Problem solving | 2.6 | 0.0 | 0.0 | 5.3 | 26.3 | 65.8 | 4.50 | 1 |
| Assertiveness | 5.3 | 0.0 | 0.0 | 7.9 | 28.9 | 57.9 | 4.29 | 2 |
| Stress tolerance | 2.6 | 0.0 | 0.0 | 10.5 | 36.8 | 50.0 | 4.29 | 3 |
| Impulse control | 2.6 | 0.0 | 0.0 | 7.9 | 47.4 | 42.1 | 4.24 | 4 |
| Self-actualisation | 2.6 | 0.0 | 0.0 | 10.5 | 44.7 | 42.1 | 4.21 | 5 |
| Interpersonal relationship | 5.3 | 0.0 | 2.6 | 5.3 | 36.8 | 50.0 | 4.18 | 6 |
| Optimism | 2.6 | 2.6 | 0.0 | 15.8 | 26.3 | 52.6 | 4.18 | 7 |
| Self-regard | 2.6 | 2.6 | 0.0 | 7.9 | 44.7 | 42.1 | 4.16 | 8 |
| Flexibility | 2.6 | 2.6 | 0.0 | 7.9 | 44.7 | 42.1 | 4.16 | 9 |
| Social responsibility | 2.6 | 2.6 | 2.6 | 7.9 | 39.5 | 44.7 | 4.13 | 10 |
| Reality testing | 2.6 | 2.6 | 2.6 | 10.5 | 36.8 | 44.7 | 4.11 | 11 |
| Emotional self-awareness | 2.6 | 2.6 | 2.6 | 13.2 | 31.6 | 47.4 | 4.11 | 12 |
| Empathy | 2.6 | 2.6 | 5.3 | 13.2 | 34.2 | 42.1 | 4.00 | 13 |
| Happiness | 5.3 | 2.6 | 2.6 | 23.7 | 13.2 | 52.6 | 3.95 | 14 |
| Independence | 2.6 | 5.3 | 5.3 | 23.7 | 23.7 | 39.5 | 3.79 | 15 |

Table 4 presents a comparison of the importance of attributes / states in terms of managing construction H&S and the extent to which attributes / states contribute to optimising (best possible) H&S performance in terms of MSs. The MSs range from 4.74 to 3.84 in the case of importance and from 4.50 to 3.79 in the case of contribution. Problem solving predominates both in terms of importance and in terms of contributing to optimising H&S performance. Assertiveness and stress tolerance are both ranked second and third respectively in terms of importance and contributing to optimising H&S performance. There are no notable differences between the importance and contribution of attributes / states in terms of MSs, the greatest being relative to reality testing, followed by empathy, then assertiveness, stress tolerance, and interpersonal relationship. However, in terms of rank, there are notable differences. Conversely, although the 'importance' rank of reality testing is fourth the 'contribution' rank is eleventh. Similarly, in the case of empathy it is seventh and thirteenth respectively, and in the case of emotional self-awareness it is eighth and twelfth respectively.

Table 4 Comparison of the importance of attributes / states in terms of managing construction H&S and the extent to which attributes / states contribute to optimising (best possible) H&S performance on construction projects

| Attribute / State | Importance | | Contribute | | Diffe-rence |
|---|---|---|---|---|---|
| | MS | Rank | MS | Rank | |
| Problem solving | 4.74 | 1 | 4.50 | 1 | 0.24 |
| Assertiveness | 4.55 | 2 | 4.29 | 2 | 0.26 |
| Stress tolerance | 4.50 | 3 | 4.29 | 3 | 0.26 |
| Reality testing | 4.42 | 4 | 4.11 | 11 | 0.31 |
| Impulse control | 4.39 | 5 | 4.24 | 4 | 0.15 |
| Interpersonal relationship | 4.39 | 6 | 4.18 | 6 | 0.21 |
| Empathy | 4.29 | 7 | 4.00 | 13 | 0.29 |
| Emotional self-awareness | 4.29 | 8 | 4.11 | 12 | 0.18 |
| Optimism | 4.29 | 9 | 4.18 | 7 | 0.11 |
| Self-regard | 4.13 | 10 | 4.16 | 8 | - 0.03 |
| Social responsibility | 4.11 | 11 | 4.13 | 10 | - 0.02 |
| Flexibility | 4.11 | 12 | 4.16 | 9 | - 0.05 |
| Self-actualisation | 4.08 | 13 | 4.21 | 5 | - 0.13 |
| Happiness | 3.92 | 14 | 3.95 | 14 | - 0.03 |
| Independence | 3.84 | 15 | 3.79 | 15 | 0.05 |

## 5. DISCUSSION

The study was conducted based on the premise that managing construction activities demands a measure of individual and / or work team EQ that are related to: intrapersonal EQ-relationship with oneself; interpersonal EQ-relationship with colleagues and associates, and the mood of employees. The aforesaid then affect H&S performance parameters inherent in construction projects. The results of the pilot study can be deemed to corroborate arguments that can be discerned in the literature, especially in terms of managing projects and the extent that EQ contributes to optimum performance: EQ and managerial competence impact projects positively and directly (Muller et al., 2012: 86); project personnel can use EI, interpersonal skills, and transformational leadership, to implement H&S management tasks and develop a healthy and safe climate in work environments (Sunindijo and Zou, 2011: 10); EI, particularly self-awareness, is a core factor that contributes to improvement of individual performance and the evolution of effective relationships with others (Sunindijo and Zou, 2011: 8); project personnel can show their EI in interpersonal relationships by communicating effectively, motivating others, resolving conflicts,



and building teams, and effective interpersonal relationships are needed so that employees can become transformational leaders that inspire their teams to generate superior performance (Sunindijo and Zou, 2011: 10).

Furthermore, Caruso et al. (2001: 56) contend that EI is a vital catalyst of leadership, either the charismatic or the transformational style, as it enables leaders to articulate team goals and objectives, engender enthusiasm in teams, empathise with team members, establish cooperation and trust, and identify and then encourage flexibility. The findings of the study are underscored by Carmeli (2003: 807) who confirms that managers who are considered to be 'emotionally intelligent' outperform their peers. There is also a strong positive correlation between EI and project performance in a project management domain (Zhang and Fan, 2013: 205). The correlations observed by Zhang and Fan (2013: 202) show each EI dimension affect project performance different level where emotional self-awareness, emotional self-control, empathy, organisational awareness, cultural understanding and communication deserve attentions due to their significant effects.

The particular exploratory study has thus confirmed the findings of prior and other studies reported on in the literature, and given that it is the first such study that has been conducted in South Africa, particularly in construction, it is has contributed to the debate relative to the role of EQ in managing construction H&S, and its contribution to H&S performance in South Africa. However, it should be noted that scholars need to be more attentive to the nature of the task when assessing how EI impacts upon project performance (Lindebaum and Jordan, 2012: 581). In particular, Lindebaum and Jordan (2012: 580-582) contend that differentiating between individual cognitive tasks and tasks that are relational in nature and require interpersonal interaction is expedient for future research.

## 6. CONCLUSIONS AND RECOMMENDATIONS

All the attributes / states of EI are important in terms of managing construction H&S and they all contribute to optimising, that is best possible H&S performance on construction projects. Therefore, it can be concluded that emphasis needs to be placed on developing the EI of construction managers, commencing during tertiary education, during 'graduate in training', and through continuing professional development (CPD). Furthermore, emphasis needs to be placed on the role of EQ in managing H&S during H&S education and training interventions.

Given the MS and its ranking, problem solving is a critical attribute and needs to be developed. However, the ability to solve problems is impacted upon by other attributes and states such as stress tolerance, reality testing, impulse control, interpersonal relationships, and empathy. In the majority of cases (66.7%), the importance of attributes / states is greater than their contribution. Therefore, reality in terms of what optimises performance as to what is perceived as being important, differs.



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# EVALUATION OF THE BARRIERS TO THE USE OF APPROPRIATE CONSTRUCTABILITY PRACTICES ON CONSTRUCTION PROJECTS

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## ABSTRACT

Within the Nigerian and Sub-Saharan African construction industries generally there has been a lack of research profiling the constructability practices of contractors and possible barriers to the use of appropriate methods. The aim of this study was to assess constructability practices of contractors in construction projects in this context. The objectives were to identify current constructability practices, and to examine the barriers typically affecting constructability practices. Convenience sampling was used to select 19 contractors in Lagos state, Nigeria, who were interviewed using a structured interview protocol. The data collected was analysed using descriptive statistics. Results indicated that constructability practices common to contractors include checking M & E drawings for clashes and errors; site-layout planning; and preparation of schedule/construction programmes. In-situ constructions, crane/lifting equipment, formwork technologies and external scaffolding systems were used during site operations. Barriers affecting constructability practices stem from contractors' internal conditions, external factors, and project-related factors including design, lack of knowledge in construction methods, and project size and complexity. The findings have important implications for policy and practice. We recommend public laws making it mandatory for projects to implement constructability reviews and analyses. We also recommend that practice-experienced constructors be employed on projects, and that professional bodies train and educate members on constructability principles and practice for the better management of projects.

**Keywords:** Assessment, Constructability practice, Contractors, Design, Knowledge, Nigeria

## 2. INTRODUCTION

Constructability and buildability are two important concepts that emerged in the construction industry in the late 1970's. According to Trigunarsyah (2004a) the idea of constructability emerged in USA, while the concept of buildability evolved in the UK construction industry. Constructability has been defined as a project management technique that involves the optimum integration of construction knowledge and experience in planning, engineering, procurement and field operations in the building process. It also entails balancing various projects and environmental constraints in achieving the overall objectives (The Institution of Professional Engineers New Zealand, [IPENZ], 2008). Buildability has been defined as the extent to which the design of the building facilitates the ease of construction, subject to the overall requirements for the completed building. These two terms are used interchangeably in construction management literature and are documented in various studies (Arditi, Elhassan and Toklu, 2002; Trigunarsyah, 2004a; IPENZ, 2008; Othman, 2011) among others. In particular, IPENZ (2008) emphasized that when a construction project becomes complex, the issues of constructability become very important. It is thus important for project participants to consider constructability early in the life of the project, in order to prevent litigation, claims, change orders and disputes, as well as client dissatisfaction with the delivery system.

Constructability principles are integrated into projects to prevent the above problems from occurring. Also, different construction management literatures (Arditi, Elhassan & Toklu, 2002; Motsa, Oladapo & Othman, 2008) have documented further benefits of constructability in terms of developing better relationships between clients and contractors, building a good reputation, providing professional satisfaction and doing efficient design. Some of these benefits could also be harnessed in construction projects in Nigeria if constructability principles and practices were to be integrated into our construction system. Fortunately, construction professionals are gradually becoming aware of the concepts of constructability and buildability in their construction practice. Several construction projects undertaken by small and medium sized contractors have used some level of constructability practice. A recent study in Nigeria (Adekunle, 2012) also revealed that construction professionals are aware of constructability concepts in their practices but do not have a documented corporate philosophy for dealing with constructability issues in their organizations. These results suggest a low level of constructability implementation in projects, which is a cause for concern.

The present study has therefore been undertaken to investigate small and medium sized contractors' constructability practices within construction projects in Nigeria. The study first determined the current constructability practices being used by the contractors, and then examined the barriers affecting constructability practices within the contractors' projects.

This study is significant in that it provides (1) current literature on constructability practice, (2) an insight into contractors' practice of constructability and (3) it reveals the factors affecting constructability practices in Nigeria.

## 2. CONSTRUCTABILITY CONCEPTS AND GUIDELINES

Constructability is viewed as the optimum use of construction knowledge and experience (Construction Industry Institute [CII] 1986 and CII 1992; 1996), construction resources (O'Connor & Tucker, 1986) and specific technology based on construction knowledge (Yu & Skibniewski 1998) in the project delivery process in order to maintain the overall project objectives and building performance at an optimal level. Constructability emphasizes the integration of construction knowledge and experience at various project stages. It refers to the optimization of different project requirements to achieve the overall goals of the project, and to make construction easier.

Early research work in the UK focused more on design rationalization, whereas the focus in the USA and Australia was on the development of management systems and subsystems which enabled construction knowledge to be brought further forward in the project delivery process (Cheetham & Lewis, 2001). In Singapore the focus was on both design rationalization and construction practice and processes. In the United States, the Construction Industry Institute (1987) developed fourteen (14) constructability concepts which were later modified to seventeen (17) (Russell et al., 1992). These modifications are to help improve constructability. In Australia, Trigunarsyah (2004a) noted that the CIIA developed twelve (12) principles of constructability based on the CII constructability concepts, which were tailored to the needs of the Australian construction industry. The Constructability Appraisal System (CAS) was also developed by the BCA in Singapore as a performance based system with flexible characteristics. Its objective was to bring about the wider use of labour-saving construction methods and technologies that would help to reduce the demand for manpower on site. The CAS is based on the construction methods adopted by the various competing contractors, determined by their individual construction knowledge, constructors' conditions or project characteristics.

While Gibson et al. (1996) note that this project approach varies widely between contractors, Uhlik and Lores (1998) argue that general contractors show a significant lack of formal constructability efforts in their work. Furthermore, it has been widely reported in the construction management literature that construction methods/practices (or constructability practices) adopted by contractors can affect the efficiency and effectiveness of construction/production processes, particularly labour productivity, project costs, schedule performance and safety (CII 1986; Gibson et al. 1996; Yu and Skibniewski 1998; Low 2001; Jergeas & Van der Put 2001; Cheetham and Lewis 2001; Trigunarsyah 2004; Pocock et al. 2006; Liu & Low 2007; Saghatforoush et al. 2009; and BCA 2011).

The foregoing discussions on constructability are relevant to the present study as the constructability practices of contractors and the factors affecting their constructability practices in construction projects in Nigeria are investigated. This study draws on construction methods/practices, issues of construction/production processes, labour productivity and schedule performance.

### *2.1 Constructability Practice in Construction Projects*

Lam et al. (2007) note that good constructability should facilitate efficient, economical and safe building processes. Table 1 presents the summary of a comprehensive literature review of constructability practices/concepts that are considered by scholars to enable effective and efficient construction processes. The objective of the review is to acquire in-depth knowledge of the constructability practices/concepts available in the literature. Scholars identified nine main constructability practices/concepts while the tenth concept, labour/skills, has specific applications to all practices. These identified practices are grouped into two, namely, construction management and site technology. Further sub-division of the nine construction methods and site practices identified, produced 41 attributes of constructability practice, which formed the basis of the criteria for the assessment of constructability regarding the contractors in this study.

**Table 1. Summary of Constructability Practices/ Concepts identified in Literature**

| Constructability Practices/Concepts | Studies on constructability in various countries | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jergeas and Put (1986) | CII (1987) | CII Australia (1996) | Uhlik and Lores (1998) | Yu and Skibniewski (1999) | Cheetham and Lewis (2001) | Trigunarsyah (2004a and b) | Pockock et al. (2006) | Liu and Low (2007) | Lam et al. (2007) | Saghatforoush et al. (2009) | Singapore BCA (2011) | Present study in Nigeria |
| Construction Analysis | | | | | | ✓ | ✓ | ✓ | | | | ✓ | ✓ |
| Analyzing site layout and temporary facilities | ✓ | ✓ | | | | ✓ | ✓ | | | | ✓ | | ✓ |
| Planning the sequence of field tasks, scheduling, estimating and organizing | | ✓ | | ✓ | | ✓ | ✓ | | ✓ | | ✓ | | ✓ |
| Monitoring and control | | | | | | | | | | | | ✓ | ✓ |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Innovation/New ideas, methods, materials and equipment | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | | | | ✓ |
| Modularization/Prefabrication | ✓ | ✓ | | | | ✓ | | | | | | ✓ | ✓ |
| Traditional in-situ methods of construction | | | | | | | | | | ✓ | | | ✓ |
| Formwork Technologies, plant and equipment | | ✓ | ✓ | | ✓ | ✓ | | | | | | ✓ | ✓ |
| Labour skills | | | | | | | | | | | | | ✓ |
| External access systems | ✓ | ✓ | | | | | ✓ | | | | | ✓ | ✓ |

Key: ✓ - Relevant literature citing particular constructability practices/concepts

(Source: Literature Study)

### *2.2 Barriers Affecting Contractors' Constructability Practices on Projects*

According to Lam et al. (2007), it is hard to realize improvements to constructability practices without clearly defining the factors affecting constructability. Yu and Skibniewski (1999) determine that certain external and internal conditions, as well as project characteristics, affect the constructability practices used by a constructor on a considered project. Tatum (1987) notes that a contractor would need to consider the level of skills available in the local industry before bringing in new ideas/innovation. Barriers identified by Pocock et al. (2006), Trigunarsyah (2004a and b), Uhlik and Lores (1998), Yu and Skibniewski (1999), Tatum (1987) and Jergeas and Put (1986), are summarized in Table 2.

**Table 2. Barriers affecting Constructability Practices identified in Literature**

| | |
|---|---|
| **External Factors** | |
| | Design |
| | Lack of open communication between designers & constructors |
| | Skilled labour shortage |
| | Contractors are usually not involved until the designs have been completed |
| | Professional designers & constructors are engaged with separate contracts |
| | Highly competitive construction market |
| | Material supply shortage |
| | Building Codes do not require constructability |
| | Competitive equipment rental market |
| **Contractors Internal Conditions** | |
| | No knowledge of the latest construction methods & techniques |
| | Inadequate construction experience |
| | Lack of resources |
| | Lack of project management ability/qualified personnel |
| | Low availability of skilled labour |
| | Time required to adequately train staff in the use of computer systems that seem to change frequently & lack user friendliness |
| | Equipment adequacy |
| | High material inventory |
| | Low work backlog |
| **Project Characteristics** | |
| | Size and complexity of the project |
| | High project quality requirement |
| | Congestion around construction sites especially those around operating Facilities |
| | Method used in project procurement |
| | Project duration is strictly constrained |

(Sources: Pocock et al., 2006; Trigunarsyah, 2004a and b; Uhlik and Lores, 1998; Yu and Skibniewski, 1999; Tatum, 1987; and Jergeas and Put, 1986)

Uhlik and Lores (1998) established that the method of project procurement, contract type, designers' knowledge and attitude have an impact on the constructability practices used on most projects. This study ascertains that constructability concepts are implemented more frequently in construction management and design-and-build procurement methods more than in traditional methods.

Uhlik and Lores (1998) further identified some common barriers affecting constructability as designers' lacking construction experience and knowledge of construction technologies; the use of lump-sum competitive contracting; and the adversarial attitude between designers and contractors (which includes the reluctance of designers to include contractors in the constructability review for fear of ruining their reputation). These barriers are relevant to the present study as this research explores all barriers affecting contractors' use of appropriate constructability practices on construction projects in Nigeria.

## 3. RESEARCH METHODS

The research was undertaken during the period of February to July 2012. A literature review was undertaken to ascertain the main issues relating to constructability concepts and guidelines, constructability practice on construction projects, as well as barriers affecting contractors' constructability practices. The study took place in Lagos State, Nigeria. The population of the study consisted of small and medium sized contractors that have on-going construction projects. The study used an exploratory multi-case study research design that utilized semi-structured interview protocols to collect information from respondents. The research instrument was designed with the constructability concepts identified by the BCA (2011) on Buildability. They separate the need for buildable design upstream from construction methods/technologies (or constructability) adopted by the contractors downstream.

The development of the research instrument drew on previous research by Jergeas and Put (1986), CII (1987), Uhlik and Lores (1998), Cheetham and Lewis (2001), Trigunarsyah (2004a and b), Pocock et al. (2006), Liu and Low (2007) and Saghatforoush et al. (2009). To ensure that each respondent had the same understanding of constructability, definitions of constructability were provided. For each of the constructability attributes, respondents were asked to select their responses based on a 3-point Likert Scale where 1= not used, 2 = partially used, 3 = fully used, for contractors' constructability practices. For measuring the barriers affecting constructability practice responses were based on a 3-point Likert Scale of 1 = no influence, 2 = partial influence and 3 = high influence.

Convenience sampling was used in selecting the participants for the study. The criteria for selection of the contractors were that they must be (1) listed in the Nigerian Institute of Building (NIOB) Business Directory, (2) be based in Lagos State Nigeria and (3) must have on-going construction projects. Contractors that fitted these categories were all contacted either by telephone or at their business addresses in order to determine who would be willing to participate in the study.

In all, 19 contractors agreed to participate. Personal interviews were undertaken to collect empirical data from the respondents. The information from these contractors was used for the data analysis. Descriptive statistical tools such as tables, mean item scores (MIS), percentages and rankings were used in analyzing the data collected and in making decisions about the constructability practices of small and medium sized contractors in Nigeria.

$$MIS = \frac{3M_3 + 2M_2 + 1M_1}{3 \times (M_3 + M_2 + M_1)}$$

Where M3, M2 and M1 are frequencies of the rating responses given to each constructability variable.

## 4. RESULTS AND DISCUSSION

### *4.1 Characteristics of Participants*

The characteristics of the contractors who participated in the study are presented in Table 3. Four types of organizations were represented: 37% of the respondents were general contractors, 32% were building contractors, 26% were civil engineering contractors, while the remaining 5% were developers. Since the majority of respondents were general contractors they must have been exposed to different construction projects for which constructability principles must have been used. Also, for the area of operation of respondents, 53% of these respondents operated nationally across several states, 37% operated across different regions of the country in the northern, eastern, western and southern political regions, while the remaining 5% operated both locally and internationally (i.e. beyond Nigeria's borders).

**Table 3. Characteristics of respondents that participated in the study**

| Respondent characteristics | Frequency | Percentage (%) |
|---|---|---|
| **Types of organizations** | | |
| Building contractors | 6 | 32 |
| Civil Engineering contractors | 5 | 26 |
| General contractors | 7 | 37 |
| Developer | 1 | 5 |
| Total | 19 | 100 |
| **Company's areas of operation** | | |
| Local | 1 | 5 |
| Regional | 7 | 37 |

| | | |
|---|---|---|
| National | 10 | 53 |
| International | 1 | 5 |
| Total | 19 | 100 |
| | | |
| **Designation of respondents** | | |
| Director | 7 | 37 |
| Project Manager | 4 | 21 |
| Engineer | 1 | 5 |
| Builder | 7 | 37 |
| Total | 19 | 100 |
| | | |
| **Respondents' experience in the construction industry** | | |
| Less than 5yrs | 2 | 10 |
| 6-10yrs | 3 | 16 |
| 11-15yrs | 3 | 16 |
| 16-20yrs | 5 | 26 |
| Above 20yrs | 6 | 32 |
| Total | 19 | 10 |

Further results presented in Table 3 regarding the designation of respondents show that 37% of the respondents were Directors and another 37% were Builders in their various organizations, 21% of the respondents were Project Managers while 5% of the respondents were Engineers. Since most respondents were either Directors or Builders, it suggests that they must have been involved in different construction projects from which lessons were learnt and experience was gained. Such projects can be used to provide relevant information for this study.

In addition, the results in Table 3 regarding the experience of respondents in the construction industry indicate that 32% of the respondents had over 20 years of experience in the industry, 26% had between 16-20 years experience, 16% had 6-10 years, 6% had 11-15 years experience, while the remaining 10% of the respondents had less than 5 years of experience. Since most respondents had over 15 years experience in the construction industry, they must have been fully exposed to different construction experiences and knowledge, and could therefore provide valuable information for this study. It also emerged that the average turnover of the companies interviewed was ₦ 79,643,176 ($497,770). The projects in which they had been involved included residential, educational, commercial and institutional work, and varying in size from simple one floor to five floor high projects.

### *4.2 Constructability Practices of Small and Medium Sized Contractors*

Contractors who participated in this study were asked to indicate their level of implementation of constructability principles in recently completed construction projects. Their responses to the utilization of these principles are presented in Table 4.

Results in Table 4 indicate that, in terms of implementing mechanical and electrical (M & E) design checks on projects, checking for clashes in M & E service drawings ranks highest (MIS=0.85) while production of M & E coordination drawings is ranked second (MIS=0.79). These results suggest that most contractors check for clashes on M & E drawings more often than they produce M & E coordination drawings.

**Table 4. Constructability principles implemented on construction projects**

| Constructability principles Implemented on projects | Level of Constructability Practice MIS | Group Ranking | Top Eight important areas of constructability practice |
|---|---|---|---|
| **Construction Analysis** | | | |
| Check for clashes in Mech. & Eng. (M&E) services drawings | 0.85 | 1 | |
| Produce M&E co-ordination drawings, architectural shop drawings & concrete body plan for construction purposes | 0.79 | 2 | |
| **Site Analysis** | | | |
| Allow working space for labour, materials and plant on site | 0.90 | 1 | 8 |
| Ensure less environmental nuisance (traffic, noise, dust, public safety etc.) | 0.82 | 2 | |
| Allow less wet trades on site | 0.61 | 3 | |
| **Planning** | | | |
| Prepare schedule/construction program | 0.94 | 1 | 1 |
| Prepare estimates and budgets | 0.90 | 2 | |
| Logical sequence of field tasks | 0.88 | 3 | |
| Resource analysis and scheduling | 0.85 | 4 | |
| Establish production targets – time, cost & quality | 0.85 | 4 | |
| Prepare organization structure | 0.82 | 6 | |
| Allow construction traffic early on permanent structure after erection | 0.76 | 7 | |
| Simulate construction schedules & resource planning | 0.67 | 8 | |
| **Monitoring & Controlling** | | | |
| Implement measures to improve productivity & performance | 0.85 | 1 | |
| Adopt a trade productivity monitoring system | 0.77 | 2 | |
| Benchmark outputs & project performance to leaders in the field | 0.73 | 3 | |
| Conduct monthly work study sessions to improve work processes on site | 0.67 | 4 | |
| Conduct work studies on site processes if productivity levels deviate | 0.55 | 5 | |
| **Innovation** | | | |
| Use of cranes/lifting equipment | 0.61 | 1 | |
| Use of hydraulic stationary concrete placing boom | 0.58 | 2 | |
| Use of self compacting concrete | 0.55 | 3 | |
| Use of ceiling inserts/cast-in brackets to support M&E fittings | 0.55 | 3 | |

| | | | |
|---|---|---|---|
| Strut free basement construction | 0.50 | 5 | |
| Use of prefab plant/piping modules | 0.45 | 6 | |
| Use of scissor lift/boom lift in lieu of traditional scaffold for AMEP works | 0.39 | 7 | |
| **Modularization/Prefabrication** | | | |
| Use of spray painting | 0.50 | 1 | |
| Precast concrete lintels | 0.48 | 2 | |
| Precast concrete slabs | 0.42 | 3 | |
| Precast concrete beams | 0.42 | 3 | |
| Precast concrete columns/walls | 0.39 | 5 | |
| No screed on RC floors (to immediately receive tiles, carpets etc.) | 0.39 | 5 | |
| No plaster on RC walls (ditto) | 0.39 | 5 | |
| Use of flexible pipes for domestic water systems | 0.64 | | |
| **In-situ Construction** | | | |
| Cast in-situ concrete column | 0.94 | 1 | 1 |
| Cast in situ concrete walls | 0.94 | 1 | 1 |
| Block wall construction with plastering | 0.94 | 1 | 1 |
| Cast in-situ concrete slabs | 0.91 | 4 | 5 |
| Cast in-situ concrete beams | 0.91 | 4 | 5 |
| Cast in-situ concrete lintels | 0.91 | 4 | 5 |
| **Formwork Technologies** | | | |
| Conventional/traditional timber/metal formwork – with metal props | 0.88 | 1 | |
| Ditto with Bamboo/timber props | 0.73 | 2 | |
| Equipment lifted panel form system | 0.55 | 3 | |
| No formwork (stay-in-place precast concrete form system) | 0.48 | 4 | |
| **External Access Systems** | | | |
| Traditional external scaffold – independent or putlog – constructed with metal poles & connectors | 0.85 | 1 | |
| Ditto with Bamboo/timber poles | 0.64 | 2 | |
| No external scaffold | 0.52 | 3 | |
| Self-climbing perimeter scaffold | 0.48 | 4 | |
| Crane-lifted perimeter scaffold/fly cage | 0.39 | 5 | |

These checks can help identify design problems and obstacles before field operations are carried out on the project. Also, for site–layout, planning which allows for working space for labour, materials and plant on site (MIS=0.90) ranks first, ensuring less environmental nuisance (MIS=0.82) ranks second, while allowing less wet trades on site (MIS=0.61) ranks third. These results also indicate that most contractors provide working spaces for labour, materials and the plant on site. This in itself enhances constructability of field operations where ample working spaces are available to aid manoeuvrability on site for prefabrication, formwork utilization and the use of scaffolding systems.

Of the eight factors used in rating the level of constructability practice in the conceptual planning of the project, the preparation of schedule/construction programmes (MIS=0.94) ranks first, the preparation of estimates and budgets (MIS=0.90) ranks second, logical sequencing of field tasks (MIS=0.88) ranks third while simulation of construction schedules and resource planning (MIS=0.67) ranks eighth. These results suggest that most contractors are more used to the preparation of schedule/construction programmes in their implementation of constructability principles in their projects than other planning operations. This could possibly be because of the importance attached to schedule/construction programmes in project execution. Most projects will not be constructible if schedule/construction programmes are not well prepared ahead of the field operations.

With respect to the five factors that are used in rating the level of constructability practice in project monitoring and control, implementing measures to improve productivity and performance (MIS=0.85) ranks first, adoption of a trade productivity monitoring system (MIS=0.77) ranks second, benchmarking outputs and project performance for leaders in the field (MIS=0.73) ranks third, while conducting work studies on site processes if productivity levels deviate (MIS=0.55) ranks fifth.

In terms of innovation in constructability practice, of the seven factors used in rating the contractors constructability practice, the use of crane/lifting equipment (MIS=0.61) ranks first, the use of a hydraulic stationary concrete placing boom (MIS=0.58) ranks second, the use of self compacting concrete (MIS=0.55) ranks third while the use of a scissor lift/beam lift in lieu of a scaffolding system (MIS=0.39), ranks seventh. These results suggest that most contractors in their constructability practice use crane/lifting equipment for their construction activities. This is a good innovation to aid mechanization of their lifting operations, since depending on manual labour for lifting operations is slow and reduces productivity on construction sites.

With respect to constructability practices in modularization/prefabrication techniques of site operations, the use of flexible PVC pipes for domestic water systems (MIS=0.64) ranks first, the use of spray painting (MIS=0.50) ranks second while the use of precast concrete columns/walls, no screeding on reinforced floors to immediately receive tiles, no plastering on reinforced concrete walls to receive finishing (MIS=0.39), all rank sixth. These results suggest that most contractors who participated in this study made more frequent use of flexible PVC pipes for domestic water supply, than of the other listed techniques. Site operations can be enhanced if such modularization units are employed rather than galvanized piping systems that may require time, labour and money to implement.

In terms of in-situ constructions, cast in-situ columns, concrete walls and block wall construction with plastering (MIS=0.94) all rank first, while cast in-situ concrete slabs, concrete beams and concrete lintels (MIS=0.91) all rank fourth.

These results suggest that most of the contractors use cast in-situ columns, concrete walls and block wall construction with plastering more than other in-situ construction methods. In-situ construction of vertical elements (columns, walls and block walls) can increase the speed of construction in field operations and also enhance monolithic connections with the rest of the structural frame in a building.

Regarding contractors' constructability practices in the use of formwork technologies on site operations, conventional/traditional timber/metal formwork with metal props (MIS=0.88) ranks first, use of bamboo/timber props (MIS=0.73) ranks second while the use of no formwork or stay in place precast concrete form system (MIS=0.48), ranks fourth. These results also indicate that most contractors that participated in this study utilize traditional timber/metal formwork for site operations more than other types of formwork technologies in use on site operations. Formwork is an important technology for most in-situ and prefabricated construction in reinforced and pre-stressed concrete. In Nigeria, most construction operations utilize concrete technology and hence most contractors would prefer timber/metal formwork, as both are durable, re-usable and therefore economical.

Lastly, in respect of external access systems used in site operations, the use of a traditional external scaffold system (MIS=0.85) ranks first, the use of bamboo/timber props (MIS=0.64) ranks second, while the use of a crane lifted perimeter scaffold/fly cage (MIS=0.39) ranks fifth. These results indicate that contractors use traditional external scaffolding systems for their site operations. Construction workers easily understand the technology of this external scaffold system, and its use in site operations enhances productivity. By contrast, prefabricated modular metal pipe systems may be expensive and beyond the reach of small and medium sized Nigerian contractors.

Summarizing the findings on contractors' constructability practices, it can be seen that most contractors check for clashes on their M & E drawings to minimize site operation problems; undertake site-layout planning by providing working spaces for materials, labour and plant on site to ensure maneuverability; prepare schedule/construction programmes to enhance constructability of site operations; and also implement certain measures to improve productivity and performance. Also, most contractors enhance constructability in their projects by using (1) crane/lifting equipment in their site operations to entrench mechanization in site operations, (2) PVC pipes for domestic water supply systems that integrate modularization in site operations, (3) in-situ construction in form of cast in-situ columns and walls to enhance monolithic connections, (4) formwork technologies in the form of traditional timber/metal formwork and (5) external access systems like traditional scaffolding systems.

Further results from Table 4 also indicate that the top eight constructability practice enhancement areas of most contractors in Nigeria are cast in-situ concrete columns, concrete walls, block wall construction with plastering, preparation of schedule/construction programmes (MIS=0.94), cast in-situ concrete slabs, beams and lintels (MIS=0.91), and allowing working space for labour, material and plant (MIS=0.90). These top eight constructability practice enhancement areas are from in-situ constructions, conceptual planning and site layout planning. These are areas of constructability practice that contractors can draw on to improve future construction practices in Nigeria.

***4.3 Barriers to Contractors' Constructability Practice on Construction Projects***

The various barriers affecting contactors' constructability practices on the construction projects studied are summarized in Table 2 and Figures 1 to 3. Figure 1 shows that with respect to external factors affecting contractors' constructability practices, design (MIS=0.94) ranks first, lack of open communication between designers and constructors (MIS=0.91) ranks second, while a competitive equipment rental market (MIS=0.67) ranks ninth.

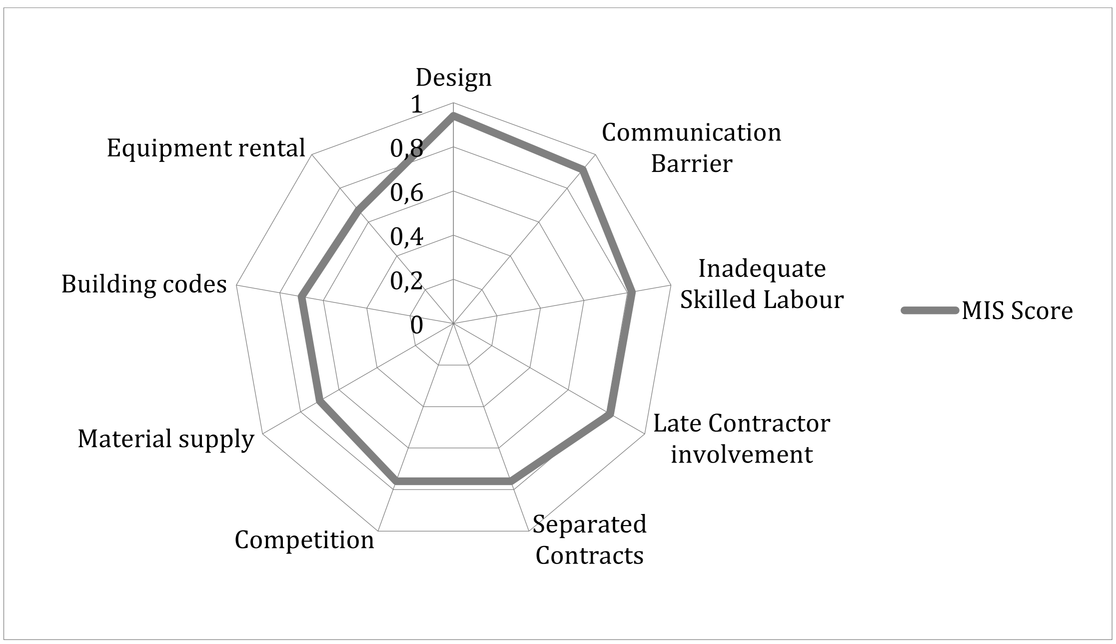


**Figure 1. Influence of External Factors on Constructability**

In terms of barriers stemming from internal factors, lack of knowledge of the latest construction methods and techniques (MIS=0.97) ranks first, inadequate construction experience (MIS=0.94) ranks second, while time required to train staff in computer literacy (MIS=0.76) ranks sixth. These results also indicate that the most important barrier to constructability practice is a contractors' lack of the latest knowledge of construction methods and techniques. This finding is valid because if contractors do not update their knowledge of construction methods and techniques it will be difficult to bring new ideas and innovations into constructability practice.

In addition, regarding barriers to constructability practice that emanate from project related factors (see Figure 3), size and complexity of the project (MIS=0.97) rank first, high project quality requirements and congestion around construction sites (MIS=0.88) both rank second, while strictly constrained project duration ranks fifth. These results demonstrate that project size and complexity are the most severe barriers to constructability practice. If the project is very large and of a complex nature, it may require more detailed constructability reviews, conceptual planning and programming to tackle and prepare for the construction problems that may arise ahead of site operations. It may also require an experienced constructor to integrate construction knowledge and experience on the project.

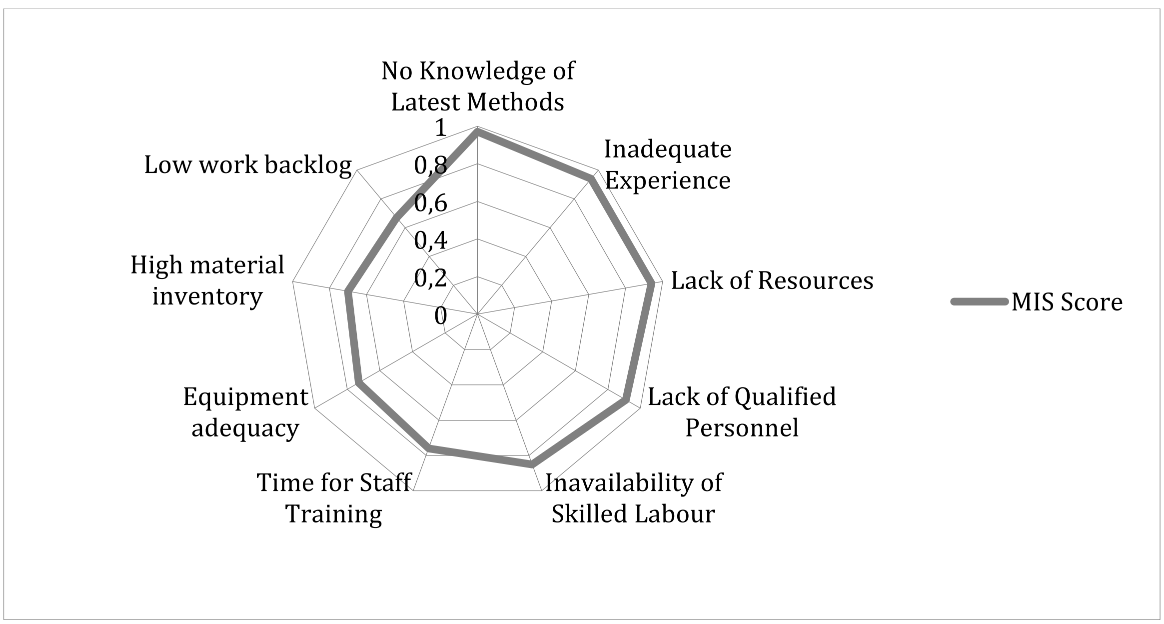

**Figure 2. Influence of Internal Conditions on Constructability**

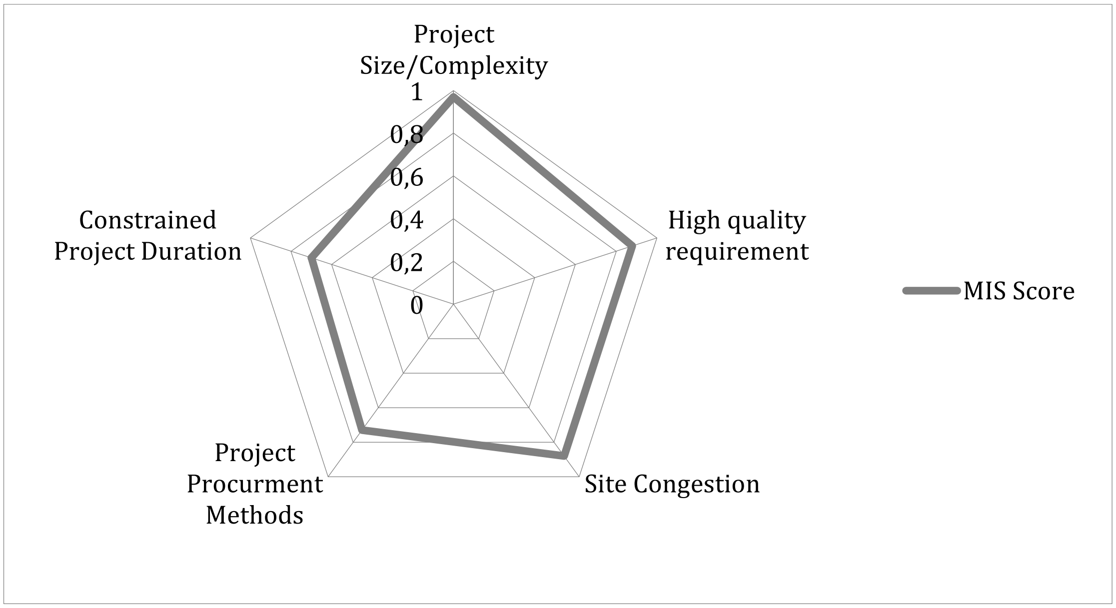


**Figure 3. Influence of Project Characteristics on Constructability**

### *4.4 Discussion of Findings*

The data suggests that the most severe barriers to improved constructability practices include a design that may be faulty or with incomplete specifications; lack of the latest knowledge on construction methods and techniques; and project size and complexity that may require extensive constructability reviews, planning and programming to tackle. Furthermore, results presented in Figure 1 to 3 indicate the top ten severe barriers to contractors' constructability practice as lack of knowledge on latest construction methods and techniques, size and complexity of the project, design, inadequate construction experience, lack of resources, lack of project management ability/qualified personnel, lack of open communication between designers and constructors, high project quality requirement, congestion around construction sites (especially those around operating facilities) and low availability of skilled labour. Most of these barriers to constructability practice stem more from contractors' internal factors than from external and project related factors. These findings are similar to those of earlier scholars such as Pocock et al. (2006), Trigunarsyah (2004a), Uhlik and Lores (1998), Yu and Skibnieski (1999), Tatum (1987) and Jergeas and Put (1986).

Based on our sample, it would appear that small and medium sized construction firms in Nigeria lean towards the use of more conventional than contemporary constructability practices, especially in the area of site technology, formwork technology and scaffold technology. Where they do conform to global construction practices is in the area of construction management. Furthermore, respondents affirmed that the construction methods used by the small and medium sized building contractors in Nigeria do not conform to global best practice. A respondent observed that contractors do not use best practice because the National Building Code in Nigeria is “unabled” (powerless) and not a legal document, and that a National Building Code that specifies the construction methods/practices to be adopted by contractors should be developed in Nigeria.

The results of this study demonstrate that design is the most important barrier to a contractors’ constructability practice. If designs are faulty, or ambiguous working drawings are provided for use on projects, it makes the project very un-constructible. This finding is in agreement with Arditi, Elhassan and Toklu (2002) who identified faulty working drawings and incomplete specifications as factors constraining constructability practices in design firms in the United States of America. This finding also supports Motsa, Oladapo and Othman (2008), whose study in KwaZulu Natal Province of South Africa found that the most significant factor hindering the implementation of constructability in design was the designer’s lack of knowledge.

## 5. IMPLICATIONS OF THE STUDY FOR POLICY, THEORY AND PRACTICE

The study is aligned to previous research (see Yu and Skibniewski, 1999; and Tatum, 1987) and provides further evidence that the barriers militating against constructability practices stem mainly from contractors’ internal conditions, and from external and project related factors. This is shown schematically in Figure 4.

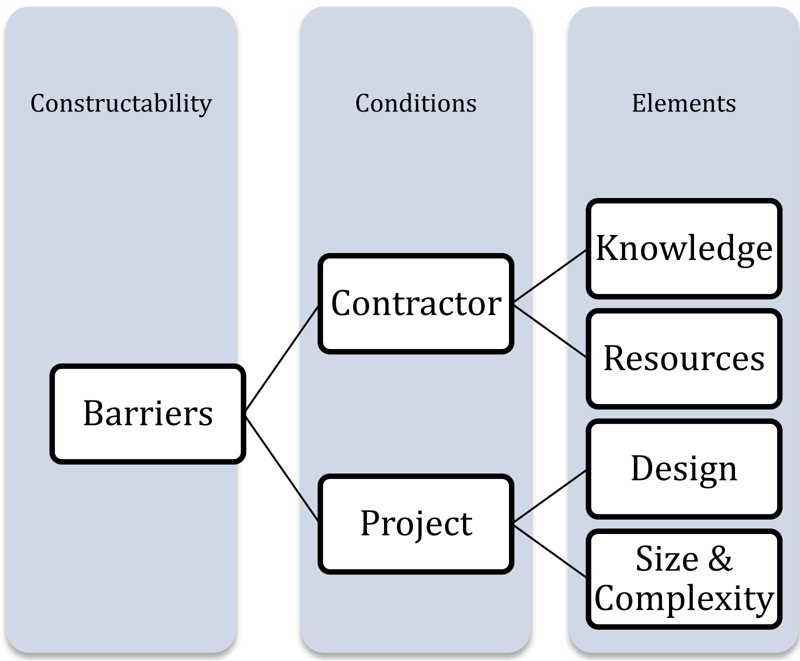


**Figure 4. Elements of Barriers to the use of suitable constructability practices on site**

It can be inferred from the results of this study that the more knowledgeable a contracting firm is, and the lower the size and complexity of the project (which are issues related to design — see Radosavljevic and Bennett, 2012), the more contractors will make use of good constructability practices. Implications of these findings for policy makers in government and practitioners is in the enactment of a public law (where such a law is not yet in existence) for all government construction projects of any value to undergo constructability reviews and analysis. The findings of this study also provide evidence to support the constructability theory that in-situ constructions, conceptual planning, and site layout planning all enhance constructability practice; and that experienced constructors should be employed for constructability reviews and analyses on construction projects in Nigeria and in other developing countries.

## 6. CONCLUSIONS

Based on the findings of this study it can be concluded that constructability practices of contractors have been enhanced by integrating a host of factors including in-situ constructions, conceptual planning and site-layout planning into their various construction projects.

The study recommends that contractors should pioneer and arrange for constructability reviews and analyses once awarded a tender. They should also work towards acquiring the necessary skills and equipment that will bring about appropriate construction methods that are aligned with global best practices. Professional bodies should train and educate their members on constructability principles to ensure better management of future projects. To maintain effective constructability practice on projects, contractors need to attend seminars, conferences and training programmes to improve their knowledge of construction methods and techniques. Finally, there should be codes that specify the construction methods/practices that should be adopted by contractors on construction projects.

This study is limited by its small sample size. Further research with larger samples is needed to validate the findings of the study. Furthermore, a further study to rank the construction practice/methods/systems that are commonly adopted in building construction, and whether there is any relationship between the levels of constructability practiced on site and project performance is recommended.

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# REWORK COST ON BUILDING PROJECTS IN THE SOUTH WESTERN PART OF NIGERIA

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**Abstract**

Right-first-time is a principle that evaluates the competence of firms, quality of product and the expertise of a professional. Rework is doing something at least one extra time due to non-conformance to requirements, could suggest the abovementioned parameter negatively either on organisation or individual. Human beings are not perfect, based on this, errors occur that may lead to rework on site and should be accommodated adequately for an uninterrupted flow of construction activities and non-delay of delivery of projects. The south western part of Nigeria was the area of study. The quantitative and descriptive research approaches were used. The questionnaire survey and historical data were the two method used for the collection of data for the study. Simple statistical means were used for data analysis. The research findings indicate that incorrect lying of forming course, poor quality of concrete, poor plastering, and construction errors during excavation dominate relative to areas of rework. Therefore, the study suggests that in order to eliminate or reduced drastically the occurrence of rework on future projects, consideration should be given to the following: the setting aside of a sum of money equal to the value of 0.6 – 5.0% of initial contract sum, engagement of knowledgeable foremen or having regular training of foremen, the correct construction processes should be followed in the execution of construction activities, and materials that are of good quality only should be used for constructional purposes.

**Keywords**: Building project, Rework, final cost, Construction process

## 1. INTRODUCTION

The construction industry is mainly project based and various complexities are inherent in the construction projects. Quality management principles and tools are critical requirements in conventional construction management practice to accommodate adequately the variability in production, relative to the diverse interests of multiple stakeholders characterised of construction projects, which when lacking may result in frequent changes / variations. As a result, rework is accepted as an inevitable feature of the construction process. A feature that is not healthy for the industry.

Quality of products in organisations reflects directly the overall performance of the organisation and a measure of competitiveness. Increased global competition has resulted in companies accepting the challenge of improving their quality of service and products by implementing total quality management (TQM). The implementation of a TQM philosophy can help a company improve its productivity, and both customer and employee satisfaction.

Ashford (2000) cited by Love and Sohai (2003) defined rework as 'the process by which an item is made to confirm to the original requirement by completion or correction. CIDA (1995) defined rework as 'doing something at least one extra time due to non-conformance to requirements'. Rework can result from errors, omissions, failures, damages and change orders. Love (2002) added that it can also result from the unnecessary redoing / rectifying efforts of incorrectly implemented processes or activities. Rework triggers claims for extra costs and time / schedule overruns (Kumaraswamy and Chan, 1998; CII, 2001b). It can generate costly ripple effects leading to delay and disruption throughout the entire project supply chain. When errors made during their formative stages are discovered necessitating costly rework, particularly, design errors, if undetected, may lead to civil, geotechnical, or structural failures, which can have catastrophic consequences including severe injuries and even fatalities. Rework can adversely affect the profitability, performance, and reputation of those organisations involved, as well as a project's organisational and social outlook (Love, Irani and Edwards, 2004). Based on the foregoing this study was initiated to assess the cost of reworks on building projects in Nigeria.

## 2. LITERATURE REVIEW

There are four types of rework cost. They are: external failure; internal failure; inspection, and prevention cost. Researches reveals that rework is a significant factor that contributes to project time and cost overruns (Love, 2002); lack of satisfaction of client and organisational adversities. The most direct metric for displaying the impact of rework is the direct cost of the rework (Zhang, 2009). During the construction phase, rework increases the delivery cost of the project. Different studies by Hammarlund and Josephson (1999) and Love and Li (2000) have found the cost of rework in design and construction to range from 2% to 12% of the contract cost, and as high as 25% of contract value (Barber et al., 2000 and Zhang, 2009). Table 1 provides summary consolidated from a set of previous studies on rework establishing the percentage figure of the value of rework on projects.

**Table 1: Some extracts of rework impacts from different studies.**

| | |
|---|---|
| Barber *et al.* (2000) | This UK study examined the quality failure costs in two highway construction projects (procured using Design-Build-Finance-Operate). The quality failure costs were 16% and 23% when the cost of delays was also included. If the cost of delay were excluded the corresponding failure costs were 3.6% and 6.6%. |
| Josephson *et al.* (2002) | The cost of defects identified from seven building projects in a Sweden based study ranged between 2.3% to 9.3% of contract value.<br>In another Sweden based study, the quality failure costs were found to be 6% of original contract value. |
| Fayek *et al.* (2004) | From the 108 field rework incidences in a Canada based study, the following findings were derived as cost contribution summary: (a) engineering and reviews - 61.65%; (b) human resource capability - 20.49%; (c) materials and equipment supply – 14.81%; (d) construction planning and scheduling – 2.61%, leadership and communication – 0.45%. |
| Rhodes and Smallwood (2002) | In a South African base study, the cost of rework was found to be 13% of the value of the completed construction.<br>In the same article it was reported that a research conducted by Associated General contractors of America found that the |

| | |
|---|---|
| | average cost of rework (from nine industrial projects) was 12.4% of the project cost. |
| Love and Edwards (2004) | Construction Industry Development Authority in Australia found that average cost of reworks of projects without a formal quality management system is 6.5% of contract value (and the high value for a project under lump sum procurement is 15%). However, the average cost of rework for projects with a quality system was found to be 0.72%.<br>In another Australian based study (Love, 2002) 161projects were studied and the mean of direct and indirect rework cost were found to be 6.4% and 5.6% of the original contract value, respectively. However, this study revealed that project procurement type may not have significant influence on the rework cost. |
| Marosszeky (2004) | In this Australian based study (in New south Wales), the rework cost on the average were found as 5.5% of contract value, that include 2.75% as direct costs; 1.75% indirect costs for main contractors, and 1% indirect costs for subcontractors. |

(Source: Palaneeswaran, 2006)

## 3. RESEARCH METHODOLOGY

Public and private projects in the south Western part of Nigeria, particularly in Ondo and Lagos states were those surveyed and the area of coverage for this study. The sampling frame consists of Architects, Builders, Quantity Surveyors and engineers. The details of respondents were obtained from the various professional state chapters institutes. These include: the Nigerian Institute of Architects (NIA), the Nigerian institute of Building (NIOB), the Nigerian institute of Quantity Surveyors, and the Nigerian society of Engineers (NSE). Probability samplings were used in the selection of respondents, and were contacted through mail. A total of one hundred and forty-five (145) well-structured questionnaires were administered to professionals, and one hundred and twenty (120) was returned filled, representing 80% response rate. The survey and historical research approach were adopted for the collection of data for the study. Relative to the qualifications of respondents; those with B.Tech / B.Sc predominate (70%), followed by M.Sc / M.Tech (13%), Diplomas (OND / HND) (12%), and PhD (5%). Respondents with over 10 years of working experience predominate (54%), next is respondents with 5 year working experience (27%), and those with over 30 years of experience (11%).

Based on the years of experience of respondents, it can be deemed, that respondents have handled many projects. This infers that they are knowledgeable relative to the area of this research and information's obtained can be relied on. Descriptive statistics was employed in the analysis of data for this study.

## 4. FINDINGS AND DISCUSSION

This section presents the data from field survey; historical, data and their analysis.

**Table 2:** ***Contractor-Related Factors relative to the causes of rework.***

| S/N | CONTRACTOR-RELATED FACTOR | NOT SEVERE | LESS SEVERE | SEVERE | MORE SEVERE | MOST SEVERE | Mean score | Rank |
|---|---|---|---|---|---|---|---|---|
| 1 | Wronging laying of forming course 1 (block work) | 3 | 21 | 12 | 42 | 78 | 4.33 | 1 |
| 2 | Poor quality of concrete | 13 | 4 | 21 | 68 | 30 | 4.22 | 2 |
| 3 | Poor plastering | 11 | 17 | 32 | 40 | 10 | 3.88 | 3 |
| 4 | Deflection of part of slab | 2 | 15 | 24 | 41 | 38 | 3.82 | 4 |
| 5 | Lack of attention to quality | 2 | 11 | 30 | 45 | 32 | 3.78 | 5 |
| 6 | Lack of support to site management | 6 | 30 | 58 | 19 | 7 | 3.76 | 6 |
| 7 | Ineffective coordination and integration of components | 4 | 25 | 12 | 32 | 47 | 3.75 | 7 |
| 8 | Incorrect laying of slab reinforcement | 3 | 24 | 31 | 10 | 52 | 3.70 | 8 |
| 9 | Lack of straightness of beam at the top and bottom | 7 | 10 | 34 | 16 | 43 | 3.69 | 9 |
| 10 | Incorrect forming of deck | 10 | 19 | 20 | 23 | 48 | 3.67 | 10 |
| 11 | Collapse of projections | 15 | 9 | 24 | $26 | 46 | 3.66 | 11 |
| 12 | Collapse of beam after construction | 4 | 12 | 24 | 63 | 17 | 3.64 | 12 |
| 13 | Use of poor materials in Sand | | | | | | 3.58 | 13 |
| 14 | Defective materials as a result of handling | 12 | 11 | 40 | 18 | 39 | 3.51 | 14 |
| 15 | Wrong opening for windows and doors | 7 | 17 | 35 | 35 | 26 | 3.47 | 15 |
| 16 | Consultant initiated changes | 7 | 14 | 31 | 52 | 16 | 3.47 | 15 |
| 17 | Non-verticality of column | 3 | 17 | 30 | 62 | 8 | 3.46 | 17 |
| 18 | Use of poor materials in Steel | | | | | | 3.85 | 18 |
| 19 | Collapse of part of slab | 14 | 6 | 49 | 20 | 31 | 3.40 | 19 |
| 20 | Contractor's request to improve quality | 17 | 13 | 27 | 31 | 32 | 3.40 | 20 |
| 21 | Construction error during excavation | 4 | 30 | 28 | 31 | 27 | 3.39 | 21 |
| 22 | Incorrect laying of electrical pipes in slab | 5 | 16 | 59 | 7 | 33 | 3.39 | 22 |
| 23 | Incorrect positioning of lighting switches and socket outlet. | 2 | 18 | 48 | 41 | 11 | 3.34 | 23 |
| 24 | Omissions during construction | 8 | 18 | 48 | 19 | 27 | 3.33 | 24 |
| 25 | Poor Safety considerations | 15 | 34 | 12 | 19 | 40 | 3.29 | 25 |
| 26 | Honeycombing of column and beam | 19 | 12 | 27 | 44 | 18 | 3.25 | 26 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 27 | Quality failure | 11 | 19 | 29 | 52 | 9 | 3.24 | 27 |
| 28 | Lack of proper monitoring and evaluation | 13 | 21 | 26 | 45 | 15 | 3.23 | 28 |
| 29 | Errors during construction | 13 | 19 | 38 | 27 | 23 | 3.23 | 29 |
| 30 | Overlooked site condition | 26 | 6 | 29 | 34 | 25 | 3.22 | 30 |
| 31 | Poor site practices | 14 | 33 | 19 | 42 | 12 | 3.04 | 31 |
| 32 | Deflection of beam | 6 | 30 | 58 | 19 | 7 | 2.93 | 32 |
| 33 | Contractor initiated changes | 20 | 23 | 47 | 12 | 18 | 2.88 | 33 |
| 34 | Incorrect laying of mechanical pipes | 36 | 12 | 49 | 17 | 6 | 2.54 | 34 |

(Source: Aiyetan, 2014)

Table 2 presents the rating of respondents relative to thirty-four contractors' related causes of rework in the form of a MS based upon percentages responses to a scale 'not severe' to 'most severe' according to respondents. It is significant that in term of the mean MS, with the exception of deflection of beam; contractor initiated changes, and incorrect laying of mechanical pipe, all the MSs are above the midpoint of 3.00, which indicates that the extent of occurrence of rework on project is significant in rating contractor related factors that are responsible for the occurrence of rework on building projects. Wrong laying of forming course in block work is first in ranking. This may be as a result of poor workmanship, non-usage of plumb when setting the bricks and wrongly done setting out. Poor quality concrete ranks next and this can result from the use of expired cement in the concrete mix, poor checking procedure for materials on site and also negligence in duties by the foreman. Poor plastering ranks third among the factors. This may be as a result of the use of poor quality materials in the mortar, unevenness of the wall surface after plastering, development of cracks and general poor workmanship. Deflection of part of slab is ranked fourth among the factors that cause reworks. The reason for this can be the usage of poor quality timber in form work which eventually results in sagging of some part of the slab. Lack of attention to quality is ranked fifth among the causes of reworks on building projects. Lack of support to site management and Ineffective coordination and integration of components can be seen as the sixth and seventh factors that cause reworks. In contrast, Incorrect laying of mechanical pipes, Contractor initiated changes, Deflection of beam, Poor site practices, Overlooked site condition, Errors during construction, Lack of proper monitoring and evaluation, Honeycombing of column and beam, Poor Safety considerations, Omissions during construction, Incorrect positioning of lighting switches and socket outlet and Incorrect laying of electrical pipes in slab, Incorrect laying of slab reinforcement contribute less to the occurrence of rework.

**Table 3 Historical data on public building projects in Lagos and Ondo States.**

| S/N | Location of project | Initial contract sum (million ₦) | Additional works (million ₦) | Rework cost (million ₦) | Final contract sum (million ₦) | Cost overrun (million ₦) | % of rework in final sum | Initial contract period (weeks) | Final contract period (weeks) | Time overrun (weeks) | % Time overrun | Areas of Reworks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| **1** | Lagos | 110.23 | 34.37 | 10.5 | 155.1 | 44.87 | 6.77 | 56 | 193 | 137 | 70.98 | Collapse of beam, Poor plastering, M & E, Poor quality of concrete, |
| **2** | Lagos | 13.4 | 1.1 | 0.5 | 15 | 1.6 | 3.33 | 53 | 53 | 0 | 0 | Poor plastering, M & E, Collapse of beam, Roofing |
| **3** | Lagos | 410.52 | 5.06 | 2.72 | 418.3 | 7.78 | 0.65 | 104 | 113 | 9 | 7.96 | Poor plastering, Collapse of beam |
| **4** | Lagos | 120.35 | 0.42 | 0.23 | 121 | 0.65 | 0.19 | 100 | 186 | 86 | 46.24 | Poor plastering, Collapse of beam , M & E, Poor quality of concrete |
| **5** | Lagos | 40 | 1.2 | 1.23 | 42.43 | 2.43 | 2.9 | 82 | 101 | 19 | 18.81 | Poor plastering, M & E, Collapse of beam |
| **6** | Lagos | 210 | 3.2 | 2.23 | 215.43 | 5.43 | 1.04 | 142 | 156 | 14 | 8.97 | Poor plastering, Collapse of beam, Poor quality of concrete |
| **7** | Lagos | 80 | 1.25 | 0.25 | 81.5 | 1.5 | 0.31 | 128 | 260 | 132 | 50.77 | Painting, Poor plastering, M & E |
| **8** | Lagos | 1000.4 | 85 | 32 | 1117.4 | 117 | 2.86 | 520 | 728 | 208 | 28.57 | Poor plastering, M & E, excavation |
| **9** | Lagos | 9.8 | 1.05 | 0.96 | 11.81 | 2.01 | 8.13 | 510 | 520 | 10 | 1.92 | Poor plastering, Collapse of beam, Painting |
| **10** | Lagos | 4.5 | 0.63 | 0.48 | 5.61 | 1.11 | 8.56 | 104 | 107 | 3 | 2.8 | Roofing, Poor plastering, Poor quality of concrete, |
| **11** | Lagos | 300 | 32 | 18 | 350 | 50 | 5.14 | 138 | 431 | 293 | 67.98 | Poor plastering, Honeycombing, M & E, excavation |
| **12** | Lagos | 98 | 5.2 | 3.7 | 106.9 | 8.9 | 3.46 | 52 | 58 | 6 | 10.34 | Poor plastering |
| **13** | Lagos | 35 | 1.58 | 0.42 | 37 | 2 | 1.14 | 42 | 88 | 42 | 52.27 | Poor plastering, Collapse of beam ,M & E |
| **14** | Lagos | 33.17 | 1.33 | 0.9 | 35.4 | 2.23 | 2.54 | 72 | 88 | 16 | 18.18 | Poor plastering, Painting |
| **15** | Lagos | 16.74 | 1.62 | 0.78 | 19.14 | 2.4 | 4.08 | 16 | 18 | 2 | 11.11 | Poor quality of concrete, Poor plastering, M & E, Collapse of beam |
| **16** | Lagos | 295 | 2.1 | 1.64 | 298.74 | 3.74 | 0.55 | 112 | 203 | 91 | 44.83 | Collapse of beam, Poor plastering, Painting, Roofing |
| **17** | Lagos | 3.5 | 0.53 | 0.18 | 4.21 | 0.71 | 4.28 | 8 | 9 | 1 | 11.11 | Poor plastering, M & E, Collapse of beam |
| **18** | Lagos | 502 | 36 | 18 | 556 | 54 | 3.24 | 102 | 113 | 11 | 9.73 | Wronging laying block work, Poor plastering, Honeycombing |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **19** | Lagos | 12.48 | 2.1 | 0.78 | 15.36 | 2.88 | 5.08 | 24 | 54 | 30 | 55.56 | Collapse of beam, Poor plastering, Roofing |
| **20** | Lagos | 17.99 | 0.55 | 0.23 | 18.77 | 0.78 | 1.23 | 38 | 44 | 6 | 13.64 | Poor plastering, Collapse of beam, Wronging laying block work, |
| **21** | Lagos | 29.88 | 0.91 | 0.39 | 31.18 | 1.3 | 1.25 | 52 | 55 | 3 | 5.45 | Poor plastering, M & E, Roofing |
| **22** | Lagos | 172.38 | 10.64 | 7.36 | 190.38 | 18 | 3.87 | 94 | 129 | 35 | 27.13 | Poor plastering, Poor quality of concrete |
| **23** | Ondo | 8.11 | 2.65 | 0.43 | 11.19 | 3.08 | 3.84 | 32 | 40 | 8 | 20 | Poor plastering, M & E, Painting |
| **24** | Ondo | 4.5 | 0.38 | 0.11 | 4.99 | 0.49 | 2.2 | 12 | 12 | 0 | 0 | Poor plastering, Furniture and Fittings, M & E |
| **25** | Ondo | 183.16 | 25.84 | 8.65 | 217.65 | 34.49 | 3.97 | 18 | 26 | 8 | 30.77 | Wronging laying block work, Collapse of beam, Poor plastering, Furniture and Fittings |
| **26** | Ondo | 67.36 | 5.62 | 4.64 | 77.62 | 10.26 | 5.98 | 42 | 65 | 23 | 35.38 | Furniture and Fittings, Poor plastering, M & E, Painting |
| **27** | Ondo | 82.3 | 19.87 | 3.74 | 105.91 | 23.61 | 3.53 | 42 | 52 | 10 | 19.23 | Poor plastering, Painting |
| **28** | Ondo | 51.65 | 0 | 0.87 | 52.52 | 0.87 | 1.66 | 38 | 82 | 44 | 53.66 | Poor plastering, M & E, Collapse of beam, Painting |
| **29** | Ondo | 98.4 | 9.34 | 5.9 | 113.64 | 15.24 | 5.19 | 38 | 43 | 5 | 11.63 | Poor plastering, M&E, Poor quality of concrete |
| **30** | Ondo | 108 | 4.7 | 2.45 | 115.15 | 7.15 | 2.13 | 76 | 82 | 6 | 7.32 | Poor plastering, M & E |
| **31** | Ondo | 1.8 | 0.23 | 0.08 | 2.11 | 0.31 | 3.79 | 4 | 4 | 0 | 0 | Collapse of beam, Poor plastering, M & E, Poor quality of concrete |
| **Total** | | **4,120.62** | **296.47** | **130.35** | **4,547.44** | **426.82** | **102.87** | **2851** | **4122** | **1271** | **760.17** | |

(Source: Aiyetan, 2014)

Table 3 reveals cost overrun, the final contract period, percentage rework cost, and areas of reworks. It is noteworthy that 10% of the projects were completed within the time schedule, though not within the stipulated budget. Project time overrun ranges between 1 (one) week to 208 weeks (4 years). It is notable that six projects had time overrun above 50% of the initial project period. On the average the project time overrun is 24.5% of the initial project period. All the projects experienced cost overrun, it range between N0.31M to N44.87M. Averagely, the project cost overrun is N13.77M. From these cost overruns on the project, the rework cost was found to range between N0.19M to N8.56M.

Relative to the areas of reworks on the projects investigated. It could be observed that all components of the building experienced rework. These reworks denote activities in the process cycle of building construction. For example, there were construction errors starting from excavation, through to the roof trusses and up to the plastering of the project.

It should be noted that only the direct costs of rework for the failures observed were estimated, the indirect rework costs such as site overheads and work undertaken for the site from contractor's office have not been included in estimates for rework of quality failures. This means that there is an under-estimate of their full rework cost through the exclusion of overheads.

**Table 4: Areas of reworks from historical data.**

| S/N | Area or rework | Frequency of occurrence | Average rework cost (Million ₦) | Rank |
|---|---|---|---|---|
| 1 | Poor plastering | 31 | 2.63 | **1** |
| 2 | Construction error during excavation | 23 | 2.60 | **2** |
| 3 | Wronging laying of forming course (block work) | 36 | 2.43 | **3** |
| 4 | Honeycombing of column and beam | 30 | 2.01 | **4** |
| 5 | Furniture and Fittings | 7 | 1.93 | **5** |
| 6 | Use of poor materials in Steel | 12 | 1.57 | **6** |
| 7 | Roof trusses and covering | 28 | 1.40 | **7** |
| 8 | Painting | 4 | 1.12 | **8** |
| 9 | Incorrect laying of slab reinforcement | 16 | 1.09 | **9** |
| 10 | Poor quality of concrete | 7 | 1.07 | **10** |
| 11 | Incorrect laying of electrical pipes in slab | 15 | 0.97 | **11** |
| 12 | Non-verticality of column | 18 | 0.95 | **12** |
| 13 | Incorrect forming of deck | 4 | 0.93 | **13** |
| 14 | Use of poor materials in Sand | 9 | 0.74 | **14** |
| 15 | Lack of straightness of beam at the top and bottom | 6 | 0.71 | **15** |
| 16 | Wrong opening for windows and doors | 14 | 0.59 | **16** |
| 17 | Incorrect laying of mechanical pipes | 17 | 0.59 | **16** |
| 18 | Collapse of beam after construction | 1 | 0.35 | **18** |
| 19 | Deflection of beam | 3 | 0.29 | **19** |
| 20 | Incorrect positioning of lighting switches and socket outlet | 4 | 0.19 | **20** |

(Source: Aiyetan, 2014)

Table 4 presents a ranking of areas of rework on building projects. The area / activity, which is first in ranking and indicates the activity most prone to rework is plastering. There are two likely causes of this phenomenon are: firstly, blocks not properly laid, and the second, non-taking of gauge before commencing on the actual plastering of the building. The second in ranking pertaining to areas of rework in the building process is construction errors during excavation. The probable cause of rework from this activity stems from omission during setting out or non-coordination of dimensions and building drawings. The third in ranking regarding area of rework in the building process is wrong lying of forming course (block work). The cause may be partly lack of adequate supervision and incompetency on the part of the foreman, relative to understanding building drawing. The fourth ranked common defect resulting into rework is honeycombing of column and beam.

Honeycombing could result from coarse concrete mix produced, and lack of adequate compaction. The use of head pan for casting of concrete over a long distance is mostly the cause of honeycombing. Jolting of aggregates occurs, a process whereby heavier aggregates settle at the base of headpin and the lighter one remain at the top. The pouring of such concrete result into separation of aggregates i.e improper mixing of the constituents of concrete and result in honeycombing. The three least ranked areas of reworks are: incorrect positioning of building switches and socket outlets, deflection of beam and collapse of beam after construction. The first from the bottom, which is incorrect positioning of building switches and socket outlets, may occur from mistakes in consideration the right outlet. The second ranked from the bottom, which is beam deflection. This may result from incorrect levelling of the bottom of beam at the false work stage. The third ranked from the bottom is collapse of beam after construction. There are three factors that could be responsible for this: (a) poorly finished quality of concrete which cannot support its weight, (b) under design, and insufficient support. Attention should be paid to ensure quality concrete production, adequacy regarding reinforcement and good condition timber that will provide adequate strength or the use of steel props.

From the historical data, areas of reworks were compiled and categorised into the various building elements and the various cost were extracted relative to the various elements, based on this, Table 5 was developed. Table 5 indicates the final cost and rework cost. The element that has the highest final cost is substructure (N822.52M), next is frame and upper floors and finishes (N650.68M) and N594.61M) respectively. The element with the highest rework cost is frames and upper floors (N29.46), next is finishes (N28.10M), mechanical installations (N13.87M) and substructure (N12.34M). The element with the least rework is door and windows (N1.32M). Following this element is furniture and fittings (N2.73M). Reworks from these elements are not frequent, and may be due to non-complexity of work of these elements. Based on the historical data, rework cost is between N0.19M to N2.63M.

**Table 5: Building elements and their contributions to rework.**

| Elements | Initial cost (₦) | Additional works (₦) | Rework cost (₦) | Cost Overrun (₦) | Final cost (₦) | % of rework cost overrun | % of rework cost in final cost |
|---|---|---|---|---|---|---|---|
| Substructure | 758.34 | 51.85 | 12.34 | 64.19 | 822.53 | 19.22 | 1.50 |
| frames and upper floors | 594.75 | 26.47 | 29.46 | 55.93 | 650.68 | 52.67 | 4.53 |
| Roof and covering | 234.74 | 20.36 | 13.01 | 33.37 | 268.11 | 38.99 | 4.85 |
| Wall | 389.58 | 23.32 | 9.76 | 33.08 | 422.66 | 29.50 | 2.31 |
| Doors and Windows | 213.00 | 15.91 | 1.32 | 17.23 | 230.23 | 7.66 | 0.57 |
| Furniture and Fittings | 297.31 | 19.65 | 2.73 | 22.38 | 319.69 | 12.20 | 0.85 |
| Mechanical installation | 343.65 | 14.78 | 13.87 | 28.65 | 372.30 | 48.41 | 3.73 |
| Finishes | 486.95 | 79.56 | 28.10 | 107.66 | 594.61 | 26.10 | 4.73 |
| Painting | 242.00 | 19.33 | 4.50 | 23.83 | 265.83 | 18.88 | 1.69 |
| Electrical installation | 397.80 | 12.37 | 9.18 | 21.55 | 419.35 | 42.60 | 2.19 |
| External works and drainage | 162.50 | 12.87 | 6.08 | 18.95 | 181.45 | 32.08 | 3.35 |

(Source: Aiyetan, 2014)

From Table 5 the building element with the highest rework cost is frames and upper floors (N29.46M) , and that which has the least rework cost is doors and windows (N1.32M), and of their initial cost. These could be represented in percentages as 5.0% and 0.6%. This finding agrees with those of Barber *et al.* (2000); Josephson *et al.* (2002), and Marosszeky (2004) as reflected on Table 1.

### *4.1 Comparison of rework cost relative to survey and historical data*

From the historical data, poor plastering is first in ranking among areas of frequent rework on building construction and third in ranking from the contractors' perception of causes of rework. Construction error during excavation is ranked second among frequent areas of rework from historical data and twenty-one position in ranking from the contractors' rating. Wrong lying of forming course is ranked third from the historical data and ranked first from the contractors' rating of frequent causes of rework.

Based on the above analysis, there exist similarities among both findings relative to causes of rework. It implies, that attention should be given to construction activities at the substructure stage, laying of forming courses, plastering and quality of materials for concrete. Foremen that understand building drawings should be engaged; those without this knowledge should be trained via short programme. The correct procedure of plastering should be enforced, while carrying out plastering work. Adequate supervision should be given to forming courses.

### *4.2 Consequences of rework*

There are consequences relative to rework that are a lot harder to express in terms of money or costs. Love (2002) enumerated on the indirect consequences of rework, which include: end-user dissatisfaction, inter-organizational conflicts, stress, fatigue, work inactivity, de-motivation, loss of future work, absenteeism, poor moral, reduced profit and damage to professional image. These all have adverse impact on project delivery relative to time, cost, quality and construction industry image, and on the part of the contract, his image, competitive advantage, profitability, and survival.

## 5. DISCUSSION OF RESULT

Based on this study, it can be concluded that rework occurs most at the construction stage stemming from the level of expertise of the skilled workers. This agrees with the study by Love and Sohai (2003) that identify that rework occurs at the construction stage mostly as a result of damages to work and improvement required to bring work to an acceptable standard.

It was found in this study that rework cost ranges between 0.6 – 5.0%. When compared with finding from study documented in Table 1, the range of rework cost in Nigeria is within the same range with that of most country in the world. Contrary, in the study of Love and Li (2000) it ranges between 20 – 80%. In another study by Love and Edwards (2004) rework cost was found to be 52% of the cost increases experience in projects. Alwi *et al.* (1999) found two main factors to be causes of rework, lack of supervision and skills by labourers. These results in mistakes and poor quality work production, necessitating rework. Based on these, it can be deemed that with adequate supervision rework may be drastically reduce to a negligible percentage.

## 6. CONCLUSION AND RECOMMENDATION

The data obtained of this study were analysed and conclusions were drawn. Conclusions to the study are in two parts, relative to the questionnaire survey and the historical data.

From the questionnaire survey, wrong lying of forming course, poor quality of concrete and poor plastering are the three main areas of occurrence of rework. From the historical data, poor plastering, construction errors during excavation and wrong lying of forming course prevalent.

Based on the elements of building with rework cost, the study found that the building element, which has the highest rework cost, is frames and upper floors (N29.45M), and the element with the lowest rework cost is doors and windows (N1.32M). The study found that rework cost ranges between 0.6 – 5.0% of initial contract sum. Based on the conclusion made from the analysis of data, the following are recommended: Since rework occurs mostly at the construction stage and to avoid disputes among parties relative to project cost. The process of award / selecting a contractor should emphasis strongly the competence of the contractor relative to past projects, quality of staff, tools and equipment owned, relevant advanced construction technologies and quality assurance of the contractor to ensure work could be done right-first-time. Relevant construction technology will engender correct construction processes should be followed in the execution of construction activities and ensure materials that are of good quality only are used for constructional purposes. On the other hand, client should set aside a sum of money for rework occurrence to ensure an uninterrupted flow of work or avoid delay on project, to mitigate the instance of rework. This range of 0.6 – 5.0% should be used in the calculation of money to be set aside.

The foremen that are knowledgeable, have understanding of building drawing should be engaged and if otherwise, they should be trained to be able to read building drawing.

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# A COMPARISON OF CONSTRUCTION RELATED REWORK IN UGANDA AND MOZAMBIQUE

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## ABSTRACT

The realisation of the expected minimum client quality requirements in both the products and processes in the construction industry remains challenging. The effects have been increased wastage and value loss through rework in both public and private sector initiatives providing social services in developing countries. The purpose of the research was to compare the impact of construction related rework on project budgets and schedule in public building construction in both Uganda and Mozambique, being examples of developing countries. The objective of such comparison is to document where focus should probably be placed in ensuring that quality requirements in construction are achieved. Case study approach was adopted and separate case study protocols prepared. The scope of study in the Ugandan project involved construction of classroom blocks, health centres and staff housing between 2008 and 2011. The scope of study in the Mozambique project involved the construction of 209 public housing units in Mozambique. The units of study were rework-related project budget and schedule overruns with further comparison of rework-related impacts on both project budgets and schedules under study. In Uganda, the mean percentage rework range was 12.45% - 15.58% of the construction contract scope. It was determined that the mean percentage of rework-related impact on project budget and schedule was 4.53% and 8.42% respectively. In Mozambique, the mean percentage rework range was 3.35% - 4.40% of the construction contract scope. It was determined that the mean percentage of rework-related impact on project budget and schedule was 0.56% and 12.0% respectively. Acknowledging the differing cultural contexts of both countries where the study was conducted, these findings could improve governance and strengthen the regulatory framework on quality management in both Uganda and Mozambique.

**Keywords;** Mozambique, Public Construction, Rework, Uganda

## 1. INTRODUCTION

The quality of a construction project is measured by its conformance to a quality plan designed to meet client quality requirements (Arditi and Lee, 2004). The realisation of the expected minimum client quality requirements in both the products and processes in the construction industry remains challenging. As Haupt and Whiteman (2004) posit, the construction industry has been slow in embracing a philosophy that seeks continual improvement of quality management in construction; only seeking to implement aspects that provide them with a competitive edge and improved financial performance. The effects have been increased wastage and value loss through rework in both public and private sector initiatives providing social services in developing countries. Emerging economies and developed countries are not the exception much as this seems more formidable with developing countries. For instance, quality failure related costs in residential construction projects were found to be 4% (Mills et al., 2009) of construction contract value in Australia and 0.7% (Abdelsalam and Gad, 2009) in the United Arab Emirates. Suffice it to note that developed countries and emerging economies are a significant step ahead because of the research and industry initiatives that ensure considerable collection and publication of ordinal data on quality achievement in construction. Unfortunately, this is not so for developing countries and because of this, it is not easy to establish inherent quality failures and related costs not only in construction but also in the operation and maintenance of constructed facilities. Kazaz et.al (2005) and Kakitahi et.al (2013) acknowledge that much as public sector provision of services is noble, it should be noted that it is the end-users that are likely to be encumbered with operation-related rework costs.

Notably, quality costs are incurred when rework, a quality failure attribute, occurs; affecting productivity, requiring more construction resources and leading to budget and schedule overruns (Low and Yeo, 1998, Love and Li, 2000, Love and Mandal, 1999). Furthermore, where rework impact mitigation measures are not instituted in developing countries particularly, research even shows an increased preference for expatriate contractors since they seem to provide better workmanship and quality materials, and an environment where less costs are incurred on rectifying defects (Idoro, 2010). Both private and public sector clients, therefore, need to be more pragmatic in their efforts to have stipulated quality requirements in construction achieved. As initiators of these projects, clients, particularly, in developing countries should ensure an adequate understanding and related publication of the causality of quality failures in construction. Suffice it note, though, that this in itself is insufficient because it does not provide a thorough understanding of the mechanics and complex correlations among other causes of quality failures (Aljassmi and Han, 2012). Yet, there still remains insufficient concern and purposeful action being raised on the issue in developing countries. This could be attributed to the mind-set regarding quality attainment in construction where public sector entities, for example, perceive the benefits of providing social services as far outweighing quality failure related costs in construction. The private sector is also considered to have similar attitudes because as Love et al. (2011) found out, for example, there was a perception that revenue from production with regards to off-shore projects far exceeded any incurred quality failure related costs.

The paper, therefore, sought to compare the occurrence of construction related rework in two African developing countries; Uganda and Mozambique. These two countries were considered a convenient representation of similar economies within the East, Central and Southern African continent. The objective of such comparison is to document where focus should probably be placed in ensuring that quality requirements in construction are achieved. The variables for comparison are causality and related impacts on project budget and schedule of construction-related rework. This involved studying schedules and costs of two public sector projects that focused on the provision of education and health sector facilities in Uganda and mass residential housing in Mozambique.

## 2. HOW CLIENTS CAN IMPROVE QUALITY IN CONSTRUCTION

A pragmatic client, particularly for the public sector, is a prerequisite for quality achievement in construction. Suffice to note that some client-based initiatives are presently already being utilised. For example, the mandatory requirement in Singapore for contractor selection on the basis of their application of ISO9000 –based quality management systems (Palaneeswaran et al., 2006). These initiatives notwithstanding, clients have been noted as primary contributors to an inefficient construction process through delayed payment of contractors, inadequate support of requisite skills training and development and inability to regularly keep track of project developments (Alinaitwe, 2008). Yet, clients are the significant entity that draw up the minimum expected quality requirements and influence the contractual environment which ensures that quality in construction is achieved. Clients can also ensure that at project inception, the processes in the selection of contractors and consultants are based on sound procurement and project management principles. Additionally, quality auditing can be incorporated as an evaluation tool that determines whether or not expected quality requirements have been achieved and implemented effectively (Arditi and Lee, 2003). Such audits would provide feedback to the construction process which could lead to increased adoption of best building practices and the minimal use of low quality building products. It should be understood that the effective involvement of clients and the efficient use of quality management tools are key tenets of a holistic total quality management framework. Notably, the construction industry has been found to be resistant to the adoption of such a framework due to; product diversity, organisational stability, contractual relationships and overall teamwork and management behaviour (Sommerville and Robertson, 2000). These could, however, be long term strategies and yet, impacts from quality failures need to be addressed, particularly in developing countries. Client-initiated interventions could place prominence on understanding causality and impact of quality failures through studying attributes such as rework. Documentation of such interventions would create awareness of the need for improved quality management in construction, which as Wells (1993) put it, “is not easy to enforce, particularly in African conditions”.

## 3. A BRIEF ON THE CASE STUDIES IN UGANDA AND MOZAMBIQUE

The case under study in Uganda was phase one of the Peace Recovery and Development Programme (PRDP I) located in Northern Uganda.

The programme that was being studied involved the construction of classroom blocks, health centres and staff housing and it was directly supervised by the Office of the Prime Minister. The PRDP I was the first phase of the US$606 million programme and it covered the financial period 2007/8 – 2009/10 in the Northern Uganda sub-regions of Abim, Adjumani, Amuru, Apac, Gulu, Kaabong, Kitgum, Lira and Pader. The programme was designed to ameliorate social services in the region following a protracted 20 year war between the government and rebels of the Lord's resistance army. In Mozambique, the case under study was the construction of 5,000 public mass residential housing units located in Intaca, Municipao da Matola and implemented by FFH/Henan Gouji Development Company; a partnership established as a contractual arrangement between the Mozambique government and the Chinese company, Henan Gouji Industry and Development Company that formed the client entity. The focus of study under the Mozambique project was the Projecto De Construcao De Uma Habitacao Tipo 3 which involved the construction of various design types of housing under the project.

## 4. RESEARCH METHODS

The research compares the outcome from two independent case study researches conducted in Uganda and Mozambique. The units of study were rework-related project budget and schedule overruns. It further compares rework-related impacts on both budgets and schedules for public projects in Uganda and Mozambique. In Uganda, for the provision of education and health services; while for Mozambique, for the provision of mass residential housing. Case study research approach was adopted and the case study protocols prepared included a checklist, observation schedules and an interview guide. Sample selection under the PRDP I programme was from contracts that involved construction of classroom blocks, health centres and staff housing between 2008 and 2011. The sample size considered for the study was the construction of 140 classroom blocks, 30 health centres and 30 staff housing units. The scope of study in the Mozambique project involved the construction of 209 type 3 public housing units from which the construction of 48 type 3C and 11 type 3B houses constituted the sample size. The project categorised various housing design types and these included types 3C and 3B of housing design type 3 that was selected for study. Within the parameters of the 95% confidence Interval, the sample sizes directly relate to the overall works under both programmes. Rework related impacts on budget and schedule arising from materials quality, workmanship and design changes were measured and quantified. A building elemental breakdown was adopted for subsequent data input and analysis. The elemental breakdown included; sub-structure, building frame, wall, doors, windows, finishes, floor, roof, lighting and electrical, fixtures and installations. The cost of rework for different building elements was obtained by taking the value of works in the contractor's bill of quantities and comparing with the rework-related cost in the contractor's monthly claims for payment and approved interim payment certificates. The percentage budget overrun attributable to rework was then computed and also tabulated across the building elements and the mean percentage re-work related costs subsequently determined.

The percentage schedule overrun attributable to rework was computed by extracting related information from project progress reports and the schedule overruns were tabulated across the building elements, from which the mean percentage rework related schedules were obtained. Mean percentage variations and standard deviations were calculated across building elements and the corresponding standard deviations were determined. To ensure validity of documented data and in ensuring consistency with case study research rigour suggested by Yin (2010), interviews were conducted, using observation checklists, with representatives of the client entity in Uganda and with the contractors in Mozambique using observation checklists.

Data showing cost and time related impact on the total project budget and schedule respectively were collected. The mean percentage rework-related budget and schedule overruns was determined, as was similarly done by Oyewobi et al. (2011). All the data were then collated and analysed in MS Excel by categorization into those related to; design changes, materials quality and workmanship.

## 5. FINDINGS

A summary of the findings from both case studies is summarised in table 1. The table highlights the key factors that contributed to construction-related rework, the building elements found to have the highest frequency of rework and the mean percentage rework-related impact on project budgets and schedules.

**Table 1: Comparing construction related rework in Uganda and Mozambique**

| **Description** | **PRDP (Phase I) – Uganda** | **Projecto De Construcao De Uma Habitacao Tipo 3 – Mozambique** |
|---|---|---|
| Construction Related Rework attributed to; | • Design omissions<br>• Bad workmanship<br>• Inadequate contractor supervision | • Bad workmanship<br>• Substandard building materials<br>• Incorrect design information |
| Building elements with highest rework frequency | • Lightning conductor installations<br>• Electrical installations<br>• Roofing installations | • Wall and ceiling<br>• Finishes<br>• Roof structure<br>• Piping installations |
| Mean Percentage of rework related impact on; Project Budget | 4.53% | 0.56% |
| Mean Percentage of rework related impact on; Project Schedule | 8.42% | 12.0% |

Under the PRDP-I in Uganda, from the 140 sample units taken from a population of completed classroom blocks, the mean percentage rework range was 12.45% - 15.58% of the construction contract scope. Additionally, the mean percentage rework range was 10.83% - 13.97% and 7.90% - 10.30% respectively for the 30 health centres and 30 staff housing units. The rework-related impact on project schedule was 5.19%, 13.03% and 7.04% respectively for the classroom block, health centre and staff housing construction. The reasons for this level of rework-related impact on project schedule were; client instructions that increased work scope, delayed payment by the client and delayed handover of sites to the contractors. With regards to rework-related impact on project budget it was 3.53%, 8.02% and 2.04% respectively for the classroom block, health centre and staff housing construction. The reasons for this level of rework-related impact on project budget were; unacceptable workmanship on floor and wall finishes, roofing installations and windows, and inadequate and incorrect design information. It was determined that the mean percentage of rework-related impact on project budget and schedule was 4.53% and 8.42% respectively.

Under the Projecto De Construcao De Uma Habitacao Tipo 3 in Mozambique, from the 59 sample units taken from a population of 209 completed type 3 public residential housing units, the mean percentage rework range was 3.35% - 4.40% of the construction contract scope. Additionally, the mean percentage rework range was 3.35% - 3.85% and 3.55% - 4.40% for the 48 type 3C and 11 type 3B houses respectively. The rework-related impact on project schedule was 10.75% and 13.25% respectively for the type 3C and type 3B respectively. The reasons for this level of rework-related impact on project schedule were; making good defective fascia boards to roofing structure and incorrect piping installations. With regards to rework-related impact on project budget it was 0.65% and 0.47% respectively for the type 3C and type 3B respectively. The reasons for this level of rework-related impact on project budget were; unacceptable workmanship on wall and ceiling finishes and replacing substandard materials used in piping installations; and incorrect design information related to doors. It was determined that the mean percentage of rework-related impact on project budget and schedule was 0.56% and 12.0% respectively.

## 6. DISCUSSION

It is acknowledged that the comparative study is limited in scope and generalisable to the African sub-continent but what it does is highlight three requisite tenets of effective construction quality management: improved supply chain management, efficient design management and adequate supervision of works.

Fostering improved supply chain management requires the anterior step of defining supply chain; which has been defined as the integrated process of various business entities working together to acquire and transform raw materials and deliver value added products to consumers (Beamon, 1998). For the construction industry in developing countries, it requires a concerted effort to see that the processes of manufacturing, delivering and installing building materials focus on value addition and client satisfaction.

This not only requires certification with national and international quality management organisations such as the ISO, but also encourages localised research and development into appropriate building technologies and products. Notably, the use of locally-produced building materials and labour intensive construction techniques, for example, should not obscure other factors affecting effective construction project management in developing countries. The construction industry could subsequently benefit by extending cost of quality measurement techniques to entire supply chains within the construction and not to just the internal entity systems (Castillo-Villar et al., 2012).Within such a framework, as Briscoe et.al (2004) suggest, clients can sufficiently influence the degree of supply chain integration, develop sustainable long term relationships and reduce the detrimental preference for competitive price tendering.

Incorrect design information within contract documentation is presumed to lead to rework that adversely impacts organisational performance and public financial expenditure; and it is a system of dysfunctional organisational and managerial practices prevailing within the construction industry (Love et al., 2012). Models such as those discussed by Love et al. (2012) could be utilised in providing insight into the interdependencies and behaviour between variables that contribute to incorrect design information, and they emphasise the notion that the degree of rework required is dependent on how long the latent incorrect design information remains undetected.

Effective design management minimises post contract design changes from various project stakeholders and rework arising from design omissions. The cost benefits could be substantial because even for construction projects considered successful, about 5 – 8% of construction budget overruns arose from post contract design changes (Cox et al., 1999).This brings to the fore the importance of adequately planning pre-contract award activities to ensure all quality requirements in the client brief have been incorporated in the project designs. These activities should be well-defined as this is the most important planning process that significantly influences project success (Zwikael, 2009).

Adequate supervision of works should be the priority of competent project stakeholders that ideally include; clients and end-users, consultants, contractors and suppliers of materials. In developing countries where stakeholder societies are considered more inclusive, two stakeholder management principles could be adopted; participatory decision making and a sustainable fiduciary relationship between the stakeholders and the project (Newcombe, 2003).To enrich the stakeholder participatory process, increased skills training and development could be prioritised, especially vocational skills such as building and concrete practice, welding and metalwork, and electrical installations and fittings. With these increased competencies, project stakeholders would ably translate client quality requirements into expected building products and improved construction processes.

Relatedly, the adoption of quality costing techniques could improve the contractor's site management abilities with the primary benefit being attitudinal changes that subsequently create an increased consciousness of non-conformance events and their impact on project budgets and schedules (Abdul-Rahman, 1996). These quality costing techniques require that accurate sets of comparative data across projects be collated with rework costs being a key component.

The rework costs include items such as rework, material waste and warranty repairs (Josephson et al., 2002). Rework during construction would be documented and related costs determined bearing in mind that related costs from material waste and warranty repairs might be more complex to ascertain especially since warranty repairs could occur after the buildings are handed back to the clients. This would ably track rework-related impacts on project budgets, in particular, but to do the same for project schedules, contracts could require contractors to incorporate rework into existing scheduling tools with the aim of calculating revised project duration that considers rework in project delay analysis and devises corrective actions (Hegazy et al., 2011). A quantitative mechanism by Hegazy et al. (2011) surmises the three steps necessary in a contractor's quantitative analysis of rework impact on a project's schedule as being;

- Recording all progress events that includes rework and calculates expected project delay;
- Analysing project delay, including identifying schedule overruns to project stakeholders; and
- Analysing options that determine the least costly action that recovers schedule overruns.

## 7. CONCLUSION

Public sector entities in developing countries have seemingly remained intransigent in adopting processes that continually improve public procurement and quality in construction management (Kakitahi et al., 2013, Kam and Tang, 1997, Rwelamila et al., 1999). Subsequently, the construction industry has continued to utilise unsuccessful traditional processes which as, Lenferink et al. (2014) suggest, leads to implementation gaps because the project entities are focused on concluding the respective project phases (design and construction) than on the overall objective of delivering the end-product; buildings built to established client quality requirements within budget and schedule.

Contractors, on their part, have had to also show their capability to improve their performance due to higher end-user requirements, environmental awareness and limited resources (Enshassi et al., 2007). However, as Palaneeswaran et al. (2006) discusses, much as contractor performance and project outcomes are the primary contributors to client satisfaction, there is no sufficient data for project participants to use in evaluation of compliance to client quality requirements. Nevertheless, contractors should be continually encouraged to minimise wastage and value loss through strict conformance to specifications in order to overcome disputes, schedule, budget and quality management challenges (Enshassi et al., 2007). Garvin (1987) discusses this conformance as the degree to which a product's design and operating characteristics meets established standards. In the construction industry, the products are the buildings and the established standards are the client quality requirements. The context in which both the buildings and the established client quality requirements should be considered is the whole life value of the buildings (Kakitahi et al., 2013).

Now, whether or not it is a public or private sector development, it remains that quality attainment in construction is a challenge in developing countries. Firstly, contractors should focus on the quality of their products and processes, a corporate quality culture, because in so doing they would realise high productivity and profitability as the quality of their operations and services improve (Yasamis et al., 2002). Furthermore, the other contractual entity, the client would realise improved conformance to their stipulated quality requirements. By comparing construction related rework in two African developing countries the study has documented quality failures and their impact on project budgets and schedules, something that could eventually highlight the subsequent influence it has on public sector expenditure on social service provision. Acknowledging the differing cultural contexts of both countries where the study was conducted, these findings could improve governance and strengthen the regulatory framework on quality management in both Uganda and Mozambique.

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# RETENTION BOND AND PERFORMANCE OF CONSTRUCTION PROJECTS IN NIGERIA

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## ABSTRACT

Retention bond guarantees that the contractor will carry out all necessary work to correct structural and/or other defects discovered immediately after completion of the contract, even if full payment has been made to the contractor. This research work assesses the effects of retention bond on construction project performance in Nigerian construction industry. Cost data were collected through the distribution of sixty (60) questionnaires of which fifty-seven administered questionnaires were retrieved. Data were analysed using correlation and regression methods of analysis. The findings from the study indicated that there is a significant relationship between retention bond and construction project performance in terms of cost and time. The study recommends that professional bodies should encourage the use of retention bond in the Nigerian construction industry by sensitizing professionals of its importance which is to enable effective delivery of projects within its initial cost and time. Also, contractors should encourage their clients to always include sum to cover up for retention bond in their contract sum.

**Keywords**: bond; construction project; Nigeria; performance; retention bond.

## 1 INTRODUCTION

Murdoch and Hughes (2008) asserted that the preparation of a cost estimate is an important part of the procurement process of a construction project because it forms the basis of the price upon which a contract is let. However, in practice, project estimates are not always accurate (Akintoye and Fitzgerald, 2000). Sometimes the cost estimate for a project is calculated by a builder or contractor. At other times, a consulting estimator or quantity surveyor is employed to calculate the estimate (Laryea and Hughes 2008).

Wedlake (2007) concluded that the best guarantee of performance for a construction project lies not in financial leverage but the selection of a properly qualified Specialist Contractor that is able to carry out the required work to a high standard, it is accepted that clients require a form of monetary protection in the event of defects being discovered in their supply chains' works.

However, you can offer substantial security to clients and contractors for the work that you carry out without providing cash retentions. Cash retention used to be the most prevalent form of protection against sub-standard work on a construction project.

## 2 LITERATURE REVIEW

### 2.1 Purpose of bonds in the construction industry

The ultimate goal of any construction project is to be delivered in the shortest possible time, at the lowest possible cost and highest quality (Laryea and Hughes, 2011). Emily (2009) asserted that Construction bonding is a risk management tool used to protect project owners and developers. A bond constitutes a legal guarantee that the project will be completed as expected.

The main purpose of retention is in twofold (Wedlake 2007). Firstly, it provides the client with a financial protection fund should the contractor fail to rectify defects and secondly, it provides a mechanism by which to motivate the contractor in completing both defects and outstanding works during the defects liability period. Operation of the system is typically straightforward in that retention of between 3% and 5% is deducted from the contractor's income each month in respect of both temporary and permanent works, and usually until retention limit is reached. Half the retention held is then released once the project is certified as being practically complete, with the other half being released at the end of the defects liability period, or once any and all defects have been rectified.

Similar provisions are usually made further down the subcontracting chain with retention deducted by the contractor from the subcontractor's income each month. The amount and release dates of retention are not necessarily 'back to back' with the contractor and may be more or less favourable (O'Neill, 2007).

### 2.2 Retention bond

Retention bonds have the dual benefit of providing the same level of protection to the client as the cash retention system in the event of defective work, but without the financial disadvantages to the contractor, and therefore, to the industry generally.

A retention bond represents a commitment by a third party (typically an insurance company or a bank), to guarantee the obligations of the contractor under a contract, up to an agreed limit, which would typically be the same as the maximum cash retention amount. As work is completed on site, the contractor is then paid in full for the works carried out in accordance with the contract and with the client being protected against default by the bond. The system thus provides better value to the contractor during the construction phase but at the same time without being detrimental to the client's concerns regarding sub-standard work at the end of the construction phase. For obvious reasons, retention bonds need to be in the form of on demand bonds, which have the effect of giving the client the same degree of comfort and control over the rectification of possible defects as he would have if he simply withheld 5% cash from the contractor's interim payments.

Retention bonds do not come free of course, and as with all forms of insurance, there is a premium to pay for the level of cover provided.

Albeit the cost of a retention bond would be assessed on its own merits, the cost is nevertheless influenced by factors such as the financial strength of the contractor, the volume of the bond business generally and the guarantors underwriting analysis of the concerned project. Research in Hong Kong indicates that the cost associated with a retention bond can be as low as 0.5% to 1% of the bond value. Research in the UK suggests that funding retention bonds can be up to seven times less than funding cash retentions, albeit the cost of the credit facility is dependent on the contractor's financial strength and performance as well as the contractor's ability to continue to trade both profitably and within their capabilities, and, of course, the prevailing interest rates. If the bond was obtained from an insurance company, a further added bonus is that neither the contractor's working capital nor the contractor's borrowing facilities would be affected, thereby making the arrangement a further attractive alternative to withholding cash.

### 2.3 Requirements for retention bond

The information that needs to be inserted when completing the retention bond by the guarantor according to JCT (Barnes and Davies, 2008) standard includes:

1. The date of the retention.
2. The name and address of the surety (that is, the party that guarantees payment of the bond amount).
3. The name and address of the contractor.
4. The name and address of the sub-contractor.
5. The surety's maximum aggregate liability amount under the bond, stated as a sum. This will be the same sum as stated in the sub-contract under item nine of the contract particulars.
6. The surety's address where a demand under the bond should be sent.
7. The surety's address where a copy of the written notice to the sub-contractor of his liability for the amount demanded should be sent.
8. The (default) expiry date of the bond. This will be the date as stated in the sub-contract under item nine of the sub-contract particulars.
9. The bond then needs to be signed as a deed by or on behalf of the surety.

## 3 RESEARCH METHODOLOGY

The research adopted a cross-sectional and correlation study carried out on a conveniently selected sample, since it cut across some professionals in construction industry. Two sets of data were collected; primary and secondary data. Primary data were collected with structured questionnaires comprising of open and closed-ended questions. Pre-qualified and registered Architectural firms, Quantity surveying firms and Contractors are the population of this field survey. In order to arrive at an accurate sample frame, the lists of these registered firms were obtained from the Ondo State Ministry of Works as shown in Table 1. This was on the premise that most projects where bonds are administered are government owned and only registered firms with the state government can submit bid for such projects.

**Table 1: Sample Size**

| Ref No | Respondents | Population | Questionnaires distributed | Total retrieved and filled | % filled |
|---|---|---|---|---|---|
| 1 | Quantity surveyors | 20 | 20 | 17 | 29.82 |
| 2 | Architects | 25 | 25 | 13 | 22.81 |
| 3 | Contractors | 195 | 40 | 27 | 47.37 |
| | TOTAL | 240 | 90 | 57 | 100.00 |

**Source: Ondo state Ministry of Work, Akure**

Secondary data were collected through records of completed building projects. Cost-data of 47 completed construction projects with retention bond were obtained using convenience sampling method out of which only 19 were fit for analysis. For statistical verification of the relationship and determination of the effect of retention bond on construction project delivery indices, a linear regression analysis was carried out.

$$\longrightarrow \quad Y = B_o+B_1X_1-B_2X_2...B_nX_n + e_1 \quad \text{.......} 2$$

Where $B_o$ = Regression constant
$B_1$ = Regression co-efficient for variable $X_1$
$B_2$ = Regression co-efficient for variable $X_2$
$B_n$ = Regression co-efficient for variable $X_n$
$_n$ = Number of independent variables
$e_1$ = Residual error

## 4 DATA ANALYSIS AND FINDINGS

Table 2 shows the background information of the respondents. The professionals surveyed were Quantity Surveyors (29.8%), Architects (22.8%), and Contractors (47.4%) who had an average of 11.4 years of experience in the construction industry. Using the academic and professional qualifications, years of experience and academic qualification of the respondents in the construction industry, it can be inferred that the data obtained for this research work can be relied upon. This is because all the respondents are highly educated, with recognizable professional qualification and substantial years of professional experience.

**Table 2: Characteristics of respondents**

| Characteristics | Frequency | Percent |
|---|---|---|
| **Academic qualification of respondent** | | |
| B. SC/B. Tech | 24.00 | 41.67 |
| M. Sc/M. Tech | 17.00 | 30.00 |
| HND | 13.00 | 23.33 |
| Ph. D | 3.00 | 5.00 |
| **Total** | **57.00** | **100.00** |
| **Category of organisation** | | |
| Consulting | 29.00 | 50.00 |
| Contracting | 27.00 | 46.67 |
| Not stated | 1.00 | 3.33 |
| **Total** | **57.00** | **100.00** |
| **Years of experience** | | |
| 0-4 years | 21.00 | 36.67 |
| 5-10 years | 22.00 | 38.33 |
| 11-15 years | 8.00 | 15.00 |
| 16-20 years | 2.00 | 3.33 |
| above 20 | 4.00 | 6.67 |
| **Average** | **11.40** | |

## 4.1 Cost of retention bond and project cost

**Variables**

Crb = Cost of retention bond, Icp = initial cost of project, Fcp = Final cost of project, Cor = cost overrun, Csb = cost of securing bond, Tor = time overrun, Dsb = duration in securing retention bond, Idp = initial duration of project and Fdp = final duration of project.

**Table 3: Retention Bond and Construction Project Cost and Time**

| Variable comparison | Ps-value | Remark |
|---|---|---|
| Cost of retention bond and initial cost of project | 0.898 | significant |
| Cost of retention bond and final cost of project | 0.898 | significant |
| Cost of retention bond and cost overrun | -0.388 | insignificant |
| Cost of retention bond and initial cost of project, final cost of project & cost overrun | 0.899, 0.898, -0.199 | significant |
| Cost of securing bond and initial cost of project | 0.652 | significant |
| Cost of securing bond and final cost of project | 0.650 | significant |
| Cost of securing bond and cost overrun | -0.162 | insignificant |
| Cost of securing bond and initial cost, final cost & cost overrun of a project | 0.652, 0.650, -0.162 | significant |
| Duration to secure retention bond and initial duration of project | 0.280 | significant |

| | | |
|---|---|---|
| Duration to secure retention bond and final duration of project | 0.103 | significant |
| Duration to secure retention bond and time overrun | -0.013 | insignificant |
| Duration to secure retention bond and initial duration of project, final duration of project & time overrun | 0.280, 0.103, -0.013 | significant |

**Correlation of variables to establish relationships using Pearson test analysis**
The test to establish the relationship between variables is shown in table 3.
**Hypothesis 1**
**Ho=**cost of retention bond has no significant effect on initial cost of a project, final cost of a project and cost overrun construction.
**$H_1$=**cost of retention bond has significant initial cost of a project, final cost of a project and cost overrun.
**Decision 1:**Ps values greater than 0.05. Hence, the null hypothesis is rejected and the alternative which says that "cost of retention bond, has significant effect on initial cost, final cost and cost overrun of a construction project" is accepted. The effect is a very high and positive type.
**Decision 2:**Ps values less than 0.05. Hence, the null hypothesis is accepted and the alternative which says that "cost of retention bond, has significant effect on initial cost, final cost and cost overrun of a construction project" is rejected.

Pearson test was conducted to determine the significance of the relationship between two variables. It is established that Crb and Icp correlate with each other with significant at the 0.01 level. The higher the initial cost of project, the higher the cost of retention bond. Correlation between Crb and Fcp establishes its relationship to be significant at the 0.01 level, Pearson correlation relationship with a very low significance of 0.898, having equal relationship with Icp. Correlation between Crb and Cor of which establishes a very low significant of 0.388 unlike the previous significance of correlation. Correlation between Crb, Icp, Fcp and Cor variables were conducted to establish a significant of relationship at the 0.01 level.

Crb against Icp and Fcp having significance of 0.000, indicate in the relationship that the higher Crb the higher Icp and Fcp. Icp against Fcp with significance of 0.000, indicate that the correlation moves at same direction. While there are still some weak relationship between some of the variable which include, Crb against Cor with low significant of 0.287and Fcp against cost overrun with low significance of 0.431.

**Regression between variables**
The relationship between Cost of retention bond and initial cost of projects, final cost of the project, and cost overrun is stated thus;

**Crb= 325871.91+0.054Fcp-0.034Cor**
**(R= 0.899, $R^2$= 0.808, Adjusted $R^2$= 0.787)**
While, Y= cost of the retention bond, Constant= 325871.91, Fcp= Final cost of project, Cor= cost overrun
Ps value is 0.860 as revealed in table 4 depicting that correlation is significant. It was evident that cost of retention bond which is the dependent variable has no significant impact on cost overrun as an independent variable has 99% significant impact on final cost of projects.

**Table 4.11: Effect of Retention Bond on Construction Project; Cost and Time**

| Variables | R-value | Equation |
|---|---|---|
| Cost of retention bond and Initial cost of projects, Final cost of the project, and Cost overrun. | 0.899 | 325871.91+0.054Fcp-0.034Cor |
| Duration to secure bond and Initial duration of projects and Time overrun. | 0.652 | 12.248+0.064Idp- 0.016Tor |
| Cost to secure bond and Final cost of projects, Cost overrun. | 0.319 | 343526+0.005Fcp-0.006Cor |
| Cost overrun and initial cost of projects, Cost of the bond, Cost of securing the bond, No. of days to secure bond and Initial duration of the project. | 0.358 | 2.E7+0.194Cob-0.398Csb-201662Nsb-191535Idp-0.016Icp |
| Time overrun and Initial cost of projects, Cost of the bond, Cost of securing the bond, No. of days to secure bond and Initial duration of the project. | 0.944 | 15.86858+4.28E-06Cob-2.5E-06Csb-1.60722Nsb+0.353108Idp-1.2E-07Icp |

## 4.2: Cost of securing retention bond and project cost

**Correlation of variables to establish relationships using Pearson test analysis**

The test analysis on table 3, helped to assess the effect of retention bond in the construction industry through cost of securing retention bond and project cost:

**Hypothesis 2**

**Ho=**cost of securing retention bond has no significant effect on initial cost of a project, final cost of a project and cost overrun construction.

**$H_1$=**cost of securing retention bond has significant initial cost of a project, final cost of a project and cost overrun.

**Decision 1:**Ps values greater than 0.05 on table 3 and 4. Hence, the null hypothesis is rejected and the alternative which says that "cost of securing retention bond, has significant effect on initial cost, final cost and cost overrun of a construction project" is accepted. The effect is a very high and positive type.

**Decision 2:**Ps values less than 0.05 on table 3 and 4. Hence, the null hypothesis is accepted and the alternative which says that "cost of securing retention bond, has significant effect on initial cost, final cost and cost overrun of a construction project" is rejected.

Variables include;

Icp= initial cost of project, Fcp= Final cost of project, Cor= cost overrun, Csb= cost of securing bond.

Establishing relationship between Csb against Icp and Fcp by correlation gives a significance of 0.001 levels. Correlation between the CSRB and difference in cost of project include 0.483 of no significance in relationship. Correlation was conducted to establish relationship between Csb and Icp, Fcp & Tor. Csb form correlation with significance of 0.001 with Icp and Fcp. Correlation of Icp against Cor gave an insignificant valve of 0.483.

**Regression equation between variables.**
From the model shown on table 4, it is clear that the dependent variable does not have any significant impact on its independent variable. The cost of securing retention bond which is the dependent variable has no significant impact on cost overrun as an independent variable but has significant impact on final cost of projects.

Model design;
**Y= 343526+0.005Fcp-0.006Co**
**(R= 0.319, $R^2$= 0.102, Adjusted $R^2$= 0.002)**
Ps value is 0.436 shows that correlation is significant 95% level of significant. The model design equation for cost of securing the retention bond is 99% efficient in estimation of final cost of a project and cost overrun. It was evident that difference in cost of project known as cost overrun cannot be significant in any of the independent variables that, the initial cost of projects, cost of retention bond, Cost of securing the bond, No. of days to secure retention bond and initial duration of the project.

## 4.3 Duration to secure retention bond and project time

**Correlation of variables to establish relationships using Pearson test analysis**
The test analysis on table 3 was used to assess the effect of time to secure retention bond on project time in the construction industry:
**Hypothesis 3**
**$H_o$=** duration to secure retention bond has no significant effect on initial duration of project, final duration of a project and time overrun.
**$H_1$=** duration to secure retention bond has significant effect on initial duration of project, final duration of a project and time overrun.
**Decision 1:**Ps-values greater than 0.05 on table 3 and 4. Hence, the null hypothesis is rejected and the alternative which says that "duration to secure retention bond has significant effect on initial duration of project, final duration of a project and time overrun" is accepted. The effect is a very high and positive type.

**Decision 2:**Ps values less than 0.05 on table 3 and 4. Hence, the null hypothesis is accepted and the alternative which says that "duration to secure retention bond has significant effect on initial duration of project, final duration of a project and time overrun" is rejected.
Correlation between duration to secure retention bond and Idp, Fdp, Tor is to be significant at 0.01 and 0.05 levels while time overrun is not significant at -0.013 values.

Designed model from table 4 shows that, Y= duration to secure bond, Constant = 12.248, Idp = Initial duration of project and Tor = Time overrun
**Y=12.248 + 0.064Idp - 0.016Tor**
**(R= 0.652, $R^2$= 0.425, Adjusted $R^2$= 0.361)**

Ps value is 0.436 depicting that correlation is significant as shown in table 4. From the model, it is clearly that the dependent variable does not have any significant impact on its independent variable.

It could also be deduced that time to securing retention bond which is the dependent variable has no significant impact on time overrun as an independent variable but has significant impact on final time of projects.

## 5 CONCLUSION AND RECOMMENDATION

In other to assess the effect of retention bond on construction project performance, the analysis of this research was based on the relationship between retention bond and cost and time of construction projects. It could be observed that there is a significant relationship between retention bond and construction project in terms of cost and time. This implies that usage or non-usage of retention bond can significantly affect cost and time performance of construction projects positively and negatively respectively. Clients, contractors and other construction experts are therefore encouraged to ensure usage of retention bond in construction projects in order to provide security for clients' investment. This will also ensure that contractors are paid as appropriate after the practical completion of the defect liability period.

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# CONSTRAINTS TO THE DEVELOPMENT OF PROFESSIONAL PROJECT MANAGEMENT PRACTICES IN THE GHANAIAN CONSTRUCTION INDUSTRY

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## Abstract

Evidence of Professional Project Management Practices in the Ghanaian Construction Industry (GCI) dates back to the 1980s. However, to date not much has been achieved in its advancement and deployment especially in an era where project management is considered as an important management philosophy in achieving project success. This paper reports on a study to determine the constraints that exist in the advancement of project management practices in the GCI. The paper adopted a two-stage data-gathering approach involving qualitative and quantitative techniques. The qualitative approach helped in identifying eighteen (18) Project Management (PM) variables that stakeholders believe are posing challenges to effective PM practices in Ghana. Out of the eighteen variables, nine supported existing literature while the remaining nine appear to be peculiar to the Ghanaian context. Subsequently, questionnaire containing the eighteen (18) variables were administered to 183 professionals who are involved in PM practices and then subjected to factor analysis. The paper highlights five (5) major underlying constraints namely: weak project management knowledge base, lack of clearly defined role for project managers, poor understanding of procurement practices, weak institutional framework and poor communication practices. The paper therefore recommends that, it is important for these underlying factors to be addressed conscientiously as they provide firm basis for advancing professional project management practices in the GCI.

**Keywords:** Constraints, Development, Ghanaian Construction Industry (GCI), Professional Project Management Practices (PPMP)

## 1. INTRODUCTION

Various definitions exist for project management in the literature; however, the general consensus is that it seeks to ultimately achieve successful delivery of projects on behalf of the client.

For instance, Walker (2002) defines project management in the construction context to mean the art and science of planning, coordination and control of project with the main aim of satisfying client objectives. The Chartered Institution of Builders (CIOB, 2012) also describes project management as a professional discipline that separates the function of management from design of a project from inception to completion and especially aimed at meeting client requirements. The various The various Project Management Body of Knowledge books, while acknowledging that project management involves the planning, controlling and coordination of resources to meet project objectives also recognise the significant focus on the client (c.f Omidvar et al., 2011). Within this context Goodwin (1993) has long suggested that project integration is fundamental to the concept of project management. Subsequently Goodwin (1993) advocated that the basic function of project management is for the authority and responsibility of the management of a project to be vested in a single individual and/or entity. It is within this context of having a single individual take charge of the authority and responsibility of the success of a project that the concept of professional project management is argued. Indeed, the fact that project management is a distinct managerial process and require professional expertise is now recognised in both academic and industry (Winch, 1997; White and Fortune, 2002). Furthermore, it has become one of the most demanding professional domains and plays a primary role in project success (c.f Albass and AL-Mharmah, 2000; Cheng et al., 2005).

Notwithstanding this, professional project management practices in the construction industry remains inert in many developing countries such as Ghana, especially regarding the full integration, deployment and advancement of its knowledge base in the industry (Ahadzie et al., 2012). Moreover, stakeholders lack full understanding of the prospective project management environment including the potential challenges and how this should be adequately addressed. For instance, professional project management is noted to have been first used in Ghana in the late 1980s. Subsequently, there has been recognition of the title project manager in Ghana's Procurement Act (i.e. Act 663 of 2003). Nonetheless, project management practice in the GCI is very rudimentary and has remained inert since the 1980s when it was first used. Given that project management has become vital discipline in the world over, it is important for the factors mitigating the advancement of PM practice to be fully understood in the context of developing countries such as Ghana. Thus, the paper gives a report of a study which was aimed at identifying the constraints affecting PPMP the in GCI in order for effective strategies to be promulgated for improvement

The paper starts by providing a brief background of the genesis of professional project management practices in GCI. This is then followed by research methodology adopted involving a two-stage data gathering approach. The penultimate section of the paper focuses on discussing the findings while the final sectional provide a summary of the issues presented in the paper.

## 2. PROJECT MANAGEMENT PRACTICES IN GHANA

In Ghana, evidence suggest that project management practices in the construction industry emerged around the late 1980s when it was first used in Mass Housing Building Production (MHBPs) by a quasi-government organization, Social Security and National Insurance Trust (SSNIT) across the country (Ahadzie and Amoah-Mensah, 2010). According to Ahadzie and Amoah-Mensah (2010), this saw the successful completion of 1637 single-storey housing in the Sakumono area in the Greater Accra Region of Ghana within five years of construction. It is noted that the successful completion of the 1637 housing units with time and cost targets had been one of the remarkable project success history in the annals of the Ghanaian house building (Amoa-Mensah, 1999; 2002). However, following this, very little has been achieved in terms of riding on the success achieved on MHBPs to fully integrating the practice within the overall GCI. That is, while the mass housing environment is noted to have seen some entrenchment in the use of project management practices (perhaps because of it speculative and in-house nature of organizing the project team from inception to completion) the situation is not exactly the same in main stream construction practice. Indeed, it was not until quite recently in the year 2003 that project management practice was to receive some boost by the specific mentioning and recognition of the title project manager in Ghana's Procurement Act 663 (c.f. The manual to the Act). Quite recently also, the private sector through alliance with development partners has also established the Ghana Chapter of Project Management Institute (PMI) with the aim of providing leading edge in the practices of PM. Admittedly, the Ghanaian construction industry presents a suitable environment for reviewing the development of professional practices as nearly its activities are based (drawing from Edum-Fotwe & McCaffer, 2000).

However, despite the potential of the GCI in using its project based activities in advancing PPMP, the industry is also plagued by a lot of challenges arising from myriad of project management issues which leave stakeholders including the government often disappointed. Hence, the recent call from the government for the improvement of knowledge base in project management has reinforced the need to identify these constraints as stated in the research objectives (Ministry of Finance and Economic Planning Report, 2006; Amponsah, 2010). Thus, the need to determine the constraints to the development of professional project management arises out of national concerns towards seeking for improvement in the GCI.

## 3. RESEARCH METHODOLOGY

The paper adopts a two stage data-gathering approach. At the first stage, exploratory method was used to identify the relevant factors constraining the development of professional project management practice in the Ghanaian construction industry. This involved the use of a purposive sampling of twenty-(20) major stakeholders (see table 1). The sample was chosen based on their rich experience from being involved in management of large scale projects in the GCI for over four decades.

The stakeholders comprised five major clients, five major consultants with project management experience, five major contractors who have handled some of milestone projects in Ghana and five leading members of professional and association affiliates in the GCI. The professional association are namely, the Ghana Institution of Engineers (GHIE), the Ghana Institution of Architects (GHIA), the Ghana Institution of Surveyors (GHIS), the Project Management Institute (PMI), Ghana Chapter and the Association of Building and Civil Engineers of Ghana (ABCEG) (table 1). The client organizations comprised three major public institutions and two major private institutions, however for ethical reasons pseudo-names (CC 2 & CC3) have been used for the private companies (see table 1). Similarly the consultants comprised two major public institutions and three private, however pseudo names (CT2 CT3 & CT 4) have been used for the private institution. The contractors are all private and among the 10 top contractors operating in Ghana (labelled as CONT1 CONT2 CONT3 CONT4 & CONT5). Data were collected by the use of semi- structured interview and then transcribed and coded using Nvivo 8 Software. Nvivo offers a useful toolkit for thinking, reflecting and linking elements of qualitative data to develop memos and also annotate the contents of responses for factors to emerge (Kikooma, 2010; Walter, 2011). Here the Nvivo helped in identifying eighteen (18) key constraints. It was observed that nine of these constraints are consistent with general project management literature (see table 2), whilst the remaining nine are inconsistent, suggesting that they might be peculiar to conditions pertaining to project management practices in the construction industry of developing countries such as Ghana.

**Table 1: Sample for Qualitative Study**

| **Clients** | **Consultants** | **Contractors** | **Institutions** |
|---|---|---|---|
| Social Security and Insurance Trust (SSNIT) | Building and Road Research Institute | **CNT 1** | Ghana Institution of Surveyor (GhIS) |
| **CC2** | **CT 2** | **CNT 2** | Ghana Institution of Engineers (GhIE) |
| Ministry of Water, Work and Housing | **CT 3** | **CONT 3** | Ghana Institution of Architect (GIA) |
| **CC3** | **CT 4** | **CNT 4** | Project Management Institute, Ghana Chapter (PMI) |
| Ghana Education Trust Fund | Architectural Engineering and Services Limited | **CNT 5** | Association of Building and Civil Engineers Ghana.(ABCEG) |

**Table 2: Variables Posing Challenges to PM Practices in Ghana**

| Consistent with Literature | Inconsistent With Literature and Unique to Ghanaian Practice |
|---|---|
| Inadequate knowledge of construction project management practices by government agencies /public service (Rwelamila, 2004; Gow and Morss, 1988; Kartam *et al.*, 2000). | Lack of ethics and code of practice for construction project management professionals. |
| Construction professional's inability to acquire basic knowledge in project management (Du, 2001). | Inadequate legislative framework and enabling environment for project management practices. |
| Misunderstanding among construction professionals on project management concepts (Liu 2004). | The unwillingness of construction professionals to accept the role of project managers. |
| Poor definition of construction project scope (Chung-Suk and Gibson, 2001). | Non-availability of project management training facilities for construction professionals. |
| Lukewarm attitude towards change by construction professionals (Loo,2002) | Poor understanding of procurement practices. |
| Communication barriers among project participants (Albbasi And Al-Mharmah, 2000). | Wrong choice of procurement approach |
| Lack of client understanding of what they want from construction professionals (Irem, 2005). | Insufficient technical details and specification as provided by other professionals. |
| Increasing complexity of projects and the scarcity of human capital (Crawford *et al.*, 2006). | Limited authority for project managers in contractual documentation. |
| Difficulty in accessing information on project management theory in practices (Koskela and Howell, 2002; Shenhar 1998; Turner, 1999). | Ignorance of the benefits of project management practices over other traditional management principles. |

The second stage involved the use of constructs generated at the exploratory survey stage in designing questionnaire, using a five-point rating scale. The essence was to help subject the eighteen variables to factor analysis towards understanding their underlying nature. The respondents were asked to rate the level of severity of each identified constraint on the development of professional project management practices in Ghana. The five-point rating scale for the levels of severity range from 1= Least, 2 = Lower, 3 = High, 4 = Higher, 5 = Highest. In all 183 questionnaires were distributed to professionals who have had some experience in construction project management practices in Ghana. Out of these, 143 were retrieved representing response rate of 78%. This high response rate was achieved through personal distribution of the questionnaires and several follow ups visits made for retrieval.

Data generated from the survey was further analysed by the use of principal component analysis, which was aimed at finding groups of related variables and thus ideal for reducing a large number of variables into a more easily understood framework (Field, 2005a)

### *3.1 The Factor Analysis*

The fundamental concept underlying factor analysis is the ability to statistically manipulate the empirical relationship among several variables to help reveal conjectural constructs of the relationships (Kreuger and Neumann, 2003). More so, to check for reliability that samples are adequate for factor analysis, Kaiser-Meyer-Olkin measure of sampling adequacy (KMO-test) was conducted. Field, (2005a) indicates that the sample is adequate if the value of KMO is greater than 0.5. As presented in Table 3, the KMO measure of this study achieved a high value of 0.852 indicating the adequacy of the sample size for the factor analysis. The Bartlett's test of sphericity was also significant suggesting that the population was not an identity matrix; therefore, there exist some relationships between the variables. Bartlett's Test for this study was highly significant ($p<0.001$), and therefore suggesting that factor analysis is appropriate.

**Table 3: KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .852 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 7.300E3 |
| | Df | 153 |
| | Sig. | .000 |

After the KMO sampling adequacy and Bartlett's test of sphericity, data was then subjected to principal component analysis (with varimax rotation). Subsequent to principal component analysis, the communalities involved were first established. Communality describes the total amount an original variable shares with all other variables included in the analysis and is very useful in deciding which variables to finally extract (see table 4).

**Table 4: Communalities**

| Constraints to the Development of PPMP | Initial | Extraction |
|---|---|---|
| Lack of ethics and code of practice for construction project management professionals | 1.000 | .966 |
| Inadequate legislative framework and enabling environment for project management | 1.000 | .998 |
| Inadequate knowledge of construction project management practices by government agencies/public service | 1.000 | .996 |
| The unwillingness of construction some categories professionals to accept the role of project managers | 1.000 | .994 |
| Construction professionals inability to acquire basic knowledge in project management | 1.000 | .939 |

| | | |
|---|---|---|
| Misunderstanding among construction professionals on project management concepts | 1.000 | .991 |
| Non-availability of project management training facilities for construction professionals | 1.000 | .978 |
| Poor understanding of procurement practices | 1.000 | .997 |
| Wrong choice of procurement approach | 1.000 | .991 |
| Insufficient technical details and specification in contract documentation | 1.000 | .980 |
| Difficulty in assessing information on project management theory in practices | 1.000 | .977 |
| Poor definition of construction project scope | 1.000 | .990 |
| Lack of client understanding of what they want from construction professionals | 1.000 | .993 |
| Communication barriers among project participants | 1.000 | .993 |
| Ignorance of benefits of project management practices over other traditional management principles | 1.000 | .991 |
| Lukewarm attitude towards change by construction professionals | 1.000 | .984 |
| Increasing complexity of projects and the scarcity of human capital | 1.000 | .992 |
| Limited authority for project managers in contractual documentation | 1.000 | .996 |

**Extraction Method: Principal Component Analysis**

From the results in Table 4, the average communality of the variables after extraction was above 0.80.The conventional rule about communality values is that; extraction values (eigenvalues) of more than 0.50 at the initial iteration indicates that the variable is significant; and should be included in the data for further analysis or otherwise removed (Field, 2005a, b). In applying the latent root criterion, five (5) components were extracted, as their respective eigenvalues were greater than one (see table 5) and also from the scree plot in Figure 1 five (5) components with eigenvalues greater than 1.0 were extracted using the factor loading of 0.50 as the cut-off point. In addition, the five components extracted cumulatively explained 98.582% of the variation in the data set, which agrees with the cumulative proportion of variance criterion, which says that the extracted components should together explain at least 50% of the variation in the data set.

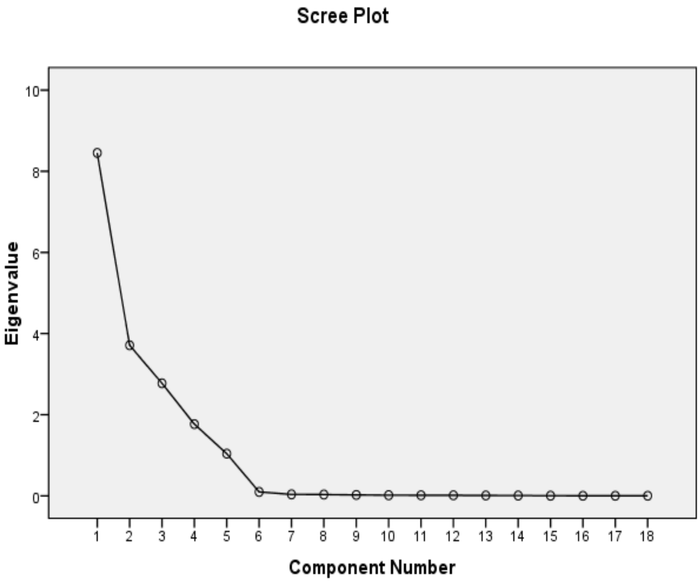


**Figure 1 Scree Plot**

**Table 5: Rotated Component Matrix[a]**

| Constraints to the Development of PPMP | Component | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Lack of ethics and code of practice for construction project management professionals | | | | **.858** | |
| Inadequate legislative framework and enabling environment for project management | | | | **.881** | |
| Inadequate knowledge of construction project management practices by government agencies/public service | **.978** | | | | |
| The unwillingness of construction some categories professionals to accept the role of project managers | | **.952** | | | |
| Construction professionals inability to acquire basic knowledge in project management | **.946** | | | | |
| Misunderstanding among construction professionals on project management concepts | | **.948** | | | |
| Non-availability of project management training facilities for construction professionals | | | | **.880** | |
| Poor understanding of procurement practices | | | **.979** | | |
| Wrong choice of procurement approach | | | **.974** | | |
| Insufficient technical details and specification in contract documentation | | **.943** | | | |
| Difficulty in assessing information on project management theory in practices | **.967** | | | | |
| Poor definition of construction project scope | | **.950** | | | |

| | | | | | |
|---|---|---|---|---|---|
| Lack of client understanding of what they want from construction professionals | | | | | **.962** |
| Communication barriers among project participants | | | | | **.969** |
| Ignorance of benefits of project management practices over other traditional management principles | **.977** | | | | |
| Lukewarm attitude towards change by construction professionals | **.971** | | | | |
| Increasing complexity of projects and the scarcity of human capital | **.975** | | | | |
| Limited authority for project managers in contractual documentation | | | **.980** | | |

**Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 6 iterations**.

According to Norusis (1988) and Dogbegah et al., (2011) the ability to interpret the results of principal component analysis can be improved through rotation. Hence, rotation was to achieve a simple structure from the large loadings factors in absolute value for some of the variables, making it easier to identify and interpret them. More so, it is desirable that each variable has large loadings for only a few factors, preferably one, helping to differentiate the factors from each other. If several factors have high loadings on the same variables, it is difficult to determine how factors differ. As noted by Chris (2004), results after factor rotation indicate the amount of variance between the variables that each factor accounts for and provides loadings of all the variables on each factor (Ibid). As demonstrated in table 6 all the five (5) components have more than one variable loading on it, resulting in keeping all the five components which form 98.582% of the total variable of eighteen (18). The total variance explained by each component extracted is as follows: The first principal component accounted for 46.96% of the total variance whilst the second component, explained 20.62%. Component 3 accounted for 15.42%, component 4 accounted for 9.824%, and component 5 accounted for 5.772% of the variance.

**Table 6: Total Variance Explained**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 8.453 | 46.959 | 46.959 | 8.453 | 46.959 | 46.959 | 5.896 | 32.753 | 32.753 |
| 2 | 3.711 | 20.619 | 67.578 | 3.711 | 20.619 | 67.578 | 4.101 | 22.784 | 55.538 |
| 3 | 2.774 | 15.408 | 82.987 | 2.774 | 15.408 | 82.987 | 3.048 | 16.934 | 72.472 |
| 4 | 1.768 | 9.824 | 92.810 | 1.768 | 9.824 | 92.810 | 2.695 | 14.975 | 87.446 |
| 5 | 1.039 | 5.772 | 98.582 | 1.039 | 5.772 | 98.582 | 2.004 | 11.136 | 98.582 |
| 6 | .096 | .533 | 99.115 | | | | | | |
| 7 | .036 | .201 | 99.316 | | | | | | |
| 8 | .032 | .180 | 99.496 | | | | | | |
| 9 | .023 | .126 | 99.622 | | | | | | |
| 10 | .016 | .087 | 99.710 | | | | | | |
| 11 | .014 | .078 | 99.788 | | | | | | |
| 12 | .013 | .073 | 99.861 | | | | | | |
| 13 | .008 | .047 | 99.908 | | | | | | |
| 14 | .007 | .038 | 99.946 | | | | | | |
| 15 | .003 | .016 | 99.961 | | | | | | |
| 16 | .003 | .015 | 99.976 | | | | | | |
| 17 | .002 | .013 | 99.990 | | | | | | |
| 18 | .002 | .010 | 100.000 | | | | | | |

**Extraction Method: Principal Component Analysis**

## 4. FINDINGS AND DISCUSSION

On the basis of the exploratory factor analysis, the names of various components were derived based on the factors with the highest loadings and the understanding of the relevance of these factors in the Ghanaian construction industry. Similarly, Chen and Choy (2007) argued that critical examination of inherent relationships among various factors should be consider in naming the components. On this basis, component 1 was labelled weak project management knowledge base; component 2 was labelled lack of clearly defined role for project managers; component 3 was labelled poor procurement management practices; component 4 was labelled weak institutional framework and component 5 was labelled poor communication management. The following section now discusses each component individually.

### *4.1 Component 1: Weak Project Management Knowledge Base*

Component 1 comprises six (6) variables, which accounted for 46.959% of the total variance. These are : inadequate knowledge of construction project management practices by government agencies/public service (0.978) construction professionals' inability to acquire basic knowledge in project management (0.946) difficulty in assessing information on project management theory in practice (0.967) ignorance of benefits of project management practices over other traditional management principles (0.977) lukewarm attitude towards change by construction professionals (0.971) increasing complexity of projects and the scarcity of human capital (0.975) (see Table 6). The figures in the bracket indicate the loading of each variable impact on the component. This component was named as weak project management knowledge base. Dib (2007) has noted that the construction industry generally suffers from what is described as the "islands of knowledge syndrome" due to the lack of connectivity between its various participants and functions. Albbasi and Al-Mharmah (2000) and Kartam et al., (2000) opined that lack of project management knowledge are common in most developing countries. It is also interesting to note that, this component is associated with human resources management issues. Indeed, Dogbegah et al., (2011) and Isik et al., (2009) postulate, that human resources management is an inevitable dimension of project management since it is people who deliver projects. This aligns with Langford et al., (1995), who postulate that the survival of the industry depends to large extend, on its ability to develop this basic resource that is human resources. Thus if the GCI is to reap the full benefit of PM in today's competitive environment the stakeholders must critically or strongly pursue a strong knowledge base in PM practices.

### *4.2 Component 2: Lack of Clearly Defined Role for Project Managers*

Component 2 consists of unwillingness of some categories of construction professionals to accept the role of project managers (0.952) misunderstanding among construction professionals on project management concepts (0.948) insufficient technical details and specification in contract documentation (0.943) and poor definition of construction project scope (0.950). This was labelled lack of clearly defined roles for project managers, accounting for 20.619% of the total variance (see Table 6).

It is worth noting that Liu et al., (2004) in assessing the same situation in China rank misunderstanding as second most influential constraint to PM practices in China. Chan et al., (1999) indicates that misunderstanding is normally caused by the influence of traditional construction management systems, which is very much dominant in Ghana as well. As noted earlier, in Ghana, evidence of project management practice dates to the late 1980s when it was first used on Mass Housing Building Production (MHBPs) (Ahadzie and Amoah-Mensah, 2010). However, while the knowledge in project management theory is gaining grounds especially in academia, there is still much to be done especially regarding the full integration of the project management practice in general construction. Notwithstanding that the title project manager has now been given recognition in Ghana's procurement Act the clear responsibility and authority of the project managers is not clearly understood and many projects are still awarded based on traditional procurement practices without recourse to an independent professional project manager (c.f Ahadzie et al., 2012). Moreover, on projects where project managers have been appointed the responsibility and powers of the project manager remain limited within the project lifecycle due to the strong attachment of participants to tradition procurement practices. It is clear that some of the challenges militating against the development of PM practices in GCI borders on cultural and structural weakness, it would be necessary for the GCI seek ways of addressing this (c.f Bredillet et al., 2010; Ahadzie et al., 2013). As noted by Gibson and Hamilton, (1994) for project management to be successful, the start-up phases of a project to the completion stage should be highly defined in terms of the procedures and operation to be undertaken and the GCI need to take a cue by clearly defining the role and scope of the project manager from inception to completion.

### *4.3 Component 3: Poor Understanding of Procurement Practices*

Three variables loaded onto the third component accounting for 15.408% of the remaining variance. The three variables are poor understanding of procurement practices, (0.979) wrong choice of procurement approach (0.974) and limited authority for project managers in contractual documentation (0.980). Examination of the three variables that correlated very well indicates that the underlying factor for the component could be named as poor understanding of procurement practices. The Procurement Act (Act 663 of 2003) is legal framework for procuring goods and services including construction projects in Ghana. The framework for the contract document is based on International Federation of Consulting Engineers (FIDIC) contract documents. Prior to the enactment of the Procurement Act in 2003, the legal framework for awarding and executing contracts called the pink form was based on the Joint Contract Tribunal (JCT), UK. The striking change in Ghana's procurement Act is the recognition given to the title project manager which did not exist in the pink form. Apart from this, the Act lacks any detail regarding the various forms of procurement and how they are to apply in different contract conditions. However, as noted by Masterman (1992; 2012) and many other researchers (c.f Kong & Gray, 2006; Chang & Ive, 2002; Murray & Langford, 1998), the correct choice and application of the right procurement system has a huge impact on the success of a project.

Interestingly construction performance in Ghana has for many years been poor and many reports have decried the public sector's lack of commercial edge in the exercise of its procurement function (Anvuur and Kumaraswamy, 2006). An efficient public procurement practice remains the principal foundation for effective project management practices and it is therefore, important that the Public Procurement Act is reviewed to reflect the choices and application of specific procurement systems depending on project type and the characteristics of the client. This will demand that the project managers' role is further clarified regarding the specific responsibilities for choosing and applying the various procurement systems (c.f Masterman, 1992; 2012)

### *4.4 Component 4: Weak Institutional Framework*

The fourth component consist of lack of ethics and code of practice for construction project management professionals (0.858) inadequate legislative framework, and enabling environment for project management (0.881) and non-availability of project management training facilities for professionals (0.880) and accounted for 9.824% of the variance (see Table 6). Subsequently, critically examining the latent characteristics of the variables, the component was labelled weak institutional framework. From the literature, it is noted that the majority of project managers in the construction industry in many developing countries (PMs) learn their trade experientially on the job and this is due to fact that, there is no single professional body to regulate their practice for current and future development (c.f Odusami et al., 2003; Ahadzie and Amoah–Mensah, 2010). Presently, there is also no academic institution in Ghana which offers specific construction project management programme although it must be admitted that some attempts are now in place to commence the programme soon. The few project managers who have the requisite professional training often belong to either belong to the PMI (US) or APM (UK). Admittedly, there is also now Project Management Institute (Ghana chapter) but they are far from making any impact yet given that institutional landscape is not robust to support their activities (Ahadzie et al., 2012). The bottom line will be a holistic approach of linking the Procurement Act to creating a strong institutional framework that has the potential of supporting the growth of professional project management practices.

### *4.5 Component 5: Poor Communication Practices*

Component 5 accounted for 5.772% of the variance. The respective loading factors are lack of client understanding of what they want from professionals (0.962) and communication barriers among project participants (0.969). Subsequently, this component was labelled poor communication practices. Considering the complex nature of project management practice, project managers are supposed to communicate the project goals and vision to the team members and ensure that they understand their role and responsibility. For instance, Chan and Kumarsawamy, (1999) indicated, that effective communication structure within contracting organisation with clients, consultants and sub-contractors need to be developed, in order to enhance project management practise thereby improving project performance.

The BRE, (2011) also emphasizes that the most weaknesses in the construction industry is as a result of poor communication. In Ghana and many developing countries poor communication practices among project construction participants has since long been noted as one of the bane to project performance in the industry (c.f World Bank, 1996; 2003, Westering, 1997; Anvuur and Kumaraswamy, 2006; Fugar and Agyakwah-Baah, 2010). Drawing from the findings of this study, it is therefore important that communication mediums are clearly defined and here the root among others can be traced to improving communication channels in the Ghana's Procurement Act.

## 5. CONCLUSION AND RECOMMENDATIONS

PM as a professional practice continues to expand and develop in many developing countries such as Ghana; however, the pace of its development is constrained by local inhibiting factors. This paper reports of a study that sought to identify these constraints in the Ghanaian context and propose recommendations for further development of professional project management practices. The study employed a two stage data collection techniques involving both qualitative and quantitative approaches. Data collected was analysed using Nvivo 8 and principal component analysis.

To this extent, the paper has identified five major constraints to the development of professional project management practices in the GCI. These are weak project management knowledge base, lack of clearly defined role for project managers, poor understanding of procurement practices, weak institutional framework and poor communication practices. The findings reflect the inherent cultural and structural weakness of the construction industry in many developing countries (c.f Bredillet et al., 2010). In the light of the findings it is recommended that, given that PM practice has become that management philosophy for achieving project success in modern construction practice, In the case of Ghana, it is noted that the root cause of many of the challenges would be addressed if a critical look is taken at improving and strengthening the legal and communication channels regarding the role and responsibilities of the project manager. Specifically it is advocated that the project managers' role should be clearly defined within the project cycle and going forward there would be the need for a strong institutional and or professional affiliation to certify and give recognition to PM practice in the industry. Many successful construction economies have since long embraced the project management concept and indication are that it has led to improvement in project performance in these countries. The GCI has in the past been bedevilled with so many management problems and it is high time that structural reforms are introduced to incorporate the positive side of professional project management practices. While the study focuses on Ghana, the findings are similar to what pertains in many developing countries. There are therefore useful lessons that can be carried across in terms of the recommendations.

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# IS BUILD-OPERATE-TRANSFER (BOT) SYSTEM AN EFFECTIVE INITIATIVE COMPARED WITH TRADITIONAL PROCUREMENT METHOD IN STUDENT HOUSING PROVISION IN AN EMERGING ECONOMY?

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## ABSTRACT

BOT is a scheme or private finance initiative (PFI) or alternative procurement method in which a government contractually grants to a private sector entity a concession requiring the entity to obtain financing for design, build and operate a public facility or infrastructure for a fixed period of time, during which the private entity can recover its costs of construction, plus profit, by charging fees or tools for its use and at the end of the concession period, transfer ownership and operation of the facility back to the government. This paper examines stakeholders' perception in Nigeria on the effectiveness of BOT as a private finance initiative (PFI) for student housing provision and compares it with traditional procurement method (TPM). It also determines the association between the respondents' years of experience in BOT procurement and the outcome of assessment based on the identified factor frameworks. To achieve these objectives, questionnaires were administered on a sample of the core professionals and experts who are staff in Physical Planning and Development Units (PPDU), Housing unit, Works and Maintenance sections of the selected tertiary institutions in Nigeria. Data were analyzed using descriptive statistics, Chi-square and t-test. The result indicates higher level of effectiveness in favour of BOT than TPM. It also found that, except for cost/funding, there is a significant relationship between the respondents' years of experience and other factors. It also found that there is significant difference in the respondents' assessment of BOT and TPM.

**Keywords**: BOT, PFI, Student Housing, TPM, Tertiary Institutions.

## 1. INTRODUCTION

Recent surveys suggest that the usual delays experienced in the procurement of infrastructure and abandonment cases which arise as a result of insufficient fund necessitate the need for the adoption of PFIs towards financing housing infrastructure in Nigerian tertiary institutions of learning. Yet, the adoption of the initiative is argued to be influenced by a variant of factors which introduce elements of doubt on its relative effectiveness, compared with traditional procurement method (TPM) (Zhang, 2001; Cheung et al., 2010 and Li. et al., 2003).

Sustaining and improving on the existing infrastructure in Nigerian tertiary institutions of learning are germane to the government of the nation. As part of the effort to augment the frantic effort of government, campaign for economic deregulation, privatization and commercialization have been embraced in other to encourage private participation in both educational and economic sectors. Inadequate infrastructure is one of the challenges confronting Nigerian tertiary institutions of learning which emanates from inadequate funding. The menace of infrastructure decay stemmed from the inability to sustain and upgrade the existing facilities such as student – hostels, lecture halls, road networks, sport facilities, staff housing, administrative blocks and offices, laboratories and others. The importance of infrastructure in Nigerian tertiary institutions today cannot be over-emphasized as efficient infrastructure facilities act as catalysts for educational and research activities. The effects of the inadequate maintenance and renewal of equipment and facilities are visible in all subsectors, education inclusive. Against this backdrop, the need to embrace PFI becomes necessary and BOT initiative therefore is currently adopted in selected tertiary institutions in southwestern Nigeria.

Private Finance Initiative (PFI) is one of several procurement routes that situates under the general heading of Public Private Partnership (PPP). The rationale for PPP is described as the combination of the resources of the public and private sectors in the quest for more efficient service provision (Akintoye et al., 2003). This idea has been used over the past 20 -30 years by governments in developed countries to finance infrastructure projects to meet the public demand for service. Wilson et al. (2010) opined that in today turbulent "post – global financial crisis" environment, governments, at any level are confronted with an increasing demand for services but with significantly diminished revenue base.

Empirical studies have identified various routes of PFI in procuring infrastructure, among which is BOT. Some studies are concerned with public ownership and operation through public enterprises or government department, or public ownership with private sector management and operations or private ownership and private operation or community provisioning. The choice of any of the above options depends on economic, institutional and social characteristics which vary among countries. Recent trends according to Ogunlana and Dey's (2004) study in the industry indicates continuous use of alternative procurement methods to compliment traditional procurement approach.

As long as infrastructure is sine qua non to educational and research success, there is need for alternative finance strategies like BOT in the emerging economy. Budgetary constraint in the developing nation like Nigeria, has led government to seek alternative methods of financing infrastructure provision even in educational sector. However, the adoption of the initiative is argued to be influenced by a variant of factors which introduce elements of doubt on its relative effectiveness compared with traditional procurement method (TPM). Against the foregoing, the following research questions emanate:

- What is the status of respondents' experience on project procurement?
- What is the perception of stakeholders on the effectiveness of BOT mechanism when compared with TPM within the pace of time it operates in the selected tertiary institutions in southwestern Nigeria?
- Do the years of experience in PPP/BOT have influence on the respondent's assessment status of BOT and TPM?
- Is there any significant difference between the respondents' assessment status of BOT and TPM?

Hence, this study therefore examines the stakeholders' perception on the level of effectiveness of BOT as a private finance initiative/ alternative procurement method, compared with TPM. It also determines the influence of respondents' years of experience in PPP/BOT procurement and the outcome of assessment based on the identified factor frameworks. It further compares the respondents' assessment status of BOT and TPM system in housing infrastructure. The last two objectives generate two null hypotheses:

- **Ho:** Respondents' years of experience in PPP/BOT procurement methods have no significant influence on their assessment.
- **Ho:** There is no significant difference in the respondents' assessment of BOT and TPM systems based on each of the factor frameworks.

## 2. LITERATURE REVIEW

### *2.1 BOT Project Procurement*

The concept of BOT is examined by Morris (1994) as a scheme more applicable to projects which are primarily infrastructure projects. It is a system in which private promoters instead of public sectors finance, build and operate a facility for a fixed period. The private promoters obtain their profit not from being paid for the work, but from the revenue stream obtained by charging the public a 'toll' for using the facility. The author identified two important reasons for BOT; a growing trend towards replacing public sector financing with private sector, and encouragement of the principal participants to concentrate on its overall business success.

In the study conducted by Shalakany (1996) which was supported by Askar and Gab-Allah (2002) revealed major reasons for private sectors' participation through BOT among which are; the need of the government to get the project, unwillingness of the government to finance infrastructure project, willingness of the government to share risk in such projects, availability of offering finance from lending institutions and investors.

The model and arrangement in BOT is well described in literature: Kumaraswamy et al., (2002); Concession company providing the finance, design, construction, operation and maintenance of all privatized infrastructure projects for a fixed period. Zhang (2001); a structure that uses private investment to undertake infrastructural development for public sector. Shalakany (1996); a concession by the government to provide a promoter known as concessionaire who is responsible for the financing, construction, operation and maintenance of a facility over the concession period. Navarro (2005); a contractual arrangement and a new legal concept to encourage private enterprises and entrepreneurs to help the government in its development effort. Tiong (1990), Haley (1992); phases of development such as pre-investment, pre-construction, construction, operation and transfer which involve consultants, project sponsors, contractors and equity holders.

BOT has also been viewed to incorporate some downsides. Kumaraswamy et al., (2002) researched that BOT is neither well possible nor advisable in all civil engineering mega-projects, yet provides an excellent vehicle to reverse the over fragmentation of functions that has led to development agendas of the multiple participants. In the opinion of Tiong (1990), conflicts of interest might work against the success of the scheme especially when it comes to the issues of environmental impacts or the availability to disadvantaged segments of the community of low or no-cost access to such facilities or infrastructure. Askar and Gab – Allah (2002) opined that risks manifest in various stage of BOT arrangement; off-take arrangement which entails the uncertainty of total product distribution, supply arrangement, environmental law, technical problems, domestic political events and high development cost. In the study conducted by Wang et al.(2000), Ogunlana and Dey (2004), Kumaraswamy et al. (2002), various risk associated with BOT system are identified: such as political risk, construction risk, operation risk, financial risk, market and revenue risk. This study hence compares the initiative-BOT to traditional procurement method (TPM) using some variables identified in literature.

### *2.2 Traditional Procurement Methods (TPM)*

Traditional infrastructure procurement represents the acquisition by government of infrastructure such as roads and buildings (i.e. hospital buildings, school buildings) (Burger and Hawkesworth (2011). It is called traditional because it has been in existence for a long time and has been the only choice available for most years. Onwusunye (2002) describes traditional method as a multiplex contractor) usually outsourced using competition bidding, agreed price.

According to Ojo and Gbadebo (2012), this procurement method usually involves relationship between a public or private organization. The sole responsibility for financing of the project lies on the client's organization. However, independent multi-discipline consultants on behalf of the client organization undertake the management of the project to completion. Burger and Hawkesworth (2011) posit that in traditional procurement system, the governments specifies the quantity and quality of the service, while the infrastructure is constructed by private companies to whom the construction is typically awarded through tender. At the completion, the asset is delivered to and operated by the government. OECD (2008) opined that in a traditionally procured project, the transfer of risk to the private parties involved is very limited and usually does not extend beyond the construction phase of the project.

JCT (2008) posits that TPM is characterized by the separation of services-design and full documentation required before the award and construction commences by the contractor. The method at this juncture has been criticized because of burden of bureaucracies and poor contract management. Mathonsi and Thwala's, (2012) study indicates that TPM entails client entering into an agreement with the design consultant to actually carry out the design work and prepare contract documents.

TPM incorporates tender invitation either selective tendering which requires client submitting the lists of contracts adjudged qualified based on technical competence and profiles or open tendering which entails an interested contractor to submit a tender for the work placed on public advertisement or tendering through negotiation whereby a single contractor is invited for a special or specific project (Pilcher, 1992). Ojo and Gbadebo (2012) confirmed that TPM has been a standard practice in the building industry for long years, and it is still widely used for range of situations and condition, despite the advent of new initiatives of PPP in the emerging economies.

### *2.3 Comparing BOT and TPM*

Comptroller and Auditor General (2003) indicated that under the private finance initiative (PFI) the performance of projects in terms of completion of work within time and budget is a considerable improvement when compared to projects procured in a traditional manner. TPM is known to be the usual approach asides the idea of PPP. BOT has emerged to serve as an infrastructural arrangement scheme. Algarni et al. (2007) reported that the Build –Operate – Transfer (BOT) delivery system has gained world- wide popularity as a mechanism to limit spending on government budgets and facilitate private financing of desirable public facility projects. The adoption of BOT initiative is argued to be influenced by a variant of factors which introduced elements of doubt on its relative effectiveness compared with traditional procurement method (TPM).

These factors include; duration /timing of project, cost/budget factors, accountability factors, economic factors, environmental factors, political factors, client factors and nature of projects factors. It is also important to state that these factors are rooted in the studies conducted by Zhang (2005) on financial risk factors, Li (2003); Time, project innovation, economic development, completion, technology etc, Cheung et al.(2010); duration, cost, budget, risk, economic, environment etc, Mathonsi and Thwala (2012); project risk, political consideration, client level of knowledge, economic factor, due diligence, project, competition and technology, Ojo and Gbadebo (2006);Project management, technicality, risk management and policy. The assessment is therefore based on the adapted identified factors in Table I.

**Table I: Summary of the Factors Framework that gauge the Performance and Selection Criteria of BOT and TPM as identified from Literature.**

| Authors | Summarized Factors | Procurement Subject Issues | Adapted and Validated Factors/Criteria(Appendix A) |
|---|---|---|---|
| Li (2003), Cheung e tal.(2010) | Duration/timing,competition, cost/financing, budget, risk distribution, project innovation,Economic development, technology etc. | PPPs large project in Hong Kong, Australia and UK | -Construction duration, cost/funding,<br>-Clients' satisfaction,<br>-Risk distribution,<br>-Nature of project,<br>-Political influence and policy<br>-Accountability.due process<br>-Economic and environmental compliance |
| Mathonsi and Thwala (2012); Ojo and Gbadebo (2012); Maison e t al.(2006) | Duration, cost/budget, political consideration, economic condition, emerging technology, government policy, nature of projects, level of knowledge, risk. etc. | Criteria for procurement strategy for project delivery in Nigeria. | |
| De Marco e tal.(2012), Graham (2011) | Time taken to award contract, deliver the asset, transaction costs, cost certainty, whole of life maintenance, budget certainty, project due diligence, environmental approvals, performance | Assessment of PPP and Traditional Procurement Methods | |

| | | | |
|---|---|---|---|
| | requirement, regulatory quality, country index, currency exchange rate and partnership | | |

**Source: Authors' Literature Search**

## 3. METHODOLOGY

### *3.1 Questionnaire Design Technique, Data Validation and Reliability Test*

To achieve the objectives of this study, factors that measure the performance and selection criteria of procurement systems identified from literature were adapted as indicated in Table I. The variables were developed on 4-point Likert scale-(Very effective to not effective) under each framework to generate a procurement checklist. The instrument-Procurement Checklist (Appendix A) were administered on seventy five respondents, sampled at the initial pilot survey, twenty five questionnaires for each of the three surveyed institutions. The sample technique was chosen because the time taken for conducting the survey is lessened and the response rate is reasonably high.

The internal consistency test of all the 28 factors indicated in the procurement checklist-Appendix A provides a cronbach alpha of 0.886.The individual factor of the instrument indicates the following results:

**Table II: Validity and Reliability Test**

| **Factors** | **No of sub-factors** | **Cronbach's Alpha(Reliability Test)** |
|---|---|---|
| Duration/Timing | 3 | 0.660 |
| Cost/Financing | 4 | 0.790 |
| Nature of Project | 5 | 0.801 |
| Accountability/Due Process | 3 | 0.644 |
| Economic/Environmental Compliance | 5 | 0.781 |
| Political Influence/Policy | 3 | 0.718 |
| Client Satisfaction | 4 | 0.763 |

**Source: Authors' Statistical Analysis Result (2013)**

The foregoing results provide a sufficient and strong reliability test on the data collected through project procurement checklist.

### *3.2 Data Description and Empirical Analysis*

Out of seventy five questionnaires administered, 59 completed sets were received useful, given a response rate of 79%. Table III presents the descriptive analysis of the respondents' demographics.

**Table III: Demographic Characteristics of the Respondents**

| Variables | Status | Frequency (f) | Percentage (%) |
|---|---|---|---|
| **Sex** | Male | 56 | 94.9 |
| | Female | 1 | 1.7 |
| | No Response | 2 | 3.4 |
| | Total | 59 | 100.0 |
| **Age** | 20-30 years | 12 | 20.3 |
| | 31-40 years | 18 | 30.5 |
| | 41-50 years | 25 | 42.4 |
| | Above 50 years | 2 | 3.4 |
| | No Response | 2 | 3.4 |
| | Total | 59 | 100.0 |
| **Academic Qualification** | Diploma/Certificate | 7 | 11.9 |
| | HND/Bachelor of science | 42 | 71.2 |
| | Master | 5 | 8.5 |
| | Ph.D. | 2 | 3.4 |
| | No Response | 3 | 5.1 |
| | Total | 59 | 100.0 |
| **Years of Experience** | 1-10 years | 4 | 6.8 |
| | 11-20 years | 39 | 66.1 |
| | 21-30 years | 10 | 16.9 |
| | Over 30 years | 3 | 5.1 |
| | No Response | 3 | 5.1 |
| | Total | 59 | 100.0 |

**Source: Authors' Field Survey (2013)**

### *3.3 Gender and Age*

Table III indicates that 56 (94.9%) of the respondents are male and 1 (1.7%) is female. Out of them 25 (42.4%) are within the age of 41-45, 18 (30.5%) are within the age bracket of 31-35 and 12 (20.3%) are within the age of 20-30 years old. These imply that the data collected are from mature respondents who are well disposed to provide reliable information in respect of the empirical study.

### *3.4 Academic Qualification and Professional Status*

Table III also indicates that 42 (71.2%) possess either HND or B.Sc, 5 (8.5%) possess masters degree, 7 (11.9%) possess Diploma/certificate and 2 (3.4%) possess PhD .The foregoing information imply that response on this study emanate from reliable source who are well disposed in age with requisite academic qualifications.

### *3.5 Years of Experience*

It is also shown in Table III that the respondents possess substantial years of experience with 39 (66.1%) within 11-20 years of service, 10 (16.9%) within 21-30 years of experience.

To investigate the level of experience in project procurement, Table IV presents the result.

**Table IV: Level of experience in project procurement**

| Experience in project procurement | Frequency (f) | Percent (%) |
|---|---|---|
| Very High | 11 | 18.6 |
| High | 16 | 27.1 |
| Satisfactory | 25 | 42.4 |
| Low | 7 | 11.9 |
| Total | 59 | 100.0 |

**Source: Authors' Field Survey (2013)**

Table IV shows the levels of personal experience of the respondents in project procurement and it can be seen from the table that 11(18.6%) of the respondents had a very high level of experience in project procurement, 16 (27.1%) indicated that they had a high level of experience, 25 (42.4%) described it as satisfactory while 7 (11.9%) had low experience in project procurement. This implies that the respondents possess substantial years of experience in project procurement which qualifies them suitable respondents for the study

To examine the level of effectiveness based on the identified components of factor framework on BOT and TPM in the provision of housing infrastructure in tertiary institutions, responses to each component of factor framework in the instrument (Appendix A) were scored and subjected to descriptive analysis. Their respective mean and standard deviation were therefore obtained. Items 8 to 10 represent "duration/timing factor", items 11 to 14 represent "cost/financing factor", items 15 to 19 represent "the nature of project factor", items 20 to 22 represent "accountability/due process factor" items 23 to 27 represent "economic/environment compliance factor" items 28 to 30 represent "political influence/policy factor" and items 31 to 34 represent "client knowledge /risk distribution factor". This is similar to the studies conducted by Li (2003), Cheung e tal. (2010), Mathonsi and Thwala (2012); Ojo and Gbadebo (2012); Maison e t al. (2006), De Marco e tal. (2012), Schaufelberger and Wipadapisut (2003) and Graham (2011), on traditional and alternative procurement approaches and criteria. The summary of the result is presented in Table V:

**Table V: Effectiveness of BOT and TPM in Student Housing Infrastructure Procurement in Tertiary Institutions.**

| CODE | Procurement Methods | BOT (PPP) | | TPM | | Rank |
|---|---|---|---|---|---|---|
| | **Factors/Scaling** | | | | | |
| | | MEAN | SD | MEAN | SD | |
| C8 | Time taken to negotiate/award contract. | 3.66 | 0.58 | 2.00 | 0.59 | 2 |
| C9 | Time taken to deliver the asset | 3.53 | 0.50 | 1.95 | 0.61 | 8 |
| C10 | Time taken to organize for finance. | 3.63 | 0.49 | 1.81 | 0.66 | 3 |
| C11 | Cheaper Transaction cost | 3.58 | 0.50 | 1.73 | 0.69 | 6 |
| C12 | Cost certainty | 3.58 | 0.53 | 1.71 | 0.70 | 6 |
| C13 | Funding arrangement | 3.47 | 0.50 | 1.95 | 0.71 | 10 |
| C14 | Budget Certainty | 3.51 | 0.54 | 2.00 | 0.67 | 9 |
| C15 | Whole of life maintenance | 3.32 | 0.68 | 1.97 | 0.61 | 17 |
| C16 | Design innovation | 3.22 | 0.74 | 1.86 | 0.66 | 20 |
| C17 | Construction innovation | 3.31 | 0.73 | 1.75 | 0.63 | 18 |
| C18 | Size & Technical Complexity of the project. | 3.40 | 0.56 | 1.83 | 0.62 | 15 |
| C19 | Flexibility of the design. | 3.25 | 0.51 | 1.86 | 0.60 | 19 |
| C20 | Due diligence | 3.19 | 0.51 | 1.86 | 0.69 | 21 |
| C21 | Due process | 3.43 | 0.60 | 1.60 | 0.78 | 13 |
| C22 | Relative level of accountability/ Transparency | 3.58 | 0.50 | 1.59 | 0.77 | 6 |
| C23 | Availability of resources | 3.56 | 0.53 | 1.56 | 0.70 | 7 |
| C24 | Competition | 3.39 | 0.56 | 1.69 | 0.68 | 16 |
| C25 | Market/economic Compliance | 3.46 | 0.54 | 1.75 | 0.68 | 11 |
| C26 | Environmental approval | 3.61 | 0.56 | 1.78 | 0.65 | 5 |
| C27 | Change in performance requirement | 3.61 | 0.59 | 1.88 | 0.56 | 5 |
| C28 | Positive Political influence | 4.07 | 3.88 | 1.92 | 0.57 | 1 |
| C29 | Political support | 3.42 | 0.53 | 1.76 | 0.66 | 14 |
| C30 | Affirmative action/policies | 3.42 | 0.56 | 1.89 | 0.63 | 14 |
| C31 | Familiarity of procurement system | 3.51 | 0.54 | 1.62 | 0.71 | 9 |
| C32 | Client's specific requirement | 3.62 | 0.52 | 1.77 | 0.64 | 4 |
| C33 | Risk allocation/ reduction | 3.45 | 0.54 | 1.62 | 0.69 | 12 |
| C34 | Client's level of knowledge. | 3.40 | 0.56 | 1.81 | 0.62 | 15 |

Table V indicates that BOT has more relative advantages than TPM considering the mean value and standard deviation of individual component of factor framework on BOT and TPM in the procurement of student housing in the tertiary institutions.

On timing/duration factor, the mean value for BOT is 3.66 and that of TPM is 2.00 as the time taken to negotiate/award contract. The mean value on the time taken to deliver the project in BOT is 3.53 and that of TPM is 1.95. The mean value on the time taken to organize for finance in BOT is 3.63 and that of TPM is 1.81.

Under cost/finance factor, the mean value for transaction cost in BOT is 3.58 and that of TPM is 1.73. The mean value on cost certainty in BOT is 3.58 and that of TPM is 1.71. The mean value on funding arrangement in BOT is 3.47 and that of TPM is 1.95. The mean value on budget certainty in BOT is 3.51 and that of TPM is 2.00. For the nature of project, the mean value for whole of life maintenance in BOT is 3.32 and that of TPM is 1.97.The mean value for design innovation in BOT is 3.22 and that of TPM is 1.86. The mean value for construction innovation in BOT is 3.31 and that of TPM is 1.75. The mean value for size & technical complexity of the project in BOT is 3.40 and that of TPM is 1.83 and the mean value for flexibility of the design in BOT is 3.25 and that of TPM is 1.86.

On accountability/due process, the mean value for due diligence in BOT is 3.19 and that of TPM is 1.86. The mean value for due process in BOT is 3.43 and that of TPM is 1.60. The mean value for relative level of accountability/ transparency in BOT is 3.58 and that of TPM is 1.59.

For economic/environment compliance, the mean value for availability of resources in BOT is 3.56 and that of TPM is 1.56. The mean value for competition in BOT is 3.39 and that of TPM is 1.69. The mean value for market/economic compliance in BOT is 3.46 and that of TPM is 1.75. The mean value for environmental approval in BOT is 3.61 and that of TPM is 1.78. The mean value for change in performance requirement in BOT is 3.61 and that of TPM is 1.88.

Under political influence/policy, the mean value for positive political influence in BOT is 4.07 and that of TPM is 1.92. The mean value for political support in BOT is 3.42 and that of TPM is 1.76. The mean value for affirmative action/policies in BOT is 3.42 and that of TPM is 1.89. Finally, for client knowledge/risk distribution, the mean value for familiarity of procurement system in BOT is 3.51 and that of TPM is 1.62. The mean value for client's specific requirement in BOT is 3.62 and that of TPM is 1.77. The mean value for risk allocation/ reduction in BOT is 3.45 and that of TPM is 1.62. The mean value for client's level of knowledge in BOT is 3.40 and that of TPM is 1.81.

The results of the whole analysis indicate that the identified factor frameworks were considered to be more relevant and beneficial in BOT than TPM. Political influence/ policy produces component with highest mean rating, similar in content to the studies by Zhang (2001), Cheung et al. (2010) and Li. et al.(2003) while investigating the positive and negative attraction of BOT suitability for public projects.

To determine the influence of years of experience on the respondents' assessment of BOT procurement method, constituting items were scored and the respective mean and standard deviation are determined, for each of the category.

Any score below the mean value was considered as "not effective", scores of mean value plus one standard deviation is considered as "fairly effective" while mean plus two standard deviation is considered as "very effective". The assessment factors framework such as duration/ timing, cost/financing, nature of the project, accountability/due process, economic/environment compliance, political influence/policy and client satisfaction/risk distribution were subjected to a chi-square analysis. The results are presented in Table VI:

**Table VI: Chi-square analysis of influence of respondent's years of experience on PPP/BOT procurement methods based on factors identified.**

| S/N | Factors | Years of Experience | | |
|---|---|---|---|---|
| | | **df** | **$\chi^2$** | **p** |
| **1** | Duration/time factors framework | **19,679** | **6** | **.003** |
| **2** | Cost/financing factors | **11.101** | **6** | **.085** |
| **3** | Nature of the project | **21.229** | **6** | **.002** |
| **4** | Accountability/due process | **30.249** | **6** | **.000** |
| **5** | Economic/environment compliance | **18.226** | **6** | **.006** |
| **6** | Political influence/policy | **22.715** | **6** | **.001** |
| **7** | Client satisfaction/risk distribution | **12.795** | **6** | **.046** |

**Source: Authors' Field Survey (2013)**

Table VI shows that for "duration/time" the Chi square value obtained is 19.679, df =6, p < .05). Since p- value is less than 0.05, the stated null hypothesis is rejected. This result therefore concludes that respondents' years of experience in PPP/BOT procurement methods have significant influence on the assessment of duration/time factor framework. This implies there is a significant relationship between the respondents' years of experience and their perception the 'duration/timing" factor of BOT projects

On "cost/finance factor", it shows that the Chi square value obtained is 11.101, df =6, p > .05). Since p- value is greater than 0.05 threshold, the stated null hypothesis is upheld. This result therefore concludes that respondents' years of experience in PPP/BOT procurement methods have no significant influence on the assessment of cost/financing factor framework.

Chi square value obtained on "the nature of project" is 21.229, df =6, p < .05). Since p- value is less than 0.05, the stated null hypothesis is rejected. This result therefore concludes that respondents' years of experience in PPP/BOT procurement methods have significant influence on their assessment of the nature of the project factors framework.

The Chi square value obtained on "accountability/due process" is 30.249, df =6, p < .05). Since p- value is less than 0.05, the stated null hypothesis is rejected.

This result therefore concludes that respondents' years of experience in PPP/BOT procurement methods have significant influence on their assessment of accountability/due process factors framework.

The Chi square value obtained for "economic/environmental compliance" is 18.226, df =6, $p < .05$). Since p- value is less than 0.05, the stated null hypothesis is rejected. This result therefore concludes that respondents' years of experience in PPP/BOT procurement methods have significant influence on the assessment of economic/environment compliance factors framework.

The Chi square value obtained for "political/policy factor" is 22.715, df =6, $p < .05$). Since p- value is less than 0.05, the stated null hypothesis is rejected. This result therefore concludes that respondent's years of experience in PPP/BOT procurement methods have significant influence on their assessment of political influence/policy factors framework.

The Chi square value obtained for "client satisfaction/risk distribution" is 12.795, df =6, $p < .05$). Since p- value is less than 0.05, the stated null hypothesis is rejected. This result therefore concludes that respondents' years of experience in PPP/BOT procurement methods have significant influence on the assessment of client satisfaction/risk distribution factors framework. To compare the respondents' assessment of BOT and TPM systems, respondents' assessment of BOT and TPM systems based on each of the factor framework were subjected to *t-test of significance*.

**Table VII: Test of significant different in the assessment of BOT and TPM system (*t-test)***

| Assessment of BOT&TPM | Mean | N | Std. Deviation | t | df | p |
|---|---|---|---|---|---|---|
| duration/time(BOT) | 10.7627 | 59 | 1.35620 | 19.601 | 58 | .000 |
| duration/time(TPM) | 5.6271 | 59 | 1.85601 | | | |
| Cost/financing (BOT) | 14.1356 | 59 | 1.62372 | 18.661 | 58 | .000 |
| Cost/financing (TPM) | 7.3898 | 59 | 2.41416 | | | |
| Nature of Project(BOT) | 16.2712 | 59 | 2.80904 | 15.368 | 58 | .000 |
| Nature of Project(TPM) | 9.2712 | 59 | 2.55849 | | | |
| Accountability/Due process (BOT) | 10.0847 | 59 | 1.46556 | 16.935 | 58 | .000 |
| Accountability/Due process (TPM) | 4.8983 | 59 | 2.15515 | | | |
| Economic/Environment compliance(BOT) | 17.6271 | 59 | 2.02483 | 20.479 | 58 | .000 |
| Economic/Environment compliance(TPM) | 8.6610 | 59 | 2.63668 | | | |
| Political influence/policy(BOT) | 10.4068 | 59 | 1.35339 | | | |

| Assessment of BOT&TPM | Mean | N | Std. Deviation | t | df | p |
|---|---|---|---|---|---|---|
| duration/time(BOT) | 10.7627 | 59 | 1.35620 | 19.601 | 58 | .000 |
| duration/time(TPM) | 5.6271 | 59 | 1.85601 | | | |
| Political influence/policy(TPM | 5.3729 | 59 | 1.59631 | 17.990 | 58 | .000 |
| Client satisfaction/Risk distribution(BOT) | 13.7966 | 59 | 2.03232 | 15.677 | 58 | .000 |
| Client satisfaction/Risk distribution(BOT) | 6.1356 | 59 | 3.03120 | | | |

**Source: Authors' Field Survey (2013).**

Table VII shows that the respondents' mean scores for BOT are generally higher than those of TPM for all factors. With t-values results at p- values which are less than 0.05, with 58 as the degree of freedom, the stated null hypothesis is rejected. These results conclude that there is significant difference in the respondents' assessment of BOT and TPM systems based on all factor frameworks. The results indicate a further confirmation of the analysis in table v similar to the studies conducted by De Marco e tal. (2012) and Graham (2011) which uphold that with the variants of factors, performance of alternative procurement methods and TPM behave differently.

## 4. SUMMARY OF FINDINGS AND DISCUSSION

In this study, four objectives are examined: First, it investigated the level of experience in project procurement. Second, it examined the respondents' perception on effectiveness of BOT and TPM in procuring student housing infrastructure, based on the identified framework from literature. Third, it determined the influence of respondents' years of experience in PPP/BOT procurement using chi-square, based on the identified factors. Lastly, it compared respondents' assessment of BOT and TPM system using t- test.

Consequently, the study revealed that majority of the respondents possess a high level of experience in project procurement. It is confirmed that BOT has relative advantages than TPM using all identified factors which include duration, cost/financing, nature of project, accountability, political influence, client satisfaction and risk distribution, economic and environmental compliance. It is further confirmed that apart from cost/financing, there is significant relationship between the respondents' years of experience and project duration, accountability, economic/environmental compliance, nature of project, client satisfaction and risk distribution. Finally, the respondents' mean scores for BOT are generally higher than those of TPM for all factors. With t-values results at p- values which are less than 0.05, with 58 as the degree of freedom, it can be concluded that there is significant difference in the respondents' assessment of BOT and TPM.

## 5. PRACTICAL IMPLICATION AND RECOMMENDATION

This study serves as one of the few studies that compare BOT initiative and TPM on student housing which emerges from a developing economy which attempts to investigate the effectiveness of the initiative within the context of Nigeria educational sector for housing infrastructure. Findings from this study would provide blue prints for effective decision making on student housing delivery in tertiary institutions globally. It also suggests a viable alternative route towards housing delivery and an investment opportunity for international investors in student housing in an emerging economy.

It is therefore recommended that BOT should be embraced as a viable alternative route to procure student housing which is usually inadequate in most tertiary institutions of learning in emerging economies. Based on the findings from the study, it is also recommended that while adopting BOT approach, the stakeholders and committees on BOT within the tertiary institutions should work to address the discrepancies which manifest in the aspect of costing /financing of BOT. The frontier of knowledge in BOT and procurement method should be extended and tested against other infrastructural projects.

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# EVALUATION OF SAFETY AND QUALITY MANAGEMENT IN CONSTRUCTION PROJECTS- A STUDY OF IBOM TROPICANA CONSTRUCTION PROJECTS

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## ABSTRACT
The nature of the construction industry necessities dangerous activities and the proper implementation of safety and quality management is essential to control hazards and wastes, and also to improve project success. This paper aims at adopting failure mode, effect and criticality analysis on an on-going project to investigate on how to improve safety and quality management in construction projects. In order to achieve this, the study evaluates the most critical factors influencing safety and quality management. Normative and empirical approaches are used for data collection. The possible failure mode of structural components and accident occurrence rate are analysed using the failure mode, effect and critically analysis sheets. Research findings reveal the possible causes and effects of failures and accidents. From the decision rule, the risk priority number is less than decision index number, which implies that risks/ hazards can be accepted and mitigated through the safety and quality policy designed to resolve the identified possible causes. The most critical safety and quality factors are identified as parameters for policy implementation.

**Keywords:** Safety factors, Quality factors, Failure mode effect and criticality analysis, Project implementation, Nigeria.

## 1. INTRODUCTION

The advance in technology has given rise to diverse construction procedures and improved systems in project implementation (Ogwueleka, 2010). Regardless of the improved technology, the work-related accident and injury cases have also prevailed (Aksom and Hadikusumo, 2008). The statistics reveal that the twenty percent of both industrial accidents and fatalists are reported on construction sites (FMWHD, 2007). Globally, construction employees have three times more chances of dying and two times of getting injured than any worker of other economic activity (Sousa and Teixeira, 2004). The construction industry employs a greater proportion of workforce when compared to other industrial sectors (ETA/ Business Relations Group Report, 2004). This implies that a high population of construction workforce is prone to occupational injuries and fatalities.

Major causes of these accidents on a construction site are identified as collapse of construction parts or elements, unsafe working areas, human behavior, and misuse of machineries (Abdelhamid and Everett, 2000). Stanley (2010) reports that majority of construction accident cases are simply related to poor decision making, which might be prevented using adequate safety culture. Harmoniously, Construction Engineering and Infrastructure Management (2010) reports on the study conducted by Dr Dung investigating on reasons for construction accidents in Vietnam. Poor quality and un-safety of different temporary structure systems are identified as the major causes of construction accidents. The adoption of health and safety culture is without doubt one of the most important functions within and throughout the construction process, which can influence operating environment to achieve project objectives (Abdul-Raouf, 2004; Husin et al., 2008; Ogwueleka, 2011).

Researchers and project participants have adopted different management practices for project execution targeted towards reducing occupational injuries and fatalities. The positive drivers adopted for these management practices, in other industrial sectors are centered on quality management philosophies. In the construction sector, the recent development has shifted clients' objectives towards improved service quality, faster buildings and innovations in technology, and also the quality management practices are designed to meet clients' views of quality, as well as, complying with specifications. Husin et al. (2008) advocate that the integration of safety management into quality assurance and control will show a more comprehensive approach for safety assurance practices, as well as, improve the realisation of project objectives. Most researchers emphasise that safety is parallel to quality in a one-way relationship, where safety management can be improved through quality management processes, not the other way round (Krause, 1994; Cooper & Phillips, 1995). Contrary, recent studies have proved that safety leads to quality, and also working safe can enhance performance, likewise quality can support safety by reducing losses of assets (Husin et al. 2008; Stewart & Townsend, 1999).

An integration of safety and quality management will encourage the support and synergistic of each other, thereby maximise their mutual effectiveness. Numerous safety and quality management tools have been developed for improving efficiency and effectiveness of construction processes by eliminating waste and increase profit. For example, Construction Safety and Health Monitoring (CSHM) web based system, Occupational Safety and Health Administration Voluntary Protection Programs (OSHA VPP), Occupational Safety Health Administration (OSHA) construction E-tool, Occupational Health Safety Management system (OHSA 18001), and International Organisation of Standardisation (ISO 9001). Despite several efforts to prevent occupational injuries and fatalities, construction workers still remain casualties. Chan and Tam (2000) attribute these problems to poor safety and quality measures, which can be prevented through proper management of design complexities.

Achieving project success requires cooperative efforts of contracting parties, but this may be difficult to attain due to different priorities amongst the parties. This might resulted in design complexities with frequent changes to design details. Extreme changes in project design can bring about risk to project quality. Risk is evitable in safety and quality management, there is need for effective practices with underlying procedures for achieving safety in environment, during job execution, and amongst project participants, and also for achieving quality in clients' expectations and specifications. Most of these approaches focus on symptoms and have failed to identify the possible causes and the impact of occupational injuries and fatalities on project sites.

Failure mode, effects, and critically analysis is a technique used to identify, to prioritize, and to eliminate potential failures from the system, design or process before they reach the customer. This paper adopts the failure mode, effects, and critically analysis to assess the potential failure mode of the structural components of Ibom Tropicana construction projects and possible accident causes. In order to achieve this, the following objectives are considered: a) identification of critical factors influencing safety and quality management b) assessment of possible causes and effects of failure and occupational accidents.

## 2. REVIEW OF SAFETY AND QUALITY FACTORS

Quality management has become a focal point in the construction sector, most stakeholders are concerned with the quality of their projects, while contractors are more concerned with safety of their workers (Ogwueleka, 2011). Although, adequate quality management can facilitate project success and organisational sustainability, but negligence of safety management has increasingly resulted in occupational accidents and injuries to construction workers. Occupational injuries and fatalities can affect the manpower output of workers and project success. Husin et al. (2008) emphasise that safety leads to quality. For example, it is difficult for a mason to lay brick on a straight line, if one hand is needed to hang onto the scaffold. Hoonakker et al. (2003) advocates for an integration of safety and quality management system, in order to reduce variability in the construction process, for example, failure of building elements, workers inefficiencies, and injuries. Several researchers have proved that the integration of both safety and quality management can improve productivity and occupational safety/ health and also minimize cost overruns (Mckim and Kiani, 1995; Schriener et al., 1995; Kuprenas and Kenney, 1998). The functions of safety and quality management are similar in several aspects such as: scope, critically to success and goal, detection, obstacles and problem causes, response, effect of failure, and difficult in optimizing the program (Husin et al., 2008).

The similarities between safety and quality functions and their abilities to co-exist in the same environment can prove that they can be easily integrated to produce positive effect. The literature scan reviews specific factors that are significantly important towards successful implementation of safety and quality programs to achieve desired outcomes. Tam et al. (2004) reveals elements of poor construction safety management in China as: lack of training, poor safety awareness of project managers, reluctance of input resources to safety, and reckless operation. Client requirement, insurance company requirement and employee requirement are identified as criteria for safety management system implementation (Law et al., 2006). Smallwood (2000) highlights the most common barriers to safety implementation as: lack of skilled workers, poor management commitment, workers altitude, and type and nature of construction. Coble and Kibert (1994) stipulate that construction accidents mostly occur on site, due to inappropriate knowledge or training, errors in judgment or carelessness and poor machineries. These causes can be eliminated or reduced by adoption of safety performance indicators such as: management commitment/ review, cost effectiveness/ time, communication, audits/ observations, strong safety culture/ climate, emphases on short-term objectives, and employee involvement/ empowerment (Hoonakkar et al., 2003).

European process safety center (1994) specifies the core safety management elements as: safety policy/ arrangement, organization, management practices and procedures, monitoring and auditing and management review. Husin et al. (2008) list the threats to safety implementation as: tight project schedule, low management competency, unsuitable planning, excessive approval procedures, variations, lack of coordination between project participants, and unavailability of skilled labor. Customer requirement, insurance company requirement, employee requirement and cost effectiveness are regarded as safety management criteria (Ashmore, 1995; Sakvik and Nytro, 1996; Harms-Ringdahl et al., 2000; Pun and Hui, 2002). Table 1 represents the summary of factors influencing safety management in construction projects.

Husin and Adnan (2008) highlight the threats to quality management implementation as: tight project schedule, inadequate scheduling, unsuitable construction planning, incomplete or inaccurate cost estimate, low management competency, variations, lack of coordination between project participants, unavailability of sufficient skilled labour. Supervision, relationship between project participants, bid selection process, training, quality policy and performance of quality tools are identified as quality factors (Arditi and Gunaydin, 1998). Chan and Tam (2000) state the major factors influencing quality performance in construction projects as: planning process, design/ project complexities, nature uniqueness, availability of resources and project environment. The most common barriers to a successful quality management are lack of management/ leadership skills, poor understanding of customer/ client expectation, lack of worker empowerment/ incentive and nature of job or construction industry (Loushine and Hoonakker, 2002).

Hoonakker (2006) identifies quality indicators as teamwork, continuous improvement, management commitment, communication, customer or client focus, employment involvement/ empowerment.

Joaquin et al. (2008) spell out quality problems as: low quality continuous improvement, lack of quality policy and poor availability of resources. Wong and Fung (1999) point out project supervision and subcontractor responsibility as critical factors influencing quality performance. Reduced subcontractor responsibility, inappropriate bid selection method, lack of auditing system, low quality continuous improvement and lack of motivation are listed as quality problems (Pheng and Wei, 1996). Marosszeky et al. (2002) identify quality setbacks as poor organization structure, lack of motivation, poor management commitment and poor teamwork. Other previous studies have identified quality factors as coordination between project participants, expertise knowledge/ training, design complexity, subcontractor responsibility, planning process, auditing system, management commitment, availability of resources, incentives and nature uniqueness (Jha and Iyer, 2006; Tang et al., 2009; Leonard, 2008; Moody, 2005; Saraph et al., 1989; Samuels, 1994; Hiyassat, 2000; Yung and Yip, 2010; Mohammed and Abdullah, 2006; Serpell, 1999; Kanji and Wong, 1998).Table 2 denotes the summary of factors influencing quality management in construction projects.

## 3. THE APPLICATION OF FAILURE MODE, EFFECTS AND CRITICALLY ANALYSIS

Failure mode, effects and criticality analysis (FMECA) was one of the first systematic techniques used in US Military for failure analysis, which was guided by Military procedure MIL-P-1629 (Rausand and Hoyland, 2004). This technique is usually adopted as the early stage of system to identify errors and failures, where the mitigation measures of failure mode will be cost-effective. It has been previously adopted by different researchers to identify technical risks, potential failure and construction errors. Barlett and Cliff (1999) adopt FMECA in Building Research Establishment to analyse supply chain of buildings during whole system lifecycle. This technique was used to identify critical failures of the supply chain, and also in decision making on the correction actions and modifications applied. Wyatt (2005) employs FMECA and fault tree method to assess building performance, the study reveals possible errors in the design phase. In the study conducted by Pollo (2003), FMECA was adopted as a part of the technique used in analysing the system lifecycle of building components during design phase in the University of Turin. Results of the analysis reveal degradation rates for each component, and this also assisted in improving maintenance and optimizing the global cost. In window and cladding technology, Layzell and Ledbetter (1998) apply FMECA to study cladding failures of both elemental and building process levels. The findings of the research are considered relevant to improve cladding quality during design phase, to facilitate inspection, and to survey actions during installation phase.

**Table 1: Summary of factors influencing safety management in construction projects**

| SAFETY FACTORS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Management Commitment | | x | | | | x | | | | | x |
| Employee involvement/ altitude | | x | | | x | x | | | x | | x |
| Errors in judgement or carelessness | x | | x | | | | | | | | |
| Expertise knowledge or training | x | | x | | | x | | | | x | |
| Poor machineries | x | | | | | | | | | | |
| Communication | | x | | | | | | | | | x |
| Audits/ observations | | x | | x | | | | | | | x |
| Safety culture/ climate | | x | | | | | | | | | x |
| Safety awareness of top management/ top managers | | | x | | | | | | | x | |
| Reluctance of input resources to safety | | | x | | | | | | | | |
| Safety policy/ arrangement | | | | x | | | | | | | |
| Type/ nature of construction | | | | | | x | | | | | |
| Safety management/ practices/ procedures/ review | | | | x | | | | | | x | |
| Client involvement | | | | | x | | x | | | | |
| Insurance company requirement | | | | | x | | | x | | | |
| Cost-effective/ time | | | | | | | | | | | x |
| Tight project schedule | | | | | | | | | | x | |
| Improper construction planning/ programs | | | | | | | | | | x | |
| Variations | | | | | | | | | | | |
| Lack of coordination between project participants | | | | | | | | | | x | |
| Employee empowerment | | | | | | | | | | | x |
| Emphases on short-term objectives | | | | | | | | | | | x |

(1) Coble and Kibert (1994), (2) Loushine and Hoonakker (2002), (3) Tam et al (2004), (4) European process safety centre (1994), (5) Law et al (2006), (6) Smallwood (2000), (7) Pun and Hui (2002), (8) Harm-Ringdahl (2000), (9) Saksvik and Nytro (1996), (10) Husin et al (2008), (11) Hoonakker (2002).

**Table 2: Summary of factors influencing quality management in construction projects**

| QUALITY FACTORS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Management/ leadership skills | x | | | | | | | | | | | | | | | | | | | |
| Interpretations of client/customer expectations | x | | | | | | | | | | | | | | | | | | | |
| Worker empowerment/incentive | x | | | x | | | | | | | | x | | | | | x | x | | |
| Organization structure | | | | | | | | | | | | | | | | | x | | | |
| Nature of construction | x | | | | | | | | | | | | | | | | | | | |
| Continuous improvement | | | | | | | x | | | | | x | | | | | | | | |
| Management commitment | | x | x | x | | | | | | | | | | x | | | x | | | |
| Communication | | x | | | | | | | | | | | | | | | | | | |
| Client/customer focus | | x | | | | | | | | | | | | | | | | | | |
| Employee involvement/ altitude | | x | | x | | | | | | | | | | | | | | | | |
| Tight project schedule | | | x | | | | | | | | | | | | | | | | | |
| Inaccurate or incomplete estimate | | | x | | | | | | | | | | | | | | | | | |
| Variations | | | x | | | | | | | | | | | | | | | | | |
| Planning/ scheduling process | | | x | | x | | | | | | | | x | | | x | | | | |
| Coordination between project participants | | x | x | | | x | | | x | x | | | | | | | x | | | |
| Expertise knowledge or training system | | | x | x | | x | | | | | | | | | | | | x | x | |
| Tendering and bidding climate | | | | x | | x | | | x | | | x | | | | | | | | |
| Emphases on short-term objectives | | | | x | | | | | | | | | | | | | | | | |
| Cost and time implementation | | | | x | | | | | | | | | | | | | | | | |
| Design complexity | | | | | x | | | | | x | | | | | | | | | | |
| Quality policy | | | | | | x | x | | | | | | | | | | | | | |
| Project supervision | | | | | | x | | x | | | | | | | | | | | | |
| Auditing system | | | | | | | | | | | | x | | x | | | | | | |
| Subcontractor's responsibility | | | | | | | | x | | | | x | | | | | | | | |
| Nature uniqueness | | | | | x | | | | | | | | | | | | | | | x |
| Availability of resources | | | | | x | | x | | | | | | | | x | | | | | |
| Project environment | | | | | x | | | | | | | | | | | | | | | |

(1) Loushine and Hoonakker (2002), (2) Hoonakker (2006), (3) Husin and Adnan (2008), (4) Hoonakker et al, (2003), (5) Chan and Tam (2000), (6) Arditi and Gunayalin (1998), (7) Joaquin et al (2008), (8) Wong and Fung (1999), (9) Jha and Iyer (2006), (10) Tang et al (2009), (11) Leonard (2008), (12) Pheng and Wei (1996), (13)Moody (2005), (15) Saraph et al (1989), (16) Samuels (1994), (17) Hiyassat (2000), (18) Marosszeky et al (2002), (19) Yung and Yip (2010), (20) Mohammed and Abudullah (1999), (21) kanji and Wong (1998).

## 4. RESEARCH METHODOLOGY

### *4.1 Questionnaire Design*

This paper is designed to analyse safety and quality management using failure mode, effects and criticality analysis (FMECA) in an ongoing Ibom Tropicana and Tourism project. The study adopted normative and empirical approach to ensure unbiased judgment. The normative approach involves the collection of data from existing safety and quality management records of both contractors and subcontractors.

The empirical approach involves the administration of structured questionnaire to consultants, consultants and subcontractors participating in the project. The questionnaire is designed to determine the importance index for both safety and quality factors. In order to achieve this, the respondents are expected to rank each factor using two scales. The first scale ranges from 0 for never occurred to 4 for Always and the second scale ranges from 0 for never severe to 4 for extremely severe. Pilot studies were carried out to ensure clarity and relevance of the drafted questionnaire. The drafted questionnaire was reviewed by four professionals in the research field. The two professionals are university professors, while the other two are researchers in the related field. Amendments are made on the drafted questionnaire based on the suggestions made by reviewers. The questionnaire was administered to respondents using face to face method to ensure validity of their responses.

### *4.2 Characteristics of Respondents*

The project site is located at Akwa Ibom State in Nigeria. In recent times, Akwa Ibom state has been recognised by both local and international bodies for rapid development, which has earned the present administration several awards for gigantic efforts. The signing of Nigeria’s National Building Code (NBC) into law in 2007 has increased the demand of adequate safety, health, and quality in construction. However, unofficial statistics reveal an increase in safety related incidents and collapse of buildings year to year since 2007. The struggle to enforce the law has led to the demand for possible solutions to work-related accidents and injuries on construction sites. The study project is owned by Akwa Ibom government covering an area of about 84 hectares of land, with about seven different construction projects including Convention Centre, seven-star hotel, mega cinema, ground hall, children’s park, and others. The structure consists of 235 numbers of piles with diameter varying from 600 – 1000mm. This study targeted 220 construction professionals working on the project site. For varied reasons, 40 did not respond which reduced the population size to 180 professionals. Figures 1, 2 and 3 reveal the demographic data of respondents with 50% of subcontractors, 42% of contractors and 8% of consultants. This reveals that majority of respondents as actively involved in project implementation as subcontractors (see figure1). Figure 2 reveals the working experience of respondents below 5 years (30 percent), between 5 to 9 years (13 percent), between 10 to 15 years (51 percent) and above 15 years (6 percent) while figure 3 shows 56 percent of the respondents are experienced in both building/ industrial projects, 32 percent in bridge/ road projects, and 12 percent in both.

Figure 1: Distribution of respondents by profession in projects

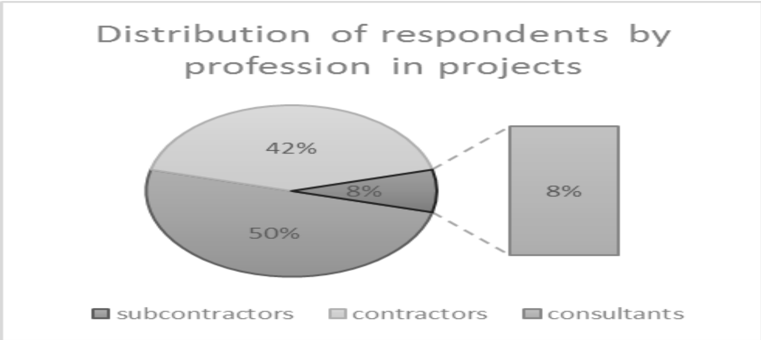



Figure 2: Distribution of respondents by years of working experience in the construction industry

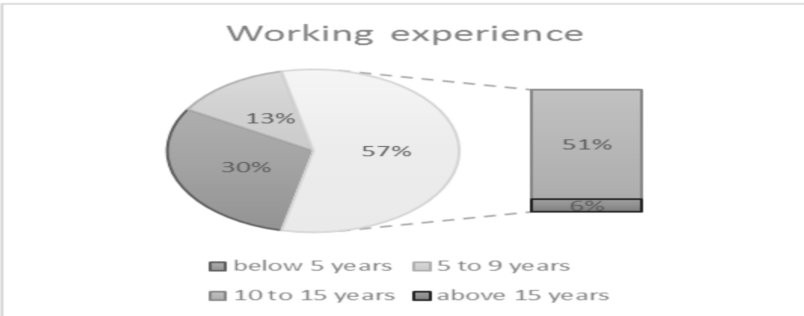
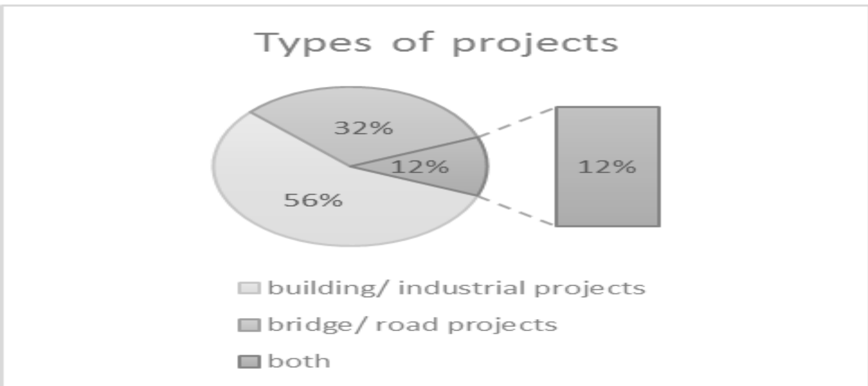



Figure 3: Types of project involved by respondents



### *4.3 Method of Data Analysis*

The data collected by normative approach are analysed using importance index in FMECA known as Risk Priority Number (RPN). The RPN is a measure of the risk of failures which can be expressed as:

RPN = O x S x D

Where O is the occurrence of failure showing the probability that the failure mode will occur as a result of specific case; S is the severity representing the measurement of the seriousness of the effect of the potential failure mode on the system; and D presents the rank of likelihood that a potential failure will be detected.

The formula for decision rule is stated as:

$$DIN = \frac{N \times 10^6}{10^N}$$

Where DIN represents Decision index number and N is the number of identified failure/ risk. For this study, the total number of potential failure/ accident mode identified is 4. Using the decision rule formula, it is calculated as:

$$DIN = \frac{4 \times 10^6}{10^4} = 400$$

The decision rule states that where RPN<DIN, the potential failure will be accepted and where RPN>DIN, the potential failure will be rejected. Evaluation of data collected through empirical approach was done using three types of indices namely frequency, severity and importance indices. The frequency and severity indices are calculated using both formulas:

$$F.I. = \frac{\sum_{0}^{4} a_i n_i}{4N}$$

and

$$S.I. = \frac{\sum_{0}^{4} a_i n_i}{4N}$$

Where a represents weight assigned; n is frequency of each response; and N is total number of responses. The importance index expresses the overview of the factors of both frequency and severity indices. It is calculated using the formula:

IMPORTANT INDEX = FREQUENCY INDEX x SEVERITY INDEX

## 5. FINDINGS AND DISCUSSIONS

The Pareto rule states that the highest ranked has the greatest influence, assumptions are made based on this rule. Table 3 and 4 reveal the frequency, severity and important indices of the factors influencing safety and quality management in construction projects. From table 3, the index rank reveals the three most important factors influencing safety management in construction projects as: poor machineries, errors in judgment or carelessness, and management commitment. The use of both manual and non-manual machineries is essential for execution of all types of building and construction projects. The analysis shows that poor machineries as factor, which has contributed immensely to the challenges associated with safety management in construction projects in Nigeria. Decision making is a crucial aspect in project implementation. Errors in judgment or carelessness is ranked second, it is generally accepted by respondents that decisions taken by project participants can greatly influence the management of safety in projects. The commitment of top management is concerned as a crucial requisite for safety policy implementation. A sincere commitment by management and consistency in enforcement of safety rules are foundations for effective safety program. The least important factor is concerned as audits and observations. Most respondents believed that audits and observations of work progress can only play little or no significant influence in safety procedure.

From table 4, the three important factors influencing quality management are considered as: inaccurate or incomplete cost estimate, employee involvement and altitude, and finally expertise knowledge or training. The most commonly adopted bidding process in Nigeria is the lowest bid selection process. Most bidders are mostly concerned with winning the bid by tendering the lowest bids , where they might submit inaccurate or incomplete cost estimates deliberately or accidently. If eventually they win, they try to cut corners in order to complete the projects which will affect the quality of their jobs. The analysis reveals inaccurate or incomplete cost estimate as the highest ranked factor influencing quality management in construction projects. The behavioral pattern of project employees has a major role to play in project productivity or output. The analysis ranks employee involvement and altitude to work as second highest factor influencing quality management. For complex and larger projects, a construction company may not have all the required expertise. In specialized areas, it is important to employ an expert in the related field to manage the work element. The study shows that the quality of a project can be enhanced through proper involvement of experts in the relevant areas; this is ranked as the third factor.

The table 5 discloses the possible failure mode of the component, where four possible failure modes are identified. These possible failure modes are breakage while driving in, un- monolithic curing of concrete, drilling without bailing underground water and inability of pile to reach the desired depth. The causes and effects of these possible failure modes are analysed, in order to assess the possible impacts. The assessment exposes the possible failure mode, causes and effects on components. The risk priority number (RPN) is calculated as 340 as against decision index number (DIN) of 400. Based on the decision rule, the RPN < DIN where this is possibility the component failure rate can occur, but can be accepted and prevented through proper mitigations. Table 6 shows the possible accident occurrence on project site where four possible accident modes are identified. These modes are driving hammer falling on worker, spattered pile falling on worker, suspended drilling hook dropping on worker and worker dropping into drilled holes. The analysis reveals the causes and effects of these possible accident modes. The risk priority number (RPN) for possible accident occurrence is calculated as 385 as against decision index number (DIN) of 400. Although, the RPN is close to DIN, but RPN< DIN, therefore the accident occurrence rate will be accepted and mitigated.

**Table 3: Frequency, severity and importance indices of factors influencing safety management in construction projects**

| Safety factors | Frequency index | Severity index | Importance index | Index rank |
|---|---|---|---|---|
| Management commitment | 0.928 | 0.824 | 0.765 | 3 |
| Employee involvement/ altitude | 0.527 | 0.425 | 0.224 | 19 |
| Errors in judgment or carelessness | 0.892 | 0.877 | 0.782 | 2 |
| Expertise knowledge or training | 0.884 | 0.535 | 0.473 | 9 |
| Poor machineries | 0.880 | 0.921 | 0.811 | 1 |
| Communication | 0.651 | 0.544 | 0.354 | 14 |
| Audit/ observations | 0.421 | 0.351 | 0.148 | 22 |
| Safety culture/climate | 0.782 | 0.447 | 0.350 | 15 |
| Safety awareness of top management/ project managers | 0.904 | 0.838 | 0.758 | 4 |
| Reluctance of input resources to safety | 0.724 | 0.652 | 0.472 | 10 |
| Safety policy/ arrangement | 0.681 | 0.521 | 0.355 | 13 |
| Safety management practices/ procedure/ review | 0.525 | 0.488 | 0.256 | 16 |
| Type and nature of construction | 0.482 | 0.323 | 0.156 | 21 |
| Client involvement | 0.854 | 0.712 | 0.608 | 5 |
| Insurance company requirement | 0.723 | 0.318 | 0.230 | 18 |
| Cost effectiveness/ time | 0.654 | 0.587 | 0.384 | 11 |
| Tight project schedule | 0.812 | 0.725 | 0.589 | 7 |
| Improper construction planning/ procedure | 0.743 | 0.656 | 0.487 | 8 |
| Variations | 0.654 | 0.921 | 0.604 | 6 |
| Lack of coordination between project participants | 0.548 | 0.685 | 0.375 | 12 |
| Employee empowerment | 0.482 | 0.512 | 0.248 | 17 |
| Emphases on short objectives | 0.526 | 0.321 | 0.169 | 20 |

**Table 4: Frequency, severity and importance indices of factors influencing quality management in construction projects**

| Quality factors | Frequency index | Severity index | Importance index | Index rank |
|---|---|---|---|---|
| Management/ leadership skills | 0.833 | 0.751 | 0.626 | 9 |
| Interpretation of client/ customer expectation | 0.759 | 0.521 | 0.395 | 19 |
| Worker empowerment through incentive | 0.778 | 0.431 | 0.335 | 23 |
| Organization structure | 0.658 | 0.523 | 0.344 | 22 |
| Teamwork | 0.806 | 0.648 | 0.522 | 15 |
| Continuous improvement | 0.788 | 0.858 | 0.676 | 5 |
| Management commitment | 0.724 | 0.725 | 0.525 | 14 |
| Communication | 0.812 | 0.631 | 0.512 | 17 |
| Client/ customer focus | 0.851 | 0.723 | 0.615 | 10 |
| Employee involvement/ altitude | 0.901 | 0.890 | 0.801 | 2 |
| Tight project schedule | 0.478 | 0.527 | 0.252 | 25 |
| Inaccurate or incomplete cost estimate | 0.854 | 0.950 | 0.811 | 1 |
| Variations | 0.724 | 0.823 | 0.596 | 12 |
| Improper planning/ scheduling | 0.644 | 0.545 | 0.351 | 20 |
| Coordination between project participants | 0.756 | 0.831 | 0.628 | 8 |
| Expertise knowledge and training | 0.890 | 0.884 | 0.787 | 3 |
| Tendering/bidding climate | 0.806 | 0.702 | 0.566 | 13 |
| Emphases on short term objectives | 0.792 | 0.653 | 0.517 | 16 |
| Cost and time implementation | 0.347 | 0.575 | 0.200 | 26 |
| Design complexity | 0.856 | 0.766 | 0.656 | 7 |
| Quality policy | 0.726 | 0.823 | 0.597 | 11 |
| Project supervision | 0.923 | 0.811 | 0.749 | 4 |
| Auditing system | 0.665 | 0.522 | 0.347 | 21 |
| Subcontractors responsibility | 0.754 | 0.892 | 0.673 | 6 |
| Nature uniqueness | 0.215 | 0.451 | 0.097 | 27 |
| Availability of resources | 0.670 | 0.758 | 0.508 | 18 |
| Project environment | 0.421 | 0.688 | 0.289 | 24 |

Table 5: FMECA sheet of possible failure mode of structural component

Project: IBOM TROPICANA
Component Name: PILING
Component Location: STRUCTURAL/ CONVENTION CENTRE
Issue Number: 1

| Part or system name | Function | Possible failure mode | Cause of failure mode | Effects of failure on component | O | S | D | RPN |
|---|---|---|---|---|---|---|---|---|
| 1. Precast piles | Serves as substructure to high rise buildings | Breakage while driving in. | Excessive driving in load. | Foundation settlement. | 8 | 5 | 1 | 40 |
| 2. Bored piles | Transmits building load to a good soil bearing capacity which cannot be easily reached | Un-monolithic curing of concrete. | Height of casting. | Undesired strength is achieved. | 6 | 3 | 5 | 90 |
| | | Drilling without bailing underground water. | Lack of workers supervision. | Undesired chemicals react with concrete thereby reducing its strength. | 5 | 3 | 2 | 30 |
| | | Pile not getting to the desired depth | Pile can reach a false firm stratum. | Settlement of the structure overtime | 2 | 10 | 9 | 180 |
| | | | | | | | | **340** |

Table 6: FMECA sheet of possible accident occurrence

Project: IBOM TROPICANA
Work Item: DRILLING HOLES FOR PILES
Work Location: STRUCTURAL/ CONVENTION CENTRE
Issue Number: 2

| Part or system name | Function | Possible accident mode | Cause of accident mode | Effects of accident on work | O | S | D | RPN |
|---|---|---|---|---|---|---|---|---|
| 1. Driving in precast piles | Serves as substructure to high rise buildings | Driving hammer head falling worker. | Unsecured hammer head. | Death of worker. | 3 | 2 | 10 | 60 |
| 2. Boring holes in piles | Transmits building load to a good soil bearing capacity which cannot be easily reached | Spattered piles falling on worker. | Improper fixing of absorber to pile head. | Reduced workforce. | 7 | 5 | 3 | 105 |
| | | Suspended drilling hook falling on worker. | No PPE use and safety signs. | Reduced workforce and efficiency. | 4 | 5 | 1 | 20 |
| | | Worker falling into drilled hole. | No caution and safety signs. | Death of worker. | 2 | 10 | 10 | 200 |
| | | | | | | | | **385** |

## 6. CONCLUSION AND RECOMMENDATION

The research survey demonstrated that safety and quality management is a vital tool in improving performance, profitability and productivity during project implementation. In the literature scan, the study identified a total number of 22 safety factors and 27 quality factors which was evaluated. The result reveals three important safety factors as: poor machineries, errors in judgment or carelessness, and management commitment. The three most important quality factors are identified as: inaccurate or incomplete cost estimate, employee involvement, and altitude and finally expertise knowledge or training. The analysis reveals both manual and non-manual machineries are essential for all building and construction projects. Therefore, poor machineries are considered as most important factor influencing safety management. Challenges associated with bid evaluation process have resulted to contractors submitting inaccurate or incomplete cost estimates deliberately or accidently in order to achieve lowest bid prices. If eventually they are selected to execute the jobs, then they cut corners to complete their jobs within the quoted bid prices. The analysis also discloses inaccurate and incomplete cost estimate as the most important factor influencing quality management.

The application of failure mode, effects and critically analysis (FMECA) on the on-going project reveals the component failure rate as RPN<DIN, which implies that there is possibility of component failure occurrence on the project site, but it can be accepted and mitigated. The possible accident occurrence rate on project site is estimated as RPN<DIN, which still emphasises the possibility of accident and injury occurrence, but it can be accepted and mitigated. From the research findings, the on-going project is prone to risks associated to the identified failure and accident modes. In order to resolve these risks, safety and quality management programs must be efficient in addressing their issues. This study has created insight for the adoption of FMECA in safety and quality management from the perspective of Akwa Ibom state government projects in Nigeria. More so, it has also exposed the critical factors to be considered in managing both safety and quality issues. Similar studies are hereby recommended in both developing and developed countries for comparison.

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# INFRASTRUCTURE PROJECT CHALLENGES: THE CASE OF DR KENNETH KAUNDA DISTRICT MUNICIPALITY

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## ABSTRACT

Project management as an application is utilised increasingly by municipalities in South Africa to render services on time, within budget, and according to quality and performance specifications. But the translation of integrated development planning (IDP), top-layer service delivery and budget implementation plans (SDBIPs) into successful projects often do not yield the desired results. This is especially true for capital-intensive infrastructure projects. Typical municipal infrastructure projects entail the construction of roads, pavements and bridges and storm water systems. It also include the provision of electricity (generation, transmission and reticulation e.g. street lighting), water (e.g. dams, reservoirs, and water purification), and sanitation (e.g. reticulation and sewerage purification). This article reports on empirical findings of research conducted at the Dr Kenneth Kaunda District Municipality (henceforth referred to as Dr KKDM), North-West Province, which include four local (category B) municipalities, namely Maquassi Hills, Matlosana, Tlokwe, and Ventersdorp local municipalities. The aim of the study was to explore practices and challenges associated with the design and execution of infrastructure (capital) projects and to uncover best practice for innovative project governance. Case study methodology was utilised in the research.

**Keywords:** capital projects, Dr Kenneth Kaunda District Municipality, development, infrastructure, project management

## 1. INTRODUCTION

In a system of co-operative and integrated governance the developmental role of the 278 municipalities holds the key to address the significant backlog of infrastructure in South Africa. The institution of developmental local government actively promotes social and economic development, shapes local spaces in a more equitable and efficient manner, and plays a strong strategic role in the state. Furthermore, developmental local government allows for effective service delivery, greater community participation, and has the interest of the lower socio-economic sector at the core of its mandate.

As towns and cities expand, municipal services often do not satisfy the basic needs of urban residents, especially the urban citizens in the lower socio-economic range. Services such as infrastructure development are often plagued by insufficient planning, limited operating capacity, corruption, inadequate maintenance, and negative environmental consequences.

Innovative management applications and techniques such as project management are required to improve municipal service delivery. The application of project management, however, should square with the environmental, socio-political, economical, and institutional realities of particular municipalities. Increasingly municipalities in South Africa utilise project management as a management application to render services on time, within budget, and according to quality and performance specifications. This process, however, is frustrated by the fact that integrated development planning (IDP), top-layer service delivery and budget implementation plans (SDBIPs) are not operationalised successfully into delivery of infrastructure projects.

Construction plays a vital role in South Africa's economic and social development. It provides the physical infrastructure and the backbone for economic activity. The construction sector is also a large-scale provider of employment. The purpose of this article is to report on empirical findings flowing from research conducted at Dr Kenneth Kaunda District Municipality (henceforth referred to as Dr KKDM), North-West Province. The aim is to investigate the challenges associated with infrastructure (capital) projects, in order to uncover potential best practice, and to make recommendations on how to meet the challenges that are identified. Lessons learned from such case studies provide a sound foundation for the development of theory and the identification of innovative best practices. Such best practice guidelines should eventually lead to standard operating procedures for infrastructure development in municipalities.

## 2. THE STATE OF INFRASTRUCTURE DEVELOPMENT IN SOUTH AFRICAN MUNICIPALITIES

Currently in South Africa there are significant infrastructure service delivery backlogs to deal with. This situation is due to historical, socio-political realities and current demographic trends, including the processes of rapid urbanisation and rising poverty levels. This is true particularly for low-capacity local and district municipalities that are situated in rural areas.

One of the ten strategic priorities and programmes outlined in the Medium-Term Strategic Framework for 2012/2013 is a programme to build economic and social infrastructure (The Presidency, 2009: 11). Government's Infrastructure Investment Programme (IIP) is aimed at expanding and improving social and economic infrastructure, as well as transport and energy. This also includes basic amenities such as water, sanitation, as well as information and communications infrastructure. The aim of this Programme is to increase access, quality and reliability of public services and to support economic activities, whilst considering environmental sustainability and pursuing maximum employment. Based on an integrated infrastructure development strategy, infrastructure projects are to be spatially referenced and planned for in an integrated manner.

An analysis of the state of infrastructure development in South African municipalities is complicated due to a number of factors. The first factor is that considerable disparities exist between different types of infrastructure (e.g. housing, electricity, water provisioning) as well as the quantity and quality of these services (e.g. service levels) in municipalities. A particular municipality, for example, may excel in areas of sewerage processing, but fail dismally in their performance regarding road maintenance. Considering municipal infrastructure backlogs, it should be noted that the severity or significance of "backlogs" depends on the definition of the particular service level.

For example, contrasting a "below basic" pit latrine with a "basic" ventilated improved pit latrine, as well as with a "full" services level of water-borne sanitation, determines significantly how backlogs are identified. The Municipal Infrastructure Investment Framework (DBSA, 2011: 59) defines a "backlog" in terms of "a service level less than that needed to ensure a household's health and safety", which in itself is also a rather unquantifiable and subjectively inferred performance indicator.

A second factor that clouds analysis is that infrastructure development in different categories of municipalities (local, district and metropolitan) show vast dissimilarities. Census 2011, for example, differentiates between "urban formal", "urban informal", "rural formal" (commercial farms) and "tribal areas" ("communal areas in former homelands"). This classification of areas does not fit neatly within either municipal boundaries or the A, B and C categories of municipalities. Furthermore, due to a more substantial tax basis and staff capacities, asymmetry exists between metropolitan municipalities, which are generally in a more advantageous position than local municipalities, which may find themselves in economically-stagnant "urban informal" (rural) areas.

Based on the 2011 Census, services backlogs are shown to be considerably larger in communal areas and urban informal settlements than in urban formal areas and commercial farm areas. For example, 54% of households in communal areas and 38% of households in urban informal areas have no access to basic water amenities. As a further example, 77% of households in communal areas and 69% of households in urban informal areas lack access to basic sanitation. An analysis of the state of infrastructure development should thus recognise the significantly different circumstances that exist in municipalities across the country and the related differences in the financial viability of these local governments. This matter is complicated further by the seven sub-categories of municipalities that the Department of Cooperative Governance and Traditional Affairs (CoGTA), National Treasury, and the Municipal Infrastructure Investment Framework (MIIF) utilise for purposes of service level modelling, namely:

- A: metropolitan (currently 6 in total);
- B1: secondary cities: (21 local municipalities with the largest budgets);
- B2: municipalities with a large town as core (29);
- B3: municipalities with relatively small populations and a significant proportion of urban population but with no large town as core (111);
- B4: municipalities which are mainly rural with, at most, one or two small towns in its area (70);
- C1: district municipalities that are not water service providers; and
- C2: district municipalities that are water service providers.

A third factor is the different geo-spatial patterns that are evident in municipal performance. The recent State of the Cities Report (2011), for example, revealed that in more political stable regions the municipalities generally perform on higher levels than in areas which are characterised by so-called "factionalism" in the ruling political party, poor political and administrative leadership and low capacity.

A fourth factor that compounds an analysis of the status of infrastructure development is that reliable data sets and accurate statistics are largely unavailable. There is general consensus, based on recent StatsSA census data (2011), that municipalities face a daunting task to eradicate backlogs.

Nevertheless it is not clear what the current state of affairs is on the specifics of the status of municipal infrastructure development. The Institution of Municipal Engineering of Southern Africa (IMESA) undertook for example in 2002, a survey of infrastructure maintenance among South African municipalities to determine their appreciation for and application of infrastructure maintenance. On the positive side the findings of the survey that stood out were that municipalities generally have adequate infrastructure maintenance practices in place. These practices mostly include asset registers, demand analysis, asset utilisation, maintenance and disposal. However, the survey also revealed poor financial planning for the improvement of existing infrastructure, and the lack of best practice regarding asset accounting. Generally Recognised Accounting Practices (GRAP) and the former Generally Accepted Municipal Accounting Practice (GAMAP) require municipalities to depreciate assets. Generally, however, municipalities do not apply a depreciation model that will determine the funding to be put aside each financial year to meet future liabilities for the renewal of infrastructure.

The survey concluded that municipalities generally have low capability levels of infrastructure maintenance. It was also found that municipalities generally struggle to adhere to statutory obligations, such as the compilation of Integrated Development Plans (IDPs) and Water Services Development Plans (WSDPs). Furthermore, an audit conducted by the Council for Scientific and Industrial Research (CSIR) in conjunction with the Construction Industry Development Board (CIDB) in 2007 concluded that no record could be found of any formal broad-based audits or studies of the state of municipal infrastructure in South Africa. The Infrastructure Barometer of the Development Bank of Southern Africa (DBSA, 2006) provides an overview of the state of infrastructure in the key sectors of water and sanitation, energy, ICT and transport. This Barometer also identifies backlogs and the challenges and constraints in the provision of these services. The Barometer (2006, and subsequently in 2012) focussed primarily on municipal infrastructure services and noted with concern the serious lack of information on infrastructure assets in many municipalities (DBSA, 2006:179; 2012: 103).

Various agencies, such as the South African Local Government Association (SALGA), National Treasury, the Department of Co-operative Governance and Traditional Affairs (CoGTA), as well as individual municipalities, perform audits of their own infrastructure. Nevertheless there seems to be no reliable data about the state and performance of municipal infrastructure and its maintenance. Data available from the South African Cities Network's "State of the Cities Report (2011)", "State of Cities Finance Report (2013)", and the "South African Informal City Book (2013)", reflect that in especially low-capacity municipalities statistics on the extent and capacity of infrastructure assets can be highly unreliable. The CSIR/CIDB audit report (2007) concluded that many municipalities do not conform to the requirements of the following: Municipal Finance Management Act 56 of 2003, the Local Government: Municipal Systems Act 32 of 2000 (MSA), and the Free Basic Services Policy, (which entitles all households to an agreed level of free basic services), as well as other legislation that requires local authorities to ensure that adequate provision is made for the long-term maintenance of their infrastructure assets. The audit report concluded that there are "gross shortcomings in maintenance policies and practice".

A final factor which hampers analysis is the different budgeting and spending patterns of municipalities. According to the National Treasury (2011), local and district municipalities spend more of their budgets (24,9%) on capital projects than the metros do (15,6%), but less on operations. In other words, local and district municipalities budget relatively more (than the metros do) to acquire infrastructure than they do for operating and managing it.

Furthermore, the range of dependency on national transfers varies widely - from the lower level of dependency found in some of the metros, through to the extremely high levels of dependency found in mostly rural municipalities. More and more new infrastructure is being constructed without addressing the condition of the existing infrastructure, in the attempt to address imbalances in access to services. However, this has the unintended consequence of widening the gap among municipalities in their maintenance of infrastructure. Generally the poorest municipalities have acquired the most infrastructure relative to their ability to look after it, but lack the resources to maintain the new and existing infrastructure adequately. Furthermore, a study conducted as far back as 2004 by Gibson revealed that over 75% of the non-capital income for infrastructure development in local and district municipalities is contributed by national grants and subsidies, compared to 11% averaged by metropolitan municipalities.

From the above it is evident that municipalities face serious challenges with respect to backlogs. Municipalities are expected to collaborate with the Department of Public Works through the Expanded Public Works Programme to deal with poverty and unemployment. It is therefore noted with concern that the Department of Public Works misspent R3.65 billion since 2009 (Cronin, 2013). Municipalities should also partner with the Department of Human Settlement to provide decent housing for the destitute. South Africa still has a large number of informal settlements ("shacks"), which has serious consequences since these areas are generally poorly located, do not have access to (legal) electricity, and are prone to fires, health hazards, and other risks.

Progress in addressing infrastructure backlogs shows some positive and also negative trends. According to Minister Baloyi (Budget Vote, 2013), only 54% of the country's population has access to all four basic services of water, sanitation, electricity, and refuse removal. This ranges from 88% of the people in the Western Cape to 15% in Limpopo. An audit report presented by the Department of Performance Monitoring and Evaluation (2013) to the Portfolio Committee in Parliament states that currently 94.5% of households have access to clean water. However, due to of a lack of maintenance, 21% of the households with access to running water do not always get the water from it. There are also signs that the rate of delivery of water infrastructure is slowing down, due to a lack of bulk infrastructure and a shortage of engineering expertise for maintenance and operation. Access to sanitation increased from 77% in 2009 to 82% in 2011, but is not on target for 100% in 2014. Again 26% of households are affected by sanitation services and facilities that are not fully functional. Access to electricity improved from 81% in 2009 to 84% in 2011, but is also not on target for 100% in 2014. This is due to limited generation capacity, as well as the lack of bulk infrastructure and distribution networks. According to the Local Government Revenue and Expenditure: Third Quarter Local Government Section 71 Report released in June 2013 by the South African Local Government Association (SALGA), municipalities achieved a revenue collection rate of 94.6% in the year to date. However, in spite of improved revenue collection, the same report revealed that only 73% of municipalities pay suppliers within the 30 days mandated by Cabinet.

### *2.1 Municipal capacity required to deliver infrastructure projects*

As stated earlier, asymmetry exists between the capacity of various types and categories of municipalities in South Africa. However, it is evident that municipalities generally experience significant challenges in adhering to its Constitutional mandate of turning "developmental" and to deliver services on an acceptable level.

The MSA requires municipalities to prepare Integrated Development Plans (IDP) in cooperation with their communities so that inclusive future development requirements can be projected. The process of developing IDPs has highlighted serious institutional, capacity and capability constraints which municipalities face in their servicing of marginal communities. This problem is compounded by the revised mandate introduced through the National Department of Housing's amended policy, "Breaking New Ground". This policy requires "accredited municipalities" to prepare "Housing and Municipal Integrated Development Plans" as part of the process of gaining access to housing programme funding. Furthermore, most district and local municipalities have an extremely limited capacity to function as authorities and to be providers of energy, water, sanitation, transport and other municipal services. The 2003 Municipal Demarcation Board's capacity assessment of district and local municipalities revealed a range of institutional capacity challenges which confront most district and local municipalities. These challenges revolve mainly around municipalities' capacity to render basic services with its equitable share and grant allocations, limited tax base and poor revenue and debt collection practices. Due to these limitations municipalities generally find it extremely difficult to provide free basic services as expected. Such free basic services are defined as:

- water: 6 kilolitres per household per month;
- electricity: 50 kWh per household per month;
- waste removal: access to a refuse dump in rural areas, a communal refuse dump that is well-managed by the community, and collection at least weekly in urban areas.

This challenge thus concerns the poor linkage between marginal communities and the institutional and financial capacity of municipalities. According to the Auditor General's 2011/12 consolidated report, released in August 2013, only 5% (17 out of 278) of municipalities in South Africa received a clean audit. The Auditor General (at that time), Terence Nombembe, questioned the level of leadership, accountability, and commitment of municipalities to improve this unsatisfactory state of affairs. The South African Institute of Chartered Accountants also expressed concern over the slow progress made by municipalities to achieve clean audits. The Institute singled out the diminished capacity of human resources in municipalities as an underlying cause of poor audit reports.

A further challenge is the causal relationship between the delivery of basic services and housing. This dependency correlation implies that infrastructure projects cannot be executed if housing is not delivered. The lack of integrated and coordinated planning by municipalities leads to a situation where infrastructure projects, such as electricity supply, sewerage, and water pipelines, only take form after the construction of houses. To connect electricity, water pipes, and sewerage after a house is already constructed, is highly problematic and costly. Municipalities generally lack the capacity to plan infrastructure projects in a coordinated way and to plot milestone dependencies on Gantt-charts.

Due to political and other dynamics, municipalities generally experience a high turn-over of senior administrative and political leaders. This generally leads to a situation in which some senior managers are not cooperative and may still pay allegiance to a suspended manager or councillor. Where there is tension between offices and factions a divisive atmosphere is created within the organisation. A lack of cooperation and coordination between the various departments and directorates generally also leads to insufficient planning for infrastructure projects.

## 3. MUNICIPAL INFRASTRUCTURE DEVELOPMENT: SUPPORT FRAMEWORK AND STRUCTURES

Since democratisation in 1994, the South African local sphere of government experienced (and is still experiencing) major restructuring exercises, and is exposed to political dynamics, and different strategic orientations. A positive outcome of this fluidity was the establishment of a comprehensive statutory and regulatory framework, which helped to identify, design, and execute infrastructure development projects in municipalities. Based on this framework, support structures were established to facilitate infrastructure projects.

In terms of the Constitution of the Republic of South Africa, 1996 (Section 152) municipalities are obliged to ensure that municipal services, as provided for in Part B of Schedule 4 and Part B of Schedule 5, are delivered in a sustainable way. The White Paper on Local Government (1998) also recommends that municipalities establish innovative ways of providing and accelerating the delivery of municipal services. Further impetus to the establishment of a framework for infrastructure projects was provided by the White Paper on Municipal Service Partnerships (2004), which established municipal service partnerships (MSP) as a core mechanism to render basic municipal services. The MSP aims to provide a framework within which to optimally utilise limited resources of municipalities. The MSP has been derived from the principles of Batho Pele (White Paper on Public Service Delivery, 1997), by means of integrated development planning (IDP) processes and through participation of the community in helping to determine service priorities. The MSP policy encourages universal access to basic municipal services, the progressive improvement in service standards and openness and transparency in the processes used for selecting service providers.

To support municipalities in their obligations to develop infrastructure, the South African government established extensive legislative, strategic and financial support frameworks and structures. On a national sphere these include the President's State of the Nation Address (SONA); the Government's Programme of Action (GPoA) in which so-called "apex" priorities for Government are specified; the National Development Plan: Vision 2030 that specifies the parameters and context of infrastructure development; the Medium-Term Strategic Framework, as well as the Medium-Term Expenditure Framework. The Infrastructure Development Cluster comprises all infrastructure sector departments and is tasked with oversight and the integration of infrastructure planning and implementation.

The Presidency has two departments that are tasked with integrated planning of infrastructure. Firstly, the National Planning Commission (NPC) develops long-term integrated development plans for all sectors, including infrastructure. Secondly, the Department of Performance Monitoring and Evaluation (DPME) has a dedicated economic infrastructure outcome that is monitored and reported to Cabinet periodically. Furthermore, the Presidential Infrastructure Coordination Commission (PICC), headed by the President, is tasked with coordinating and overseeing the implementation of strategic infrastructure projects. The National Treasury is responsible for providing the budget for national infrastructure. Infrastructure-related departments are responsible for medium- to long-term planning of specific infrastructure sectors, programmes and projects.

Further structures and frameworks include the Expanded Public Works Programme (EPWP), the Municipal Infrastructure Investment Framework (MIIF), the Urban Development Framework, the Integrated Rural Development Strategy, the Urban Renewal Strategy, the National Spatial Development Perspective, and the Consolidated Municipal Infrastructure Programme (CMIP). The Municipal Infrastructure Grant (MIG) and the Equitable Share Grant were created for financial support.

For management support, Planning and Implementation Management Support Centres (PIMS-Centres) were established at district council level to assist local municipalities with the execution of their IDP processes.

Given the 2013/14 financial year budget of R56.12 billion, it is the task of the Ministry of Cooperative Governance and Traditional Affairs (CoGTA) to facilitate support to municipalities and to coordinate governance among the three spheres of Government. In this regard R1.6 billion has been allocated to the Community Works Programme to minimise the impact of poverty due to unemployment. According to SALGA (2013), spending of the Municipal Infrastructure Grant was at 79% for 2012/13. On the other hand, expenditure by municipalities of the Urban Settlements Development Grant, which assists municipalities to upgrade informal settlements, improved over the 90% spending level of 2011/12. Municipalities receiving direct conditional grants reported an average expenditure of 88.4%. This is a significant improvement from the 2011/12 underperformance, when an average expenditure of 48.7% was reported for 155 of the 278 municipalities that complied with the National Treasury's process to verify expenditure.

The National Strategic Framework for Comprehensive Municipal Infrastructure Management (2010) was developed by the former Department of Provincial and Local Government (currently CoGTA) as a strategy for a comprehensive plan to manage infrastructure and thereby ensure sustainable service delivery. The development of a Comprehensive Infrastructure Plan (CIP) should serve as a business model to provide strategic focal inputs to municipalities' integrated development plans (IDPs). The CIP provides an enabling framework for the implementation of the IDP by focusing the efforts of government programmes in a consolidated manner towards sustainable service delivery.

A further support mechanism is the development of the Industry Guide 2007 (as revised in 2009/10) by CoGTA in conjunction with stakeholders such as professional bodies. This Guide, officially known as "An Industry Guide – Infrastructure Service Delivery Levels and Unit Costs 2009/10", has the following aims:

- Reflect the broad stakeholder inputs and adoption of unit standards and costs for infrastructure.
- Address regional/provincial and sectoral/industry-related cost values, as well as to allow for national impacts such as variance in labour rates, fuel and transport costs, materials, and other related factors.
- Align the associated costs of infrastructure construction within the changed market conditions to reflect the escalation since the 2007.
- Ensure that infrastructure types such as sport facilities are incorporated into the revised Guide document.

The overall objective is therefore to develop a practical, contemporary and relevant nation-wide system of guidance for municipalities. The focus will be on providing cost values for infrastructure, planning estimates and assessment guidelines that are value for money. The Industry Guide should be used in conjunction with related mechanisms, such as the Municipal Services Financial Model (MSFM) and the Municipal Infrastructure Investment Model MIIF), to corroborate cost estimates for planning of infrastructure.

A further significant initiative taken by Government to establish a framework conducive for infrastructure development was the establishment of the Municipal Infrastructure Grant (MIG).

MIG is a conditional grant to municipalities and it complements the equitable share grant for local government (DPLG MIG, 2006: 14). This grant is provided on a conditional basis to municipalities and is allocated to specific municipalities on the basis of a formula. The MIG programme aims to provide only basic infrastructure service (DPLG MIG, 2006: 3). Through the MIG programme the Government helps municipalities to develop the capacity of their capital project management. This is facilitated mainly through establishing project management units (PMUs) within municipalities. The PMUs are accountable to the council and management structure of the municipality (DPLG MIG, 2006:16). The national MIG unit and the provincial programme management units fulfil a support role to PMUs. The MIG programme further promotes the devolution of the project management function, which implies the establishment of a project management function within a municipality. The Municipal Infrastructure Investment Framework (MIIF), for example, covers the maintenance of roads (DPLG MIG, 2005:4). This framework for the delivery of municipal infrastructure is based on Chapter 3, section 41(i) of the Constitution (1996).

A further initiative taken by Government was the establishment of the Construction Industry Development Board (CIDB). The CIDB was created to provide leadership to stakeholders and to stimulate sustainable growth, reform and improvement of the construction sector. The objective is effective delivery and the industry's enhanced role in the country's economy. The CIDB designed a "Toolkit for Infrastructure Delivery Management" (2006) to improve the design and execution of infrastructure projects. The CIDB further published its "Standard for Developing Skills through Infrastructure Contracts" and the "Standard for Contractor Performance Reports for use on Construction Works Contracts" (Grades 2 to 9) in August 2013.

Based on the Local Government Turn-Around Strategy (2011) and the fact that municipalities failed to spend approximately 14% of their R9.9 billion MIG budget, CoGTA established the Municipal Infrastructure Support Agency (MISA). MISA's main purpose is to address capacity challenges. This is accomplished by supporting municipalities with planning, management and other technical expertise to roll-out infrastructure more efficiently and effectively. MISA builds on some of the key initiatives which are relevant here, including:

- Project Consolidate;
- The Five Year Strategic Agenda;
- Siyenza Manje programme (managed by the Development Bank of Southern Africa's Development Fund to deploy technical experts to municipalities); and
- Operation Clean Audit 2014.

Special infrastructure development projects earmarked for MISA's support include water, sanitation, electricity, waste management and the building of access roads. To support MISA in this support role, Government put in place norms and standards for infrastructure delivery as well as adequate monitoring mechanisms to enforce these norms and standards. Government also focuses on accelerating the building of skills and capacity for enhanced infrastructure delivery where it is lacking in municipalities. It is estimated that meeting the infrastructure backlogs in local government would cost at least R495 billion (CoGTA, 2013).

On the provincial level, municipal support for projects to develop infrastructure include the following: Provincial Growth and Development Plan, Provincial Programme Management Units, Project Registers at the Offices of the Premier and Provincial PIMSS forums.

These national and provincial frameworks and structures in turn inform municipal project planning of infrastructure through related mechanisms such as the Integrated Waste Management Plan, the Environmental Management Framework, and its top-layer Service Delivery and Budget Implementation Plans (SDBIPs). In terms of Section 55(1)(a) of the Local Government: Municipal Systems Act 32 of 2000 (MSA), municipalities must provide services in a sustainable and equitable manner. To adhere to this mandate, the Director: Infrastructure must work in close collaboration with Project Management Units (PMUs) to support the design and execution of infrastructure projects. Furthermore, the IDP of the municipality must contain a Capital Investment Programme within the parameters set by the Local Spatial Development Framework (MSA, Section 26(e)).

In terms of section 153(b) of the Constitution, municipalities have a duty to participate in national and provincial development programmes. The municipalities use the Integrated Development Plan (IDP) to fulfil these constitutional obligations. In terms of section 25(1) of the MSA, each municipal council must adopt an IDP. The IDP integrates and co-ordinates plans and takes into account proposals for the development in the municipality. The IDP is a strategic plan for the sustainable development of the municipality (Steytler & De Visser, 2010: 7-4).

From the brief orientation above it is evident that an extensive framework already exists which can support municipalities in designing, executing and maintaining infrastructure projects. The alignment of these various efforts into a coherent and synergistic approach could go a long way towards improving the effectiveness of project planning for better infrastructure in South Africa. In the next section the nature of infrastructure projects will be highlighted to obtain conceptual clarity of the key construct of this article.

## 4. MUNICIPAL INFRASTRUCTURE PROJECTS: CONCEPTUAL CLARIFICATION

In its most simple form a project probably can be regarded as an endeavour that has a beginning and an end (Turner, 1993: 4; Maylor, 1999: 5). To this definition Wyscohi, Beck and Crane (2000: 65), Meredith and Mantel (2003: 9), as well as Turner (2009: 2), add that a project can be regarded as a "…temporary organisation to which resources are assigned to do work, to deliver beneficial change". Kutzen and Blitz (1991: 2) in turn describe a project as a set of principles, methods, tools and techniques for the effective management of objective-oriented work. A project can also be defined by focusing on its managerial dimensions: the optimal utilisation of resources to ensure that the project output is adhered to in terms of time, budget and quality constraints (Kutzen & Blitz, 1991: 2; Kerzner, 2003: 9). Maylor (1999: 3) and Burke (2006: 2-3) elaborate further: this includes planning, organising, directing and controlling activities. As both discipline (theory) and application (praxis), project management is guided by the Project Management Institute's (PMI) Project Management Body of Knowledge (PMBOK). PMI's purpose is to establish best practice standards across industries (Heldman, 2003: 27; Klastorin, 2004: 18). The PMI provides the fundamentals of project management as an international recognised standard (IEEE STD 1490 – 2003). It recognises five process groups or life-cycle phases and ten knowledge areas (PMBOK Guide, 2012).

In a municipal context projects are typically clustered in portfolios within strategic programmes (i.e. IDP, LED and MIG) to render particular services (Van der Waldt, 2009:72). With the MIG programme, CoGTA emphasises the fact that project management is an integral function of any municipality.

The main mechanism for this purpose is the establishment of Project Management Units (PMUs) to oversee the design and execution of infrastructure projects. As an example, the City Council of Matlosana set up a PMU during the 2004/2005 financial year. The PMU structure received an amount of R1.2 billion from the MIG during the 2010/2011 financial year (City of Matlosana, 2009-2010). The PMU must ensure compliance with the scope and budget parameters specified in the IDP. In the development of their IDPs, district councils have to take the following factors into consideration:

- community infrastructure needs in the council areas, by targeting the poorest communities;
- capital expenditure and available funding resources, which include an equitable share from national government, grants from national government for infrastructure projects, the Consolidated Municipal Infrastructure Programme, departmental budgets, and other sources, such as donations from donors or the private sector, loans and public-private partnerships;
- policy options (cost-benefit) available to municipalities;
- community involvement in selecting the most urgent priorities;
- developmental needs and development of infrastructure;
- the vision for the municipality on infrastructure development; and
- on-going maintenance and integration of infrastructure projects.

According to DBSA (2006: 20) municipal infrastructure projects are generally categorised in terms of the following three types:

- physical infrastructure, such as water pipes, roads and storm water drains;
- social infrastructure including houses, clinics, sports grounds and schools; and
- economic infrastructure consisting of the establishment of business districts, transport systems and telecommunication networks.

For the purpose of this article and the empirical investigation conducted at Dr KKDM, "infrastructure projects" only refer to the development and construction of physical capital projects typically undertaken by district municipalities.

## 5. RESEARCH METHODOLOGY: DR KENNETH KAUNDA DISTRICT MUNICIPALITY AS CASE STUDY

Based on an empirical investigation, this section outlines the practices and challenges associated with infrastructure development projects at Dr Kenneth Kaunda District Municipality (Dr KKDM) as case study.

### *5.1 Case study methodology*

Through a qualitative research design, a case study method was utilised for the present study. A case is a concept in research that refers to the fact that a number of (or single) units of analysis are selected that are highly representative of the particular target population under investigation (Leedy & Ormrod, 2001: 149; Babbie & Mouton, 2002: 280-283).

The instruments used for data collection were semi-structured interviews with key role-players responsible for infrastructure projects, as well as document analyses of financial and performance reports and strategic and technical documents (period March – Augustus 2013).

As a member of the Audit and Risk Committee (ARC) of Dr KKDM, the author/researcher had access to such documentation as well as to senior managers of the respective managers of Departments of Infrastructure (local municipalities) and PMUs. These respondents were targeted (i.e. by purposive and convenience sampling) as units of analysis. In compliance with ethical research guidelines, great care was taken not to reveal sensitive information or the identity of the respondents. The author/researcher further ensured that he did not contravene the confidentiality clauses and code of conduct of the ARC.

Semi-structured interviews enabled the author/researcher to obtain multiple responses to set questions and allowed for detailed responses. It gave the researcher the opportunity to pose questions about specified topics and the respondents had a great deal of leeway to reply (*see* Struwig & Stead, 2001: 98; Bryman, 2001: 314). The researcher constructed an interview schedule to conduct the interviews in a uniform manner. Some biographical details of the respondents, such as their managerial level, years of experience in infrastructure projects, and their managerial position, were vital for the interpretation of responses. The total number of eighteen respondents was representative of the target population. The aim of the study was to explore practices and challenges associated with the design and execution of infrastructure (capital) projects and to uncover innovative best practice in the governance of infrastructure projects.

### *5.2 Profile of Dr KKDM*

Dr KKDM is situated in the North-West Province, and includes four local (category B) municipalities, namely Maquassi Hills (Wolmaranstad), Matlosana (Klerksdorp), Tlokwe (Potchefstroom), and Ventersdorp local municipalities.

The area covered by the District Municipality appears on the map below (Figure 1).

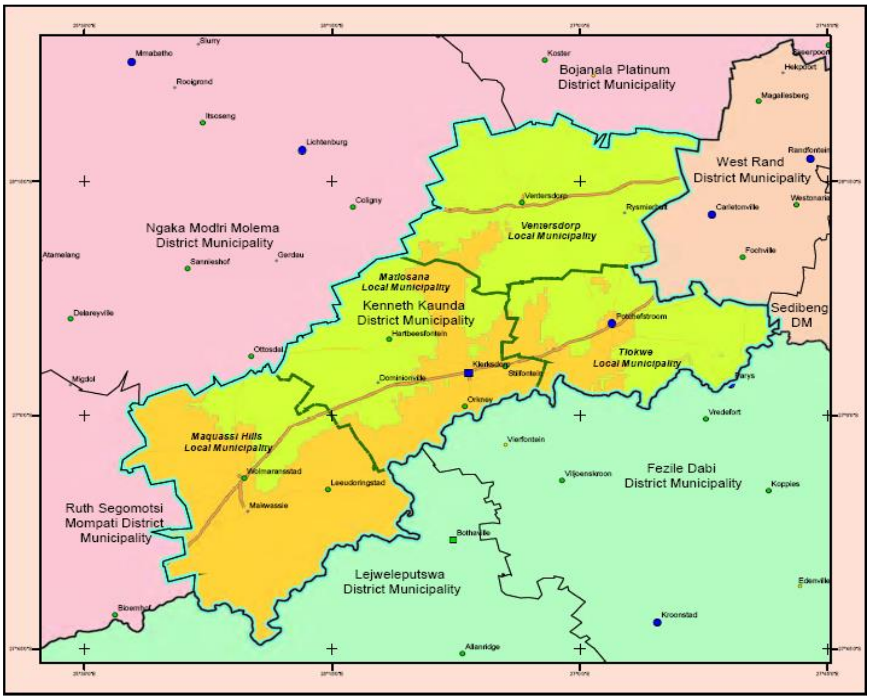


***Figure 1*: Map of Dr Kenneth Kaunda District Municipality**
(Source: Maxim Planning Populations, 2007)

The office of the District Municipality is situated in Orkney, in the Matlosana Local Municipality, and is located approximately 65 km southwest of the Gauteng Province. This District Municipality borders the Gauteng Province to the northeast and the Free State Province to the south. According to Statistics South Africa (StatsSA Community Survey, 2007), the population of the Dr KKDM was 634 134 (Table 1). The population is unevenly distributed among the four local municipalities.

***Table 1:*** **Population Composition**

| Area | Population |
|---|---|
| Ventersdorp LM | 36 532 |
| Tlokwe LM | 124 350 |
| City of Matlosana LM | 385 784 |
| Maquassi Hills LM | 87 468 |
| Dr Kenneth Kaunda DM | 634 134 |

(Source: Statistics South Africa, *Community Survey*, 2007)

The majority of the Dr KKDM population resides within the City of Matlosana LM (60.8%), followed by City of Tlokwe LM (19.6%), Maquassi Hills (13.8%), and Ventersdorp (5.8%). The number of wards per local municipality is: Matlosana (35), Tlokwe (26), Maquassi Hills (11) and Ventersdorp (6) for a total of 78 in the district. The number of households within the DM was estimated at about 287 000 during the StatsSA Community Survey (2007).

The infrastructure competencies of the Directorate: Infrastructure and Utilities include the following functions:

- Support and administration
- Development planning and building control
- Roads and storm water
- Waste landfill sites
- Water
- Sanitation
- Building construction.

## 6. RESEARCH FINDINGS: INFRASTRUCTURE PROJECT CHALLENGES AND POSSIBLE SOLUTIONS

The findings from this study indicate various challenges associated with infrastructure projects. For purposes of analysis these challenges are categorised broadly into technical/administrative, financial, and political/governance challenges below. It should be noted that these three areas are highly interrelated and interdependent. Some financial challenges, for example, may have political causes and remedies. Where possible, the challenges that are highlighted are reported in descending order, based on the relative significance attached to it by the respondents and inferences made from document analysis (performance reports). In line with the aims of this article, best practice and possible remedies or solutions to address these challenges are reflected next to some of the most significant challenges.

### *6.1 Technical/administrative challenges and solutions*

The most significant challenge highlighted by the respondents (83%) is the limited interaction between the district and local municipalities. Limited interaction causes problems especially for IDP planning and priority-setting of infrastructure projects. The respective Directors: Infrastructure do not adequately plan jointly and there is a general lack of coordination and cooperation. This challenge could be the outcome of politics, but could ironically also be cured by political intervention. A division of responsibilities should be clarified between district and local municipalities in this regard.

Respondents (63%) also indicated a lack of coordination between the district and local municipalities and the provincial and national departments. This results in provincial and national departments implementing infrastructure projects unilaterally and without proper consultation with municipalities. Ultimately the municipalities could be held responsible for the maintenance of these assets within their area of jurisdiction. Sphere-driven infrastructure development should consider the operational capacity and financial implications such forms of development hold for municipalities. The principles of co-operative governance as well as the various mechanisms that are in place to facilitate intergovernmental relations should be utilised to its fullest potential to address this challenge. These mechanisms include Minister-Members of the Executive Committees (MINMECs) and the Mayoral Forums.

A further challenge that was identified (54%) is that risk assessment for the entire project life-cycle is not done adequately. Especially financial and legal liability risks should be factored into project planning for new infrastructure. Coupled with keeping poor records, the practice of risk management deserves special attention. Sensitive documents are not properly safeguarded and often simply get lost. In accordance with the National Archives and Records Services Act 43 of 1996 (as amended by Act 36 of 2001), all municipalities should design and maintain a registry of official documentation.

Another challenge is that the PMUs generally have limited capacity to plan and oversee infrastructure projects successfully. Some local municipalities often utilise MIG-funding for other purposes, even for the payment of salaries. This situation is complicated by insufficient role clarification between municipal project managers from the Department: Infrastructure *vis-a-vis* the role and responsibility of the service provider's project managers (i.e. that of private contractor). Site inspections should be undertaken regularly by the municipality to oversee progress and value-for-money delivery, and to assess the adherence to specifications for tender contracts.

Based on the document analysis it is evident that all local municipalities within the Dr KKDM struggle to recruit and retain skilled personnel. Staff capacity seems to remain a huge concern. In the case of Matlosana Local Municipality the Directorate: Infrastructure and Utilities has 1 040 approved posts, but currently 396 of these are vacant. Municipalities face substantial responsibilities for services delivery with relatively limited capacity and resources. This challenge is compounded by the fact that Dr KKDM has limited human resource policies and development strategies in place. The Human Resource Directorate is currently under-staffed. In addition there is a high-staff turnover and a general lack of commitment by senior staff members. This has led to low morale and a lack of motivation among lower staff levels. Practices of supervision, monitoring and control all deserve urgent intervention. Although most department heads had signed performance agreements, all agreements should be reviewed based on the setting of specific performance targets.

### 6.2 Financial challenges and solutions

Except for road maintenance, respondents generally concurred that the budget allocation for Dr KKDM is adequate for rendering the most pressing infrastructure services. The budget allocation for infrastructure (capital) projects for the 2012/2013 financial year is as follows:

| Capital projects | Budget allocation |
|---|---|
| Roads | R13,2m |
| Electricity | R8,1m |
| Water | R30,4m |
| Waste management and waste disposal | R21,1m |

(Source: Dr KKDM Budget 2012/2013)

The most significant challenge that was highlighted (82% of respondents) is that there is a lack of co-operation between the District Municipality (DM) and the Local Municipality (LM) – they do not work in sync. The District Municipality (DM) does plan, fund and implement certain infrastructure projects, such as the construction of high mast lights, and then transfer the asset (project) to a local municipality (LM). The problem, however, is that very often the local municipality did not budget for the operation and maintenance of the project. Furthermore, the DM cannot budget properly for projects due to the fact that LMs provide them only with a list of projects once the budget/IDP cycle has already started. This list also lacks a proper business plan, project specifications, estimates of costs, and scope. The DM must then themselves prioritise the lists of proposed projects they have received from the LMs. The DM's priorities may not be congruent with the relative priority which the IDP of the LM attaches to it. This challenge emphasises the lack of joint planning, as it was also highlighted under technical/administrative challenges above. The DM and the local municipalities should budget for the entire project cycle; not only for the construction costs, but also for its operating costs, maintenance, cessation of service, and removal of assets.

A further major challenge (55%) is the delays in payment that is experienced due to strict Tender and Supply Chain Management processes and procedures. This usually causes an escalation of the project costs. The roll-over of funding (budgets) of projects from one financial year to another is not uncommon, which frustrates auditing and complicates accounting practices. This challenge is further complicated by inadequate screening of potential suppliers in the tender evaluation process. Often the tender is awarded based on the lowest cost, without due consideration of the supplier's track record, capacity, and relevant work experience. Sometimes the contractor obtained many tenders simultaneously and money paid by the municipality is then used to fund other projects. As a result, municipal projects are neglected and the scope and duration of such projects are extended.

Further challenges emerging from the document analysis and interviews include the following:

- Strategies to contain costs are lacking.
- There is a high turn-over of accounting officers, especially of Chief Financial Officers.
- The Indigent Register is not accurate and municipalities experience relative high rates of non-payment of services (municipalities should differentiate between those who cannot pay and those who refuse to pay, and apply sanctions to the latter).
- The Revenue Enhancement Strategy and Debt Collection Strategy are not well designed and are not executed proficiently.

- Relative high levels of corruption take place in the pre-paid electricity system (installation of breached electricity), and general malpractices occur, especially in the unofficial use of municipal vehicles and the mismanagement of overtime.

### *6.3 Political/governance challenges and solutions*

In project governance the most significant challenge that was identified is the lack of alignment between the IDPs of Dr KKDM and its Local Municipalities. This includes the lack of interface between IDPs, Service Delivery and Budget Implementation Plans (SDBIPs) and the Performance Management Systems of the municipality. Such challenges seriously hamper the monitoring of the council and oversight over capital projects.

A significant percentage of respondents (67.4%) indicated that factionalism in the rural party, and especially tension between the offices of the Executive Mayor, Speaker, and Municipal Manager, leads to dysfunctional governance. Senior managers do not feel protected due to the fine line between politics and administration. This issue should be addressed by decisive political leadership and role clarification.

There is general consensus that an adequate governance framework (e.g. policies, strategies, and guidelines) does exist that provides parameters for the design and execution of infrastructure projects. Nevertheless, there is concern that these parameters are often not enforced adequately. One case in point is the requirements according to which water-quality samples from the wastewater treatment works have to be submitted routinely to monitoring authorities. In many cases it seems that these requirements are not complied with and, furthermore, there seems to be little capacity or political will to enforce these monitoring requirements. In this respect the most significant challenge seems to be inadequate financial provision for the long-term maintenance and on-going operation of infrastructure.

In many cases, the provision of municipal infrastructure implies collaboration among the DM, the LMs, the sectoral departments in the province, the National Government, and service providers. The physical provision of bulk electricity, for example, is the responsibility of National Government through Eskom. Another example is the development of water infrastructure, which is a national competence, but municipalities render this service locally to their residents.

## 7. INNOVATIVE BEST PRACTICE

Regarding innovative best practice, the study revealed interesting initiatives that deserve further investigation. Through such investigations the impact of these initiatives on the successful delivery of infrastructure projects can be measured. Some of these initiatives include the following:

- the implementation of Service Delivery Forums to identify and prioritise infrastructure needs;
- the alignment of MIG with the Financial Management Grant (FMG), and the Municipal Systems Improvement Grant;
- the implementation of a Project Register in the Office of the Premier to prioritise, document and track the progress of sectoral and municipal projects in the province;
- proper infrastructure project oversight by the Audit and Risk Committee and the Municipal Public Accounts Committee; and

- the use of a Project Management Information System (PMIS) and scientific data collection of infrastructure projects through Geographical Information System (GIS) technology, such as GISTEXT (Land Information Web based application), City Map (Intranet Map Services), and ArcGIS Server (GIS web applications).

## 8. CONCLUSION

This article reported on findings from a study undertaken at Dr KKDM to identify challenges experienced in the implementation of infrastructure projects. The aim was also to uncover potential remedies and best practice that are associated with the design and execution of these projects. It is evident that a comprehensive and integrated framework for infrastructure projects exists in all three spheres of government. The MIG is the most prominent programme to direct the development of municipal infrastructures. The challenges that were identified include significant technical/administrative, financial and political/governance obstacles. Some remedies as potential solutions to these challenges were provided.

It is clear that municipal infrastructure services play an important role in social and economic development. Such services help to create employment opportunities and provide basic services to the urban poor. However, infrastructure projects should be designed properly and executed efficiently if the benefits are to be maximised. More municipal cases should be analysed to uncover obstacles that impede successful infrastructure development and to explore avenues in which to establish innovative strategies of best practice.

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# AN ASSESSMENT OF CONSTRUCTION PROFESSIONALS' LEVEL OF COMPLIANCE TO ETHICAL STANDARDS IN THE NIGERIAN CONSTRUCTION INDUSTRY

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## ABSTRACT

The study assessed the compliance of construction professionals to ethical standards in the Nigerian construction industry. The study area was Lagos State and the target respondents were the registered professionals including architects, quantity surveyors, builders and engineers. A total of one hundred and seventy (170) questionnaire were randomly administered on the professionals and one hundred and thirty eight (138) were retrieved representing 81.18% response rate. Findings revealed that professionals displayed high level of compliance to clients service delivery with Mean Item Score (MIS) ranged between 3.22 to 3.79, educational and professional qualification with Mean Item Score (MIS) ranged 3.18 to 3.71 and standards of practice with Mean Item Score (MIS) ranged between 3.16 to 3.63. The overall rating revealed that professionals have highest level of compliance to standards of practice with 54.76%, while the least ranked ethical standards was fair compensation with 49.31%. ANOVA test established a statistical significant difference among the professionals view about compliance of the professionals to clients service delivery (F value=2.447, P value=0.020) and professional development (F value=3.774, P value = 0.001). The overall level of compliance of construction professionals to ethical standards was 52.37%. It was concluded that clients service delivery; educational training and professional qualification and standards of practices are the most significant ethical standards among construction professionals in Nigeria. Therefore, the study concluded that professionals satisfactorily complied with the ethical standards.

***Key words: Ethics, Compliance, Construction Industry, Professionals, Standards.***

## 1. INTRODUCTION

The nature of construction industry is complex and dynamic. Besides, the industry is fragmented and thereby requires the involvement of various professionals and specialists that work together to achieve a common goal (Gray 2000; Gido, Kerzner and Meredith, 2003). Construction activities involves conceptualizing, designing, managing, organizing and coordinating project requirements including time, money resources, technology and methods. All these must be integrated in the most efficient manner possible to complete construction projects on schedule, within estimated budget, in accordance to the required quality and performance expected by the client (Nadeem, et al., 2009). The industry's primary goal therefore focuses mainly on achieving value for the money the clients has paid for. This is achieved through good service delivery which centres on ethical standards displayed by the construction industry professionals. Construction industry has the sole responsibility of providing physical development through the provision of infrastructure, manpower development, resource employment, fixed capital formation and improvement of the gross domestic product (Omole, 2000; Hillebrandt, 2000). In the light of this, it is therefore expected that construction professionals should discharge their duties with utmost compliance to professional ethical standards.

Professional ethics is the justification of standards of behaviour against practical tasks, which is not necessarily limited to technologies, transactions, activities, pursuits and assessment of institutions. It rather involves practical conceptualization of public expectations in the interest of responsibilities, willingness to serve public interest with high competencies (Chalkley, 1990; Fan et al., 2003; Poon, 2003; Poon, 2004a, 2004b). The strength of the link between the construction industry and the public therefore sustains its existence through overwhelming recourse to demand for the services of its practitioners and unique products such that the relationship is a function of the pride of professionalism. However, the most important threat to the harmonious relationship between the public and the construction industry is the cultural misalignment between public expectations and the construction professionals' conducts (Pollington, 1999). This has brought various criticisms and wrong perception of the public about the professionalism of construction professionals in relation to professional ethics. Based on this fact, it is quite evident that the industry needs to be dynamic and re-appraise the ethical conducts and perception of her professionals so that services provided by the industry can be improved (Lam et al., 2001 and Doree, 2004). In response to this, the study therefore assessed the compliance level of construction professionals (focusing on selected professionals that are engaged throughout the life cycle of any project) to ethical standards in the nation's quest for modality for combating the endemic and intractable monster of corruption. The research findings from this study are expected to be of great assistance to the construction professionals in improving their professional obligations to their clients and to the general public at large.

## 2. ETHICS IN BUSINESS ENVIRONMENT: THEORY AND PRACTICE

Generally, business ethics involves two tasks. The normative task of defining standards of behaviour and the practical task of applying these standards to business conduct. This is interpreted to be the normative versus the positive approach. The normative approach is concerned with developing models of expected behaviour and seeking out for examples in the real world that validate the model. This simply means what ought to be done and what is actually done. The positive approach is about describing real world practices whereby prescriptions of the ideal are suspended until the characteristics of real world behaviour are ultimately understood. Normative and positive ethics can in some ways be considered in relation to the theory and practices of ethics and how they are combined (De - George, 1990). The normative definition of professional ethics is tied up with practical concepts and expectations from the public, such as competence and responsibility.

Combination of professional values and real life practices are not easy in real life situations. It is therefore important for business consultants to be familiar with the field within which they operate if they are to determine whether an action in ethical choices made by consultants is influenced by their values and ideas (Allen and Davis, 1993). Actions may or not coincide with professional norms; however, economic and political considerations may override commitments to ethical values and responsible behaviour. This is common particularly in situations where individual is placed under pressure or exposed to a set of opportunistic circumstances. Conflict between theory and practice have been acknowledged, consultants who maintain high personal and professional values in theory disintegrate in practice through actual ethical dilemmas (Yang, 2000).

### *2.1. Professional Ethics and Construction Professionals*

Professional ethics are embodied in codes of practice which defines the roles and responsibilities of professionals and these professionals are expected to be the upholders of virtues otherwise known as professional ethics (Harris et al., 1995; Calhoun and Wolitzer, 2001). Professional codes of practice addresses client service delivery, qualifications (both academic and professional), and standards of practice among construction professionals. Professionals must therefore adhere strictly to these standards when discharging their duties. There have been several criticisms about construction professionals concerning adherence to ethical standards. Integrity of construction professionals have been questioned with many empirical studies that emphasized practices such as illegal agreements between tenderers that resulted in seemingly competitive bids, price fixing, or market distribution schemes that circumvent the spirit of free competition and defraud clients. Others include bid-cutting, bid-shopping, cover pricing, hidden fees and commissions and compensation for unsuccessful tenderers after consultation with other tenderers (Ray et al, 1999; Zarkada-Fraser and Skitmore, 2000; Zarkada-Fraser 2000; and May et al., 2001).

The study on forms, susceptibility and possible solutions on corruption in the industry noted that uniqueness of many projects made costs difficult to compare. The study revealed the prevalence of uncovered unethical practices such as bad workmanship which may not be easily detected (Shankatu, 2003). Professional ethics in the construction industry was examined. Findings from the study revealed that various unethical issues surrounding construction activities include unfair conduct, negligence, conflict of interest, collusive tendering, fraud, bribery and violation of environmental ethics among others (Vee and Skitmore, 2003). The study concluded that all participants, regardless of professional allegiance require a common understanding of ethical and professional values to move the construction industry forward.

Competence of professionals was assessed in the South African construction industry (Nkado, 2000 and Poon 2004a). The study found out that the industry‘s performance cannot only be measured with respects to meeting clients' demands through the dynamism of technical competencies and innovative skills only. The behavioural pattern of professionals to protect clients' interest and sustain public harmony should be looked into. This shows that the attitude, behaviour and integrity by which professionals' handle matters are quite observed by the public. As an extension of the study, professional ethics in the South African construction industry was examined (Poon, 2004b, Pearl et al., 2005). The study observed that several unethical conducts and ethical dilemmas in the construction industry such as corruption, negligence, bribery, conflict of interest, cover pricing, front loading among others were rampant. The study established significant areas of concern pertaining to the practice of ethical conduct among construction professionals. The research further established that 79% of construction professionals were involved in unethical behaviour, which is on increasing trend with adequate means of curbing the practices yet unavailable. In addition to this, the relationship between professional ethics and construction quality was investigated in Malaysian construction industry. The study found out that unethical practices among professionals have direct negative consequences on the output of the construction industry (Hamzah et al., 2007). Despite the emphasis on the importance of ethical standards on the image of professionalism and practices of construction professionals, it appears little attention had been paid to examine the level of compliance of professionals to ethical standards in the Nigerian construction industry. Thus this research intends to fill this gap.

## 3. RESEARCH METHODOLOGY

The study was conducted in Lagos State on the premise that 75% of construction firms in Nigeria are either based in Lagos States or have their branches located in Lagos (Fagbemi, 2008.) Data for the study were collected through one hundred and seventy (170) copies of questionnaire administered on the professionals in the Nigerian construction industry comprising architects, builders, quantity surveyors and engineers in this area. The choice of these core professionals as the target population was on the basis that these professionals are involved throughout the various stages of construction works. Also, they are involved in the procurement of building projects (Ameh and Odusami, 2009).

Section A of the questionnaire consisted of the demographical information of the respondents, while section B focused on the study objectives. Fifteen (15) major ethical standards were identified from literature. Professionals ranked themselves and also ranked their co-professionals on the level of compliance of professionals to ethical standards on a 5-point likert scale where 5=very high, 4=High, 3= Moderate, 2=Low and 1=very low. The overall level of compliance by professionals was rated from 0-10% to 91-100% where 0 is the lowest and 100 is the highest. A total of one hundred and thirty eight (138) questionnaire were retrieved which represents 81.18% response rate of the total 170 copies administered. Data collected were analysed using descriptive and inferential statistics which includes percentages, Mean Item Score (MIS) and Analysis of Variance (ANOVA). The results of the analysis are presented in tables below. Mean Item Score (MIS) was calculated from the formula given below:

$$\text{Mean} = \frac{5_{n5} + 4_{n4} + 3_{n3} + 2_{n2} + 1_{n1}}{(n_5 + n_4 + n_3 + n_2 + n_1} \qquad (1)$$

**Where,**

$n_{5=}$ number of respondents who picked 5
$n_4$= number of respondents who picked 4
$n_3$ =number of respondents who picked 3
$n_2$ = number of respondents who picked 2
$n_1$ = number of respondents who picked 1

## 4. FINDINGS AND DISCUSSION

**Table 1: Type of Organization**

| Type of Organization | Frequency | Percentage (%) |
|---|---|---|
| Contracting | 35 | 24.27 |
| Consulting | 46 | 33.33 |
| Government | 48 | 34.78 |
| No response | 9 | 6.52 |
| **Total** | **138** | **100** |

***Source: Authors' Survey 2012***

**Table 2: Year of Establishment of Firms**

| Years of Firms | Frequency | Mid-Point | Fx | Percentage (%) |
|---|---|---|---|---|
| 0-10 years | 28 | 5 | 140 | 20.28 |
| 11-20 years | 37 | 15.5 | 573.5 | 26.81 |
| 21-30 years | 29 | 25.5 | 739.5 | 21.01 |
| 31-40 years | 5 | 35.5 | 177.5 | 3.62 |
| 40 -49 years | 18 | 44.5 | 801 | 13.04 |
| Above 50 | 4 | 50 | 200 | 2.89 |
| No response | 17 | - | - | 12.31 |
| **Total** | **138** | | **2,631.5** | **100** |

**Mean=19.06 years**

***Source: Authors' Survey 2012***

**Table 3: Respondents Classification by Profession**

| Professionals | Frequency | Percentage (%) |
|---|---|---|
| Architects | 41 | 29.70 |
| Builders | 25 | 18.10 |
| Quantity Surveyors | 33 | 23.91 |
| Engineers | 39 | 28.26 |
| **Total** | **138** | **100** |

***Source: Authors' Survey 2012***

**Table 4: Academic Qualifications of the Respondents**

| Academic Qualifications | Frequency | Percentage (%) |
|---|---|---|
| OND | 8 | 5.79 |
| HND | 32 | 23.18 |
| B.Sc./B.Tech. | 67 | 48.55 |
| M.Sc. | 10 | 7.24 |
| Ph.D | 4 | 2.89 |
| PGD | 12 | 8.69 |
| No response | 5 | 3.62 |
| **Total** | **138** | **100.0** |

***Source: Authors' Survey 2012***

**Table 5: Professional Qualification of Respondents**

| Professional Qualifications | Frequency | Percentage (%) |
|---|---|---|
| Nigerian Institute of Architects (NIA) | 37 | 26.80 |
| Nigerian Institute of Builders (NIOB) | 22 | 15.90 |
| Nigerian Institute of Quantity Surveyors (NIQS) | 29 | 21.0 |
| Nigerian Society of Engineers (NSE) | 31 | 22.46 |
| No response | 19 | 13.76 |
| **Total** | **138** | **100** |

***Source: Authors' Survey 2012***

**Table 6: Working Experience of Respondents**

| Years | Frequency | Mid-Point | Fx | Percentage % |
|---|---|---|---|---|
| 0-10 years | 39 | 5.5 | 214.5 | 28.26 |
| 11-20 years | 32 | 15.5 | 496 | 23.18 |
| 21-30 years | 28 | 25.5 | 714 | 20.28 |
| 31-40 years | 21 | 35.5 | 745.5 | 15.21 |
| >40 years and above | 18 | 40 | 720 | 13.04 |
| **Total** | **138** | **122** | **2,890** | **100** |

**Mean=20.9**

***Source: Authors' Survey 2012***

**Table 7: Types of Projects Executed by Respondents**

| Nature of Projects | Frequency | Percentage (%) |
|---|---|---|
| Residential | 46 | 33.33 |
| Commercial | 35 | 25.36 |
| Educational | 9 | 6.52 |
| Engineering | 25 | 18.11 |
| Service installation (mechanical & electrical) | 14 | 10.14 |
| No response | 9 | 6.52 |
| **Total** | **138** | **100.0** |

***Source: Authors' Survey 2012***

Table 1 and figure 1 show the type of organisation of the respondents. The result revealed that 24.27% are in the contracting firms, 33.33% are in consulting firms while 34.78% are in the government organisations. This formed a good representation of construction industry stakeholders as their various wealth of experiences at different organisations will provide a reliable data for this study. Table 2 and figure 2 present the year of establishments of firms, from the result, the average years of establishments of firms is approximately 19.06 years. This showed that the professionals are well experienced in construction activities to provide reliable information. From table 3 and figure 3, the classification of respondents by profession was presented. The result shows that 29.70% of the respondents are Architects, 18.10% are Builders, and 23.91% are Quantity Surveyors while only 28.26% are Engineers. Responses from these categories of professionals will assist the study to evaluate different perspectives of the professionals as regards ethical standards. Table 4 and figure 4 show the highest academic qualification of the respondents. The results indicated that 48.50% are holders of B.Sc/ B.Tech, 7.24% are holders of M.Sc, and 2.89% are holders of Ph.D. Only 8.69% are holders of PGD while 28.97% of the respondents have academic qualification not less than HND. From the results, 58.63% of the respondents have the minimum qualification of B.Sc/B.Tech. This indicated that the respondents have the required academic qualifications that could assist to provide a meaningful data from which inferences could be drawn for the study. Also in table 5 and figure 5, professional qualifications of respondents revealed that 86.16% of the respondents belong to various professional bodies in construction industry while only 13.76% of the respondents were not professionally qualified. This shows the ability of these professionals to provide reliable information for the study.

Table 6 and figure 6 show the working experience of respondents in which the mean industry work experience of respondents is 20.9 years. During this period, the professionals would have been exposed to various ethical issues in construction projects. This implied that the respondents have adequate professional experiences to supply required information for this study. Table 7 and figure 7 present the nature of projects the respondents have undertaken during the course of their professional practices. The results indicated that 93.46% of the respondents have undertaken projects ranging from residential, commercial and engineering. This shows that the professionals must have accumulated wealth of experience based on their exposures to various practical ethical issues on the project, which would have being gathered both from the management and administration of those projects. Therefore responses from these professionals could be relied upon in achieving the objectives of this study.

**Figure 1: Type of Organization**

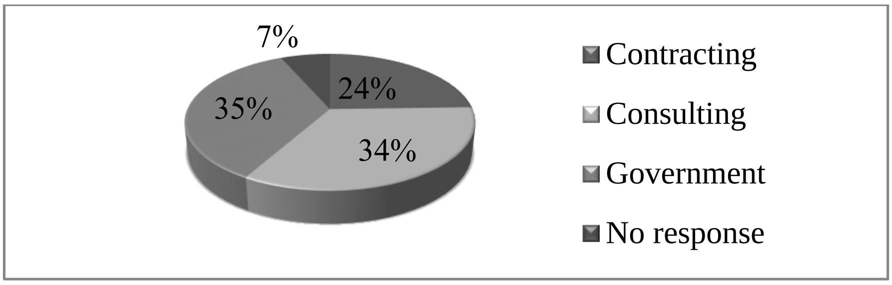


**Figure 2: Years of Establishment of Firms**

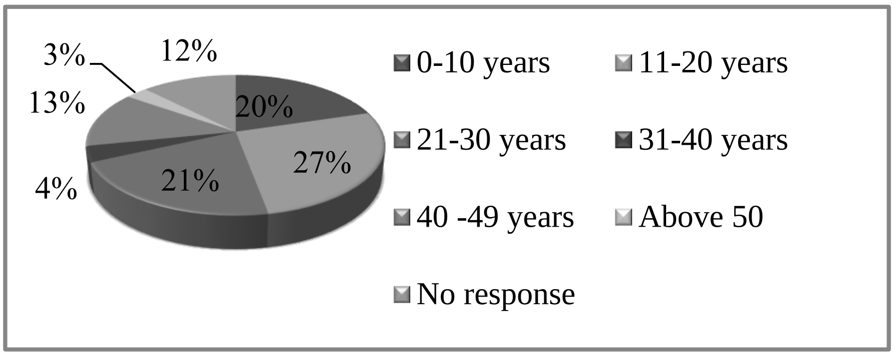


**Figure 3: Respondents Classification by Profession**

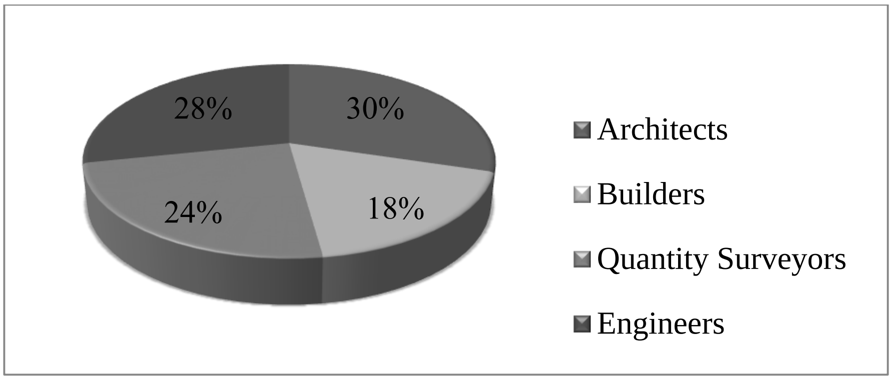


**Figure 4: Academic Qualification of Respondents**

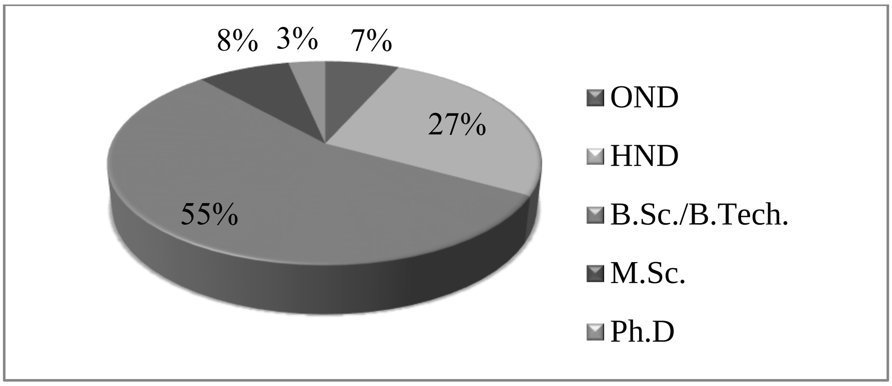


**Figure 5: Professional Qualification of Respondents**

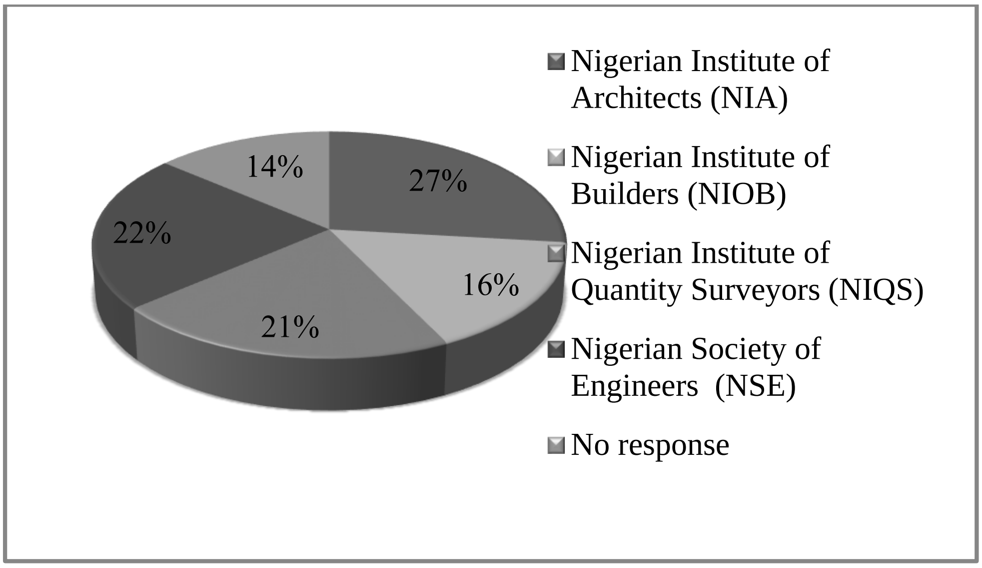


**Figure 6: Working Experience of Respondents**

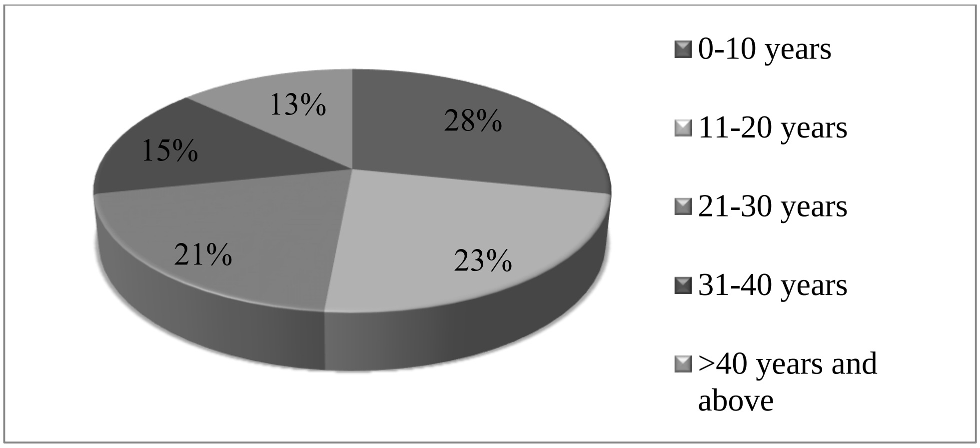

**Figure 7: Types of Projects Executed by the Respondents**

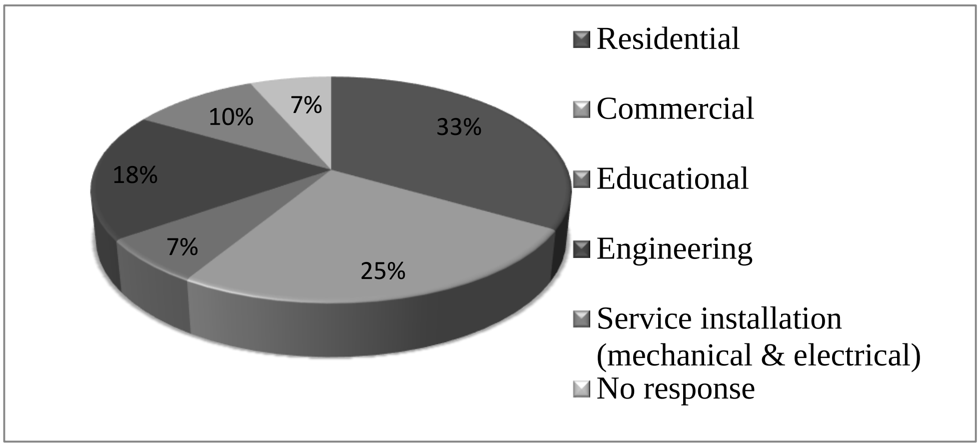


Table 8 shows the mean item score (MIS) for the level of compliance of professionals to ethical standards as perceived and ranked by each professional. From the result of the analysis, all the fifteen (15) ethical standards identified by the study were highly ranked with MIS ranged between 3.79 ≤ 2.93 which showed ranking above average. Three ethical standards were ranked 1st, 2nd, & 3rd that are client's service delivery, educational training and professional qualification and standards of practice respectively indicating client service delivery as the most significant ethical standard.

The MIS ranking shows the ranking of Architects (MIS=3.79, Rank=1st); Builders (MIS=3.38, Rank=1st), Quantity surveyors (MIS=3.29, Rank=1st) and Engineers (Mean=3.22, Rank=1st). In construction works, architects prepare both the sketch and final drawings. They also have the general knowledge of planning, designing and oversight of a building construction. Architects therefore must have standard of care and should be responsible to the clients by discovering and reporting works that are not in conformity to clients' taste (Simson and Atkins, 2006). It is crystal clear that client service delivery is paramount in all professions. In most construction projects, architects are usually the clients' representatives to protect the clients' interest. Builders also ranked this ethical standard as 1st which shows they are also in agreement that client service delivery is very important for construction professionals. In most cases, builders are the contractors that execute construction projects. They are therefore liable and responsible to the clients directly.

In all the stages of the contracts ranging from contract award, procurement of materials, site operations and up to completion, they should therefore ensure that clients receive value for the work paid for. The quantity surveyors were also in agreement to client service delivery as the first ethical standard that construction professionals should consider when performing their professional obligations. Quantity surveyors can either be working for the contractor or for the client organization. Whichever the case, they are saddled with the responsibilities of preparing the cost estimate of any proposed project, preparation of interim valuation and physical measurement of works to enable payment to the contractor etc. They are to monitor the clients' resources to ensure services are delivered with the best standards and at minimum cost which is the major service delivered by quantity surveyors.

The engineers' ranking also supported other professionals ranking on client service delivery as one of the ethical standards professionals must comply with.

Engineers are at the helm of providing the structural design details of the projects and thereby hold the duty of care to the client or whosoever appoints them. An engineer is a person in the engineering construction contract performing the same function as an architect under the traditional construction contract (Jackson and Powell, 1992). The nature of their profession makes them to have direct impact on the lives of people; therefore as professionals, they must owe special moral responsibilities (John, 1991). Due to their knowledge and importance in society, they should have standard of conducts to attend to all issues regarding the construction activities and thereby provide answers to ethical questions (Belis and Impe, 2001). This shows that as much as engineer stays in the same role with the architects as a member of design team, they must be versatile, experienced, dynamic and well trained to be suitable for the diverse roles expected in the construction activities. Also, they should adapt to the changing environment and client service delivery should be paramount to them in their professional obligations. The results indicated that majority of the professionals have high level of compliance to this ethical standards. This shows the need for professionals in the construction industry to discharge their duties in a way to satisfy and protects the client's interest. This is contrary to the work of Yakub 2005; Masidah and Khairudeen (2005) which affirmed that professional services and opinions are under chronic criticism as they are mostly unnecessary and unsatisfactory.

The 2$^{nd}$ highly ranked ethical standards were educational and professional qualification. The MIS values are as follows: Architects (MIS=3.71, Rank=2$^{nd}$), Builders (MIS = 3.26, Rank= 2$^{nd}$), Quantity Surveyors (MIS = 3.24, Rank = 2$^{nd}$) and Engineers (MIS = 3.18, Rank = 2$^{nd}$). The MIS values of the four professionals ranged $3.71 \leq 3.18$. This shows a correlation in the ranking and a level of agreement in the professionals' opinion with respect to educational and professional qualification as one ofs the ethical standards the professionals must put into consideration. Architects ranked this ethical standard highest with MIS value (3.71), while other professionals' rankings were between $3.26 \leq 3.18$. This shows that Architects believed that educational training & professional qualification is a cogent criterion for professionals to dutifully discharge their professional duties. This result is expected because majorly in most of the construction sites, Architects are majorly the clients' representative or the site manager (lay men refers to architects as "site engineer"). Educational training is therefore needed to relate with other professionals and to communicate well with the semi-skilled artisans who might not understand the technical terms used on site. Generally, apart from the academic and professional training acquired while in school, some core values such as human relations are taught in tertiary institutions. These core values are equally important in all fields of learning to successfully relate with people from different families, cultural backgrounds and also to perform the expected roles by each professional.

The rankings by the Builders, Quantity Surveyors and Engineers were similar, this revealed a relationship in their perceptions about educational training and professional qualifications as ethical standards. These rankings also supported that professionals should be academically and professionally qualified in their respective fields. Moreover, educational training and professional qualification is of great importance, because this is where professionals acquire academic training, technical competence and skills about a particular profession. It is therefore important for professionals to have sound educational background to be able to cope with the projects challenges. This finding affirmed that professionals need to be placed in appropriate educational framework to ensure their continuous relevance. Professionals should only accept to offer services for which they are qualified by education, training and professional experience (Chan and Chan, 2002).

The third ranked ethical standard by the professionals is standard of service. This ethical standard was ranked 3rd by two professionals, that is Architects (MIS = 3.63, Ranking = 3rd) and Engineers (MIS = 3.16, Ranking =3rd). The rankings showed agreement between architects and engineers on standards of practice as the 3rd important ethical standards for professionals in discharging their duties. This correlation is not farfetched as their roles are interchangeable as earlier established. Therefore a level of agreement is expected in their responses, this established the fact that they have the same perception on the subject matter. Also, builders and quantity surveyors ranked standards of practice as the 4th ethical standards with MIS = 3.19 and 3.17 respectively. The closeness in their mean ranking could be interpreted that they share the same view on this ethical standard.

The Builders (as in most cases the contractors) believed that confidentiality was more important than standards of practice as it was ranked 3rd (MIS = 3.20). On the contrary, quantity surveyors ranked integrity as the 3rd (MIS =3.18) important ethical standards. Contractors' perspective on confidentiality is expected to be high as they are involved in several monetary issues which is the backbone of ethical issues in the construction industry. Money is a strong sager in construction industry and centres so much on the contractors, ranging from the pre-contract stage to post contract period. Contractors wish to win contract at all cost and also maximize profit as much as possible. In the quest to win at all cost, some contractors might engage in bid shopping from careless consultants so as to have an idea of the tender figures of other contractors, they also engage in front and back loading of items and rates in bills of quantities. All these acts are unethical standards with respect to confidentiality of information. The position of information confidentiality have been established that unless otherwise stated should a professional release public statements that are truthful and objective. Information and records that are confidential should be kept appropriately, improper information flow both internally and externally should be discouraged (Vee and Skitmore, 2003). Confidentiality as ranked 3$^{rd}$ by the Builders (contractors) cannot be compared with other professionals' ranking because contractors might not be a trained professional. Architects ranked confidentiality 5$^{th}$; Quantity Surveyors ranked it 6$^{th}$ while Engineers ranked it 9$^{th}$. The view and perception of different professionals on each ethical standard are indicated and revealed in their respective rankings. Quantity Surveyors ranked integrity as the 3$^{rd}$ (MIS=3.39) significant ethical standard in the construction industry. Architects ranked it 4$^{th}$, while Builders ranked 5$^{th}$, and Engineers ranked it 6$^{th}$. Quantity surveyors deals basically with financial management of the contracts and this is the area where the integrity of most professionals are put into the mud especially if there is a conflict between personal and professional values. The moral standing and upbringing of each individual professional appears on how they protect their personal integrity in dealing with clients rather than being mindful of their personal gain.

In the case of safety as an ethical standard, Architect ranked it 8th (MIS=3.31), Builders ranked 10th (MIS = 3.07), Quantity surveyors ranked 11th (MIS=3.04) while engineers ranked 5th (MIS=3.04). The 5th ranking of safety as ethical standard by engineers shows they perceived safety both on human resources and equipment as core due to the technicalities involved in construction projects. This even manifested in the safety precautionary measures usually taken on construction sites to safeguard dangers and accidents such as wearing of helmet, restricting unnecessary visitation to site, employing safety/heath personnel among others. Little lapses could lead to great human and financial losses that might not be regained easily, and this will not be cost effective for the client.

This is also manifested in engineers ranking of cost effective as 4th (MIS= 3.06) most significant ethical standard. Architect ranked 11th (MIS = 3.27), Builders ranked 8th (MIS= 3.14) and quantity surveyors ranked 7th (MIS=3.12).

Table 8 showed, the overall rating of professionals regarding ethical standards. Standards of practice (MIS=2.73) was ranked 1st, educational & professional qualification and clients service delivery (MIS=2.71) were both ranked 2nd, while clients service delivery & professional development were both ranked 4th. The least ranked was fair compensation (MIS=2.46), which indicated that these ethical standards are important for professionals in their professional services. The overall rating of all the professionals also corroborated the importance of these ethical standards for professionals to discharge their duties with greatest professionalism and integrity. Quality services are expected by the clients for all the services paid for; professionals should therefore note that good value for money is of utmost importance. Furthermore, clients create markets for the construction industry, and so should be placed at the centre of the construction processes (Latham, 1994; Langford and Male 2001). Professionals should clearly define project performance in the services they render as the achievement of fitness-for-purpose in construction and also as the absolute realization of the client's satisfaction of his requirements (Male and Mitrovic, 2005). In addition to this, professionals are linked with notion of services they provide and should therefore focus more on their personal professional development so as to provide services that are of high quality for all that needed their services (Cardammone, 2011).

**Table 8: Level of Compliance of Professionals to Ethical Standards**

| Ethical Standards | Arc. | | Bldr.(Cont) | | QS | | Engr. | | All Professionals | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Mn.** | **Rk** | **Mn.** | **Rk.** | **Mn.** | **Rk** | **Mn.** | **Rk** | **Mn.** | **Rk.** |
| Standards of practice | 3.63 | 3 | 3.19 | 4 | 3.17 | 4 | 3.16 | 3 | 2.73 | 1 |
| Education & Professional Qualification | 3.71 | **2** | 3.26 | **2** | 3.24 | **2** | 3.18 | **2** | 2.71 | 2 |
| Safety | 3.31 | 8 | 3.07 | 10 | 3.04 | 11 | 3.04 | 5 | 2.71 | 2 |
| Clients' Service Delivery | 3.79 | **1** | 3.38 | **1** | 3.29 | **1** | 3.22 | **1** | 2.68 | 4 |
| Professional Development | 3.36 | 5 | 3.16 | 6 | 3.15 | 5 | 3.03 | 6 | 2.68 | 4 |
| Integrity | 3.39 | 4 | 3.17 | 5 | 3.18 | 3 | 3.03 | 6 | 2.64 | 6 |
| Sustainability | 3.25 | 12 | 3.06 | 11 | 3.00 | 13 | 3.03 | 6 | 2.63 | 7 |
| Confidentiality of information | 3.36 | 5 | 3.20 | 3 | 3.14 | 6 | 2.97 | 9 | 2.62 | 8 |
| Environmental Friendliness | 3.30 | 9 | 3.03 | 13 | 3.02 | 12 | 3.03 | 6 | 2.60 | 9 |
| Cost Effectiveness | 3.27 | 11 | 3.14 | 8 | 3.12 | 7 | 3.06 | 4 | 2.58 | 10 |
| Fair Competition | 3.35 | 7 | 3.09 | 9 | 3.10 | 8 | 3.03 | 6 | 2.58 | 10 |
| Maintenance Culture | 3.25 | 12 | 3.03 | 13 | 3.01 | 9 | 3.00 | 8 | 2.56 | 12 |
| Public Welfare | 3.24 | 14 | 3.05 | 12 | 2.98 | 14 | 3.02 | 7 | 2.54 | 13 |
| Conflict of Interest | 3.29 | 10 | 3.16 | 6 | 3.01 | 9 | 2.98 | 10 | 2.50 | 14 |
| Fair Compensation | 3.23 | 15 | 3.03 | 13 | 2.96 | 15 | 2.93 | 11 | 2.46 | 15 |

***Source: Authors' Survey 2012***

***Legend: Rk: Ranking, Mn. :Mean, Arc: Architects, Bldr: Builder, Cont : Contractor, QS: Quantity Surveyor, Engr: Engineer***

**Table 9: ANOVA Test: Level of Significance of Ethical Standards**

| Ethical Standards | ANOVA | | Overall Rating of Professionals |
|---|---|---|---|
| | F – Value | P- Value | % |
| Standards of practice | 0.431 | 0.882 | 54.76 |
| Educational& professional qualification | 1.824 | 0.084 | 54.33 |
| Safety | 1.193 | 0.307 | 54.03 |
| Clients' service delivery | 2.447 | **0.020*** | 53.73 |
| Professional development | 3.774 | **0.001*** | 53.61 |
| Integrity | 2.146 | 0.400 | 52.83 |
| Sustainability | 1.475 | 0.177 | 52.79 |
| Confidentiality of information | 1.707 | 0.108 | 52.45 |
| Environmental friendliness | 1.422 | 0.197 | 52.10 |
| Cost effectiveness | 1.184 | 0.313 | 51.72 |
| Fair competition | 1.686 | 0.113 | 51.63 |
| Maintenance culture | 0.351 | 0.929 | 51.29 |
| Public welfare | 0.779 | 0.630 | 50.94 |
| Conflict of interest | 1.024 | 0.415 | 50.04 |
| Fair compensation | 1.561 | 0.148 | 49.31 |

***Source: Authors' Survey 2012***

***Significant at P≤0.05***

$$\textbf{Mean} = \frac{54.76+54.33+54.03+53.73+53.61+52.83+52.79+52.45+52.10+51.72+51.63+51.29+50.94+50.04+49.31}{15}$$

**Mean:** Level of compliance = $\frac{785.56}{15} = 52.37\%$

## RESEARCH HYPOTHESIS: ANOVA TEST

In order to determine professionals' perception on the level of compliance to ethical standards identified in this study, two hypotheses were drawn below;

**$H_0$:** There is no statistically significant difference in professionals' perception of the level of all professionals' compliance to ethical practices

**$H_1$:** There is statistically significant difference in professionals' perception of the level of all professionals' compliance to ethical practices

The hypothesis was tested using ANOVA. The results showed that, only two (2) out of all the fifteen (15) ethical standards were significant, which indicated a different opinion on the two ethical standards with P value < 0.05).The two ethical standards were clients service delivery (F value=2.447, P value=0.020) and professional development (F value=3.774, P value = 0.001). This implies that the null hypothesis could not be accepted. The result established a statistically significant difference between all the professionals view about compliance of all the professionals to these two ethical standards. It means all the professionals were of the opinion that the entire professionals have different views and perception to compliance. While some professionals believed that some ethical standards were significant, other professionals are of the opinion that other elements are more important and significant than others.

From Table 9, the result showed the overall general rating of all professionals, as rated by the professionals themselves in percentages (0% - 100%). The percentage rating of respondents ranged from 49.30% ≤ 54.70%, which indicated that professionals ranked themselves on average. It can therefore be concluded that the professionals have average of 52.37% level of compliance to all ethical standards identified by the study. From this result, there is an indication that professionals in the industry know the importance of conformity with ethical standards. The construction industry professionals must discharge their duties in a way to change the perception of the public against the notion that the construction industry is the most corrupt industry due to high frequency of construction failures that have challenged the integrity of the professionals (Nduese, 2010). Improving compliance to the ethical standards in the industry would not only emanate from individual professional and the industry, but would also require inputs from governments. This is because government have responsibilities in ethical matters relating to the construction industry (John, 2006).

## 5. CONCLUSION AND RECOMMENDATION

This study assessed the compliance of construction professionals to ethical standards in the Nigerian construction industry. The study concluded that clients service delivery; educational training and professional qualification and standards of practices are the most significant ethical standards among construction professionals in Nigeria. The ethical standards that had the least professionals' compliance was fair compensation.

The study recommended that professionals should pay more attention to all ethical standards in the industry while discharging their duties so as to satisfy the clients. Also, if professionals continually uphold ethical standards, the perception of the public about the image of the construction industry would be changed while project performance and delivery will be enhanced. Further and ongoing related researches include; mechanisms for enforcement of ethical standards and factors influencing ethical compliance of construction professionals.

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