# Level of Adherence to Safety Measures On Construction Sites in Abuja, Nigeria

R. A. Jimoh[1]*, L. O. Oyewobi[2], R. B. Isa[3], A. S. Momoh[4]

[1]Building Department, Federal University of Technology, Minna, Nigeria

[2]Quantity Surveying Department, Federal University of Technology, Minna, Nigeria

[3]Built Environment Department, Central University of Technology, Bloemfontein, South Africa

[4]Centre for Disaster Risk Management & Development Studies,
Federal University of Technology, Minna, Nigeria

Received: 22nd August, 2015. Accepted: 23rd May, 2017. Published: 15th August, 2017.

**Abstract**

The construction industry is known to be one of the most hazardous industries in terms of the activities on the construction site and it has poor safety records. In order to have a comprehensive understanding and gainfully benefit from safety measures on site, the causes of accidents and level of adherence to safety rules needed to be examined. Therefore, this research assessed the level of adherence to safety measures on construction sites in Abuja, Nigeria. A well-structured self-administered questionnaire survey of 140 selected firms was conducted in Abuja. Findings showed that the Personal Protective Equipment (PPE) is the most used safety measure on construction site. Using factor analysis, the causes of accidents were classified into three dimensions namely poor safety planning; poor adherence and worker attitude, while safety measures were grouped into five underlying factors: personal protective equipment; effective enforcement; safety prevention mechanism; safety arrangement and safety culture. The study concluded that there is high adherence level to safety measures by the medium and large construction firms in the study area. It is recommended that construction firms should ensure that operatives comply with the prescribed safety and health measures so as to reduce accident occurrence on construction sites.

**Keywords**: Adherence; work place safety; accident; legislation; Abuja-Nigeria.

*Corresponding author: E-mail: rosney@futminna.edu.ng

**ISTJN** 2017; 10:3-22.

# 1 Introduction

On a yearly basis, many construction workers lost their lives and many others injured on construction sites. Accidents happen daily which give rise to increase in death rate. In the year 2005, there were 4.2 million on the job non-fatal injuries and 5,702 fatalities recorded in the United States alone (Bureau of Labour Statistics, 2006; Bureau of Labour Statistics, n.d). The construction industry is known to be one of the riskiest industries in most countries (Edmonds and Nicholas, 2002). The circumstances in developing countries like Nigeria are worse than what exist in developed countries due to lack of concern, precise records and legal regulations on health and safety. Onyejeji (2011) asserted that Nigeria lacks legal regulations on health and safety and that those regulations that serve as reference point are the British ones. This has however changed with the introduction of National Building Code in 2006.

All over the world, construction according to International Labour Organisation [ILO] (1999) remains one of the highest employers of labour, ranging between 9-12% and could be as high as 20% in some countries working population. This high percentage has attendant consequence in terms of accidents rates on construction sites due largely to poor health and safety practices among others. Getting accurate reports on accidents in most countries is a huge challenge as many of them go either undetected or not reported at all. Kheni et al. (2006) stated that small and medium firms dominate in the developing countries and this domination has given rise to the high rate of accidents found on construction sites of these countries. In a related development, ILO (1999) alluded to the fact that the high proportion of small firms and of self-employed workers contributed to the high rate of accidents and this feature distinguishes construction from the manufacturing industry. Though substantial progress has been made over the years, the need to continually improve the health and safety practices on construction sites cannot be overemphasised as a result of the dangerous nature of the industry (Langdon, 2011).

Many countries have put in place policies and legislation to reduce accidents and diseases on construction sites though having varied degree of comprehensiveness, various levels of implementation, unequal will and capacity of enforcement. In spite of these efforts, Al-Tuwaijri et al. (2008) stated that the ILO reported that there seems not to be any significant change in work related fatal and non-fatal accidents and diseases globally. This is as a result of the globalization of the world's economies. The implication is that this trend will continue as long as there are countries such as Nigeria that will be on its path to industrialisation.

As at December 2014, anecdotal report indicated that Former President Goodluck Jonathan has not assented to the 2012 Health and Safety Bill; this was passed by both the Senate and House of Representatives of the Federal Republic of Nigeria. According to Adeogun and Okafor (2013), it is the multinational construction firms that adhere and recognise health and safety practices due largely to the inclusion of such in the parent companies policies in their home countries. Adeogun and Okafor therefore concluded that health and safety practices among indigenous firms are still at developmental stages; hence, appraising the adherence to safety measures on construction sites in Abuja becomes imperative in order to know if there has been any improvement since when Adeogun and Okafor study was conducted. To this end, answers will be provided to the following research questions:

- What are the causes of accidents on construction sites?
- What is the level of adherence to the safety measures that are in place?
- What are the strategies that could be recommended for improving safety of work place environment?

## 1.1 Health and Safety in the Construction Industry

Construction workers on site are exposed to hazards of occupational diseases and injuries and the adverse effects of excessively long hours of work. Machines, plants and other sophisticated construction equipment pose danger to the operators, who in most cases do not have prior skills for operating them (Muiruri and Mulinge, 2014). Hassan et al. (2007) argued that the awareness and perception of the workers toward safety, health and their working environment are important aspects to enhancing the building construction to a better condition for the workers.

The overall construction industry is still looking at positive way to change to a safer working environment with many researchers on board (Makinde, 2014). Hassan et al. (2007) study revealed invaluable indications to the construction managers especially in improving the construction workers' attitude towards safety, health and environment and good safety culture in the building construction industries. Yakubu et al. (2012) asserted that to examine safety performance, the safety and health assessment system in the construction industry is used in order to have a platform for assessing and evaluating contractor's safety and health measures at site. In another study El-Mashaleh et al. (2010) concluded that good safety performance contractors have more detailed written safety programmes when compared to poor safety performance contractors.

The culture of the construction industry in developing countries also does not promote health and safety, as such the practices of competitive tendering and award of most public

contracts to the lowest bidder in many developing countries compels contractors to drive their prices low while cutting costs which in turn affects health and safety (Muiruri & Mulinge, 2014). It is a clear fact that, site accident sometimes happens because of complete mistakes or lack of awareness on the part of the workers, for that, such employees should have the basic knowledge of plants, materials and technology of the trade involved in the construction works (Makinde, 2014).

## 1.2 Health and Safety Measures on Construction Sites

Health and Safety measures employed on construction sites are inadequate and fail to meet the required standards especially in small sized construction firms and are non-existent in some (Bennet 2002). Therefore, provision of adequate safety measures for workers on site would improve the performance and also enhance the construction industry's productivity (Makinde, 2014). In a related development, Kikwasi (2010) asserted that improving the health and safety risk management of construction projects has repeatedly been shown to save lives, time, and money, and to increase business goodwill and good reputations. Hence, Muiruri and Mulinge (2014) established that site layout and planning, personal protective clothing (PPE), first aid kits and accident reporting, health and safety warning signs, health and safety plan and safety risk assessment, health and safety training, improved work environment and welfare facilities are some of the measures that could be put in place to ensure that project objectives are met. When these are in place, a synergy between health and safety and other project parameters (cost, environment, productivity, quality and schedule) will be created that will give rise to better performance within the industry (Smallwood, 1996 cited in Smallwood, 2002).

## 1.3 Accidents on Construction Sites

Accidents on construction sites are in most cases inevitable due to the nature of the industry, but could be controlled to prevent minor or serious-consequences on the workers (Oladiran et al., 2008). Mwombeki (2005) saw accidents as an unplanned and unexpected occurrence, which upsets a planned sequence of work; resulting to loss of production, injury to personnel, damage to plant and equipment and eventually interrupting production flow. Kadiri et al. (2014) stated that the main effect of accidents on construction sites is the loss of time in project execution depending on the extent of the accident, could lead to time overrun. Oladiran et al. (2008) concluded that accidents on construction sites, whether minor or fatal, could result to waste of resources and making the construction industry an unsafe environment to work in.

# 2 Research Methodology

This study aimed at evaluating the level of adherence to safety measures by employees on construction sites in Abuja, Federal Capital Territory, Nigeria. This study conducted a survey of small, medium and large construction organisations in the Nigerian construction industry, particularly in Abuja using a non-response bias technique in determining the population size. These three categories of contracting firms considered were classified into; small (0-49), medium (50-249) and large (> 250) based on Butler (1982) and European Commission (2003) classifications. Classifying the construction firms based on the value of contract executed as outlined by Federal Ministry of Works and Housing may not be a true reflection of the firms as they may not give correct information since this involves money. For the purpose of sampling, the sampling frame was obtained from the list of construction firms currently executing work in the Federal Capital Territory from Federal Housing Authority (FHA), Federal Capital Development Authority (FCDA) and Ministry of Works and Transport (MW&T). This produced a total of 210 construction firms currently executing contracts in Abuja.

## 2.1 Sample size determination and selection of respondents

Since, it is practically impossible to sample all the firms involved due to large geographical dispersion and the nature of the research that requires site visitations and observations of the site environment, hence non-bias method was employed using a simplified formula proportion in a Table outlined by Krejcie and Morgan (cited in Crafford, 2007). To ensure a representative sample of all the firms, the sample size selected was 136 (however, 140 questionnaires were administered) from the total population of 210 based on the Table. However, non-probability convenience sampling method was adopted for the personal observations carried out. Twenty-eight active construction sites were observed in terms of site layout considerations in order to give credence to the questionnaire survey conducted.

## 2.2 Data collection

The variables included in the questionnaire to help answer the research questions earlier presented were derived from the extensive review of relevant literature. A total of 140 self-administered and well- structured questionnaires were randomly distributed to the professionals (each professional represented a construction firm which was the unit of analysis) on these construction sites from April to June 2015 (3 months period). The questionnaire sought information on the background of the respondents and other specific issues relating

to the research such as causes of accidents. To ensure adherence to ethical issues, permission was sought from the management of each construction firm selected before the administration of questionnaires with the understanding that their participation was voluntary and that any information provided was going to be strictly confidential.

## 2.3 Reliabilities of the scales

Prior to the examination of the results of the findings, the internal consistency of the previously used scales was assessed using Cronbach's coefficient alpha. The reliability test showed that adequate values were obtained as almost all of the coefficient alphas of the variables tested (where $\alpha \geq 0.5$) were above the stated threshold in literature (e.g. Saunders, 2003). Although many authors have suggested that a minimum acceptable Cronbach's alpha value is 0.7, but Nandakumar (2008) recommended that 0.6 could be considered acceptable. In another research, Van de Ven and Ferry (1979) asserted that a Cronbach alpha coefficient of 0.55 is acceptable for measuring broad constructs. However, the reliability test for the observations recorded was below the threshold stated above ($\alpha = 0.48$). The reasons for low reliability results for these observations may be as a result of the insufficient number of observations on the sites sampled for the reliability analysis. However, the high $\alpha$ values for all other scales employed indicated that the instrument used has shown high internal consistency. In testing for validity, the study assessed content validity via the review of relevant literature on the items included in the questionnaire. In examining the validity of the measures, the convergent approach was evaluated from the correlation of the items included in each scale and the mean scores of all the items; this showed positive and significant correlation. Also, the divergent validity was evaluated through the detailed analysis of the items, which indicated that the items of measurement correlate positively and significantly with one another, but not with the items corresponding to the other scales.

## 2.4 Data analysis

The data obtained through the field survey were analysed using descriptive statistics; mainly measure of central tendencies- the mean score. However, in making decision regarding the perceptions of the respondents and observed active sites, Morenikeji (2006) cut-off points were used as shown below:

- 1.0 - 1.49= No adherence; no extent; very poor
- 1.50 - 2.49= Small adherence; small extent; poor
- 2.50 – 3.49= Moderate adherence; moderate extent; fair

- 3.50 – 4.49= High adherence; high extent; good
- $\geq$ 4.50= Very high adherence; very high extent; very good.

### 2.4.1 Factor analysis

This study also employed factor analysis to examine the content structure in mapping unknown concepts and domains, and also in categorising the variables used in measuring the causes of accidents and measures of safety on construction sites. It was also used to examine the convergent validity of the variables (Isik et al., 2010). However, the analysis presented here used exploratory factor analysis as classified by DeCoster (1998) in bringing together interrelated underlying variables to generate a factor structure using an inductive technique. This approach has been used by previous researchers (such as Hassan, Basha and Hanafi, 2007; Aksorn and Hadikusumo, 2008) in classifying or determining underlying relationship among the causes of accidents. One of the main focuses of this study was to identify the causes of accidents and measures of safety being undertaken on the studied construction sites. The Principal Component Analysis (PCA) technique was found to be an appropriate method for extracting factors, most especially where the extracted components can be employed to estimate new variables for further analyses. The sample size in this study is above 120, which means that any factor loading smaller than .50 would not be statistically reliable (Hair et al., 2010). Only factor loadings larger than or equal .50 were therefore considered when deciding which variables loaded onto which factors as sated by Hair et al. (2010) and Kaiser's criterion using the Eigenvalue technique was also used as significant factors are those with an Eigenvalue equal to or greater than 1 (Hair et al., 2010; Field, 2013).

The Kaiser-Meyer-Olkin measure of sampling adequacy (MSA) is 0.948 for causes of accidents and 0.887 for measures of safety on construction sites. Bartlett test of sphericity were conducted for the causes of accidents and measures of safety and were found to be significant at 99% confidence level as shown in Tables 7 and 8. These two tests offer the minimum threshold required for data analysis using PCA as the value of the KMO vary between 0 and 1, with .50 suggested as a minimum (Field, 2013; Hair et al., 2010). The Bartlett test conducted shows the strength of the association among variables and the significant level of the Bartlett's test is a requirement for the data to be considered suitable for analysis (Field, 2013).

Table 1: Background information of respondents

| Characteristics | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Qualification | | | |
| National Diploma | 3 | 2.4 | 2.4 |
| Higher National Diploma | 33 | 26.0 | 28.3 |
| BSC/BTECH | 36 | 28.3 | 56.7 |
| MSC/MTECH | 23 | 18.1 | 74.8 |
| Others | 32 | 25.2 | 100.0 |
| Total | 127 | 100.0 | |
| Profession | | | |
| Building | 30 | 23.6 | 23.8 |
| Civil Engineering. | 37 | 29.1 | 53.2 |
| Architecture | 22 | 17.3 | 70.6 |
| Quantity Surveying | 25 | 197 | 90.5 |
| Others | 12 | 9.4 | 100.0 |
| Total | 126 | 99.2 | |
| Professional Membership | | | |
| Fellow | 8 | 6.3 | 6.3 |
| Member | 38 | 29.9 | 36.5 |
| Associate | 45 | 35.4 | 72.2 |
| Grad/prob | 20 | 15.7 | 88.1 |
| Others | 15 | 11.8 | 100.0 |
| Total | 126 | 99.2 | |
| Years of Experience | | | |
| 0-5 | 19 | 15.0 | 15.2 |
| 6-10 | 54 | 42.5 | 58.4 |
| 11-15 | 26 | 20.5 | 79.2 |
| 16-20 | 18 | 14.2 | 93.6 |
| >20 | 8 | 6.3 | 100.0 |
| Total | 125 | 98.4 | |
| Number of workers | | | |
| 0-49 | 50 | 39.4 | 40.3 |
| 50-249 | 63 | 49.6 | 91.1 |
| >250 | 11 | 8.7 | 100.0 |
| Total | 124 | 97.6 | |

# 3 Results and Discussion

Based on the sample size of 140 selected for the administration of copies of the structured questionnaire, 127 copies were returned representing 90.7% response rate. They were substantially completed and used for the analysis below. This high response rate was largely due to the repeated trips made to the offices of the construction firms and their sites.

The academic qualifications of the respondents as shown in Table 1 shows that 2.4% had National Diploma (ND), 26.0% had Higher National Diploma (HND), 28.3% had Bachelor

of Science/Bachelor of Technology (BSc/B Tech), 18.1% had Master of Science/Master of Technology (MSc/M Tech) while the remaining 25.2% of the respondents had other qualification not listed. This is an indication that the respondents were competent largely to respond to the questions elicited based on their various levels of qualification attained. The various professions of the respondents are shown in Table 1; 23.6% belonged to Building profession, 29.1% of the respondents belonged to Civil Engineering field, 17.3% were in Architecture, 19.7% were in Quantity Surveying while 9.4% belonged to other professions not listed. Majority of the respondents (90.5%) belonged to the mainstream professions that are usually found on sites and are responsible for safety issues at all times. The professional membership cadre of the respondents as indicated in Table 1 shows that 6.3% were Fellows of their professional bodies, 29.9% were members, 35.4% were associate, 15.7% were graduate/probationer members while 11.8% of the respondents belonged to other membership cadre different from those mentioned.

The years of experience of the respondents which to a large show their competency regarding construction tasks and responsibilities are shown in Table 1. Eighty-five (85%) of the respondents had within them experience ranging from 6-10 years, 11-15 years, 16-20 years and above 20 years in the construction industry. This can be concluded that their responses could be deemed to be reliable. The number of staff in the respondents' organisations based on European Commission (2003) classification was used as shown in Table 1. Forty-nine-point six percent (49.6%) of the respondent worked in medium sized construction firms, 8.7% worked in large sized construction firms while 39.4% of the respondents worked in small sized construction firms. More than half of the respondents worked in both medium and large sized construction firms based on the classification. It is expected therefore that the level of safety adherence will be higher for these categories of firms when compared with the small sized ones owing largely to the fact that they will have more resources to be deployed in ensuring that safety issues are taking very seriously.

From Table 2, three factors were extracted from 30 variables and these factors are capable of explaining circa 75% of the total variance of the causes of accidents on the construction sites. These factors were re-christened: Poor safety planning; Poor adherence and Worker attitude.

Worker attitude: this involves unnecessary haste as well as drug and alcoholic usage. Many workers on construction sites believed the use of drug or alcoholic drink boost energy and this has been identified as one of the causes of accidents. This attitudinal behaviour according to Fang et al. (2006), can often be shaped by rules of peer groups and can be engineered by distinctive motivation. Aksorn and Hadikusumo (2008) suggested that participation or continuous reporting can help reduce the danger that can be orchestrated by the attitude during operation. Hassan et al. (2007) posited that safer behaviour is reflected by good attitude.

Table 2: Measures of causes of accidents on construction sites

| Variables | Item | Mean | Loading | % of variance explained | Cumulative % | Eigen values |
|---|---|---|---|---|---|---|
| Component 1 | Poor Safety planning | | | | | |
| cause26 | Inadequate job planning | 2.13 | 0,937 | | | |
| cause19 | Slippery conditions | 2.22 | 0,885 | | | |
| cause20 | Insufficient lighting | 2.24 | 0,872 | | | |
| cause25 | Unrealistic scheduling | 2.15 | 0,859 | | | |
| cause27 | Inadequate hiring practices | 2.08 | 0,842 | | | |
| cause28 | Inadequate workplace inspection | 2.13 | 0,785 | | | |
| cause21 | Inadequate fall protection | 2.20 | 0,754 | | | |
| cause18 | Insufficient knowledge of job | 2.25 | 0,751 | | | |
| cause16 | Poor work area layout | 2.09 | 0,736 | | | |
| cause22 | Lack of written procedures | 2.18 | 0,736 | | | |
| cause15 | Unsafe act of others | 2.29 | 0,692 | | | |
| cause23 | Un-enforcement of safety rules | 2.32 | 0,659 | | | |
| cause24 | Inadequate supervision | 2.25 | 0,614 | | | |
| cause17 | Congested work area | 2.11 | 0,608 | | | |
| cause12 | Servicing machinery in motion | 2.32 | 0,541 | 65,794 | 65,794 | 18,422 |
| Component 2 | Poor adherence to safety rules | | | | | |
| cause8 | By-passing safety devices | 2.39 | -0,961 | | | |
| cause2 | Safety rule violation | 2.76 | -0,907 | | | |
| cause1 | Improper work technique | 2.73 | -0,899 | | | |
| cause9 | Improper loading | 2.23 | -0,802 | | | |
| cause4 | PPE not used | 2.37 | -0,796 | | | |
| cause3 | Improper PPE | 2.47 | -0,765 | | | |
| cause7 | Operating cranes at improper speeds | 2.18 | -0,76 | | | |
| cause6 | Failure to warn or secure | 2.18 | -0,688 | | | |
| cause5 | Operating without authority | 2.14 | -0,627 | | | |
| cause10 | Improper placement | 2.18 | -0,549 | 5,177 | 70,971 | 1,45 |
| Component 3 | Worker attitude | | | | | |
| cause14 | Unnecessary haste | 2.42 | 0,828 | | | |
| cause13 | Drug and alcoholic usage | 2.47 | 0,814 | 3,858 | 74,829 | 1,08 |
| Cronbach's Alpha | | 0.981 | | | | |
| KMO Measure | | 0,948 | | | | |
| Bartlett's Test | Approx. Chi-Square | 3949,307 | | | | |
| | Df | 378 | | | | |
| | Sig. | 0,00 | | | | |

*personal protective equipment (PPE)
**Kaiser-Meyer-Olkin measure of sampling adequacy
+Bartlett's Test of Sphericity

Poor adherence: Many accidents on the construction sites were caused due to inadequate adherence of workers to work procedures and rules (Hassan et al., 2007). This is supported by Abdul Hamid et al. (2008) who argued that poor adherence to safety requirements on construction sites has led to a hike in the level of exposure of construction workers and the

general public to risky situation on construction sites leading to a greater chance of accidents occurrence.

Poor safety planning: Lack of planning of construction activities such as improper planning of jobs and unrealistic scheduling of construction activities may result to unsafe acts that are capable of causing accidents on construction sites (Ridley, 1986). Hence, the establishment of realistic job task and objectives will serve as a guide to all employees by giving a clearer picture and a sense of direction in performing their routine tasks in order to reduce accidents (Aksorn and Hadikusumo, 2008).

From Table 2, safety rule violation, improper work technique, improper personal protective equipment, drug and alcoholic usage and unnecessary haste with mean scores of 2.76, 2.73, 2.47, 2.47 and 2.42 respectively were ranked 1st, 2nd, 3rd, 4th and 5th by the respondents as the causes of accidents on construction sites though the extent of occurrence is low for all the causes of accidents as evidenced in the low value of mean scores recorded. Also, inadequate workplace inspection (2.13), congested work area (2.11), poor work area layout (2.09), inadequate hiring practices (2.08) and inadequate job planning (2.06) brought up the rear and ranked 23rd, 24th, 25th, 26th and 27th respectively.

Table 3 presents the safety measures on construction sites whereby five factors were extracted from 33 variables identified in literature. The extracted five factors explain 71% of total variations of the safety measures on construction sites. The factors are re-titled: Personal Protective Equipment; Effective enforcement; Safety prevention mechanism; Safety arrangement and Safety culture.

Personal protective equipment (PPE): Abdelhamid and Everett (2000) asserted that occurrence of accidents on construction sites may be as a result of failure to use the personal protective equipment (PPE) that has been provided by the management such as safety boots, safety belts, safety helmets, goggles and so on. This is supported by Abdul Hamid et al. (2008) who also identified failure to use personal protective equipment and poor worker's attitude as the root cause of accidents. In fact, Abdelhamid and Everett (2000) contended that failure to use the PPE as required is capable of escalating or make it even higher the risks the workers might be exposed to on construction sites. Effective strategy to control accident will therefore, be that PPE should be used by all workers especially in situations where safety hazards are envisaged and high and not as a substitute.

Effective Enforcement: To reduce accidents occurrence on construction sites, there is a need to enforce safety requirement. This is apparent in the findings of Lubega et al. (2000) who reported that the causes of accidents were mainly due to lack of awareness of safety regulations; lack of enforcement of safety regulations; poor regard for safety by individuals working on construction sites among other factors. Toole (2002) also reiterated that deficient enforcement of safety is a recipe for occupational hazards. However, Agumba and Haupt

Table 3: Variables of safety measures on construction sites

| Variables | Item | Mean | Loading | % of variance explained | Cumulative % | Eigen values |
|---|---|---|---|---|---|---|
| Component 1 | PPE | | | | | |
| safet28 | Provision of eye goggle | 3.76 | 0,864 | | | |
| safet3 | Protection to opening | 3.76 | 0,776 | | | |
| safet26 | Provision of safety boots | 3.90 | 0,749 | | | |
| safet4 | Fall Protection system | 3.74 | 0,726 | | | |
| safet24 | Provision of safety helmet | 4.07 | 0,661 | | | |
| safet27 | Provision of ear protection | 3.75 | 0,661 | | | |
| safet21 | Authorisation to site by the public | 3.51 | 0,633 | | | |
| safet23 | Provision of hand gloves | 3.97 | 0,599 | | | |
| safet25 | Provision of safety overall jacket | 3.93 | 0,515 | | | |
| safet5 | Personal fall arrest system | 3.61 | 0,514 | | | |
| safet19 | Provision of safety signs | 3.75 | 0,511 | | | |
| safet15 | Safety net system | 3.55 | 0,508 | 51,245 | 51,245 | 18,448 |
| Component 2 | Effective Enforcement | | | | | |
| safet8 | Enforcement of safety rules | 3.81 | 0,889 | | | |
| safet14 | Enforcement of safety | 3.80 | 0,88 | | | |
| safet9 | Safe methods or sequencing | 3.73 | 0,819 | | | |
| safet20 | Disclaimer | 3.38 | 0,811 | 7,993 | 59,238 | 2,877 |
| Component 3 | Safety prevention mechanism | | | | | |
| safet2 | Serious attitude toward safety | 4.11 | 0,794 | | | |
| safet1 | Using provided safety equipment | 4.34 | 0,705 | | | |
| safet7 | Positive attitude toward safety | 3.92 | 0,516 | 5,203 | 64,441 | 1,873 |
| Component 4 | Safety arrangement | | | | | |
| safet30 | Usage of safety net | 3.56 | -0,772 | | | |
| safet29 | Usage of nose protector | 3.77 | -0,538 | 3,655 | 68,096 | 1,316 |
| Component 5 | Safety Culture | | | | | |
| safet10 | Presence of safety culture | 3.74 | -0,738 | | | |
| safet11 | Provision of Safe equipment | 3.79 | -0,714 | | | |
| safet17 | First aid kits | 3.69 | -0,702 | | | |
| safet18 | Investigation of accidents | 3.60 | -0,671 | | | |
| safet6 | Using provided safety equipment | 3.88 | -0,642 | | | |
| safet16 | Protection from falling objects | 3.64 | -0,589 | | | |
| safet13 | Safe site conditions | 3.72 | -0,56 | | | |
| safet22 | Demarcation of site | 3.57 | -0,54 | | | |
| safet12 | Proper training of operatives | 3.67 | -0,519 | 3,218 | 71,313 | 1,158 |
| Cronbach's Alpha | | 0.971 | | | | |
| KMO Measure | | 0.887 | | | | |
| Bartlett's Test | Approx. Chi-Square | 4281.44 | | | | |
| | Df | 630 | | | | |
| | Sig. | 0.00 | | | | |

*personal protective equipment (PPE)
**Kaiser-Meyer-Olkin measure of sampling adequacy
+Bartlett's Test of Sphericity

(2009) opined that enforcement of occupational safety measures should not be driven by a legal framework it should rather be seen as a value adding factor.

Safety prevention mechanism: The popular saying is that prevention is better than cure. Aside this, deficiency in the enforcement of company's safety policy, rules and regulations will invariably result into the occurrence of accidents on sites (Abdul Hamid et al., 2008). Abdul Hamid et al. (2008) thus, argued that if the management of firms deliberately ignore or care less in upholding their company's safety policy, rules and regulations established by them into practice, the attitudes of workers may also be to ignore and care less about health and issues. This affirms the assertion of Blake (1997) and Rowlinson (2003) who contended that workers customarily emulate and keep to the attitudes of the management team; therefore, as a proactive safety measure, management is expected to set a positive standard of safety behaviour for all operatives to follow.

Safety arrangement: Safety arrangement according to Aksorn and Hadikusumo (2008), is not negotiable. Therefore, for construction organisations to remain economically viable and sustainable, basic safety measures such as usage of nose protector or safety net to eliminate or prevent many important hazards should be provided during construction (Cheng et al., 2010).

Safety culture: The development of a safety culture is one of the most effective ways of providing safety measures on construction sites. Chan (2012) reported that the company with the best safety record also had the most consistent safety culture. Evidence subsist that the best way to establish a safe working environment, is to create a safety culture within the organization (Chan, 2012). Therefore, provision of safety equipment, first aid kits as well as safe site conditions will enhance the working environment of workers and their safety consciousness will increase.

From Table 4, the level of adherence of safety measures were ranked; using provided safety equipment, serious attitude toward safety, provision of safety helmet, provision of hand gloves and provision of safety overall jacket were ranked 1st, 2nd, 3rd, 4th and 5th respectively with mean scores of 4.34, 4.11, 4.07, 3.97 and 3.93. From the rear, demarcation of site, provision of safety net, safety net system, authorisation to site by the public and disclaimer were ranked 26th, 27th, 28th, 29th and 30th respectively having mean scores of 3.57, 3.56, 3.55, 3.51 and 3.38. It is interesting to note that authorisation to site by the public shows a mean score of 3.51 though high adherence but the value is low which may be an indication of limited restriction to sites by the public especially vendors that sell food, water, cigarette etc. Hence, there is limited effort to control human traffic on sites. In the same vein, disclaimer (a sign displayed indicating that vehicles parked within and around a site are parked at the risk of the owners) with a mean score of 3.38 shows that no much consideration is giving to it by the construction firms studied.

Table 4: Ranking of safety strategies on construction sites

| Strategy | Mean score | Rank |
|---|---|---|
| Complying with the prescribed safety and health measures | 4.68 | 1st |
| Removing themselves from danger to their safety or health | 4.39 | 2nd |
| Adequate enforcement by all the safety inspector agencies responsible for enforcement | 4.37 | 3rd |
| Participation in regular safety and health meetings | 4.37 | 4th |
| Appropriate inspection services to enforce the laws | 4.33 | 5th |
| Adequate laws, regulations or codes | 4.29 | 6th |
| Adequate resources to carry out the inspection for enforcement of the laws | 4.29 | 7th |
| Prequalifying contractors by evaluating their safety performance history on safe work practices | 4.29 | 8th |
| Acquisition of plant and equipment conforms to national laws, regulation and codes on health and safety on sites | 4.28 | 9th |
| Dangers liable to arise at the workplace are prevented as soon as possible | 4.24 | 10th |
| Materials are used which are suitable from a safety and health point of view | 4.18 | 11th |
| Nominating a competent person to co-ordinate all safety and health activities on their projects | 4.17 | 12th |
| Excessively strenuous work movements are avoided | 4.09 | 13th |

Respondents were asked to rank strategies which could improve safety in workplace environment; the following are the strategies that were ranked highest. Complying with the prescribed safety and health measures with mean score of 4.68 was ranked 1st; removing themselves from danger to their safety or health was ranked 2nd with a mean score of 4.39; adequate enforcement by all the safety inspector agencies responsible for enforcement was ranked 3rd having a mean score of 4.37; participation in regular safety and health meetings with mean score of 4.37 was ranked 4th and appropriate inspection services to enforce the laws was ranked 5th with a mean score of 4.33. In a related development, appropriate inspection services to enforce the laws was ranked 13th with a mean score of 4.09, nominating a competent person to co-ordinate all safety and health activities on their projects was ranked 12th with a mean score of 4.17, using materials which are suitable from a safety and health point of view with a mean score of 4.18 was ranked 11th, dangers liable to arise at the workplace are prevented as soon as possible was ranked 10th with a mean score of 4.24 and acquisition of plant and equipment conforms to national laws, regulation and codes on health and safety on sites was ranked 9th with a mean score of 4.28.

This aspect of the research analysed the data collected from the personal observation of 28 active construction sites descriptively by means of percentages and mean scores. These observations were carried out to know how the construction sites visited and observed were able to meet up with site layout considerations in relation to what was obtainable in the literature. This aspect of the study was to corroborate the findings from the questionnaire

Table 5: Ranking of site layout considerations

| Consideration | Mean score | Rank | Decision |
|---|---|---|---|
| Fencing and hoarding considerations | 4.18 | 1st | Good |
| Access considerations | 4.14 | 2nd | Good |
| Health and safety considerations | 4.04 | 3rd | Good |
| Storage considerations | 3.86 | 4th | Good |
| Accommodation considerations | 3.46 | 5th | Good |
| Temporary services considerations | 3.38 | 6th | Fair |
| Plant considerations | 3.29 | 7th | Fair |

survey especially the level of adherence of the firms to safety measures. To a large extent, the results were similar. Table 5 shows the results. Ranking the site layout in terms of the 7 considerations, fencing and hoarding was ranked 1st with a mean score value of 4.18, access was ranked 2nd with a mean score of 4.14, health and safety was ranked 3rd with a mean score of 4.04, storage was ranked 4th with a mean score of 3.86 and accommodation was ranked 5th with a mean score of 3.46.

# 4 Discussion of Results

This paper presents a study that evaluated the level of adherence to safety measures by employees on construction sites in Abuja. It examines the causes of accidents on the construction sites, the safety measures provided, safety strategies being used and site layout considerations in terms of safety of the construction site. The findings revealed that the three most ranked causes of accidents are majorly safety rules violation, improper work techniques as well as improper personal protective equipment. These results were in tandem with the assertion of Ridley (1986) who argued that 99 per cent of the accidents are caused by either unsafe acts or unsafe conditions or both where unsafe act is a violation of an accepted safe procedure which could permit the occurrence of an accident. A similar study conducted by Abdelhamid and Everett (2000) in the USA identified that failure to secure and warn; failure to wear personal protective equipment (PPE); and operating equipment without authority among others are the human factors that often resulted into accidents. Our findings also resonate the results presented by Pipitsupaphol and Watanabe (2000), Toole (2002) and Tam et al. (2004) in different studies conducted in Thailand, USA and China respectively. The causes of accidents on the Nigerian construction sites were found to be analogous to those that have been reported in literature review.

Muiruri and Mulinge (2014) reported that in most developing countries, the issue of health and safety in construction project delivery process is not given priority, and as such they view the use of safety measures during construction as a burden. On this basis, the study

identified 30 likely safety measures from literature and the respondents ranked the use of provided safety equipment, serious attitude towards safety as well as provision of safety gadgets (such as helmet, glove, boot) as the most used safety measures on the site. The findings are in consonance with the reported results by Muiruri and Mulinge (2014) who identified personal protective clothing as one of the most important safety measures to be adopted as a proper measure of safety on construction sites.

The safety strategies identified to be the most used on the construction sites sampled are compliance with the prescribed safety and health measures, ability to be safe from danger and adequate enforcement by all the safety inspector agencies responsible for enforcement. These findings are in line with the assertion of Smallwood and Haupt (2008), who reported that one of the possible ways of reducing the magnitude of injuries and fatalities on construction sites in South Africa is through compliance to the Health and Safety Legislation and adequate control. However, Agumba and Haupt (2009) argued that Occupational Health and Safety should not be driven by a legal framework but should rather be seen as a value adding parameter.

# 5 Conclusion

A study of adherence to safety measures on construction sites in Abuja was undertaken. The number of staff in the respondents' organisations based on European Commission (2003) classification was used. Almost half of the respondents (49.6%) worked in medium sized construction firms, 8.7% worked in large sized construction firms while 39.4% of the respondents worked in small sized construction firms. More than half of the respondents worked in both medium and large sized construction firms based on the classification. It is expected therefore that the level of safety adherence will be higher for these categories of firms when compared with the small sized ones owing largely to the fact that they will have more resources to be deployed in ensuring that safety issues are taken very seriously. Out of 30 safety measures that were examined in terms of the construction firms' adherence level, only one safety measure (disclaimer) had a mean score value of 3.38 which fell below the high adherence level based on Morenikeji's cut-off points. Using factor analysis, the causes of accidents was classified into three dimensions namely poor safety planning; poor adherence and worker attitude, while safety measures was grouped into five underlying factors: personal protective equipment; effective enforcement; safety prevention mechanism; safety arrangement and safety culture. In addition to this, the personal observations conducted in the 28 active sites further gave credence to the findings from the questionnaire survey since out of 8 layout considerations, 5 of them had mean score values above 3.50. To these extents, it can be concluded that the adherence level of construction firms' especially medium and large ones is high. In order to improve workplace safety environment, the following recom-

mendations are made: Construction firms should ensure that operatives comply with the prescribed safety and health measures so as to reduce accident occurrence; operatives should ensure that they remove themselves from danger to safety; adequate enforcement by all the safety inspector agencies responsible for enforcement should be stepped up so that minimum safety standard expected can be ensured; there should be regular safety and health meetings of all stakeholders so that safety issues can be resolved before they get out of control and ensuring appropriate inspection services to enforce the laws especially consultants such as Architects, Structural Engineers and Mechanical and Electrical Engineers. There should be provision of adequate laws, regulation and codes by the relevant agencies of Government. Efforts should be made by the present National Assembly to speedily consider and pass into Law the 2012 Health and Safety Bill.

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