# Construction Safety Management: A Requisite for Efficiency and Productivity Using Some Selected Firms in Minna, Niger State, Nigeria

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***Abstract:-*** **Construction firms' activities and accidents on sites are significantly rated high in Nigeria. To reduce this menace, various construction sites in Minna, Niger state were examined and the aim was to study the attitude of construction firms towards the awareness of safety in construction site, and to establish whether there is relationship between safety provision for workers and workers' productivity. Five construction firms in minna were used for this research. In achieving this objectives, questionnaire were distributed to some firms within minna. Primary and secondary data was used to analyze the data. Primary data were obtained through interviews and structured worksheet. In each of the construction companies, some workers were interviewed. Secondary data were obtained from the reviews of relevant academic materials to this research. The data collected were analyzed using descriptive statistics. Among the findings are: how safety measures for workers on site will improve the performance and enhance the company's productivity; the trends of experience in management of construction firms has tremendously improved the nomadic nature of construction operation as ranked sequentially; dissemination of information on safety techniques will reduce accidents on site and increase the worker's morale for better performance. Ineffectiveness of government policy on safety measures especially in construction work was found to have contributed to low productivity by workers on site, since they don't have access to any claim even when accident occurred on site. The study recommends that government should address the issue of safety policy (safety act) from grass root to ensure workers are fully compensated when there is accident on site; law must protect the health, safety and welfare of workers.**

***Keywords:*** **Construction, Safety, Management Hazards, Health.**

## I. INTRODUCTION

Today there is high focus on safety in the industries, and many companies have recognized that safety and well-being of their workers deserve the highest priority. Historically, this is a common occurrence if one look at the attitude and many deaths occurrence during project such as the great Chinese wall's which is considered to be the largest construction project which is a visible construction till date. Ancient Chinese myth states each wall stands for a life lost during the wall construction ,although no record available that this myth may be closer to the fact than we would like to think .Archaeologist have discovered thousands of bodies buried in the foundation of wall ,bodies were also were also used to made up the wall's thickness .It has been estimated that millions of workers lost their lives due through accident due to intensive physical labour ,starvation and diseases .This in order of magnitude of life per meter of wall length . It is rare not to find safety in mission statement of large construction firms or companies. Building construction activities and accidents on construction sites are activities that are significantly rated high in Nigeria (Peter and fedelis 2016).In view of the rapid rate of construction in Nigeria, it became obvious that more workers are needed and for this to be achieved, people must be in good health and must also engage in construction activities and jobs which do earn them as much as to be comfortable with little or no health hazards. Excessive exposures to certain substances or agents during building construction may result in acute injury, chronic illness, permanent disability or even death. Therefore, to reduce this problem, this research was targeted at determining the extent in which the health of workers on building construction sites in minna are being affected by the construction activities taking into considerations the sources of responsible hazards in order to generate guideline to reduce hazards in construction sites in Nigeria. The objectives of the study are : to investigate construction firm's attitude towards safety provision for workers on site ; to create awareness on safety programs in order to reduce the number of workers compensation claims and cost due to accident; determine if there are benefits associated with adequate safety for workers; to examine government safety regulations on construction firms and their compliance for their workers.

During industrial revolution, little time was spent to ensure the machineries were safe. In Management of safety for efficiency, one need to execute a project ,go through their life cycle of design, procurement to ensure safety in all phases of construction .This is a standard basis for a safe construction is already laid during the front end loading (FEL)of a project .This encompasses all the work done until completion of the basic designs and solid execution plans including many aspect of early planning for safety execution which is supported by correlations, some of these correlations were by organization such as independent project analysis (IPA) .It has been

statistically proven that there is correlation between good (FEL) and safety performance .Good (FEL) will ensure for example a basic layout that shows important items needed to be considered before embarking on construction work .A design that can done safely needs to be review time to time ,this will add value to safety programs induction on site .Therefore ,a safety induction program before mobilization to site is highly recommended. The parameters shown will normally be logged together with number of working hours and also be presented as frequencies e.g lost time injury frequencies(LITF) Most system use 200,000 working hours as the reference point so ,LTIF=1 Means LTI Per 200,000 work hours (roughly 100 working years)

## II. METHODOLOGY

This research was based on medium sized construction firm and specialized contractors operating within Minna, Niger state. The method adopted for this research work includes;

- The use of questionnaire distributed to the construction firms within Minna, Niger state.
- Interviews especially with the workers on site.
- Previous records on safety measures and direct observation of altitude of workers on site
- Unsafe practices by workers on site.

*Data analysis*

The data collected were analyzed using standard statistical techniques these include: ranking method, Chi-square and simple percentage.

Ranking method: This is a simple statistical scale where subject are ranked based on specific criterion or an operationally defined characteristics or property. The method is effective once the numbers of measures to be analyzed exceed three but does not exceed thirty young Man (1981).using the ranking method weight or scores is assigned to a given number of factors .therefore, the rank sum is obtained using the formula below.

$$S=\sum NW \quad (1)$$

where: N=Numbers of respondents, W= corresponding weight of rank category.

Empirical ranking method: this method is used for reports and some results concerning the effect of serial correlation. Let there be N physical value taken from different years, let these values be ranked in increasing order of size from the smallest value. M=1 to the largest M= Thus M represents the rank of each N values with M increasing as the value increases. Jenkinson (1997) gives as estimate of the cumulative probability p corresponding to rank as

$$P = 100\frac{M-0.3}{N+0.4} \quad (2)$$

Jenkinson rounded up the numerical value in the numerator to 0.3 and denominator 0.4.Jenkinson discussed this formula in the context of ranked annual maximum values of a variable. The formula can be applied to any ranked series of continuously distributed measurement as it can be regarded as random sample. Therefore, Chi – square formula is given as

$$X^2 = \sum \frac{Observed\ \ frequency\ -Expected\ \ frequency}{Expected\ \ fequency} = X^2 = \sum \frac{f_o - f_e}{f_e} \quad (3)$$

$$f_{e=\frac{RXC}{T}}$$

where: R= Row total, C = column total and T=Grand total response

Simple percentage: The simple percentage is calculated using the formula

$$\frac{X}{n}\ X\ 100\% \quad (4)$$

where: X= number of observation in each question and n = total number of observation in each question.

## III. RESULTS AND DISCUSSION

*Data presentation*

All statistical analysis is in respect of data from sample of the case study of selected construction firms within minna Niger state. A total of ten (10) Questionnaires were distributed, only five (5) was retrieved and were found Suitable for the analysis.

*Summary of management staff background*

The table below shows the summary of management staff background off each Construction firm operating within Minna, out of which five considered were male Engineers.

Table 1.0 also shows that 60% of the respondents were 30-35years of age and 40% of respondents were 40-45% years of age .This clearly indicates that majority of workers on site were young and have ability to improve the output of the construction firms. Only 60% of the respondents residing in one bedroom, 20% of the respondents residing in two bedroom and other bedrooms. With Only 60% of A respondent residing in two bedrooms has fair condition of building and 40% has good condition.66.67% workers on site had tertiary education .This indicates that Educated workers on site will improve better performance as expected in construction operations. 0% had no Quran and No formal education. 33.33% of the respondents were site supervisors i.e only 33.33% of respondents considered in each construction firm engaged in supervision work.16.67% of the respondents of each firm considered are site engineer, consultants, foreman and clerk of work.

Table 1.0 Summary of management staff background.

| (A)PERSONAL DATA | No of respondents / company | | | | | Total scores | % scores |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | | |
| ( a) Gender | M | M | M | M | M | | |
| (b) Age range | | | | | | | |
| 1. 30-35 | 1 | 1 | 1 | 0 | 0 | 3 | 60 |
| 2. 35-40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3. 40-45 | 0 | 0 | 0 | 1 | 1 | 2 | 40 |
| (c) Type of building residing | | | | | | | |
| 1. One bedroom | 0 | 1 | 0 | 0 | 0 | 1 | 20 |
| 2. Two bedroom | 1 | 0 | 1 | 0 | 1 | 3 | 60 |
| 3. Others | 0 | 0 | 0 | 1 | 0 | 1 | 20 |
| (d) condition of building | | | | | | | |
| 1. Good | 1 | 0 | 1 | 0 | 0 | 2 | 40 |
| 2. Fair | 0 | 1 | 0 | 1 | 1 | 3 | 60 |
| 3.Poor | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (B) EDUCATIONAL LEVEL | | | | | | | |
| 1. Primary | 0 | 0 | 0 | 1 | 0 | 1 | 16.67 |
| 2. Secondary | 0 | 0 | 0 | 0 | 1 | 1 | 16.67 |
| 3. Tertiary | 1 | 1 | 1 | 0 | 1 | 4 | 66.67 |
| 4. Quran | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5. No formal Education | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (C) PROFESSION IN CONSTRUCTION FIELD | | | | | | | |
| 1. Site Engineer | 0 | 0 | 0 | 0 | 1 | 1 | 16.67 |
| 2. Consultant | 0 | 0 | 0 | 1 | 0 | 1 | 16.67 |
| 3. Foreman | 0 | 0 | 1 | 0 | 0 | 1 | 16.67 |
| 4. Site supervisor | 1 | 0 | 1 | 0 | 0 | 2 | 33.33 |
| 5. Clerk of work | 0 | 1 | 0 | 0 | 0 | 1 | 16.67 |

KEY
M-GENDER, A-SOLMALID NIGERIA LIMITED, B-NAIRDA NIGERIA LIMITED, C-NEW COMPLEX NIGERIA LIMITED
D-TRACTA NIGERIA LIMITED, E-UPPER NIGER BASIN DEVELOPMENT AUTHORITY

Table 2.0 Trends of experience in management of construction

| S/N | No of respondents/Company | | | | | | | Cumulative (prob) $P=100\,\frac{M-0.3}{N+0.4}$ |
|---|---|---|---|---|---|---|---|---|
| | Company | Total Agree | Total disagree | NxTotal agree | NxTotal disagree | Ranking order(Agree) | Ranking order (disagree) | |
| 1 | A | 8 | 0 | 248 | 0 | $1^{ST}$ | $5^{TH}$ | 12.96 |
| 2 | B | 4 | 4 | 124 | 36 | $5^{TH}$ | $1^{ST}$ | 31.48 |
| 3 | C | 7 | 1 | 217 | 9 | $2^{ND}$ | $4^{TH}$ | 50.00 |
| 4 | D | 5 | 3 | 155 | 27 | $4^{TH}$ | $2^{ND}$ | 68.50 |
| 5 | E | 6 | 2 | 186 | 18 | $3^{RD}$ | $3^{RD}$ | 87.00 |
| | (N) Total | 31 | 9 | | | | | |

In order to get ranking order for Total No of Agree Respondents and total No of

Disagree Respondents.

It can be calculated as follows:-

N x total Agree (A) = 31x8=248

N x Total Disagree (A) = 9x0=0

The process for calculating the ranking order continues for the corresponding

Companies B, C, D and E Respectively.

To calculate the cumulative probability P corresponding to rank as

$P = 100\ \frac{M-0.3}{N+0.4}$

Increase order of ranking of No of Agree correspondents are as follows:-

From M=1, N=5

$P=100\left(\frac{1-0.3}{5+0.4}\right) = 100\ \left(\frac{0.7}{5.4}\right) = 12.96$

From M=2, $100\left(\frac{2-0.3}{5+0.4}\right) = 100\ \left(\frac{1.7}{5.4}\right) = 31.48$

From M=3, $100\left(\frac{3-0.3}{5+0.4}\right) = 100\ \left(\frac{2.7}{5.4}\right) = 50.0$

From M= 4, $100\left(\frac{4-0.3}{5+0.4}\right) = 100\ \left(\frac{3.7}{5.4}\right) = 68.5$

From M=5, $100\left(\frac{5-0.3}{5+0.4}\right) = 100\ \left(\frac{4.1}{5.4}\right) = 87.0$

Table 3.0 Summary of trends experience in management of construction

| Company | Cumulative Probability $P=100\frac{M-0.3}{N+0.4}$ | Ranking order (Agree) | Ranking Order (Disagree) | Cumulative Probability $P=100\frac{M-0.3}{N+0.4}$ |
|---|---|---|---|---|
| A | $1^{ST}$ | 12.96 | $5^{TH}$ | 87.0 |
| B | $5^{TH}$ | 87.0 | $1^{ST}$ | 12.96 |
| C | $2^{ND}$ | 31.48 | $4^{TH}$ | 68.50 |
| D | $4^{TH}$ | 68.50 | $2^{ND}$ | 31.48 |
| E | $3^{RD}$ | 50.0 | $3^{RD}$ | 50.0 |

It can be seen from the table above that company A is ranked $1^{ST}$ with Total No of Agree respondents of 248. Company C is ranked $2^{ND}$ with Total No of respondents of 217.

Other companies that are ranked with the options above includes; E, D, B respectively (i.e $3^{RD}$, $4^{TH}$, $5^{TH}$).

The inference drawn is that the trends of experience in management of construction have tremendously improved the nomadic nature of construction operation work as ranked sequentially.

The No of respondents who disagree with the options mentioned above are ranked in decreasing order as follows from $5^{TH}$, $4^{TH}$, 3TH, $2^{ND}$, $1^{ST}$ (A,C,E,D,B).

This shows that trends of experience in management of construction will have great effects on the management as the company experience backwardness in every stage of construction operation.

The cumulative probability increased from M=1to5. This reflects that as trends of management in construction has improved; also there is gradual improvement of workers' productivity on site.

Table 4.0 Test Results for significant level of provision of adequate safety measures for workers on site and towards their productivity

| | Response | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Agree Respondents | | | | | Disagree Respondents | | | | |
| Company | **A** | **B** | **C** | **D** | **E** | **A** | **B** | **C** | **D** | **E** |
| Variables | | | | | | | | | | |
| (A). Has Good safety knowledge improved your workers' productivity since your firm imbibes safety?. | A | A | A | | A | | | | D | D |
| (B). everyone is responsible for his or her safety in your organization | | | | | A | D | D | D | D | |
| (C). Are you always provided with safety equipment on site? | A | A | A | | | | | | D | D |
| (D) If yes, are they provided with correct protective equipment on site? | A | A | A | | | | | | D | D |

**KEY**

**A** - AGREE

**D** - DISAGREE

Table 5.0 Summary test Results for significant level of provision of adequate safety measures for workers on site and towards their productivity

| S/N | AGREE | % | DISAGREE | % | TOTAL |
|---|---|---|---|---|---|
| 1 | 4 | 36.36 | 2 | 20 | 6 |
| 2 | 1 | 9.09 | 4 | 40 | 5 |
| 3 | 3 | 27.28 | 2 | 20 | 5 |
| 4 | 3 | 27.28 | 2 | 20 | 5 |
| TOTAL | 11 | 100 | 10 | 100 | 21 |

Table 6.0 Significant level of provision of adequate safety measures for workers on site and towards their productivity

| CELL | Fo | Fe | (fo-fe) | $(fo-fe)^2$ | $X^2$ |
|---|---|---|---|---|---|
| 1,1 | 4 | 3.14 | 0.86 | 0.73 | 0.23 |
| 1,2 | 2 | 2.85 | -0.86 | 0.72 | 0.25 |
| 2,1 | 1 | 2.61 | -1.61 | 2.60 | 0.99 |
| 2,2 | 4 | 2.39 | 1.61 | 2.60 | 1.09 |
| 3,1 | 3 | 2.61 | 0.39 | 0.15 | 0.05 |
| 3,3 | 2 | 2.39 | -0.39 | 0.15 | 0.06 |
| 4,1 | 3 | 2.61 | 0.39 | 0.15 | 0.05 |
| 4,4 | 2 | 2.39 | -0.39 | 0.15 | 0.06 |
| TOTAL | | 20.99 | | 7.25 | 2.78 |

From the table 5.0 , $x^2 = \sum x^2 = 2.78$ .Therefore, $x^2$ Calculated is $x^2 = \sum \frac{(fo-fe)2}{fe} = \frac{2.75}{20.99} = 0.34$

It can seen from the table that Chi-square ($x^2$) is greater than the calculated $x^2$

i.e 2.78 >0.34.

**Conditions**

1. If $x^2$ Calculated is greater than the table chi-square ($x^2$) value .Accept Null Hypothesis (**Ho).**

2. If $x^2$ calculated is greater than the Table $x^2$ , reject the alternate Hypothesis **($H_1$)**

The result is very significant .the inference drawn here, is need for a sound safety provision for workers on site to improve their productivity.

**$H_0$:** Ignorance of safety techniques on the part management and construction Workers onsite has no significance relationship with output of workers.

**$H_1$:** Ignorance of safety techniques on the part of management and construction Workers on site has significant relationship with the output of the workers.

Table 7.0 Sample of job Hazards Analysis Survey

| | Name of Respondents/ Company | | | | | Total Score | % Total Score |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | | |
| No of Employers | 10 | 95 | 30 | 60 | 50 | | |
| Job Title | GC W | RC | CB | DC | SW | | |
| Forms of Hazards | | | | | | | |
| 1.Dust | V | V | V | V | V | 5 | 55.55 |
| 2.Liquid | * | * | * | * | * | 0 | 0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3.Vapour | * | * | * | * | * | 0 | 0 |
| 4.Gas | * | * | * | V | V | 2 | 22.33 |
| 5.Fumes | * | * | V | V | * | 2 | 22.23 |
| Route of Entry | | | | | | | |
| 1.Skin | * | * | * | V | * | 1 | 20 |
| 2.Inhaled | V | V | V | * | V | 4 | 80 |
| Control method | | | | | | | |
| 1.Hand Gloves | * | * | V | * | * | 1 | 9.09 |
| 2.Respirator | * | * | V | V | V | 3 | 27.28 |
| 3.Face protection | V | * | V | V | * | 3 | 27.28 |
| 4.Local protection | * | * | * | * | * | 0 | 0 |
| 5.General protection | V | * | * | V | V | 3 | 27.28 |
| 6.Other protection | * | V | * | * | * | 1 | 9.09 |
| | | | | | | | |

KEY

GCW – GENERAL CONSTRUCTION WORK

RC –ROAD CONSTRCUTION

CB-CONSTRCUTION OF BUILDING

DC- DAM CONSTRUCTION

SW- SUPERVISION WORK

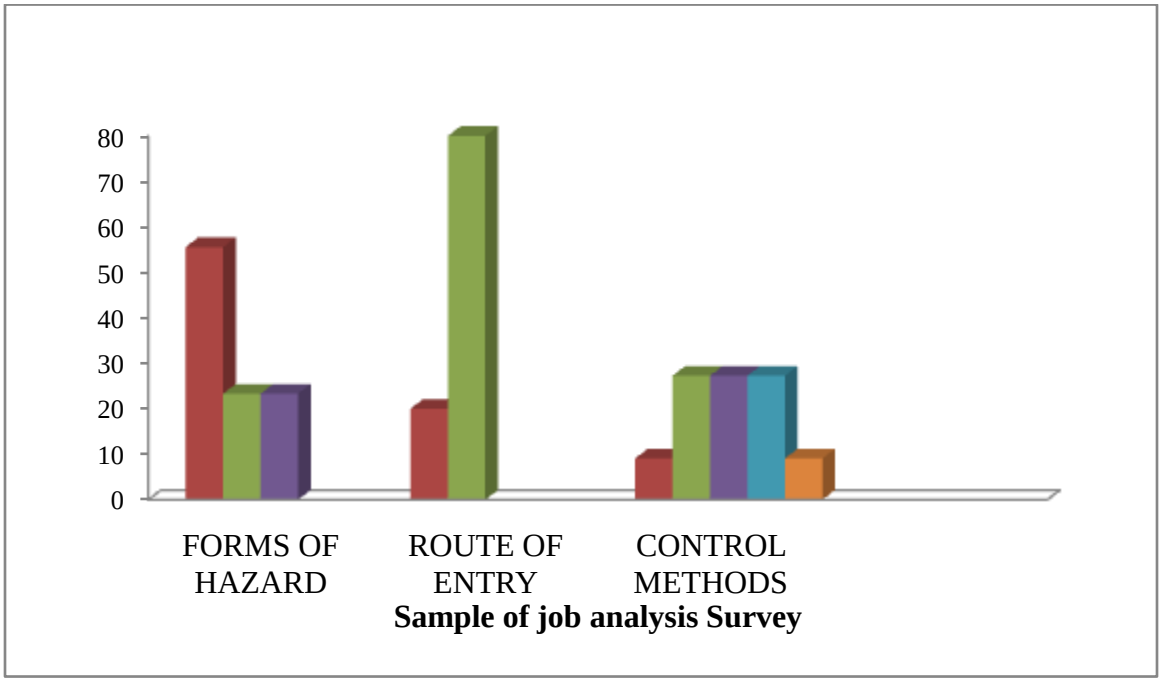


Figure 1.Sample of job analysis Survey

It can be seen from the figure that 55.50% were expose to dust. 22.23% of the respondents were exposed to both Gas and Fumes.

Only 80% inhaled either dust, Fumes and Gas. And 20% of the respondents were their skin exposed to one of the hazards mentioned above.

9.09% from the respondents used both hand gloves and other protection as their control methods to ensure safety at construction site. While 27.28% used respirator, face protection and general protection as their control methods before working at the construction site.

## IV. CONCLUSION

The study reveals that accidents are caused by a wide range of factors which includes job site condition, unique nature of industry, unsafe Method, human element and management. From the test results for significant level of provision of adequate safety measures. It was discovered that all respondents are aware of the root causes of accident in construction firms which mostly attributed to workers negligence, failure of workers to comply with working procedures, operating equipment without safety devices, harsh operation, Knowledge about safe and unsafe conditions. Also, the trends of management in construction have tremendously improved workers efficiency and productivity on site. Ignorance of safety techniques on the part of management and construction workers on site has significant relationship with the output of workers.

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