Safety Culture In Building Construction Industry In Nigeria

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Abstract: Measures of safety are after-the-fact measures; namely, that safety is measured after injuries have already occurred. In recent years, there has been a movement away from safety measures purely based on retrospective data or ‘‘lagging indicators,’’ such as accident rates, toward so-called ‘‘leading indicators’’ such as measurements of safety climate. In this research, safety performance measurement of various construction firms as well as the overall construction industry of Nigeria based on an investigative site survey has been done. Salient findings of the study are ear defenders not worn (while using noisy equipment); protective footwear not worn; and face masks not worn (in dusty conditions). Most of the safety nonperformance issues belong to self-protection category. This shows that the site workers themselves are either unaware of the importance of personnel safety practices or they do not want to wear protective gears and kits as they consider it as a hindrance in their work productivity. Also, it was observed that the site management seemed non-interested in emphasizing the need of personnel safety practices among their workers. Overall, most of the companies lie in the range of extremely unsafe to moderately unsafe range thus showing that the overall level of the industry as regard to site safety needs drastic improvement. Safety seems to be on the less priority on the agenda even during the execution phase which is not a healthy trend. A mean value of Safety Performance Index of 0.52 was assessed for the building construction sites, which indicates that even the basic practices required for safety are not present at most construction sites. Also, the scattered safety performance levels of firms indicates lack of standard safety management systems. The major recommendations of the study are safety rules and regulations need to be defined, documented and enforced at the industry level thereby incorporating administrative body for occupational safety and health implementation. Awareness programs need to be developed and implemented through appropriate arrangement of training in safety rules, formal and informal education and career development programs.
[Maryam Abidemi Akomolafe. **Safety Culture In Building Construction Industry In Nigeria.** *Researcher* 2018;10(10):9-16]. ISSN 1553-9865 (print); ISSN 2163-8950 (online). http://www.sciencepub.net/researcher. 2. doi:10.7537/marsrsj101018.02.

Keywords Safety Performance Measurement, Safety Non-Performance Index, Safety Performance Index, Developing Countries, Construction Industry, Nigeria

1. Introduction

In the developed as well as developing part of the world, construction industry is considered to be one of the most significant industries in terms of contributing to GDP and also in terms of its impact on health and safety of the working population. Construction industry is both economically and socially important. However, the construction industry, at the same time, is also recognized to be the most hazardous (Suazo and Jaselskis, 1993). Although dramatic improvements have taken place in recent decades, the safety record in the construction industry continues to be one of the poorest (Huang and Hinze, 2006). Research shows that the major causes of accidents are related to the unique nature of the industry, human behavior, difficult work site conditions, and poor safety management, which result in unsafe work methods, equipment and procedures (Abdelhamid and Everett, 2000). Emphasis in both developing and developed countries needs to be placed on training and the utilization of comprehensive safety programs (Koehn et al., 1995). In developed countries, recent advancement in technology, on one hand, has contributed positively to industry productivity, but on the other hand, has created a more challenging and unsafe work environment. Evidently, construction accidents and the associated damage caused to the employees, property, equipment and morale have generated negative effects on the industry profitability and, to some extent, the industry productivity. Responding to this increased safety requirement generated by technology advancement, the industry control environment in developed countries has incorporated safety as an integral part in the regulatory framework. In the U.S.A., for instance, the workers compensation rates are a function of the loss experience of a contractor, and each labor hour is affected through the reflection of those losses in the experience modification rating (EMR). On one hand, a safe contractor can create a substantial competitive advantage through superior safe experience while, on the other hand, an unsafe contractor can be liable to pay huge penalties in terms of insurance. Safety, therefore, and the effects of its absence – accidents – is now a key cost driver for

construction firms in such countries. Safe work experience is also becoming a business survival issue for them, as more and more owners are reluctant to permit contractors to bid work without acceptable EMRs. Thus, the most important step in controlling costs for contractors in these countries is to run safe construction projects. Hence the contractors are compelled to implement safety as their business strategy, which has led to recent improvements in global construction safety records. In contrast, developing countries like Nigeria have yet to respond to recent technological improvements. Lack of response to technology, however, has not resulted in safer construction sites. In fact, a larger share of construction work being performed by human resources has led to increased number of site accidents. Informal assessments have identified a few major reasons for safety non-performance which include: lack of development of construction sector in the shape of mechanization and industrialization; lack of professional construction management practices which has not only led to unsafe project sites but have also resulted in construction delays, cost overruns, poor productivity and poor product and process quality; inadequate safety provisions laid by the existing regulatory environment which has failed to establish safety as a major industry objective; insufficient and incentive-less insurance mechanisms which have failed to establish safety as a business survival issue; and unfavorable business environment which has led to adversarial business relationships among stakeholders resulting in controversies, conflicts, claims and litigation and hence diverting the focus away from issues like safety.

Compared to the past, the current decade is witnessing massive infrastructure growth in Nigeria especially in large cities and towns. There are numerous infrastructure development projects in progress as well as under planning. All of these projects have the potential to lead the local Industry to gain glory, status and international recognition but only when appropriate efforts are extended to achieve the same. With the stage set for a golden era for development, the challenges are still higher. One of the important areas that require quick and drastic improvement is safety. It is highly essential that all occupational injuries and illnesses should be given due attention. There should be an effort to raise the level of awareness between both employees and employers of the importance of health and safety at worksites. Prior research done in construction safety indicates the significance of conducting formal assessment exercises for safety management implementation in the construction industry in general. Such assessment exercises are particularly important in benchmarking safety performance as well as formulating safety management policies and strategies appropriate to the particular work environment under study.

Consequently, this research aims to delve into the safety performance measurement of local construction firms and hence the overall construction industry of Nigeria based on an investigative site survey. In this research, a proactive investigative approach has been adopted to measure the safety performance of construction firms at their work sites. Conclusions and recommendations in relation to safety performance of Nigerian construction industry have been drawn based on statistical analysis of the data.

2. Global Construction Safety Performance Scenario

In developed countries, recent advancement in technology, on one hand, has contributed positively to industry productivity, but on the other hand, has created a more challenging and unsafe work environment (Farooqui et al., 2007). According to research findings, those who spend their working lives on construction sites have a 1 in 300 chance of being killed at work. The chance of being disabled by injury or serious illness is much greater than in most other industrial fields. Every construction worker is likely to be temporarily unfit for work at some time as a result of a minor injury or a health problem after working on a construction site (Ahmed et al., 2000). Rowlinson (2003) reported that between 1989 and 1992, 256 people were fatally injured in the Australian Construction Industry. Statistics revealed that the fatality rate was 10.4 per 100,000 workers, which was similar to the fatality rate for road accidents. In 2000, a study was conducted in China (Huang et al. 2000), which revealed that 3,000 construction workers are killed in work related accidents each year. In Hong Kong, 275 reportable accidents per 1,000 workers per year were recorded in 1994; this figure stood at around 150 in 2000 (Rowlinson, 2003). In comparison, 10 construction workers in every 1,000 suffer an injury in a year in Japan, and the figure is around 50 for the United Kingdom (Rowlinson, 2003). A study of the Egyptian construction industry concluded that safety programs applied by contractors operating in Egypt were less formal and the accident insurance costs were fixed irrespective of the contractor's safety performance (Hassanein, 2008).

Table 1 compares the fatality rates in global scenerio of all industries to that of construction industry in 2012. The table clearly indicates the unsafe nature of the construction industry.

Construction Safety Performance Scenario in Nigeria

Construction in developing countries, such as Nigeria is more labour intensive than that in the developed areas of the globe, involving 2.5-10 times

as many workers per activity (Koehn and Regmi 1991). Typically workers tend to be unskilled and migrate in a group, with or without their families, throughout the country in search of employment. In fact, they are usually divided into various factions. Communication problems related to differences in language, religion and culture tend to inhibit safety on the work site. In Nigeria, there is a significant difference between large and small contractors. Most large firms do have a safety policy, on paper, but employees in general are not aware of its existence. Nevertheless, a number of major constructors exhibit a concern for safety and have established various safety procedures. They also provide training for workers and maintain safety personnel on the jobsite. For the majority of contractors, however, maximizing profit is the prime concern. Unsafe conditions exist on many sites, both large and small, and laborers are subjected to numerous hazards. On many sites, no training programs for the staff and workers exist; therefore, no orientation for new staff or workers is conducted, hazards are not pointed out, and no safety meetings are held. Employees are required to learn from their own mistakes or experience. In addition, lack of medical facilities, shanty housing, and substandard sanitation tend to exist on remote projects. Workers undertake a risk while at work and the following problem areas are common:

Table 1: Fatality rates in selected countries in 2012 (Deaths/100,000 Employees)

Country	All Industry	Construction
Australia	2.0	5.0
Canada	6.1	20.9
Hong Kong	8.6	64.2
Sweden	1.4	5.0
United Kingdom	0.7	4.4

i. While excavating in deep trenches (with no proper shoring or bracing), accidents due to cave-ins often occur.

ii. Concreting is done mainly by laborers, and cements burns due to the unavailability of protective gloves and boots are common.

iii. Workers fall from heights due to weak scaffolding and the unavailability of safety belts.

iv. Workers sustain injuries on the head, fingers, eyes, feet, and face due to absence of personal protection equipment.

v. There is improper housekeeping.

Lack of understanding of the job and poor equipment maintenance are also major causes of accidents. Injuries generally are unreported; however, if necessary, a laborer might receive first aid or preliminary medical care. In most cases, specialized medical treatment or compensation is unavailable. Workers themselves consider accidents as due to their own negligence, and accept that construction is a dangerous occupation. Nevertheless, major accidents involving the death of a worker may be reported due to the financial expenses and litigation that could be involved.

Maintenance and inspection schedules often are not followed, and only after a breakdown is equipment repaired. This approach leads to loss of time, idle workers, and project delays. It may also cause damage to property. Breakdown of concrete mixers, vibrators, water pumps, and tractors are common. Electrocution is also a major hazard, due to use of substandard electrical equipment and underground cables. Workers, especially young ones, take chances, and often do not follow safety norms or use personal protective equipment. Also laborers and staff are sometimes are under the influence of alcohol and drugs. Unfortunately, crew members are not checked for drugs and alcohol before the start of and during work.

Owners and consultants do stress safety before work commences, but as the work progresses their concerns for deadlines becomes a priority and they tend to pay less attention to safety. On large projects, the owners may provide medical facilities at the site, but ultimately safety is the contractors' responsibility. According to the survey conducted by Farooqui et al. (2007), the major injuries faced by contracting firms in Pakistan on their project sites, in descending order of occurrence, were given as follows:

i. Fall injuries
ii. Struck-by injuries
iii. Injuries by wastage and raw materials
iv. Heat stroke
v. Head injuries
vi. Eye injuries
vii. Burning cases

3. Research Scope & Objectives

Although safety management is a collective effort of all the stakeholders including the owners, consultants, contractors, subcontractors, suppliers, regulating bodies etc., this research is targeted to assessing the contractor safety management practices. Safety is implemented, in essence, by contractors on work sites who indeed need to adopt adequate safety related systems designed to respond to hazardous and

potentially hazardous project conditions as well as designed to take the process to a safe state when predetermined conditions are violated. This is required for successful implementation of a safety management mechanism for the provision and control of work environment systems and human behavior, which together give relative freedom from those conditions and circumstances, which can cause personal injury, disease or death, or property damage (Samelson and Levitt, 1982). Hence presence of a safety culture on construction work sites is immensely needed (Mohamed, 2003).

Hence this research assesses the safety management practices of contractors on construction work sites in Pakistan with the objective to diagnose the current safety practices among contractors associated with the construction industry of Pakistan and hence identify the safety performance in the construction industry of Nigeria. The objective has been achieved by investigating the extent to which on-site safety precautions have been adopted at different construction projects currently underway in Nigeria.

The study is specially targeted towards multi-storey buildings where there is abundance of such construction activities that require extra precautionary measures for safety for both laborers and equipment. It is expected that the findings of the study will present a true picture of construction safety performance in Nigeria.

4. Research Methodology

A survey team was developed and trained for conducting the survey. During training, the team was theoretically exposed to various aspects of construction site safety, methods of safety performance measurement, site selection process for safety surveys, and identification of survey parameters, such as things to be observed on site, appropriate time of survey, suitable days for survey and preferable weather for survey, etc. Site observation surveys were conducted on 27 sites. As a preference, building construction sites constituting scaffolding operations and working on heights operations were selected. Observations were taken on Mondays and Thursdays. The investigators were instructed to mark the level of agreement to the safety observation statement on the survey instrument on a scale defining the level of *safety non-performance***.** Some snapshots were also taken as evidence of the observations and also for confirming the validity of the observations. Findings based on the observations were then used to analyze the site safety performance of the local construction industry. Some conclusions and recommendations were drawn based on the analysis of the data.

5. Analysis and Discussion of Findings

A total of twenty seven (21) construction sites were investigated. The data of twenty-one sites (almost 78%) was found valid for the analysis. The safety performance investigation Performa was divided in four different categories covering various aspects of site safety measurement. These included (1) personnel safety; (2) housekeeping; (3) scaffolding safety, and (4) access to height. Each category had certain statements. Every statement was also supplemented by various positions and ways to judge the level of safety non-performance of a particular aspect. The investigator had to mark the *level of agreement* to the statement on a scale defining *level of safety non-performance* with non-performance level increasing from a score of 0 to 10.

5.1 Safety Performance Factor Analysis

A total of twenty five (25) safety performance factors were observed during the site investigation. Based on the level of safety non-performance, the Factor Non-Performance Index (FNPI) and the Factor Performance index (FPI) were calculated using the following formulae. The indices for all the factors are shown in Table 2.

Factor Non-performance Index (FNPI) = ∑ (Factor score x No. of sites at a particular score)

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(Total no. of responses for a factor x 10)

where "10" in denominator indicates the score at the maximum level of safety non-performance.

Factor Performance Index [FPI) = 1 – FNPI] On the basis of Factor Non-Performance Indices the top ten safety non-performance practices found on sites are as follows.

1. Ear defenders not worn (while using noisy equipment)
2. Protective footwear not worn
3. Face masks not worn (in dusty conditions)
4. Guardrails are missing on working scaffold platforms
5. Safety helmets not worn
6. Gloves not worn (while handling materials which have sharp edges, hot or could cause skin problems)
7. Openings left uncovered or unguarded
8. Goggles or other items of eye protectors not worn (when using motorized cutting equipment, welding and cartridge operated tools)
9. Timbers left lying around, have nails left in
10. Tools or small machinery not placed or stored properly.

Most of the safety non-performance practices belong to self-protection category. This shows that the site workers themselves are either unaware of the importance of personnel safety practices or they do not want to wear protective gears and kits as they consider

it as a hindrance in their work productivity. Also, it was observed that the site management seemed non-interested in emphasizing the need of personnel safety practices among their workers.

Table 2: Factor Indices

Safety Performance Measuring Factor	Factor Non-Performance Index	Factor Performance Index
Self Protection Category		
Safety helmet not worn	0.65	0.35
Protective footwear not worn	0.73	0.27
Gloves not worn	0.61	0.39
Ear defender not worn	0.88	0.16
Goggle or other item of eye protector not worn	0.51	0.49
Face mask not worn	0.73	0.27
Housekeeping Category		
Timber left lying around, have nail on it	0.51	0.50
Opening left uncovered or unguarded	0.59	0.41
Store material stacked/stored unsafely	0.30	0.70
Littering walkaway, access roads, routes and stair case with debris	0.43	0.57
Proportion of operatives, who are working at heights, have you seen throwing down objects	0.23	0.77
Tools or small machinery not placed or store properly	0.49	0.52
Excavation not provided with safety mesh erected all around	0.37	0.63
Scaffolding Category		
Working scaffold platform missing boards	0.33	0.67
Incorrectly placed scaffold platform	0.36	0.64
Toe-boards missing on working scaffold	0.44	0.56
Formwork missing base-plates under	0.33	0.67
Site personnel, who are working at height climbing up and down	0.36	0.64
Guardrails are missing on working scaffold platform	0.69	0.31
Access To Height Category		
Ladder too short for the job	0.22	0.78
Ladder used without been tied	0.33	0.67
Ladder used unsafely	0.24	0.76
Ladder placed with broken rungs	0,26	0.74
Mobile tower scaffold used unsafely	0.28	0.72
Mobile work platform being used unsafely	0.40	0.60

5.3 Safety Performance Category Analysis

Based on the factors non-performance and factors performance indices, the category Non-Performance and category performance indices of the four categories have been calculated with the following formulae. The indices are shown in Table 3.

Category Non Performance Index (CNPI) = ∑ FNPI (of the factors in the category)

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No. of Factors in the category

Category Performance Index (CNPI) = ∑ FPI (of the factors in the category)

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No. of Factors in the category

Self- protection category has got the highest non-performance index (i.e. 0.69) that again supplements weakness identified in the self-protecting safety practices.

5.4 Safety Performance Index

The safety performance index of the twenty one sites investigated has been calculated. For this, firstly the safety non-performance score of each site has been calculated by summing up the scores of safety nonperformance of all the factors for a site. Then the safety non-performance index have been calculated using the following formula.

Safety non-performance Index = ∑(Score of Safety non-performance of all factors for a site)

Maximum Score for a particular site where, Maximum Score for a particular site = No. of factors investigated x 10

Further, the Safety Performance Index (SPI) has been calculated using following formula:

Safety Performance Index (SPI) = 1 – Safety Non-Performance Index

A construction firm's safety performance level has been assessed based on percentage safety performance index (%SPI) using the criteria shown in Table 3.

Table 3: Category Indices

Safety Performance Measurement Category	**CNPI**	**CPI**
Self-Protection category	**0.69**	**0.31**
House-keeping category	**0.42**	**0.58**
Scaffolding category	**0.42**	**0.58**
Access to Height category	**0.29**	**0.71**

Table 4: Safety Performance Levels

%SPI	**0<20**	**20<40**	**40<60**	**60<80**	**80<100**
Safety Performace Level	**Extremely Unsafe [Eus]**	**Unsafe [Us]**	**Moderately Unsafe [Mus]**	**Safe [S]**	**Extremely Safe [Es]**

The summarized data for the 21 sites visited is shown below

Table 5: The summarized data

Site Number	Safety nonperformance score	Safety nonperformance index	SPI	%SPI	Safety performance level
1	17	0.2	0.8	83.0	ES
2	46	0.2	0.8	81.6	ES
3	57	0.3	0.7	71.5	S
4	64	0.3	0.7	69.5	S
5	60	0.3	0.7	68.4	S
6	77	0.4	0.7	65.0	S
7	82	0.4	0.6	64.3	S
8	80	0.4	0.6	63.6	S
9	27	0.4	0.6	61.4	S
10	84	0.4	0.6	60.0	MUS
11	89	0.4	0.6	59.5	MUS
12	97	0.5	0.5	53.8	MUS
13	33	0.5	0.5	52.9	MUS
14	105	0.5	0.5	52.3	MUS
15	129	0.6	0.4	38.6	US
16	142	0.6	0.4	38.3	US
17	146	0.7	0.3	33.6	US
18	55	0.7	0.3	31.3	US
19	138	0.8	0.2	23.3	US
20	66	0.8	0.2	17.5	EUS
21	149	0.8	0.2	17.2	EUS

Results indicate that most of the companies lie in the range of extremely unsafe to moderately unsafe (about 58%) and the rest are in the safer range (42%). This shows that the overall level of the industry as regard to site safety needs drastic improvement. Safety seems to be on the less priority on the agenda even during the execution phase that is not a healty trend. Statistical analysis of the safety performance indices of the twenty one sites is shown in table 6.

Table 6: Statistical Analysis of SPIs

Mean	0.52
Standard Error	0.04
Median	0.59
Standard Deviation	0.19
Sample Variance	0.39
Kurtosis	-0.78
Skewness	-0.44

The mean value of SPI of 0.52 indicates that the overall safety performance of building construction organizations on work sites is only average. This is alarming finding and should be further diagnosed as to the causes of safety non-performance and improvement measures that can be adopted. One important highlight from the statistical analysis is that the kurtosis has come out to be a negative value (i.e. -0.78) which indicates the forming of a platycurtic curve. This indicates that the safety performance index data is very scattered, which in turn shows that the safety performance levels are not at any standard level but are rather dispersed. A major conclusion from this statistical inference is the lack of presence of standard system with regards to safety management in the construction industry.

6. Conclusions

Safety non-performance practices at building construction work sites are Ear defenders not worn (while using noisy equipment), protective footwear not worn and face masks not worn (in dusty conditions. Most of the safety non-performance issues belong to self -protection category. This shows that the site workers themselves are either unaware of the importance of personnel safety practices or they do not want to wear protective gears and kits as they consider it as a hindrance in their work productivity. Also, it was observed that the site management seemed non-interested in emphasizing the need of personnel safety practices among their workers. Most of the companies lie in the range of extremely unsafe to moderately unsafe (about 58%). This shows that the overall level of the industry as regard to site safety needs drastic improvement. Safety seems to be on the less priority on the agenda even during the execution phase which is not a healthy trend. A mean value of Safety Performance Index of 0.52 indicates that even the basic practices required for safety are not present at most construction sites. Also, the scattered safety performance levels of firms indicate lack of standard safety management systems.

7. Recommendations

Analysis shows that there are many barriers due to which safety culture is not implemented on projects and some recommendations to overcome these barriers are:

1. There is a need of strong awareness campaign amongst the site workers that could be generated through many methods like on site safety charts having pictures to explain the safe work habits, practical demonstrations on site etc.

2. It would be appropriate to arrange some form of formal and/or informal education and training for the workers on site. These could be linked with the bonuses and other incentives on completion of such trainings.

3. The authors strongly believe that a major need of the industry is to develop the attitude of project construction firms towards an active on site safety implementation plan. The owners should also discuss it with the construction firms before giving them the contract. They should give safety some weighting in the award of the contract.

5. As a catalyst for maintaining a safe project, contractor top management should formulate strategies and develop policies that nurture a safe culture. Safety should be emphasized at all times no matter how fast the construction needs to be completed and under what budget constraints.

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10/25/2018