International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 9 Issue 8 ǁ 2021 ǁ PP. 60-64

Determination of Root Causes of Accidents on Construction Sites (Non Human Error)

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ABSTRACT
The construction industry is associated with a proportionally high number of job related accidents and despite mechanization, the industry is still largely labour intensive while working environments are frequently changing involving different parties. Over 270 million workers suffer occupational accidents yearly and there are at least 60,000 fatal accidents yearly on constructions sites including non-human error factor. This paper determined the root causes of accidents on constructions site (non-human error). 50 questionnaires were administered to a construction company quoted in the Nigerian Stock Exchange, the respondents under this study were the entire population which are the 50 respondents in which only 42 were retrieved, the study employed the descriptive design, questionnaires in addition to library research were applied in order to collect data. Primary and Secondary data were analyzed using correlation statistical tools at 5% level of significance which was presented in frequency tables and percentages. Findings in the research shows that there have been decrease in numbers of accidents that occur during project most especially non-human error factors as a result of implementation of safety policy, recording and investigation of accidents to prevent re-occurrence. However, the one that occurs are said to be as a result of nonchalant attitude of constructions site workers in the process of discharging their duties and it is concluded that despite the reduced rate of accidents (non human error) on constructions site. This does not mean the safety act employed should no longer be carried out and it is recommended that not only should safety policy be stated, constructions firm should strive to ensure that those engage in construction must be checked in the process of discharging their duties.
KEYWORDS*: Accidents, Construction, Error, Human and Site*

Date of Submission: 28-07-2021 Date of acceptance: 12-08-2021

I. INTRODUCTION

The construction industry is one of the main and important industry in any country, a large workforce has been employed in this industry, directly or indirectly. Health, Safety and Environment (HSE) problems and challenges in this industry as a major threat to labour, workforce and this industry can be very hazardous and harmful. Some studies indicated that construction sites and projects are the most dangerous workplaces; additionally, the risk of occupational accident, human injury is reportedly high. (Tam, Zeng, Deng, 2004). Accidents are the main issue to consider in any industries, Construction industry is no exemption. It is a high risk industry that covers a wide range of activities involving construction, and/or reparations. Lucky (1999) views accidents as an unplanned and unexpected occurrence which upsets a planned sequence of work resulting to loss of injury to personnel, damage to plant and equipment and eventually interrupting production flow. Every year many people fall victim to injury, harm and even death caused by accidents on construction sites. Therefore, Determination & control of accidents is vital in the construction industry, employers are required to access risk and take practical measures to protect, ensure safety and health of their workers, minimizing risk by means of continuous surveillance and monitoring of where accidents are likely to occur Odetoyinbo, (1992). There are numerous and an enumerable cause of accidents that occurs onsite that are mainly non-human error factors, which this study is poised to determine. Siri Wardena (2006) points that act of God or disasters as related to construction are events or actions which causes severe damages to construction progress, processes and stakeholders. Various act of God that causes casualties onsite are rain, flooding, wind, earthquake, landslides etc.

Adeniye (2011) states that it is easier to carry out construction works on-site during the dry season than the wet season, in event of rain, workers on scaffold may lose balance and step or slid off the plank. Hence resulting to fall accident. Sotoire (1992) also point out that since construction workers work on unsheltered adverse weather conditions should be avoided because continuous exposure to adverse weather could lead to general discomfort & illness. Continuous exposure to moderately highnoise level or relatively high level of

impulse noise such as explosives on-site, noise produced byheavy equipment, welding noise e.t.c . These are major causes of occupational deafness Adeniye (2011).

Lucky (1999) mentioned that human error is considered to be an undesirable human decisions or action that reduces or has the potential of reducing effectiveness of safety or system performance. This is also due to failures on the part of construction workers, error in judgments, lack of concentration at work, lack of awareness on the danger surrounding the activities and safety requirement. Therefore, there must be adequate safety training for all construction and building site workers and personnel on-site to raise awareness level about safety.

II. LITERATURE REVIEW

Accidents are some unpleasant and damaging happenings or occurrence that happens unexpectedly or by chance or by mistake. (Longman's Dictionary of Contemporary English). Encarta Dictionary also state that accidents are mishap which are unplanned and unfortunate events that result into damage, injury or upset of some kind. Accident on construction sites cannot be over emphasized; it could happen as a result of a mistake or lack of concentration or even natural disaster, Accidents can occur even when job to be done is minimal and could be very disastrous.

2.1 Classification of Accident on Construction site

King and Hudson (1985) classify accidents into four categories, namely

- Accidents which causes neither property loss nor personnel injury.
- Accidents which causes property loss without personnel injury.
- Accidents which caused personnel injury without property loss.
- Accidents which causes both personnel injury and property loss.

Generally, most contractors are not very concerned when accident does not involve personnel injury or property damage. The focus of attestation is always on accidents that involve personnel injury (Idoro 2001). International Labour Organization (ILO,1997) classifies accident into five different groups, following a resolution adopted at the 10th international Conference of Labour statistician in October 1962. This classification includes:

1 Multiple Causation Model

This model was presented by Petersen in 1971 that has totally different concept with the domino theory that influenced many researchers during Heinrich time. This model was inspired by his believed that many contributing factors, causes, and sub-causes are the main culprits in an accident scenario. Under this concept, the factors combine together in random fashion, causing accidents. By using multiple causation models, the surrounding factors to the accident would be revealed (Abdelhamid and Everett, 2000).

2 Domino Theory

Accident causation model was pioneered by Heinrich in 1930, which discussed accident causation theory, the interaction between man and machine, the acts, the management role in accident prevention, the costs of accident, and the effect of safety on efficiency. Heinrich developed the domino theory (model) of causation that consist of five dominoes namely ancestry and social environment, fault of a person, unsafe acts and condition, accident, and injury. This five dominoes model suggested that through inherited or acquired undesirable traits, people may commit unsafe acts or cause the existence of mechanical or physical hazards that result in injury (Abdelhamid and Everett, 2000). Adams (2001) and Weaver (2004) had also put forward the updated version of the domino theory. Adam had the same view as of Bird′s but emphasized more on the organisational structure of the management.

3 Accident Causation Models

Accident causation model is not a new model to identify the root problem of safety in construction and other industry. The objective of this model is to provide tools for better industrial accident prevention program (Abdelhamid and Everett, 2000). As described by Heinrich (1980) accident prevention is an integral program, a series of coordinate activities, directed to the control of unsafe personal performance and unsafe mechanical conditions, and based on certain knowledge, attitudes, and abilities. The famous models that were developed that relate to accident causation are namely domino theory that was invented by Heinrich in 1980 and multiple causation theory that was developed by Petersen in 1971.

2 Classifications According to the Type of Event Causing the Injury

ILO identifies nine main categories of events capable of causing injury on site. These are described as following:

a. Fall of person.
b. Struck by falling object.

c. Stepping on, striking against or struck by object including falling objects.
d. Caught in or between objects.
e. Over exertion or strenuous movement.
f. Exposure to or contact with electric current.
g. Exposure to or contact with extreme temperature.
h. Exposure to or contact with harmful substance or radiation.
i. Other types of accident.

4 Classifications According to the Degree of Injury

This is an accident which may be classified based on the magnitude of damage or harm done to the victim. This we have fatal accident, major accident and minor accident.

i. Fatal Accident: An accident is said to be fatal if it resulted in death of the victim.
ii. Major Accident: Major accident includes accident which causes suffering from any of the following injuries or conditions in connection with work. Fracture of the skull spins or pelvic fracture, ankle amputation or hand, foot, finger or thumb or of the bones in the arm, wrist and leg, kneel to toe, Loss of consciousness resulting from lack of oxygen or struck by objects, decompression sickness, acute illness requiring treatment resulting from absorption of any substance, inhalation, ingestion or through skin.
iii. Minor Accident: This refer to any accidental injury which does not cause any harm up to the extent of hospitalizing the victim or the victim losing working days.

5 Human Error Theories

The approach of this theory is pointed to the worker as the main factor of the accident. This approach as mentioned by Abdelhamid (2000) studies the tendency of humans to make error under various conditions and situations, with the blame mostly fall on human (unsafe) characteristics only. But this theory does not blame the workers as the main problem for accident, other factors such as design of workplace and tasks that do not consider worker (human) limitation also take part as the reason why accident happened (Abdelhamid and Everett, 2000). In general, the overall objective of human error theory is to create a better design workplace, tasks, and tools that suitable with human limitation.

2.2. Causes of Accident

Accident don′t just happen, they are caused. According to Ridley 99 per cent of the accident are caused by either unsafe acts or unsafe conditions or both (Ridley, 2011). As such, accidents could be prevented. The unsafe act is a violation of an accepted safe procedure which could permit the occurrence of an accident. The unsafe condition is a hazardous physical condition or circumstances which could directly permit the occurrence of an accident.Kartam and Bouz (1998) did a study in Kuwaiti construction and noted that the causes of accidents were due to worker turnover and false acts; inadequate safety performance; improper cleaning and unusable materials; destiny; low tool maintenance; supervisory fault; and misplacing objects.Human factors were due failed to secure and warn; Failed to wear personal protective equipment (PPE); horseplay; operating equipment without authority; operating at unsafe speed; personal factor; remove safety device; serviced moving and energized equipment; took unsafe position or posture; used defective tool or equipment; and other unsafe action. Lubega et al (2000) conducted a study in Uganda and concluded 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 people involved in construction projects; engaging incompetent personnel; non-vibrant professionalism; mechanical failure of construction machinery/equipment; physical and emotional stress; and chemical impairment. Pipitsupaphol and Watanabe (2000) investigated a study in Thailand construction sites and classified the causes into the most influential factors i.e. unique nature of the industry; job site conditions; unsafe equipment; unsafe methods; human elements; and management factors. Toole (2002) suggested that the causes of accidents were due to lack of proper training; deficient enforcement of safety; safety equipment not provided; unsafe methods or sequencing; unsafe site conditions; not using provided safety equipment; poor attitude toward safety; and isolated and sudden deviation from prescribed behavior.

III. METHODOLOGY

3.1 Method of Data Collection

The survey researches were used in carrying out the research.However, this research work is to evaluate the causes of accidents on construction sites (Non-Human Error Factors). For the purpose of this research, history data on past executed projects is required to meet the objectives of the research.

More so, data collection instrument would be limited to primary data. The primary data was obtained from one Nigerian Stock Exchange quoted construction firm via self-administered questionnaire.

Furthermore, data collected from retrieved questionnaires were analyzed appropriately using percentage, mean score, and five point likert scale to obtained accurate and valid result and result analyzed would be presented in APA table format.The population of the study is the construction sites operated by construction firms operating within the country and the number of professional which the researcher wishes to draw his or her conclusion from. Since these companies are few in number, they equally constitute the sampling frame. Fifty (50) copies of questionnaires were administered on the sampled respondents. The data shall be analyzed using mean response analysis (MRA). It was used to determine the prominent, the rate at which various factors occurred.

IV. PRESENTATION AND ANALYSIS OF DATA

Table 1 Causes of accident on construction site

	N	Minimum	Maximum	Mean	Std. Deviation	Ranking
Poor site layout	42	1.00	3.00	1.2857	.55373	1st
Incompetence	42	1.00	3.00	1.8810	.63255	2nd
Poor supervision techniques	42	1.00	4.00	2.2143	.89812	3rd
Ignorance of safety techniques	42	1.00	4.00	2.2381	.87818	4th
Non implementation of safety policy	42	1.00	5.00	2.9048	1.33999	5th
Non-human error	42	2.00	5.00	3.6190	1.26785	6th

Source: field survey, July 2018

From Table 1 shows that accident is caused mostly by poor site layout mean (1.29), followed by incompetence mean (1.88), followed by poor supervision techniques mean (2.21)

Table 2 factor that causes frequent occurrence of accident

	N	Minimum	Maximum	Mean	Std. Deviation	Ranking
Lack of investigation and record of accident	42	1.00	2.00	1.1429	.35417	1st
Nonchalant attitudes	42	1.00	4.00	2.4286	1.12927	2nd
Lack of health and safety management system	42	1.00	4.00	2.5238	1.06469	3rd
Non implementation of safety policy	42	1.00	5.00	2.9048	1.33999	4th
Non-human error	42	2.00	5.00	3.6905	1.29705	5th

Source: field survey, July 2018

From table 2 shows that frequent causes of accident is caused by lack of investigation and record of accident mean (1.14), followed by nonchalant attitudes mean (2.42), followed by lack of health and safety management system mean (2.52).

Table 3 Non-human error factors that causes accident

	N	Minimum	Maximum	Mean	Std. Deviation	Ranking
Weather	42	1.00	3.00	1.1905	.45468	1st
Electrical hazard	42	1.00	3.00	1.3810	.66083	2nd
Equipment design	42	1.00	4.00	2.3333	1.26234	3rd
Dust	42	1.00	4.00	2.3810	1.14663	4th
Vibration	42	1.00	4.00	2.4286	1.29054	5th
Quality of material	42	1.00	5.00	2.4286	1.39935	6th
Work hour	42	1.00	5.00	2.6667	1.30041	7th
Insufficient light/glare reflection from equipment	42	1.00	5.00	3.0000	1.32518	8th
Direct sunlight	42	1.00	5.00	3.1905	1.21451	9th

Source: field survey, July 2018

From table 3 shows that non-human error that causes accident mostly on construction site is weather mean (1.19), followed by electrical hazard mean (1.38), followed by equipment design mean (2.33).

Table 4 Method to prevent accident on construction site

	N	Minimum	Maximum	Mean	Std. Deviation	Ranking
Effective and consistent investigation and record of accident	42	1.00	2.00	1.2857	.45723	1st
Adequate supervision	42	1.00	3.00	1.6190	.79487	2nd
Adequate site layout	42	1.00	4.00	2.0000	1.18938	3rd
Preparation against any form of non-human error	39	1.00	4.00	2.3590	1.13525	4th
Implementation of safety policy	42	1.00	5.00	2.4286	1.17167	5th

Source: field survey, July 2018

From table 4 shows that the best method to prevent accident on construction is effective and consistent investigation and record of accident mean (1.28), followed by adequate supervision mean (1.62), and followed by adequate site layout mean (2.00).

V. CONCLUSIONS ANDRECOMMENDATIONS

5.1 Conclusions

From the research conducted, Determining root causes of accidents on construction site emanates from the shortcomings of management and site managers which are mainly lack of adequate supervision on site which leads to construction site workers behaving nonchalantly while on site and during their respective work, although accidents (which include both minor and major ones e.t.c) are at their respective minimum including the accidents which leads to death as well as accidents that leads to permanent deformation which are said to have never occur or at their lowest and Non Human Error factors which are reduced in the causation of accidents on construction sites and also can be reduced to the bears minimum.

5.2 RECOMMENDATIONS

The following recommendations were given based on the conclusion derived from data analyses in this research:

1. The Nigerian construction industry in collaboration with the Ministry of Work and Housing should adopt a safety standard that would be enforced in Nigerian construction industry and code like the (National Building Code) should be enforced for regulations.
2. Management endeavour that safe policies and safety rules are implemented in their organization at optimum cost and any personnel that breaches the safety policy stated must be dealt with severely.
3. Government should set up disciplinary committee which consists of representative from construction industry and local authority that would be empowered to inspect construction sites and penalized firms who do not conform to safety policy and safety rules. Also, review and develops policies on safety.

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