

Effects of Poor Plants Management and Operator's Behaviour on Construction Site Health and Safety Performance

Dr Okorie V.N¹, Dr Ajator U.O.², Dr Duno Mobarango³

¹Department of Quantity Surveying University of Benin, Edo State, Nigeria

²Department of Quantity Surveying Nnamdi Azikiwe University Awka, Nigeria

³Department of Quantity Surveying, Rivers State University of Science and Technology PortHarcourt, Nigeria

Abstract—The construction work site is often a chaotic place with an incredible high amount of action taking place. Workers and machines move about in frenzy manner, with everyone focused on the task at hand. In such working environment, accidents can and do happen. This study seeks to evaluate the extent poor plant management and operators' behavior, contribute to construction site accidents and incidents. The review of relevant literature provides the platform for the structured questionnaire survey, which was administered to site managers, supervisors and plant operators within the South-South Geopolitical zone of Nigeria. This was followed by interviews conducted with five (5) construction companies operating within Benin City in Edo State and Warri in Delta State. The findings from questionnaire survey indicated that inadequate plant maintenance, poor supervision, and untrained operators are major factors contributing to plants and equipment accidents. It was further revealed that alcohol and drug use among plant operators contribute to their unsafe behavior on sites. Results of the interviews conducted with the site managers and operators also revealed that there is a general lack of commitment and poor leadership among the management of contracting firms particularly the small and medium size contractors. The paper therefore, concludes that contracting firms whether large or small should demonstrate visible commitment towards the maintenance and training of plant operators. Regular maintenance of available plants, machineries and retraining of operators should be a core value to the contractors.

Keywords—Effects, construction site, health and safety, plant management.

I. INTRODUCTION

The construction industry is known for its significant contribution to the global and national economies, but despite this the industry is one of the most dangerous places to work (Goetsch, 2013). However, the industry accounts for 7-10% of the world's employment, but 30-40% of the world's fatal injuries (International Labour Organisation (ILO) (2011). Okorie, Okolie and Ajator (2015) maintain that the high rates of fatalities and injuries cases in the industry have caused much pain and suffering to the workers' families and financial losses to the nations. Lutchman, Maharaj and Ghanem (2012) argue that substantial financial savings can be achieved through effective management of workers' H&S including plants and equipment. Studies have shown that prevention and reduction of construction accidents can yield as much as 47% of return on investment (Goetsch, 2013). The governments of every nation impose legal responsibilities on employers to maintain a safe work environment. In addition, the employers have moral obligations as well as corporate and social responsibilities to maintain a healthy and safe work environment. According to ILO (2011) accident may lead to prosecution and claims that can threaten the financial health of a company. Beside this, the reputation of a company is also at risk when it cannot implement proper H&S management systems, which ensures workers' health, safety and wellbeing (Lingard and Rowlinson, 2005).

Effective management of construction site activities should include management of plants and equipment. However, statistics have revealed that major construction site fatalities have been linked to plants and equipment accidents (Hughes and Ferrett, 2010). Construction site operations involve the use of sophisticated plants and equipment and hand tools. The sizes and sophistications of the machines

and equipment used on construction site can be a source of major fatal and injury cases (ILO, 2011; Spangenberg, 2009). Plants and equipment such as saws, ladders, scaffoldings, forklifts, cranes, hoists, derricks, tractors, scrapers, bulldozers, and hydraulic drills have caused major fatalities and injuries on sites. The World Health Organization (WHO) (2010), reports that over 3 500 site workers are killed every year as a result of plants and equipment accidents. Proper management of plants and equipment on site not only prolong the useful life span of those plants, but also provide necessary measures to protect lives of workers. Effective management of plants and equipment entails that site managers and supervisors conduct regular inspections and ensure that competent operators are hired to operate plants they have the certification. Anecdotal evidence has shown that some contracting firms hire the services of untrained plants operators to cut corners which have resulted in fatalities and plants and equipment damage.

Globally, poor maintenance culture among contracting firms is a serious challenge to effective management of plants and equipment. Construction plants and equipment, like every other types of machinery, can experience failure particularly if it is overused or improperly maintained. Hughes and Ferrett (2010) contend that poor maintenance culture is one of the major factors attributable to plants and equipment accidents. However, in the developing countries and Nigeria in particular, most of the spare parts for plants and equipment maintenance are imported as a result the industry has a poor maintenance records. Improper maintenance of plants and equipment often resulted in malfunctioning or failure. Fewings (2010) argues that most of the plants and equipment accidents could be prevented by regular inspection and maintenance. Plant managers and supervisors have duties and responsibilities to ensure that plants and equipment are regularly maintained for optimal performance. Brauer (2006) asserts that plants and equipment accidents are indication of poor management and supervision. The link between management practices and sites H&S performance have been extensively investigated. It has been found that lack of management and supervision relative to construction plants and equipment has resulted in fatalities, injuries and equipment damage (Hughes and Ferrett, 2010).

Alcohol use is common among Nigerian site workers and particularly plant operators. Majority of the accidents involving heavy plants on sites have been linked to drug and alcohol users. Unsafe behaviour of plant operators has been identified by many researchers amongst (Fewings,

2010) as a factor contributing to accidents, incidents, plants and equipment damage. Unsafe behaviour of plants operators such as over speeding has resulted in fatalities and damage to company's property and equipment.

Several studies have examined the causes of site accidents in terms of management commitment, workers' H&S training, site conditions and supervisory leadership roles. For example, a past study relative to management commitment concluded that lack of management commitment among site managers or supervisors are contributory factors to unsafe conditions and unsafe acts found on construction sites (Lutchman et al., 2012). However, this study aimed at examining the effects of poor plant management relative to site managers', supervisors' roles and plant operators' behaviour concerning plants and equipment accidents on construction sites in Nigeria.

Aim and objectives of the study

The aim of this study was to evaluate the effects of poor plant management and operators' behaviour on construction site accidents in the South-South Geopolitical zone of Nigeria and recommend strategies/measures that would help to reduce plants and equipment accidents on sites. Thus, the specific objectives of the study include:

- To assess the extent poor plant management contribute to construction site accidents and incidents,
- To assess the extent supervision impact on plants and equipment accidents on site,
- To determine if plant operators' behaviour contribute to plant accidents and incidents

II. LITERATURE

Cause of plants and equipment accidents on site

Accidents as defined by Hughes and Ferrett (2010) are unplanned events that results in injury or ill-health of workers, or damage or loss of property, plant, equipment and materials. Many factors are attributable to the causes of site accidents such as poor management (Goetsch, 2013; Kheni 2008); poor site supervision (Lutchman et al., 2012); noncompliance to site H&S rules and regulations (Hinze, 2006); lack of maintenance culture (Spangenberg, 2009) and workers' unsafe behaviour (Brauer, 2006). The above causes of site accidents lie within the domain of site managers and supervisors in maintaining an accident-free workplace.

Effective site management is crucial to secure and maintain a healthy and safe workplace which complies with relevant legal requirements. Hughes and Ferrett (2010) assert that for

the plants and equipment to continue performing properly in the way they were designed, adequate and regular maintenance and cleaning are required. Site managers and supervisors who are always on site have these responsibilities. However, Lingard and Rowlinson (2005) argue that most site accidents and incidents involving plants and equipment occur because managers and supervisors are unaware of the intricacies and functioning of some plants and equipment on their sites. Brauer (2006) and Goetsch(2013) maintain that managers and supervisors need specialist H&S training to acquire the necessary competencies for effective management of plants and equipment. However, it has been found that top management invests little or no funds in maintaining plants on sites. Brauer (2006) states that inadequate allocation of funds for plant and equipment maintenance by top management is a major factor to poor plants and equipment on sites. Goetsch (2013) further identifies the following as factors responsible for plants and equipment accidents on site: poor maintenance culture; incompetent plant operators; operating at unsafe speed; emotional state of the operators; operating equipment without certification; irregular inspection of plant and equipment; and unsafe behaviour of operators.

Construction H&S performance is susceptible to the extent site managers and supervisors are willing to assume supervisory roles pertaining to H&S matters (Lutchman et al., 2012). It is understood that most plants and equipment accidents occur because site managers and supervisors lack the requisite skills and competencies to manage workers' H&S and plants and equipment on sites. Brauer (2006) and Hughes and Ferrett (2010) maintain that site managers and supervisors have important role to play in terms of regular inspections of plants and equipment, coordinating and motivating workers on sites. In addition, managers and supervisors have responsibilities to ensure that plant operators comply with H&S legislation. Researchers (Spangenberg, 2009) have found that lack of commitment and requisite skills among site managers and supervisors are some of the impediment militating against effective plants and equipment on sites. Managers and supervisors have duties and responsibilities to maintain accidents free work environment. According to the WHO (2010), it is a right for every working man and woman to return home safely after a day work. Nevertheless, the numbers of site fatalities and injuries cases on construction sites involving plants and equipment are far greater than most other types of accidents (Fewings, 2010).

Plants and equipment management

Poor H&S record is often associated with poor site management. Literature over the years revealed that site managers and supervisors play very important roles in providing site safety to worksites and also in maintaining plants and equipment for optimal uses (Goetsch, 2013 and Hughes and Ferrett, 2010). It has also been found that lack of commitment and negligence by site managers and supervisors often resulted in fatalities and serious injuries. An example, are a case that involved an electrician who was injured after falling from a scaffold used on site. Upon investigation, it was revealed that the scaffold was built improperly due to supervisor's negligence. However, many site accidents that were caused by plants and equipment could have been prevented had the site managers or supervisors exercised due diligent and care in carrying out their duties and responsibilities as required by law.

Howarth and Watson (2009) argue that managers play a crucial role in promoting H&S management, which results in lower site accidents. Studies comparing low and high accidents plants have shown that on the safest sites, managers who demonstrated good quality leaders, planner and organizer have excellent H&S performance (Hinze, 2006). Conversely, Sunidijo and Zou (2012) point out that lack of intelligence and interpersonal skills have been found to negatively impact on managers in promoting a positive H&S culture including effective management of plants and equipment. Hughes and Ferrett(2010) concur and state that major plants and equipment accidents have been linked to poor management and lack of commitment by the site managers and supervisors.

Spangenberg (2009) states that majority of plants and equipment accidents could have been prevented through management actions and interventions. The Health and Safety Executive (HSE) (2008) states that supervisors have responsibilities to ensure that only certified person operates any plant or equipment, and that plant should only be operated when it is in safe condition. However, construction site managers and supervisors have a great deal of responsibilities. In addition to managing projects constraints like deadlines and qualities, they must ensure that plants and equipment are properly maintained. Lutchman et al, (2012) argue that the causes of site accidents and incidents involving heavy plants are due to lack of management and sites supervision. The reckless destruction of precious lives and property worth billions of Naira resulting in plants and equipment accidents is highly unacceptable.

Plants and equipment maintenance

An efficient utilization of plants and equipment is highly dependent upon its maintenance. Principally the production

efficiency and residual values of plants and equipment have a direct relationship with maintenance (Fewings, 2010). Geotsch (2013) maintains that many fatal accidents involving plants and equipment on site have occurred as a result of a lack of maintenance culture. HSE (2008) contends that an effective utilization of plant depends upon the maintenance culture of the organization. Plants need to be regularly inspected, maintained, repaired and cleaned. Fewings, (2010) states that regular maintenance of plants and equipment prolongs their useful life spans and its efficiency. Geotsch (2013) argue that contracting firms should adopt a well planned maintenance culture which entails regular inspections and maintenance in accordance with manufacturer's instructions.

Construction plants and equipment like every other type of machinery can experience malfunction and failure particularly when it is not properly maintained. Plant and Equipment Regulations (2003 cited in Hughes and Ferrett, 2010) requires that plants and equipment be maintained so that it works efficiently and safely and that where the equipment has a maintenance log book, then the log book should be kept up to date. Also, the Regulation further requires that plants and equipment be inspected at suitable intervals to ensure its safety, and that any defects found can be remedied in 'good time'. Hughes and Ferrett (2010) maintain that major site fatalities and injuries cases over the years are due to negligence by those responsible for repair and maintenance of construction plants and equipment.

Plants operators' behaviour

Plant operator's emotional states are affected by many factors such as work pressures, supervisor' behaviour, conditions of their plants, alcohol and drug use and family problems. These factors have been found to impact on plants and equipment operators' H&S behaviours. Goetsch (2013) noted that it is not only lack of competency and certification of operators that contribute to plants and equipment accidents on construction site, but there are other exigency factors such as drug and alcohol use. According to ILO (2010) reports many site fatalities resulting in plants and equipment accidents have been linked to drug and alcohol abuse. Hinze(2006) asserts that alcohol and drugs users contribute to 40% of industrial fatalities and 47% of industrial injuries. Hughes and Ferrett (2010) also argued that almost 50% of fatal accidents involving heavy plants operators could be attributable to alcohol and drug use.

Deacon (2006) maintains that the prevalent cases of absenteeism, rework, and sites incidents have been linked to drug and alcohol users. It was also found that madras and marijuana use predominated among plants operators.

Research conducted in South Africa by Deacon (2006) found that 48.2% of contractors believed that their workers used alcohol before work, 29.6% during working hours and 22.25 during lunch time. The research concluded that drug and alcohol users particularly plants operators' impact negatively on their H&S behaviour. For instance, one 'joint' of marijuana can cause significant impairment of skills for up to 10 hours (Deacon, 2006). The effects of drug, alcohol and other substances abuse pose a serious challenge towards the improvement of construction H&S (Hinze, 2006). Smallwood (2006) added that workers who use drug and alcohol influence their peers and also undertake theft to support drug use.

Specialist H&S training

Fewings (2010) states that most of the site plants and equipment related accidents and incidents occur due to incompetent operators, lack of supervision, inadequate H&S training. Hughes and Ferrett (2010) argue that specialist H&S training is normally needed for activities that are not directly related to a specific job, but more to an activity, such as drivers and operators training, excavators, pile-driving training. It is therefore essential that operators and supervisors are given adequate training with regard to equipment and types of work. Training of plant operators should be in accordance with the H&S legislation prevailing in a particular country. Section 7 of the United Kingdom (UK) Health and Safety Executive (2008) states that the employer must ensure, so far as is reasonably practicable, that employees receive "such information, instruction, training and supervision as is necessary to maintain" their health and safety at work.

Many construction plants and equipment have been damaged on site as a result of a lack of prerequisite skills and competencies to operate the equipment. Fewings (2010) asserts that many contractors who cut corners often employed inexperienced and incompetent plant operators, and the consequences have been fatalities and plants and equipment damage. It is therefore essential that they are given sufficient training and information to enable them to know how to operate and check the safe operation of the machine. Fewings (2010) identifies the conditions to be implemented by companies that hire or use contractor in relation to plants operators' specialist training; all operators of contractors plant must receive adequate basic training, they should also receive specific job training under supervision in relation to the actual plant(s) to be operated, and all operators must be certified by recognized training centre in that region. Construction firms should strictly adhere to all site H&S rules and regulations to reduce the

deaths tolls and equipment damage on their sites. The ILO (2010) opines that there is no price that can be put on human lives.

Effects of poor plant and equipment management on site H&S performance

Hughes and Ferrett (2010) point out that one of the major effects of plants and equipment accidents is visible through continuous plants damage and low production. An ILO (2010) report shows that 30,000 man hours are lost daily due to plants and equipment accidents and incidents. This statistical figure has a significant negative impact on a national economy. It has been argued that plants and equipment accidents and incidents can devastate contractors' profit margin (Hinze, 2006). On the national scale, the estimated costs of plants and equipment accidents can be as high as 7-10% of the Gross National Product (ILO, 2010).

The other potential effect is the high compensation paid to the workers or to their families. Indeed, one obvious effect of plants and equipment accidents is the human suffering caused to the workers' families, which cannot be compensated with money. There are grievous economic consequences on contractors and families for the deceased worker (s) alike. Furthermore, accidents resulting in poor plants and equipment management tarnishes contractor's image (Hinze, 2006). The tarnished image often accompanied with adverse publicity, which resulted in the contractors being less attractive to prospective clients. Given the economic and social cost of the poor plants and equipment management, all hands must be on deck to prevent its manifestation in construction.

III. RESEARCH METHOD

To achieve the objectives of this study, a literature survey was conducted in the field of construction H&S, plants management and maintenance and workers' health and safety. The review of relevant literature resulted in formulation of a structured questionnaire. Seven construction firms were contacted within the South-South Geopolitical zone of Nigeria for the purpose of the study. Five firms accepted to participate in the study; one large and two medium and two small sized firms.

Questionnaires were administered to site managers, supervisors and plants and equipment operators. The main purpose of the questionnaire was to determine the extent plant management and operators' behaviour contribute to construction site accidents and incidents. One hundred and twenty (120) questionnaires were distributed, sixty five were completed and returned, and this resulted in a response

rate of 54%. The response rate achieved for this research is similar to that achieved in other surveys (Collins, 2008; Sutrisna, 2009). It could be inferred from Sutrisna (2009) and Dainty (2008) that performing a statistical analysis in survey within the response rate equal to or above the threshold of thirty (30) is acceptable. Thus 54% response rate achieved in this survey provides reasonable data for analysis. Interviews were also conducted with manager, supervisors and plants operators of five firms randomly selected within Benin City and Warri in Delta State. An interview is an interaction between two or more people to gain insight relative to problems (Leedy and Ormrod, 2010). The interviews assisted the researcher to understand the awareness and perceptions of respondents relative to plants and equipment management and operators' behaviour.

Data analysis

The majority of the responses (70%) were received from site managers and supervisors of the small and medium sized construction companies. Over 54% of the respondents have been involved in construction for the past 10 years; 60% have Diploma and Trade Tested qualifications, while 35% have Bachelor degrees and Higher National Diploma in environmental related courses. A 5-point Likert-scale measurement was used to obtain the opinions of the respondents and to analysis the results. Leedy and Ormrod (2010) maintain that Likert scales are effective to elicit participants' opinions on various statements. The statistica (version 10.0) was used to generate the descriptive and inferential statistics. When using Likert scales, it became imperative to calculate and report Cronbach's *alpha* coefficients as well as the internal consistency and reliability (Gliem and Gliem, 2003). Maree and Pietersen (2007) suggest that the following guidelines for the interpretation of Cronbach's *alpha* coefficient: 0.90 – high reliability; 0.80 – moderate reliability, and 0.70 low reliability. The questionnaire survey shows a high reliability Cronbach's *alpha* of 0.90.

IV. INTERPRETATION OF RESULTS FINDINGS

Plant and equipment management

The questionnaire examines the extent identified statement contribute to plant and equipment accidents on construction site. Table 1 indicates the respondents assessments of the extent to which identified statements contribute to plant and equipment accidents. It shows in terms of percentage responses to a scale of 1 (minor) to 5 (major), and mean score (MS) ranging between 1.00 and 5.00. It is notable that

all the nine statements related to plants and equipment management have MSs above the midpoint of 3.00, which, with an average MS of 3.41, indicates that the respondents

viewed the identified statements as contributing to plants and equipment accidents on construction sites.

Table.1: Identified statement related to plant and equipment management

Statement	Unsure	Response (%)					MS	Rank
		Minor.....Major						
		1	2	3	4	5		
Inadequate maintenance	4.2	6.3	11.9	25.2	29.4	23.1	3.51	1
Poor management and supervision of plant on site	9.1	4.9	9.8	27.9	27.9	20.3	3.49	2
Irregular inspection of plant and equipment	7.7	5.6	14.7	23.1	28.7	20.3	3.45	3
Untrained plant operators	8.4	7.7	10.5	27.9	31.5	13.9	3.43	4
Carelessness of operators	7.3	6.7	11.5	27.4	27.5	13.5	3.42	5
Poor maintenance culture	8.3	7.3	13.4	23.4	28.3	20.4	3.41	6
Overloading	7.7	6.6	14.8	23.7	27.9	20.4	3.40	7
Operating non-certified equipment	8.1	5.9	15.7	23.5	28.2	20.1	3.38	8
Lack of safe operating procedures	8.2	5.6	16.3	21.8	27.5	21.3	3.37	9

Literature review supported the research findings. Howarth and Watson (2009) maintain that site managers and supervisors play very important roles in providing site safety to worksites and also in maintaining plants and equipment for optimal uses. It has also been found that lack of commitment and negligence by site managers and supervisors according to Fewings (2010) often resulted in fatalities and serious injuries. Geotsch (2013) maintains that many fatal accidents involving plants and equipment on site have occurred as a result of a lack of maintenance culture. Although operating non-certified equipment and lack of safe operating procedures have the lowest MSs of 3.38 and 3.35 respectively as indicated in Table 1, these statements cannot be overlooked as not contributing to plants and equipment accidents on site.

Site managers and supervisors from the firms that were randomly selected and interviewed agreed that inadequate plants maintenance, poor leadership and lack of commitment by management contribute to plants and equipment accidents. Literature supported their views that there are general poor leadership and lack of commitment in

plants and equipment management particularly among the small and medium sized contracting firms in Nigeria. One of the plant operators stated that ‘top management of some small contracting firms do not show concern in maintaining their plants.’ The poor maintenance culture among the small and medium sized firms is exacerbated by high cost of importation of spare parts for plants and equipment maintenance. Their views undoubtedly supported the questionnaire results.

Plant operators’ behaviour

Table 2 indicates the respondents assessments of the extent to which identified statements contribute to plants operators’ behaviour resulting in plants and equipment accidents on construction site. It shows in terms of percentage responses to a scale of 1 (minor) to 5 (major), and mean score (MS) ranging between 1.00 and 5.00. It is notable that the five MSs were above the midpoint of 3.00, which, with an average MS of 3.45, indicates that the respondents viewed the identified statements to have significant impacts on operators’ H&S behaviour on sites.

Table.2: Factors contributing to plant operator's behaviour

Factor	Unsure	Response (%)					MS	Rank
		Minor.....Major						
		1	2	3	4	5		
Drug and alcohol use	4.2	6.3	11.9	25.2	29.4	23.1	3.51	1
Work pressure	9.1	4.9	9.8	27.9	27.9	20.3	3.49	2
Family problem	7.7	5.6	14.7	23.1	28.7	20.3	3.43	3
Supervisor's behaviour	6.1	5.2	12.6	27.1	31.4	21.4	3.42	4
Plant condition (new or old)	6.4	5.1	12.3	26.9	33.2	20.6	3.41	5

Statements made by the site managers and supervisors during the interview session supported the research findings. All the managers and supervisors interviewed attested that drug and alcohol have serious negative impacts on plant and equipment operators' H&S behaviour. One of the supervisors made the following statements. "On Mondays, many operators do report sick or even absent due to weekend alcohol intake". This view was corroborated in literature that one 'joint' of marijuana can cause significant impairment of skills for up to 10 hours (Deacon, 2006). The effects of drug, alcohol and other substances abuse pose a serious challenge towards the improvement of construction H&S (Hinze, 2006).

V. CONCLUSIONS AND RECOMMENDATIONS

Based on the research findings, it can be concluded that poor plants and equipment management contribute to site accidents and incidents. Inadequate plants and equipment maintenance, poor supervision, use of untrained plant operators and irregular inspections of plants and equipment by site managers and supervisors are some the major factors contributing to plants and equipment accidents. It was determined that drug and alcohol use among plants operators impact negatively on their H&S behaviour on site. The study revealed that there is a general lack of commitment and visible leadership among the top management of the contracting firms particularly the small and medium sized contractors in terms of investing in training of supervisors and plants operators in H&S specialist courses. The following recommendations arise from the study:

Contracting firms have to adhere to H&S legislation as well as train site managers, supervisors and plants operators in specialist H&S courses;
 Site managers and supervisors should ensure that plants operators comply with work ethics. Drug and alcohol test should be strictly enforced on all plants and equipment operators. In addition, regular inspections of plants and equipment should be conducted and any defects reported to management for immediate repairs.

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