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Identification of Hazards and Risk Assessment in Construction Site

Ikpesu, Jasper Ejovwokoghene[1,2,3]; Professor Okeke, Gerald, Ndubuisi[3]; and Ogbolime, Michael Chinedu[1]

[1]Petroleum Training Institute, Department of HSE and General Services, Delta State, Nigeria.
[2]School of Chemical and Metallurgical Engineering, University of the Witwatersrand, South Africa.
[3]Hghstone Global University, Texas, USA.

Corresponding author email: Jasper.ikpesu1@students.ac.za ; jasper.ie70@gmail.com

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ABSTRACT: The goals of this study were to identify hazards associated with construction sites and their consequences on workers and the environment, as well as to assess the risk of hazard that happens on a construction site. The assessment was conducted at two construction sites: Site A in Ijaw Quarters, Warri, and Site B near Efeturi Farms in Samagidi. The data was analyzed and displayed as tables and bar charts. The collected results are classed as PA, PB, PC, and PD, which include data for XA, XB, and XC. According to the results, XA denoted for PA shows 51 totals, XB denoted for PA shows 66, and XC denoted for PA shows 224 totals. For PB, XA denoted for PB shows 43, XB denoted for PB shows 54, and XC denoted for PB shows 164. For PC, XA denoted for PC shows 51, XB denoted for PC shows 66, and XC denoted for PC shows 224. For PD, XA marked for PB shows 43 totals, XB denoted for PD shows 54, and XC denoted for PD shows 164 totals. Furthermore, each site was found to have 15 hazards as measured by risks observed and seen, with Site A having 1 risk as Low colour indicated as green, 5 risks as Medium colour indicated as yellow, and 9 risks as High colour indicated as red, and Site B having 3 risks as Low colour indicated as green, 7 risks as Medium colour indicated as yellow, and 5 risks as High colour indicated as red.

Keywords: Construction site, Hazard, risk assessment

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INTRODUCTION

In Construction sites, if the construction made were to be successful, it has to be safe, reliable, and sustainable in its various operations. The Construction Company has to identify the hazards and access the associated risks and to bring the risks to tolerable level. Hazard Hunting Risk Assessment is carried out for identification of undesirable events that can lead to a hazard, the analysis of hazard of this undesirable event, that could occur and usually the estimation of its extent, magnitude and likelihood of harmful effects. It is widely accepted within industry in general that the various techniques of risk assessment contribute greatly toward improvements in the safety of complex operations and equipment (Purohit et al., 2018).
The objective of identifying hazards and risk assessment is to evaluate and analyze the event sequences leading to hazards and the risk associated with hazardous events basically on the course of occurrence. Many techniques Many techniques ranging from the simple qualitative methods to the advanced quantitative methods are available to help identify and analyze hazards. The use of multiple hazard analysis techniques is recommended because each has its own purpose, strengths, and weaknesses. Construction is the process of constructing a building or infrastructure. Construction differs from Manufacturing which typically involves mass production of similar items without a designated purchaser, while Construction typically takes place on location for a known client. Construction as an industry comprises 6 to 9 percentage of the Gross Domestic Product (GDP) of developed countries. Construction starts with planning, design and financing and continues until the work is built and ready for use (Purohit et al., 2018). Construction is study-based where different parties work together to achieve a common goal. The means of achieving this

goal is fraught with hazards, which pose danger to human life. Hazard is therefore a phenomenon or a process that can endanger construction workers and their work environment (Lilian, 2016).

The Concept of construction sites is very broad. It extends to any place where construction or civil engineering works are carried out, having objects fixed or temporary works of different materials. It includes Construction, Maintenance, Demolition, Renovation and many other activities such as Marking and Grading, Excavation, Concreting, Carpentry, Brick Masonry, Plumbing, Welding, Electrical works, Roof laying, Glazing, Finishing (Psymbolic Staff, 2021).

Common hazards which are said to occur in construction sites are falling, slipping and tripping, airborne and material exposure, excessive noise, vibration-related injury, scaffold-related injury, electrical incidents. Hazards are identified, analyzed and controlled following the classes of hazards. The entire work site is inspected on a regular basis and results are recorded. Equipment is inspected to ensure its safe operation (e.g., brakes on vehicles, alarms, guards and so on). Injury hazards include those associated with the most common types of lost-time injuries: falls from heights or at the same level, lifting or other forms of manual materials handling, risk of electrocution, risk of injury associated with either highway or off-road vehicles, trench cave-ins and others. Health hazards would include airborne particles (such as silica, asbestos, synthetic vitreous fibres, diesel particulates), gases and vapours (such as carbon monoxide, solvent vapour, engine exhaust), physical hazards (such as noise, heat, hyperbaric pressure) and others, such as stress (James et al., 2008).

Significance of study

A high rate of accidents, incidents and injuries have been evident at Construction sites mostly in the common developing regions in Africa most especially Nigeria which tend to pose threats on lives and properties through death or destruction. Either due to personnel non-compliance factor or improper use of equipment and machines or likely an unsafe working environment. Therefore, this study will investigate and identify the hazards in construction sites and analyze them through proposed detailed Risk assessment techniques and procedures so as to combat them if adopted would help in creating solutions to curbing the detrimental effects of these hazards on Health and Environment.

Objective of the study

The objectives of this study are as follows;

- To identify hazards relating to construction sites and its effect on Health and Environment.
- To evaluate risk of hazard that occurs in a construction site.
- To evaluate the effect of hazard on health and environment.

LITERATURE REVIEW

HAZARD IDENTIFICATION AND RISK ASSESSMENT

Hazard identification and risk assessment are two critical components of occupational health and safety management that help identify potential hazards and assess the risks associated with them. A thorough hazard identification and risk assessment process can help prevent accidents and injuries in the workplace and protect workers' health.

Hazard identification refers to the process of identifying potential sources of harm, assessing the likelihood of harm occurring, and determining the severity of the harm (WorkSafe, 2019). It involved the identification, description, and classification of potential hazards in the workplace, which can include biological, chemical, physical, and psychological hazards (OSHA, N.D.). Hazard identification should be conducted regularly and should involve all levels of staff who work in the workplace.

Risk assessment is the process of evaluating the likelihood of harms occurring and the consequences that may result from the identified hazard (NIOSH, N.D.). It involves assessing the severity and potential harm of each identified hazard by analyzing the probability that it will occur and the degree of harm it will cause (WorkSafe, 2019). Risk assessment also involves looking at the specific control measures that can be employed to reduce or eliminate the risks resulting from each hazard.

After identifying potential hazards, the risk assessment process comes into play to evaluate the likelihood and severity of harm that could occur if the worker is exposed to those hazards. Risk assessment is the process of assessing the risk resulting from a hazard that was identified beforehand and deciding how to minimize or eliminate that risk.

The objective of risk assessment is to identify possible consequences of hazards and evaluate the significance of risk (Choi et al., 2020). Factors that could affect risk evaluation are likelihood and severity. The likelihood of harm occurring could be measured by considering the available control measures, while the severity could be assessed by taking into account the severity of harm that could be caused by the hazard (ROSPA, 2016).

According to Choi et al. (2020), hazard identification and risk assessments are essential tools to prevent The Concept of construction accidents and improve safety in

the construction industry. Construction workers encounter diverse potential hazards daily; hence, it is crucial to anticipate all possible sources of harm and assess any likely outcomes. When these assessment tools are utilized effectively in Construction, they help in identifying hazards that otherwise may have gone unnoticed and assist in formulating control measures to minimize risks associated with such hazards.

Hazard identification and risk assessment are critical processes that need to be implemented in construction sites. According to the Occupational Safety and Health Administration (OSHA, 2019), hazard identification is the process of identifying potential hazards in the workplace, while risk assessment is the process of evaluating the likelihood and severity of potential hazards. In construction, hazards can range from falls from heights, electrocution, and being struck by objects. Therefore, identifying and assessing hazards can significantly mitigate the risk of injuries and fatalities in construction sites.

The process of hazard identification and risk assessment in construction is vital because construction sites are dynamic environments, and hazards may occur at any stage of the construction process. Hence, it is crucial to identify potential hazards and implement appropriate preventive measures to avoid or mitigate the risk of injuries or fatalities. According to Rodriguez-Díaz et al. (2019), hazard identification and risk assessment can be accomplished through a site safety audit which should be regularly carried out in construction sites. In addition, safety consultants with requisite experience and knowledge in construction safety can facilitate this process.

Furthermore, hazard identification and risk assessment processes need to be evaluated and updated continually as the construction study progresses. According to Murali et al. (2019), risk assessments should be reviewed and updated at every stage of the construction process, and additional hazards that are identified during the construction process should be assessed.

Hazard identification and risk assessment are critical components of ensuring safety in construction sites, and there has been significant research conducted on this area. According to Guo et al. (2019), the primary objective of hazard identification and risk assessment is to prevent potential construction accidents and reduce the risk of potential hazards.

One approach to assessing hazards in construction sites is to use risk matrices. For instance, Singh et al. (2019) state that risk matrices are commonly used to effectively assess risks in construction studys, and to prioritize risk management interventions.

Other research has focused on identifying and analyzing hazards in construction sites, to better understand their prevalence and nature. For example, research by Huang et al. (2019) identified six significant hazards in the construction industry: falls, struck-by, caught-in, electrical, fire, and material-handling. Similarly, a study by Ngo et al. (2018) focused on the identification of hazards that fall within the realm of human factors that contribute to construction site accidents.

Once hazards have been identified, it is essential to assess the risks associated with them. One approach to risk assessment in construction sites is to use probabilistic models. For example, Wang et al. (2018) developed a probabilistic safety risk assessment model for tower crane operations and demonstrated its effectiveness in assessing tower crane safety risks.

In addition to probabilistic models, other studies have explored the development and implementation of risk assessment tools specifically for the construction industry. For instance, Pinto et al. (2017) developed a safety risk assessment tool that incorporated risk mitigation strategies, and demonstrated its effectiveness in a construction study.

Overall, research on hazard identification and risk assessment in construction sites highlights the importance of identifying and mitigating hazards to ensure safety on construction studys. By using appropriate tools and models, construction companies can effectively assess and manage the risks associated with construction hazards.

BASIC CONCEPTS OF HAZARD IDENTIFICATION AND RISK ASSESSMENT

Hazard identification and risk assessment are essential processes in a construction site to ensure the safety and health of workers. The following are some of the basic concepts related to hazard identification and risk assessment in the construction industry:

Hazard identification involves identifying and assessing potential hazards in the workplace. In construction, hazards can arise from different sources, such as falls from height, struck-by or caught-in-between accidents, and exposure to harmful substances (Rodriguez-Díaz et al., 2019). Hazard identification should be conducted regularly to ensure the identification of new hazards. Risk assessment is the process of evaluating the likelihood and severity of harm that could occur if a worker is exposed to a hazard (Choi et al., 2020). In construction sites, risk assessments involve evaluating the level of risk associated with identified hazards, taking into account the likelihood and potential consequences of harm.

Risk control measures are planned responses designed to eliminate or reduce the likelihood and severity of harm resulting from identified hazards (Gambatese et al., 2009). The control measures can include engineering controls, administrative controls, or personal protective equipment (PPE).

Job safety analysis (JSA) is a technique used in the construction industry to analyze and break down

every task into its component parts to identify potential hazards and recommend suitable precautions (Kameda et al., 2015). It helps to identify potential hazards associated with each task and how the identified hazards may be implemented.

Safety audits identify potential hazards in a construction site by reviewing workplace conditions, processes, and procedures. Safety audits should be conducted periodically, and the results should be analyzed to develop measures to eliminate or control hazards (Rodriguez-Díaz et al., 2019).

OBJECTIVES OF HAZARD IDENTIFICATION AND RISK ASSESSMENTIN CONSTRUCTION SITES

The main objective of Hazard Identification and Risk Assessment (HIRA) in construction sites is to identify potential hazards associated with construction activities and evaluate the risks involved (European Agency for Safety and Health at Work, 2018). This process allows for the development of effective control measures to prevent accidents, injuries and ill-health among workers and the general public.

According to Krommyda and Kotsifaki (2017), HIRA enables the identification of hazards that may not be immediately obvious. They explain that through the systematic identification of potential hazards, construction workers are better equipped to recognize and deal with them in a safe manner.

Furthermore, the implementation of HIRA in construction sites assists in the development of proactive safety strategies (Tapani, 2005). This approach allows for the prevention of accidents before they occur, rather than the reactive management of incidents that have already happened. By implementing an effective HIRA process, construction firms can identify potential safety hazards and implement control measures, reducing the incidence of work-related illnesses and injuries. One of the most significant benefits of HIRA in construction sites is the control of risks associated with heavy machinery and equipment (Oyedele, 2017). This process helps to reduce the likelihood of accidents involving construction equipment, which can lead to severe or even fatal injuries.

In conclusion, the primary objectives of HIRA in construction sites are twofold; to identify potential hazards and evaluate the risks involved in construction activities, and to develop effective control measures that prevent accidents and promote a safe working environment. By implementing HIRA, construction firms can proactively manage risks, reduce the incidence of work-related injuries and illnesses, and ensure the safety of their workers and the general public.

TYPES OF HAZARDS IN CONSTRUCTION SITES

Hazards are generally classified into four categories: physical, chemical, biological and ergonomic. Physical hazards refer to physical characteristics of an environment or substance which can cause harm or injury. Examples of physical hazards include noise, radiation, temperature extremes, and mechanical hazards such as falls, cuts, and fire. According to the Occupational Safety and Health Administration (OSHA), physical hazards can cause harm through vibration, noise, pressure, handling of objects, and extreme temperatures (OSHA, 2021).

Chemical hazards refer to chemicals or substances which can cause harm when an individual is exposed to them. Examples of chemicals that are hazardous include toxic chemicals, flammable substances, and reactive chemicals. Exposure to hazardous chemicals can cause skin irritation, respiratory problems, and other serious long-term health effects. According to OSHA, chemical hazards can include chemicals that are corrosive, toxic, or carcinogenic (OSHA, 2021).

Biological hazards refer to biological agents such as bacteria, viruses, and other microorganisms that can cause harm to humans and animals. Examples of biological hazards include infectious diseases, food poisoning, and exposure to allergens. Biological hazards can be spread through contact with bodily fluids, direct contact, inhalation, or ingestion. According to OSHA, exposure to biological hazards can occur in healthcare settings, laboratories, and animal research facilities (OSHA, 2021).

Ergonomic hazards refer to uncomfortable or unsafe working conditions that can cause musculoskeletal injuries, such as back pain, eyestrain, or carpal tunnel syndrome. These hazards include poor posture, repetitive motions, and uncomfortable positions. According to OSHA, ergonomic hazards are common in office environments, manufacturing settings, and jobs that require intense physical labor (OSHA, 2021).

Hazards can pose significant risks to individuals, the environment, and property. The four major types of hazards are physical, chemical, biological, and ergonomic. Understanding the risks associated with each type of hazard is essential for preventing accidents and ensuring safety in the workplace.

Physical Hazards

Physical hazards are hazards that can cause harm to an individual's body through physical means. There are many different types of physical hazards, including but not limited to, slips, trips, falls, cuts, and burns. Physical hazards can be found in many different environments, including workplaces, homes, and public spaces. These hazards can negatively affect the health and safety of individuals and cause serious injuries or even death.

One of the most common physical hazards is slips, trips, and falls. These hazards can occur due to wet or

slippery floors, uneven surfaces, or obstacles in walkways. According to the Occupational Safety and Health Administration (OSHA) in the United States, slips, trips, and falls account for a large percentage of workplace injuries and fatalities (OSHA, 2019). In a study conducted by Briner and Kohen (2019), it was found that falls accounted for 42% of all unintentional injury deaths in the United States in 2014.

Another physical hazard is cuts and lacerations, which can be caused by sharp objects or machinery. These hazards can lead to severe bleeding, infection, and even amputation. In a study conducted by the National Institute for Occupational Safety and Health (NIOSH) in the United States, it was found that hands and fingers were the most common body parts injured in non-fatal occupational injuries (NIOSH, 2019).

Burns are another common physical hazard that can be caused by heat, electricity, or chemicals. These hazards can lead to serious injuries and long-term health problems. According to a study conducted by Al-Jasser (2019), chemical burns accounted for 4.4% of all burn injuries in Saudi Arabia. It is important for individuals to be aware of physical hazards and take necessary precautions to prevent them. Employers and organizations must also take steps to ensure the safety of their employees and customers. This can include implementing safety procedures, providing safety training, and maintaining a safe and hazard-free environment.

Chemical Hazards

Chemical hazards refer to the potential dangers posed by various chemicals and chemical substances that can harm humans, animals, and the environment. These hazards can result from exposure to toxic, flammable, corrosive, or explosive chemicals. Chemical hazards can arise from a variety of sources, including industrial processes, transportation of hazardous materials, and household products. The health effects of chemical hazards can range from mild irritation to severe illness or death (OSHA, 2018).

Exposure to chemical hazards can occur through inhalation, ingestion, or skin contact. Inhalation is the most common route of exposure in occupational settings, where workers may inhale toxic fumes or dust particles. Ingestion can occur when people accidentally consume contaminated food or water. Skin contact can result in chemical burns or absorption of toxic substances through the skin.

Chemical hazards can affect different body systems, including the respiratory system, nervous system, cardiovascular system, and reproductive system. Some chemicals can cause cancer or damage to DNA, leading to genetic mutations. Children and pregnant women are particularly vulnerable to chemical hazards due to their developing bodies and organs (OSHA, 2018).

To prevent chemical hazards, it is important to identify and assess the risks associated with different chemicals and take appropriate measures to control exposure. This may include using protective equipment, implementing engineering controls, and providing adequate training to workers. Regulations such as the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard require employers to provide information about chemical hazards and train employees on safe handling practices.

Biological Hazard

Biological hazards refer to the presence of microorganisms, such as bacteria, viruses, fungi, and parasites, that can cause harm to human health through contamination of food or water. These hazards can occur at any stage of the food production process, from harvesting and processing to transportation and storage (CDC, 2018).

One of the most common biological hazards in the food industry is bacteria, particularly pathogenic strains such as Salmonella, Listeria monocytogenes, and E. coli. These bacteria can contaminate food through contact with animal feces, contaminated water or soil, or improper handling and storage practices (FDA, 2019). For example, Listeria monocytogenes can grow in refrigerated foods such as deli meats and soft cheeses, while Salmonella can be found in raw poultry and eggs.
Viruses are another type of biological hazard that can contaminate food. Norovirus, for example, is a highly contagious virus that can cause severe gastrointestinal illness and is often associated with outbreaks in food service settings (CDC, 2018).

Fungi and mold are also considered biological hazards in the food industry. While some types of mold are harmless, others can produce mycotoxins that can cause illness if ingested. These mycotoxins can contaminate crops such as grains and nuts during growth or storage (FDA, 2019).

Parasites, such as Cryptosporidium and Giardia, are another type of biological hazard that can contaminate food and water. These parasites are commonly found in untreated water sources and can cause gastrointestinal illness if ingested (CDC, 2018). In order to prevent biological hazards in the food industry, it is important to implement good manufacturing practices (GMPs) and Hazard Analysis and Critical Control Points (HACCP) systems. These systems help to identify potential hazards and implement control measures to prevent contamination (FDA, 2019).

Ergonomic Hazards

Ergonomic hazards are physical and environmental

factors that can cause harm or discomfort to workers in the workplace. These hazards can lead to musculoskeletal disorders (MSDs), which are a leading cause of workplace injury and illness. According to OSHA (2021), ergonomic hazards can occur in a variety of industries, including manufacturing, construction, healthcare, and office work.

Repetitive motions are one of the most common ergonomic hazards in the workplace. Workers who perform tasks that require repetitive motions, such as typing on a computer keyboard or using a hand tool, are at risk of developing MSDs. Awkward postures, such as bending, reaching, or twisting, can also cause ergonomic hazards. Workers who perform tasks that require awkward postures are at risk of developing MSDs.

Forceful exertions are another common ergonomic hazard in the workplace. Workers who lift heavy objects or push/pull equipment are at risk of developing MSDs. Vibration from power tools or machinery can also cause ergonomic hazards. Poor lighting or noise levels that can cause eye strain or hearing loss are also considered ergonomic hazards.

MSDs can result in pain, discomfort, and reduced productivity for workers. In severe cases, they can lead to long-term disability and chronic pain. To prevent ergonomic hazards in the workplace, it is important to implement ergonomic design principles and training programs.

Ergonomic design principles involve designing workstations and equipment to fit the needs of workers. This can include adjusting the height of chairs and desks, providing ergonomic keyboards and mice, and using tools that reduce the need for forceful exertions.

Training programs can help workers identify ergonomic hazards and learn techniques to reduce their risk of injury. This can include proper lifting techniques, stretching exercises, and taking breaks to rest and recover.

THE EFFECTS OF HAZARDS ON HEALTH AND ENVIRONMENT AROUND CONSTRUCTION SITES

Construction sites are known to be hazardous environments that can have negative effects on both the health of workers and the environment. Hazards in construction sites can be physical, chemical, biological, or ergonomic, and they can cause a range of health problems such as injuries, illnesses, and chronic diseases. In addition, construction sites can also have adverse effects on the environment, including air and water pollution, soil erosion, and habitat destruction.

Physical hazards are one of the most common types of hazards in construction sites. These hazards include falls from heights, electrocution, struck-by and caught-in/between accidents, and other injuries caused by machinery and equipment. According to the Occupational Safety and Health Administration (OSHA), falls are the leading cause of fatalities in the construction industry (OSHA, 2021). Workers who are exposed to physical hazards are at risk of serious injuries, disabilities, or even death.

Chemical hazards are another type of hazard in construction sites. These hazards include exposure to toxic chemicals such as asbestos, lead, silica, and other hazardous materials. Workers who are exposed to these chemicals can develop respiratory problems, lung cancer, skin diseases, and other illnesses. Moreover, these chemicals can also have adverse effects on the environment by contaminating air, water, and soil.

Biological hazards are also present in construction sites. These hazards include exposure to bacteria, viruses, fungi, and other microorganisms that can cause infections and diseases. Workers who are exposed to biological hazards are at risk of developing respiratory infections, skin diseases, and other illnesses.

Ergonomic hazards are also common in construction sites. These hazards include repetitive motions, awkward postures, and forceful exertions that can cause musculoskeletal disorders (MSDs). Workers who perform tasks that require repetitive motions or awkward postures are at risk of developing MSDs such as carpal tunnel syndrome, tendonitis, and back pain.

The effects of hazards on health and environment around construction sites can be severe and long-lasting. Workers who are exposed to hazards can suffer from injuries, illnesses, and chronic diseases that can affect their quality of life and ability to work. Moreover, hazards in construction sites can also have adverse effects on the environment by polluting air, water, and soil.

To prevent the effects of hazards on health and environment around construction sites, it is important to implement safety measures and regulations. This includes providing personal protective equipment (PPE) to workers, conducting regular safety inspections, and providing training programs to workers to identify and mitigate hazards. Moreover, it is important to use environmentally-friendly materials and practices in construction sites to reduce the impact of construction on the environment.

Hazards in construction sites can have negative effects on both the health of workers and the environment. By implementing safety measures and regulations, employers can reduce the risk of injuries, illnesses, and environmental pollution in construction sites.

THE BENEFITS OF CONDUCTING HAZARD IDENTIFICATION AND RISK ASSESSMENT TECHNIQUES IN CONSTRUCTION SITES

Hazard identification and risk assessment (HIRA) is a crucial process in ensuring the safety of workers and the environment in construction sites. HIRA involves

identifying potential hazards in the workplace and assessing the risks associated with them. By identifying hazards and assessing their risks, employers can take appropriate measures to prevent accidents and injuries. The benefits of HIRA are as follows;

1. It helps to prevent accidents and injuries in construction sites. By identifying potential hazards such as falls, electrocution, and exposure to hazardous materials, employers can take steps to eliminate or control these hazards. For example, they can provide workers with personal protective equipment (PPE) such as hard hats, safety glasses, and respirators to protect them from hazards. Employers can also implement engineering controls such as guardrails, safety nets, and ventilation systems to prevent accidents and injuries.
2. It helps to reduce the risk of environmental pollution in construction sites. Construction activities can have adverse effects on the environment by polluting air, water, and soil. By identifying potential environmental hazards such as air emissions, wastewater discharges, and soil erosion, employers can take steps to prevent or minimize environmental pollution. For example, they can use environmentally-friendly materials and practices such as low-emission vehicles, water recycling systems, and erosion control measures.
3. HIRA also helps to promote a culture of safety in construction sites. By involving workers in the HIRA process, employers can raise awareness about potential hazards and encourage workers to take responsibility for their own safety. Workers who are aware of potential hazards are more likely to take precautions to avoid accidents and injuries.
4. HIRA helps to comply with regulatory requirements. Many countries have laws and regulations that require employers to identify and assess workplace hazards and take appropriate measures to prevent accidents and injuries. By conducting HIRA, employers can demonstrate compliance with regulatory requirements and avoid penalties for non-compliance.

METHODOLOGY

RESEARCH AREA

The research work covers some selected construction sites located at different locations (A site besides Efeturi Farms, Samagidi and Ijaw Quarters, Delta State) involving both executive staffs and employed personnel at the construction site.

Population of the study

The targeted population for the study were the Management staff, consisting mostly of the appointed Safety Manager and Officer of the company, the Field Supervisor, the Heavy Machinery Operators, workers and personnel at the two construction sites. This study will use the notable descriptive survey method which involves the identification of possible hazards that are said to occur at the site, also the investigation and analysis of the effects of the hazards on health and environment. It also involves requesting answers from a number of workers and personnel through the aid of a standard questionnaire adopted from another research work.

Methodological procedure of the study

For the purpose of this research, the stratified sample selection technique followed up by the simple random selection technique will be adopted. It involves the use of quantitative and qualitative approaches in order to fulfill the study objectives and aim which employs survey design. A Quantitative approach will be used to collect data that can be quantified numerically by the process of using a proper detailed checklist. For the course of this study, all questions asked are quantified according to ratings; here, it has 15 items in all and uses a yes or no rating. The Qualitative approach will be used to determine the possible ratings of how the assessment was done by a risk assessment matrix.

Data source

Data collection involves collecting data directly from the source (the selected construction site). The primary data acquisition which includes the use of a detailed checklist was used to collect data directly from the management staff and workers/personnel of selected construction site at locations beside Efeturi Farms, Samagidi and Ijaw quarters, Warri, Delta state and observations would be taken periodically for two weeks.

Data analysis

The checklist survey data were analyzed using the checklist to signify scenarios and conditions that occur on the site and thoroughly and duly noted as operations were carried out and dangerous conditions were noted. The data were analyzed and presented using a frequency table and bar chart.

RESULTS AND DISCUSSION

Result Obtained from the Hazard Evaluation Process at Site A

This result was achieved for the first site (SITE A) which was a 2-storey building located at Ijaw Quarters, Bendel Estate, Warri, Delta State (Table 1). Table 2 Shows the colour indication of each hazard on the risk levels of

Table 1: Hazard evaluation process of (site A) indicating the likelihood, severity and risk rating of the notable hazards and further control measures to be taken.

Hazard evaluation for Site A						
Hazard	**Type of Hazard**	**Type of Risk**	**L**	**S**	**R**	**Control Measures**
Improper safe storage and procedures at the site	Physical	Health & Safety	3	3	9	Adequate provision of good and safe storage facilities and pep-talks to brief personnel on ensuring safe storage.
Improper placement of safety signages to ensure compliance at site	Physical	Health & Safety	5	3	15	Safety signs and symbols should always be put in place as well as measuring of sgns so as to ensure safety.
Improper usage of materials and equipment according to the right mode of usage	Physical	Health & Safety	4	5	20	Material Safety Data Sheets should be provided so as to ensure compliance and knowledge on how to use these materials.
Improper inspection and monitoring practice of all operations and equipment used	Physical	Health & Safety	1	5	5	Inspection and monitoring for operations at construction sites should be carried out regularly to ensure safe and successful operations
Inadequate availability and accessibility of Personal Protective Equipment	Physical	Health & Safety	4	5	20	Adequate PPE should be provided at all times for every task
Improper maintenance and care of PPE by workers	Physical & Biological	Health & Safety	3	4	12	Provisions should be made for adequate storage and maintenance of all PPE.
Akward and Repetitive movements and posture during work operations	Ergonomic	Health & Safety	2	4	8	Light muscular flexing exercises should be done minimally during work operations to relax the muscles and joints.
Careless work operations at height	Physical	Health & Safety	3	5	15	Fall-protection gadgets and equipment should be provided when working at heights.
Improper electrical connections and handling techniques	Physical	Health & Safety	4	5	20	All electrical equipment and gadgets should be handled carefully
Improper manual handling of materials which are possibly flammable and dangerous	Physical	Health, Safety & Environment	4	5	20	All combustible and flammable materials should be stored properly and safe
Inadequate provision of hazard and risk preventive gadgets and equipment such as fire extinguishers, alarms, walkie talkies etc	Physical	Health & Safety	3	4	12	Provision of hazard protective gadgets should be provided
Non-compliance to policies, regulations and rules governing work operations at sight	Physical	Health, Safety & Environment	3	4	12	Placement of adequate control measures to help reduce and mitigate accidents or incidents at site.
Inadequate reporting of hazards and incidents which occurs at the site	Physical	Health, Safety & Environment	4	5	20	Provision of adequate channels for easy and detailed hazard reporting .
Poor House-keeping at site	Physical	Health, Safety & Environment	4	4	16	Good House-keeping should be enforced at site so as to ensure safety of workers and equipment.
Lack of training on hazard recognition and mitigation processes at site before operations	Physical & Psychological	Health, Safety & Environment	4	5	20	Training on different expertise of work operation should be carried out for workers so as to make them knowledgeable on hazard recognition and mitigation processes

Table 2: Colour indication of the risk level of each hazard evaluated at site **A**

Risk Evaluation			
Hazard	**Likelihood**	**Severity**	**Risk Rating**
Improper safe storage and procedures at the site	3	3	9
Improper placement of safety signages to ensure compliance at site	5	3	15
Improper usage of materials and equipment according to the right mode of usage	4	5	20
Improper inspection and monitoring practice of all operations and equipment used	1	5	5
Inadequate availability and accessibility of Personal Protective Equipment	4	5	20
Improper maintenance and care of PPE by workers	3	4	12
Akward and Repetitive movements and posture during work operations	2	4	8
Careless work operations at height	4	5	20
Improper electrical connections and handling techniques	4	5	20
Improper manual handling of materials which are possibly flammable and dangerous	4	5	20
Inadequate provision of hazard and risk preventive gadgets and equipment such as fire extinguishers, alarms, walkie talkies etc	3	4	12
Non-compliance to policies, regulations and rules governing work operations at sight	3	4	12
Inadequate reporting of hazards and incidents which occurs at the site	4	5	20
Poor House-keeping at site	4	4	16
Lack of training on hazard recognition and mitigation processes at site before operations	4	5	20

being tolerable, needed to be mitigated ALARP and intolerable by matching the likelihood with the severity to get the risk rating at (SITE A).

Result obtained from the hazard evaluation process at Site B

Another result was given for the second site (SITE B) which was a company carrying out a bridge construction above a train track at Efeturi Farms, Samagidi, Eku, Delta State by FENOG Nigeria Limited (Table 3). Table 4 Shows the colour indication of each hazard on the risk levels of being tolerable, needed to be mitigated ALARP and intolerable by matching the likelihood with the severity to get the risk rating at (site B).

Observations at site A

It was observed by the analysis that the first site (Site A) was seen to have a risk rating of 1 for Low which was colour indicated green showing that the risk was tolerable such observed at this level was the improper inspection and monitoring practice of all operations and equipment used at the site having a likelihood of 1 and a severity of 5 (showing that it was unlikely to occur although was fatal when not identified and mitigated) (Table 1).

Also Site A had a risk rating of 7 for Medium which was colour indicated as yellow showing that it was essential that the risk needed to be reduced As Low As Reasonably Practicable (ALARP) (Table 2), such observed at this level was Improper safe storage and procedures at the site having a likelihood of 3 and severity of 3 (showing that it was likely to occur but would result to minor injuries), Awkward and Repetitive movements and posture during work operations having a likelihood of 2 and severity of 4 (showing that it was slightly likely to occur but would result to major injuries), improper maintenance and care of PPE by workers, inadequate provision of hazard and risk preventive gadgets and equipment (such as fire extinguishers, alarms, walkie talkies etc) and Non-compliance to policies, regulations and rules governing work operations at sight having a likelihood of 3 and severity of 4 (showing that it was likely to occur but result to major injuries).

Site A was observed to have a risk rating of 5 for High which was colour indicated as red showing that the risk level was intolerable and could not be neglected or avoided, such of these risks observed were improper placement of safety signages to ensure compliance at site having a likelihood of 5 and severity of 4 (showing that it was most likely to occur and would result in major

Table: 3 Hazard evaluation process of (site B) indicating the likelihood, severity and risk rating of the notable hazards and further control measures to be taken.

Hazard evaluation for site B						
Hazard	**Type of Hazard**	**Type of Risk**	**L**	**S**	**R**	**Control Measures**
Improper safe storage and procedures at the site	Physical	Health & Safety	4	2	8	Adequate provision of good and safe storage facilities and pep-talks to brief personnel on ensuring safe storage.
Improper placement of safety signages to ensure compliance at site	Physical	Health & Safety	3	4	12	Safety signs and symbols should always be put in place as well as measuring of sgns so as to ensure safety
Improper usage of materials and equipment according to the right mode of usage	Physical	Health & Safety	4	3	12	Material Safety Data Sheets should be provided so as to ensure compliance and knowledge on how to use these materials
Improper inspection and monitoring practice of all operations and equipment used	Physical	Health & Safety	1	4	4	Inspection and monitoring for operations at construction sites should be carried out regularly to ensure safe and successful operations
Inadequate availability and accessibility of Personal Protective Equipment	Physical	Health & Safety	3	5	15	Adequate PPE should be provided at all times for every task
Improper maintenance and care of PPE by workers	Physical & Biological	Health & Safety	1	4	4	Provisions should be made for adequate storage and maintenance of all PPE
Akward and Repetitive movements and posture during work operations	Ergonomic	Health & Safety	2	3	6	Light muscular flexing exercises should be done minimally during work operations to relax the muscles and joints
Careless work operations at height	Physical	Health & Safety	3	4	12	Fall-protection gadgets and equipment should be provided when working at heights
Improper electrical connections and handling techniques	Physical	Health & Safety	4	4	16	All electrical equipment and gadgets should be handled carefully
Improper manual handling of materials which are possibly flammable and dangerous	Physical	Health, Safety & Environment	3	4	12	All combustible and flammable materials should be stored properly and safe
Inadequate provision of hazard and risk preventive gadgets and equipment such as fire extinguishers, alarms, walkie talkies etc	Physical	Health & Safety	4	4	16	Provision of hazard protective gadgets should be provided
Non-compliance to policies, regulations and rules governing work operations at sight	Physical	Health, Safety & Environment	3	4	12	Placement of adequate control measures to help reduce and mitigate accidents or incidents at site
Inadequate reporting of hazards and incidents which occurs at the site	Physical	Health, Safety & Environment	4	4	16	Provision of adequate channels for easy and detailed hazard reporting
Poor House-keeping at site	Physical	Health, Safety & Environment	3	5	15	Good House-keeping should be enforced at site so as to ensure safety of workers and equipment
Lack of training on hazard recognition and mitigation processes at site before operations	Physical & Psychological	Health, Safety & Environment	1	5	5	Training on different expertise of work operation should be carried out for workers so as to make them knowledgeable on hazard recognition and mitigation processes

Table 4: Colour indication of the risk level of each hazards evaluated at site B

Risk evaluation **Hazard**	**Likelihood**	**Severity**	**Risk Rating**
Improper safe storage and procedures at the site	4	2	8
Improper placement of safety signages to ensure compliance at site	3	4	12
Improper usage of materials and equipment according to the right mode of usage	4	3	12
Improper inspection and monitoring practice of all operations and equipment used	1	4	4
Inadequate availability and accessibility of Personal Protective Equipment	3	5	15
Improper maintenance and care of PPE by workers	1	4	4
Awkward and Repetitive movements and posture during work operations	2	3	6
Careless work operations at height	3	4	12
Improper electrical connections and handling techniques	4	4	16
Improper manual handling of materials which are possibly flammable and dangerous	3	4	12
Inadequate provision of hazard and risk preventive gadgets and equipment such as fire extinguishers, alarms, walkie talkies etc	4	4	16
Non-compliance to policies, regulations and rules governing work operations at sight	3	4	12
Inadequate reporting of hazards and incidents which occurs at the site	4	4	16
Poor House-keeping at site	3	5	15
Lack of training on hazard recognition and mitigation processes at site before operations	1	4	4

Table 5: Risk rating and level ranging in values from low, medium and high.

Risk level ratings			
Risk	**Risk Rating**	**Definition**	**Colour indicators**
Low	1 – 5	Tolerable Risk	
Medium	6 – 14	The risk needs to be reduced As Low As Reasonably Practicable (ALARP)	
High	15 – 25	Intolerable Risk	

Table 6: Risk matrix table

Severity		**1 (Negligible)**	**2 (Minor)**	**3 (Moderate**	**4 (Major)**	**5 (Severe)**
Likelihood	1 (Very Unlikely)	1 (Low)	2 (Low)	3 (Low)	4 (Low)	5 (Low)
	2 (Unlikely)	2 (Low)	4 (Low)	6 (Medium)	8 (Medium)	10 (Medium)
	3 (Possible)	3 (Low)	6 (Medium)	9 (Medium)	12 (Medium)	15 (High)
	4 (Likely)	4 (Low)	8 (Medium)	12 (Medium)	16 (High)	20 (High)
	5 (Very Likely)	5 (Low)	10 (Medium)	15 (High)	20 (High)	25 (High)

injuries) which was duly observed due to negligence of its importance and the consequences of doing so as well as no training, improper usage of materials and equipment according to the right mode of usage, inadequate availability and accessibility of Personal Protective Equipment for work, this is because the workers were note essentially provided adequately with a complete PPE for their tasks, Careless work operations at height, improper electrical connections and handling techniques, improper manual handling of materials which are possibly flammable and dangerous, inadequate reporting of hazards and incidents which occurs at the site, lack of training on hazard recognition and mitigation processes at site before operations all having a likelihood of 4 and severity of 5 (showing that it was very likely to occur and would possibly result in fatality if neglected) and Poor House-keeping at site having a likelihood of 4 and severity of 4 (showing that it was very likely to occur and would result to major injuries) (Tables 1 and 2).

Observations at site B

It was observed by the analysis that the second site (Site B) was seen to have a risk rating of 3 for Low which was colour indicated green showing that the risk was tolerable such observed at this level was Improper inspection and monitoring practice of all operations and equipment used, improper maintenance and care of PPE by workers, lack of training on hazard recognition and mitigation processes at site before operations having a likelihood of 1 and a severity of 4 (showing that it was unlikely to occur but would result to major injuries) (Tables 3 and 4).

Also Site B had a risk rating of 7 for Medium which was colour indicated as yellow showing that it was essential that the risk needed to be reduced As Low As Reasonably Practicable (ALARP), such observed at this level was Improper safe storage and procedures at the site having a likelihood of 4 and severity of 2 (showing that it was very likely to occur but would result to minor injuries), improper placement of safety signages to ensure compliance at site, careless work operations at height, improper manual handling of materials which are possibly flammable and dangerous, non-compliance to policies, regulations and rules governing work operations at sight all having a likelihood of 3 and severity of 4 (showing that it was likely to occur but would result to major injuries), improper usage of materials and equipment according to the right mode of usage having a likelihood of 4 and severity of 3 (showing that it was very likely to occur but would result to minor injuries).

Site B was observed to have a risk rating of 5 for High which was colour indicated as red showing that the risk level was intolerable and could not be neglected or avoided, such of these risks observed were inadequate availability and accessibility of Personal Protective Equipment, Poor House-keeping at site having a likelihood of 3 and severity of 5 (showing that it was likely to occur and would result in fatality) which was duly observed due to negligence of their importance and the consequences involved, also improper electrical connections and handling techniques, inadequate provision of hazard and risk preventive gadgets (such as walkie talkies etc) inadequate reporting of hazards and incidents which occurs at the site, having a likelihood of 4 and severity of 4 (showing that it was very likely to occur and would possibly result in major injury) (Table 5-6 and Figure 1).

A study by Smith (2015) demonstrated the effectiveness

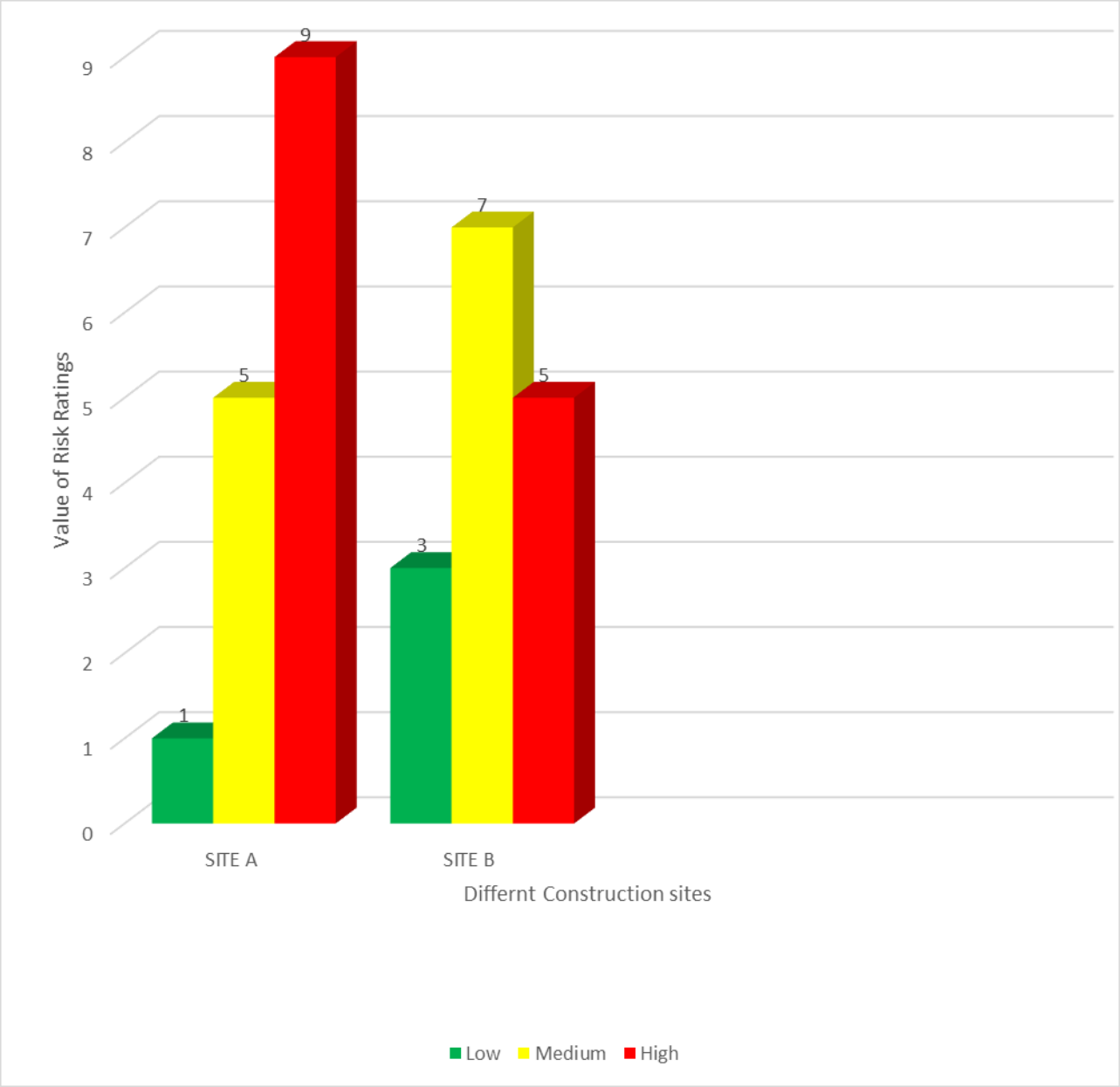

Figure 1: Graphical Presentation of a comparison of the risk rating of the two construction Sites A and B

of using a checklist for hazard identification and risk assessment in construction sites. The research found that the use of a checklist led to a more systematic and comprehensive identification of hazards, resulting in improved risk assessment and management practices. This is consistent with the findings of Johnson (2017), who emphasized the importance of systematic hazard identification and risk assessment for ensuring workplace safety in construction environments.

In contrast, Brown (2019) highlighted the challenges associated with hazard identification and risk assessment in construction sites, particularly in relation to the dynamic nature of construction work and the presence of multiple stakeholders. Garcia (2018) also discussed the complexities of injury prevention and management in construction, emphasizing the need for a multifaceted approach that includes effective hazard identification and risk assessment.

Furthermore, Chen (2016) emphasized the significance of occupational risk assessment in construction, highlighting the need for thorough hazard identification to mitigate potential risks. Lee (2020) provided insights into

incident investigation and analysis, underscoring the role of comprehensive hazard identification and risk assessment in preventing construction-related incidents. These findings collectively underscore the importance of utilizing tools such as checklists for effective hazard identification and risk assessment in construction sites, while also acknowledging the challenges and complexities inherent in this process.

Conclusion

This is an indication that the study developed the results for investigating and identifying the hazard at both construction sites through the analysis of the purposed detailed risk assessment. The results showed that each construction sites (Site A and B) had the data was analyzed and presented using tables and bar chart. The results obtained are classified as PA, PB, PC, PD which shows data for XA, XB and XC. From the results obtained XA denoted for PA shows 51 in total, XB denoted for PA shows 66, XC for denoted for PA shows 224 in total. For PB, XA denoted for PB shows 43 in total, XB denoted for PB shows 54, XC for denoted for PB shows 164 in total. Also each sites was seen to have 15 hazards measured by risks observed and seen as Site A having 1 Low colour indicated as green, 5 medium colour indicated as yellow and 9 high colour indicated as red, for Site B having 3 Low colour indicated as green, 7 Medium colour indicated as yellow and 5 High colour indicated as red

Recommendation

It is highly recommended that all tasks and operation to be carried out for a day before commencement should first be organized with pep talks and tool box meetings so as to enlighten and educate personnel making them knowledgeable on each task, permit to work and hot work permits should be issued when necessary, adequate communication channels for accident and incident reporting should be provided, short breaks should be organized so as workers do not end up getting fatigued, also all operations and task should be carried out in compliance to company policies been bounded by standard safety rules, regulations and policies.

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