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TABLE OF CONTENTS

AAUA Journal of Environmental Design and Management
Vol. 1, No. 2, August 2022 ISSN: 2971-5180
Pages 104-114

HAZARD IDENTIFICATION AND RISK ASSESSMENT IN BUILDING CONSTRUCTION PROJECTS IN ABUJA

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ABSTRACT

The study determined the most hazardous work item and assessed the risk level of hazard in building construction projects. The mean score method and the 5x5 matrix were used to analyse the data. The result on the most hazardous work items revealed that installation of electrical work, roof construction, lift installation, and steel structures with an average risk score of 11.48, 11.01, 10.74, and 10.71 respectively, representing medium risk. The result of the hazards risk assessment of work items revealed that the most occurring hazards in the work items sampled were the collapse of building structures, falls from a high level, being struck or hit by falling objects, electrocution, and falls to a lower level. It was concluded that professionals in the industry would experience more medium-level risk in the study area. It was recommended that regular hazard risk identification and assessment should be conducted during project execution.

Keywords: Building, Construction, Hazard identification, Health and safety, Risk assessment.

1 INTRODUCTION

The dynamic and dangerous nature of projects in the construction industry has exposed workers to multiple safety hazards and risks, resulting in high rates of occupational injury and fatality on sites. Workers on construction site perform a great diversity of activities, with each activity having a specific risk associated with them (Mamman *et al.*, 2021). Occupational incidents in construction workplaces have caused several drawbacks in project performance, for instance, delays in the completion of the project, cost overrun, low productivity, and create negative impressions of the organisation (Abas *et al.,* 2020). The construction sector is debatably one of the most resource-intensive and environmentally damaging industries in the world (Ejiofor *et al.*, 2018). Although Nigeria is enjoying comparatively strong growth in construction activities, efforts toward ensuring enhanced safety performance have borne minimal results. The implementation of safety regulations is not well-known within the industry. More workers are injured, killed, or suffer ill health in construction than in any other sectors (Okoye *et al.*, 2016). It is, however, disheartening that despite countless efforts towards improving the health and safety status of the construction industry in Nigeria, constant increases in the number of accidents both reported and unreported on construction sites still go unabated (Okoye *et al.*, 2016 & Ejiofor *et al.*, 2018). Moreover, due to a lack of effective monitoring, reporting, and control practices Nigeria has a very high accident record.

Accident records in the construction industry are so pronounced that it cuts across developed and developing economies (Okoye, 2016). In the United States of America, the construction industry was responsible for 21 percent of deaths in the workplace (Occupational Safety and Health

Authority (OSHA, 2018). Likewise in 2019, the death rate in the construction industry was 1.31 fatalities per 100,000 workers in the United Kingdom, which was more than thrice higher than the average of all other industries. Statistics from the Bureau of Labour Statistics (BLS, 2018) revealed that the construction industry recorded four cases of workplace injuries and illness per 100 full-time workers in 2016. In addition, the rate has been constant for years regardless of several improvements in the safety and health management in the construction industry, notwithstanding incidents occurring on construction sites and injury and fatality rates have been higher compared to other industries (BLS, 2018). Nigeria like other developing countries is not left out in this scenario, although the actual rate of occurrence of accidents is unknown as a result of a lack of reliable data (Idoro, 2008; Agwu, 2014 & Udo *et al.*, 2016). Bilir and Gurcanli (2018) revealed that the construction industry in developing countries has fallen short in their attempts to implemente laws and regulations, as well as prevention techniques to mitigate or abate hazards on construction sites. Albert *et al.* (2014) ascertained that limited attention has been given to the identification of hazards in construction projects although they are highly hazardous. To identify the root causes of safety incidents, workplace hazards must be identified and studied. This is the gap this study wants to fill by determining the most hazardous work item in building construction projects and assessing the risk level of hazard in building construction projects. The study will provide the basic background knowledge for experts who intend to carry out a risk assessment on their site.

2 REVIEW OF LITERATURE ON RISK IN CONSTRUCTION

Occupational safety and Health Administration (OSHA), 2002 described hazard as any real or potential condition to produce a harmful effect such as illness, injury, or fatality in an activity. A hazard is described as the source of potential harm or an adverse effect on the health of a worker (Vitharana *et al.*, 2015). Risk is often used interchangeably with hazard, even though they are different (Vitharana *et al.*, 2015). Risk in the construction industry is perceived to be a combination of activities, which adversely affect the project objectives of time, cost, scope, and quality. Gunduz (2020) explains that the first step in evaluating the safety performance of a construction site is to identify the hazards, evaluate their priorities and effect and take adequate measures to avoid such hazards. A well-identified hazard may reduce the rate of fatality and improve the safety management of construction projects (Ramaswamy & Mosher, 2017). Identification of potential hazards and evaluating the risk associated with the hazards is an important step toward safety risk assessment (Aminbaksh *et al.*, 2013).

Several studies have identified health and safety hazards on building construction sites, the most acknowledged have been falls from height, manual handling hazards, being struck by flying/falling objects, building structure collapse, exposure to electricity, overexertion, contact with objects, lifting (overstrain), slips and trips, struck against an object, caught in between object, equipment injury, stepping on a sharp object, handling materials/objects, caving in of excavation, electrocution, drowning, vehicle/equipment, climbing step and walking platforms, fall to the lower level, contact with working tools (Baraban and Usman, 2006; Gurcanli and Mungen, 2013; Gurcanli *et al.*,. 2015; Orji *et al.*, 2016; Udo *et al.*, 2016; Okoye, 2018; Ghousi *et al.*, 2018; Williams *et al.*, 2019 and Liang *et al.*, 2021).

2.1 Risk Assessment

Hughes and Ferret (2016) described risk as the likelihood of a substance, activity, or process to cause harm. Risk assessment is a method used to decide on priorities and set objectives for eliminating hazards and reducing risks (Hughes & Ferret, 2016). Determining the risk for construction hazards depends on the probability of an accident occurring and the severity of the impact (Carter & Smith, 2006). Jannadi and Almishari (2003) emphasised that risk is quantified by finding the product of the probability of an incident that is likelihood and the expected severity of that incident.

Risk value is expressed as R= P x S (1)

Where: P= probability of occurrence, S= severity of harm

Likelihood or probability is defined as an event likely to occur within a particular period or specified circumstances (Purohit *et al.*, 2018). Severity is defined as the magnitude of the outcome of an event. Severity could be defined numerically in terms of monetary impact, technical or human impact criteria (such as fatality, lost work time, and medical case), or any other criteria (Purohit *et al.*, 2018). According to Hughes and Ferret (2016), there are two basic forms of risk assessment, qualitative risk assessment, and quantitative risk assessment. The qualitative risk assessment is centered on individual judgment. Whereas, the quantitative risk assessment computes risk level in terms of the probability of a risk occurring to the probable severity of the consequence and allocating a mathematical value to the risk as shown in table 1.

The risk matrix method is established by the classification of probability (categorisation for frequency of harm), classification of severity (categorisation for the consequence of harm), and risk classification (category of risk). Those three categories are correlated and a risk matrix is constituted as a result. Risk classification can be based on risk level or risk acceptance. The risk matrix is a table that comprises several categories of probability on one axis and severity on the other axis (Zolfagharian *et al.*, 2014). The risk value is computed by multiplying the probability of occurrence and the severity of the impact of the hazardous event. The 5x5 risk matrix describes 5 categories of probability and 5 categories of severity and in-cooperates these categorisations both in descriptive and quantitative features (Ceylan, 2012). Each descriptive category for probability and severity has a matching quantitative value from 1 to 5 as shown in table 1-2.

Table 1 Risk matrix showing numeric rating for severity and probability

likelihood / **Severity**	Rare (1)	Remote (2)	Occasional (3)	Frequent (4)	Almost (5)
Catastrophic (5)	5	10	15	20	25
Major (4)	4	8	12	16	20
Moderate (3)	3	6	9	12	16
Minor (2)	2	4	6	8	10
Negligible (1)	1	2	3	4	5

Table 2 Categorisation of the probability of occurrence and severity of risk impact.

Probability	**Description**	**Level**	**Severity**	**Description**
Almost	Certain continual	5	Catastrophic	Fatality or multiple major injuries.
Frequent	Common occurrence	4	Major	Serious injuries or life-threatening occupational diseases.
Occasional	Possible or known to occur	3	Moderate	Injury requiring medical treatment or ill health leading to disability.
Remote	Not likely to occur under normal circumstances	2	Minor	Injury or ill health requiring first-aid only.
Rare	Not expected to occur but still possible	1	Negligible	Not likely to cause injury or ill health.

Risk is calculated by multiplying the values for probability and severity. Risk values are produced from 1 to 25 in the combination of different categories of probability and severity of consequence. Risks are classified in two ways, on the bases of risk level and risk acceptance.

According to this risk classification, risk categories are developed as, the high-risk level having (13 to 25) meaning non-acceptable risk, medium risk level having (5 to 12) meaning tolerable risk, and the low-risk level having (1 to 4) meaning acceptable risk as shown in table 3.

Table 3 Risk classification of risk level and risk acceptance

Risk score scale	**Risk level**	Risk Acceptability
$1 \leq X \leq 4$	Low	Acceptable
$4 < X \leq 12$	Medium	Tolerable
$12 < X \leq 25$	High	Not acceptable

Where x= the actual risk score for the considering variable

3 METHODOLOGY

Non-probability sampling technique in the form purposive sampling technique was adopted for the collection of data in this study. A quantitative survey was employed for the study in the form of a questionnaire. A well-structured questionnaire was designed and self-dispensed to respondents, to seek the opinion of construction professionals which include: architects, site engineers, project managers, quantity surveyors, and health and safety managers who have managed and supervised building construction projects in Abuja to assess their perception on the most hazardous work item in building construction projects and to assess the risk level of hazards in building construction work items. This was based on the project they handled during the administration of the questionnaire.

3.1 Method of Data Collection

The questionnaire for the study was structured to determine the most hazardous work items in building construction projects and to analyse the risk assessment of hazards in building construction work items. The questionnaire consists of two parts, the first division contains information on the background of the respondents which consists of academic qualifications and working experience of the respondent. The subsequent section of the questionnaire focused on determining the most hazardous work items and on the eighteen hazards on sites that were identified from the literature reviewed such as (Baraban and Usman, 2006; Gurcanli and Mungen, 2013; Gurcanli *et al.*,. 2015; Okoye, 2018; Ghousi *et al.*, 2018; Williams *et al.*, 2019 and Liang *et al.*, 2021).

Respondent opinion was requested based on their experience in the industry, on the most hazardous work item in building construction projects, and to assess the risk level of hazards in building construction work items. A 5-point Likert scale of 1-5 was deployed 1- very low risk, 2 - low risk, 3 - moderate risk, 4 – High risk, and 5 - very High risk for the most hazardous work item in building construction projects. In addition the probability of occurrence (PRO) where 1- rare, 2- remote, 3- occasional, 4- frequent, and 5- almost, and the severity of impact (SRI) where 1- negligible, 2- minor, 3- moderate, 4- major and 5- disaster.

3.2 Data Analysis

Descriptive statistics were utilised in this study for data analysis, this involves the use of mean score and risks prioritization numbers. The response items were ranked using the mean score (MS) according to the central tendency of responses, as presented in equation (2).

$$MS = \frac{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{n_1 + n_2 + n_3 + n_4 + n_5}$$

A quantitative risk analysis was carried out to assess the severity and probability of each work item in building construction projects. The 5x5 matrix was used to classify the likelihood and severity as shown in Tables 1 and 2. And the degree of risk score which is attained through risk prioritization number was computed by using equation (3):

$$R = \frac{\sum PRO}{N} \times \frac{\sum SRI}{N} \qquad (3)$$

Where PRO= Probability of occurrence, SR= Severity of risk impact, and N= Number of items.

4 RESULTS AND DISCUSSIONS

4.1 Response rate to the questionnaire

96 questionnaires were distributed to respondents and 40 were retrieved representing a response rate of 41.67%.

4.2 Analysis of Respondents' Profile

This section discloses the respondents' profiles by exploring their educational qualifications and working experience. Table 4 presents the data collated in respect of this.

Table 4 presents the education qualification of the respondents, result revealed that above 90% of the respondents had an education qualification of Bachelor's degree and higher degree, 62.5%, 7.5%, 5%, B.SC/B,TECH. MBA/MSC/M TECH and Ph.D. respectively. This indicates that the respondents are proficient and well-informed to provide applicable data for the study. On respondents' working experience, 32.5% had worked for 5-9years representing the highest score of respondents, next were 10-14years representing 27.5% of the sampled population. The third was 20 years and above representing 15% of the sampled population and the least in the chart were 15-19 and less than 5 years representing 12.5% of the population. With the outcome of the result, it would be established that the respondents could be considered highly experienced.

Table 4 Respondent's Education Qualification and Work Experience

Parameter	Frequency	Percent (%)	Cumulative percent
Qualification			
ND	2	5.0	5.0
HND/BSC/BTECH	25	62.5	67.5
MSC/MTECH	8	20.0	87.5
PhD	2	5.0	92.5
Others	3	7.5	100.0
Total	40	100.0	
Working Experience			
Less than 5years	5	12.5	12.5
5-9 years	13	32.5	45.0
10-14years	11	27.5	72.5
15-19years	5	12.5	85.0
20years and above	6	15.0	100.0
Total	40	100.0	

4.3 Determination of most hazardous work items in building construction

The risk assessment of the most hazardous work item was determined in this section as presented in Table 5. The Table demonstrates the result of the risk assessment of the most hazardous work items in building construction projects. Findings revealed that installation of electrical work was the most hazardous work item with an average risk score of 11.48. This is in agreement with Williams *et al.* (2017) that electrocution is a hazard with high risk. Construction of roofs was second with an average risk score of 11.01. This was confirmed by Baraban and Usman (2006) and Okoye (2018). Installation of a lift was ranked third with an average risk score of 10.74 and installation of structural steel was ranked fourth with an average risk score of 10.71.

Table 5 Assessment of risk in building work items

SN	Work Items.	SRI	PRO	RS	RL	Ranking
1	Installation of electrical work	3.79	3.03	11.48	M	1
2	Construction of roof	3.41	3.23	11.01	M	2
3	Installation of lift	3.78	2.84	10.74	M	3
4	Installation of structural steel	3.63	2.95	10.71	M	4

Notes: SRI= Severity, PRO= Probability, RS= Risk score, RL=Risk level, M=Medium

Identification and Assessment of Risk in Building Work Items

This section identifies the top hazard in each work item and assessed the level of risk. The probability and severity of the hazard were obtained and the risk matrix method was used to determine the level of risk as presented in table 6-9.

Table 6 demonstrates the risk level of hazard in the installation of a lift. The three top occurring hazards were electrocution, hazard due to manual handling of machine and tool usage, and exposure to fire with a probability of occurrence (PRO) score of 2.97, 2.90 and 2.60 respectively. Likewise, the three most impactful safety risk hazards in the installation of the lift were electrocution, underground line contact, and exposure to fire with severity impact (SRI) scores of 4.33, 4.17, and 3.67 respectively. The result of the risk assessment of hazards in the installation of electrical works, revealed the top three hazards to be, electrocution, underground line contact, and hazard due to manual handling of machine and tool usage with risk levels of 14.64, 8.77, and 8.69 respectively. The result is in agreement with Gurcanli *et al.* (2015) that electrocution, underground line contact, and hazard due to manual handling of machine and tools usage as a hazard with high risks in electrical work.

Table 6 Identification and Assessment of Risk in the Installation of electrical work

Hazard in the Installation of electrical work	PRO	Rank	SRI	Rank	RS	RL	Rank
Struck or hit by falling objects	2.14	14	2.38	11	5.09	M	13
Fall from high level	2.60	5	2.84	6	7.36	M	5
Collapses of Trench	1.67	17	1.88	17	3.13	L	17
Fall to the lower level	2.44	9	2.26	13	5.52	M	11
Slip trip	2.29	13	2.16	15	4.94	M	14
The collapse of a building structure	2.31	12	2.92	5	6.73	M	9
Accidents by equipment	2.60	5	2.68	7	6.94	M	6
Struck or hit by a moving vehicle	1.88	15	2.25	14	4.23	M	15
Hazard due to manual handling of machine or tools	2.90	2	3.00	4	8.69	M	3
Electrocution	3.76	1	3.90	1	14.64	H	1
Underground lines contact	2.54	8	3.45	2	8.77	M	2
Underground cavities or pit collapse	1.70	16	1.94	16	3.29	L	16
Transportation or traffic accident	1.66	18	1.81	18	3.00	L	18
Exposure to noise	2.34	11	2.43	10	5.69	M	10

Exposure to fire	2.71	3	3.03	3	8.19	M	4
Caught between objects or material	2.64	4	2.57	9	6.80	M	8
Exposure to chemicals or substance	2.36	10	2.33	12	5.52	M	11
Strain	2.60	5	2.64	8	6.85	M	7

Notes: SRI= Severity, PRO= Probability, RS= Risk score, RL=Risk level, H=High, M=Medium, L=Low

Table 7 demonstrates the risk level of hazard in the construction of the roof and the three top occurring hazards were the collapse of fall from a high level, hazard due to manual handling of machines or tools, and fall to a lower level with a probability of occurrence (PRO) score of 3.37, 2.89 and 2.87 respectively. Likewise, the three most impactful hazards in the installation of the lift were the collapse of the building structure, falls from a high level, and fall to a lower level with severity impact (SRI) scores of 4.45, 4.00, and 3.55 respectively. The result on the risk assessment of hazards in the construction of the roof revealed the top three hazards to be falls from a high level, the collapse of building structure, and fall to a lower level with the risk level of 13.47, 12.06, and 10.20 respectively. The result of the findings is similar to Gurcanli and Mungen (2013) who established that fall from a high level, and collapse of building structure as the three major cause of fatality in roof work.

Table 7 Identification and Assessment of Risk in the construction of a roof

Hazards the construction of a roof	PRO	Rank	SRI	Rank	RS	RL	Rank
Struck or hit by falling objects	2.79	4	3.45	4	9.61	M	4
Fall from high level	3.37	1	4.00	2	13.47	H	1
Collapses of Trench	1.77	14	2.08	15	3.67	L	14
Fall to a lower level	2.87	3	3.55	3	10.20	M	3
Slip trip	2.11	10	2.90	7	6.10	M	8
Collapse of building structure	2.71	5	4.45	1	12.06	H	2
Accidents by equipment	2.30	8	3.03	5	6.95	M	6
Struck or hit by moving vehicle	1.55	16	2.24	12	3.45	L	15
Hazard due to manual handling of machine or tools	2.89	2	2.95	6	8.52	M	5
Electrocution	2.17	9	2.76	9	5.98	M	9
Underground lines contact	1.41	18	1.70	16	2.39	L	17
Underground cavities or pit collapse	1.44	17	2.20	13	3.16	L	16
Transportation or traffic accident	1.56	15	1.70	16	2.65	L	18
Exposure to noise	2.42	7	2.39	11	5.77	M	10
Exposure to fire	2.03	11	2.13	14	4.32	M	12
Caught between objects or material	1.87	12	2.77	8	5.17	M	11
Exposure to chemical or substance	1.83	13	2.08	15	3.82	L	13
Strain	2.50	6	2.46	10	6.14	M	7

Notes: SRI= Severity, PRO= Probability, RS= Risk score, RL=Risk level, H=High, M=Medium, L=Low

Table 8 demonstrates the risk level of hazard in the installation of lift and the three top occurring hazards were falls from high level, strain and fall to lower level with probability of occurrence (PRO) score of 2.97, 2.90 and 2.60 respectively. Likewise, the three most impactful safety risk hazards in the installation of lift were falls from high level, electrocution and accidents by equipment with severity impact (SRI) score of 4.33, 4.17 and 3.67 respectively. Result on the risk assessment of hazards in the installation of lift, revealed the top three hazards to be, falls from high level, electrocution and accident by equipment with risk level of 12.86, 10.08 and 9.40 respectively. This outcome is in line with the findings of Williams *et al.* (2017); Ghousi *et al.* (2018) and Liang *et al.* (2021) that falls from high level, electrocution and accident by equipment are leading causes of accident on site.

Table 8 Identification and Assessment of Risk in the Installation of Lift

Hazards in the Installation of lift	PRO	Rank	SRI	Rank	RS	RL	Rank
Struck or hit by falling objects	2.52	5	3.50	4	8.80	M	4
Fall from high level	2.97	1	4.33	1	12.86	H	1
Collapses of Trench	1.89	15	2.83	9	5.35	M	12
Fall to lower level	2.60	3	3.17	7	8.23	M	5
Slip trip	2.13	12	1.67	15	3.55	L	15
Collapse of building structure	2.32	10	2.83	9	6.58	M	10
Accidents by equipment	2.56	4	3.67	3	9.40	M	3
Struck or hit by moving vehicle	1.68	17	2.00	13	3.35	L	16
Hazard due to manual handling of machine or tools	2.36	8	3.33	5	7.88	M	6
Electrocution	2.42	7	4.17	2	10.08	M	2
Underground lines contact	1.61	18	1.50	17	2.41	L	18
Underground cavities or pit collapse	1.72	16	2.83	9	4.88	M	13
Transportation or traffic accident	1.90	14	1.67	15	3.17	L	17
Exposure to noise	2.52	5	1.83	14	4.61	M	14
Exposure to fire	2.20	11	3.00	8	6.60	M	9
Caught between objects or material	2.33	9	3.17	7	7.39	M	7
Exposure to chemical or substance	2.08	13	3.25	6	6.77	M	8
Strain	2.90	2	2.25	12	6.53	M	11

Notes: SRI= Severity, PRO= Probability, RS= Risk score, RL=Risk level, H=High, M=Medium, L=Low

Table 9 demonstrates the risk level of hazard in the installation of structural steel and the three top occurring hazards were struck or hit by falling objects, collapse of building structure and fall from high level with probability of occurrence (PRO) score of 2.97 and 2.94 respectively. Likewise, the three most impactful safety risk hazards in the in installation of structural steel were fall from high level, collapse of building structure and struck or hit by falling objects with severity impact (SRI) score of 3.83, 3.79 and 3.77 respectively. Result on the risk assessment of hazards in the installation of structural steel, revealed the top three hazards to be collapse of building structure, fall from high level and struck or hit by falling objects with risk level of 11.26,11.25 and 11.19 respectively. This result is in agreement with Ghousi *et al.* (2018) that falls from high level and struck or hit by falling objects are hazards with high risks.

Table 9 Identification and Assessment of Risk in the installation of structural steel

Hazard in the installation of structural steel	PRO	Rank	SRI	Rank	RS	RL	Rank
Struck or hit by falling objects	2.97	1	3.77	3	11.19	M	3
Fall from high level	2.94	3	3.83	1	11.25	M	2
Collapses of Trench	1.94	16	2.00	18	3.87	L	18
Fall to lower level	2.58	7	3.09	7	7.96	M	7
Slip trip	2.27	11	2.39	14	5.44	M	13
Collapse of building structure	2.97	1	3.79	2	11.26	M	1
Accidents by equipment	2.46	8	3.55	4	8.70	M	5
Struck or hit by moving vehicle	1.81	17	2.62	13	4.73	M	15
Hazard due to manual handling of machine or tools	2.89	4	3.17	5	9.15	M	4
Electrocution	2.19	12	3.16	6	6.94	M	9
Underground lines contact	2.06	13	2.06	16	4.26	M	16
Underground cavities or pit collapse	2.41	9	2.85	11	6.87	M	11
Transportation or traffic accident	1.81	17	2.33	15	4.23	M	17
Exposure to noise	2.88	5	2.91	9	8.38	M	6
Exposure to fire	1.97	15	2.56	14	5.04	M	14
Caught between objects or material	2.36	10	2.92	8	6.89	M	10
Exposure to chemical or substance	2.09	14	2.64	12	5.51	M	12
Strain	2.60	6	2.90	10	7.54	M	8

Notes: SRI= Severity, PRO= Probability, RS= Risk score, RL=Risk level, H=High, M=Medium, L=Low

5 CONCLUSION AND RECOMMENDATION

Workers in construction projects are exposed to a wide variety of hazards on sites resulting in exposure to fatal accidents. The study determined the most hazardous work item in building construction projects and assessed risk level of hazard in building work items. It was revealed that installation of electrical work, construction of roofs, installation of lift and installation of structural steel were the most hazardous work items in building construction projects with medium risk. The study determined the probability and severity of hazards for each work item and revealed that the most occurring hazards in the work items sampled were collapse of building structure, falls from high level, struck or hit by falling objects, electrocution, hazards due to manual handling of machine or tools and fall to lower level. It was also discovered that the risk of hazard occurrence and the degree of impact differs from one work item to another and this depends largely on the context and settings of the activities involved and the circumstance of the working environment. It was further observed that medium risk hazards were dominating in all the work items. It was concluded that professionals in the industry would experience more of medium level risk and a little bit of high risk. It was recommended that regular hazard risk identification and assessment should be conducted during project execution in order to mitigate risk to an acceptable level. And also adequate provision should be made for safety measures for worker in order to abate accident on site. Further study should be carried out to determine the type of safety programs required to mitigate accident for each work item. The study will provide the basic background knowledge for experts who intend to carry out a risk assessment on their sites.

REFERENCE

Abas, N.H., Heong, Y.W., Mohammad, H, Yaman, S.K & Rahmat, M. H. (2020). The Analysis of Struck-By Accidents at Construction Sites in Johor, *International Journal of Integrated Engineering*, 12(4), 266–275.

Agwu, M. O. & Olele, H. E. (2014). Fatalities in the Nigerian Construction Industry: A Case of Poor Safety Culture *British Journal of Economics, Management & Trade,* *4(3), 431-452.*

Albert, A., Hallowell, M. R., & Kleiner, B. M. (2014). Experimental Field Testing of a Real-time Construction Hazard Identification and Transmission Technique. *Construction Management and Economics*, 1 – 17.

Aminbakhsh, S., Gunduz, M. & Sonmez, R. (2013) Safety risk assessment using analytic hierarchy process (AHP) during planning and budgeting of construction projects. *Journal of Safety Research*, 46(2013), 99-105.

Baradan, S, & Usmen, M 2006, 'Comparative injury and fatality risk analysis of building trades', *Journal of Construction Engineering and Management*, 132(5), 533-539.

Bilir, S., & Gurcanli, G. E. (2018). A Method for Determination of Accident Probability in the Construction Industry. *Teknik Dergi,* (511), 8537-8561.

Bureau of Labour Statistics. (2018). Injuries, Illnesses, and Fatalities, Bureau of Labour Statistics, Department of Labour, Washington DC. Retrieved from https://www.bls.gov/iif/oshsum.hym#17Summary_Tables

Carter, G. & Smith S. (2006) 'Safety Hazard Identification on Construction Projects', *Journal of Construction Engineering and Management*. 132,197-205.

Ceyhan, C. (2012). Occupational Health and Safety Hazard Identification, Risk Assessment, Determination controls: Case Study on Cut and Cover Underground Stations and Tunnel Construction. Master thesis, Civil Engineering Department, Middle East Technical University.

Ejiofor, N., Uchechi, A., & Ndidi, I. (2018). Impact of Sustainable Construction on Environmental and Health Risk in Nigerian Construction Industry. *Journal of Civil, Construction and Environmental Engineering*. 3(4), 99-105.

Ghousi, R., Khanzadi, M., & Mohammadi, A.K. (2018). A Flexible Method of Building Construction Safety Risk Assessment and Investigating Financial Aspects of Safety Program. *International Journal of Optimization in Civil Engineering. 8(3), 433-452*

Gurcanli, G.E., & Mungen, U. (2013). Analysis of construction accidents in Turkey and responsible parties. *National Industrial Health*, 51(6), 581-595.

Gurcanli, G.E., Bilir, S.M. & Sevim, M. (2015). Activity based risk assessment and safety cost estimation for residential building construction projects, *Safety Science,* 80: 1-12

Gunduz, M. & Khader, B. k. (2020). Construction Project Safety Performance Management Using Analytical Network Process (ANP) as a Multi criteria Decision-Making (MCDM) Tool. *Journal of Computational Intelligence and Neuroscience*. 2020, 1-11

Hughes, P., & Ferrett, E. (2016). *Introduction to health and safety at work* (6th ed.). New York, NY: Routledge.

Idoro, G.I. (2008). Health and Safety Management efforts as Correlates of Performance in the Nigerian Construction Industry. *Journal of Civil Engineering and Management.* 14 (4), 277–285

Jannadi, O.A. & Almishari, S. (2003). Risk assessment in construction. *Journal of Construction Engineering and Management* 12(9), 492-500.

Liang, B., Zhang, S., Li, D., Zhai, Y. Wang, F. Shi, L & Wang, Y. (2021). Safety Risk Evaluation of Construction Site Based on Unascertained Measure and Analytic Hierarchy Process. *Discrete Dynamics in Nature and Society.* 2021 (1-14)

Mamman, E. J., Yakubu, M.Y., Shittu, A. & Adamu, A. (2021). Safety Risk Assessment of Building Construction Work Items in Abuja. *Environmental Technology & Science Journal*, 12(2) 103-113.

Occupational Safety and Health Administration (OSHA). (2002). 'Job Hazard Analysis'. U.S. Department of Labor. Retrieved from https://www.osha.gov/Publications/osha3071.pdf

Occupational Safety and Health Administration (OSHA). (2018). Recommended Practices for Safety and Health Programs: Hazard Identification and Assessment. U.S. Department of Labor. Retrieved from https://www.osha.gov/shpguidelines/hazard-Identification.html

Okoye, P.U. (2016). Improving the safety performance of Nigeria construction workers: a social ecological approach. *Universal Journal of Engineering Science*, 4(2), 22-37.

Okoye, P.U. (2018). 'Occupational health and safety risk levels building construction trades in Nigeria', *Construction Economics and Building*, 18(2), 92-109.

Orji, S. E., Enebe, E., C., & Onoh. F. E. (2016). Accidents in Building Construction Sites in Nigeria: A Case of Enugu State. International Journal of Innovative Research and Development, 5(4), 244 –248.

Purohit, D.P., Siddiqui, N.A., Nandan, A & Yadav, B.P. (2018). Hazard Identification and Risk Assessment in Construction Industry. *International Journal of Applied Engineering Research*, 13(10),7639-7667.

Ramaswamy, S. K. & Mosher, G. A. (2017). 'Using worker compensation claims data to characterize occupational injuries in the commercial grain elevator Industry', *Journal of safety science,* 103.352-360.

Udo, U.E., Usip, E. E., & Asuquo, C. F. (2016). Effect of Lack of Adequate Attention to Safety Measures on Construction Sites in Akwa Ibom State, Nigeria. *Journal of Earth Sciences and Geotechnical Engineering,* 6(1), 113-121.

Vitharana, V.H.P., Subashi De Silva, G.H.M.J., & Sudhira De Silva.(2015) Health Hazards, Risk and Safety Practices in Construction Sites – A Review Study XLVIII, 03

Williams, O.S, Hamid, R.A & Misan, M.S. (2019). Causes of Building Construction Related Accidents in the South-Western states of Nigeria, International Journal of Built Environment and Sustainability, 6(1), 14-22.

Zolfaghariana, S., Irizarrya, J., Ressangb, A., Nourbakhsha, M. & Gheisaria, M. (2014). An automated safety planning approach for residential construction sites in Malaysia. *International Journal of Construction Management*, 14 (3), 134 -147.