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ASSESSMENT OF OCCUPATIONAL HAZARDS IN SELECTED OIL AND GAS DEPOTS IN THE NIGER DELTA, NIGERIA

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ABSTRACT

Assessment of occupational hazards in oil and gas depots in the Niger Delta was studied. Tank farms and oil depots store large volume of flammable petroleum products, which are hazardous to the workers and pose environmental threat due to poor facility maintenance. The study adopted a cross-sectional design where data were collected from 182 tank/depot workers purposively using questionnaire. A total of 200 copies of a closed ended questionnaire were administered to all cadres of staff which comprised of senior staff, middle and junior staff. Data were coded and analysed at 95% confidence level. Respondents acknowledged that tank farms are plagued with all types of occupational, asset and the environment grand weighted mean of 3.67. The results showed that there is a significant relationship between, hazard exposure and safety behaviour of workers in the tank farms and depots. The study recommends frequent inspection of machines; turn around maintenance of facilities and promotion of healthy work environment within the tank farms and depots.

Keywords: Occupational, Hazard, Oil and Gas Depots

INTRODUCTION

In the oil sector, leaders have a significant impact on safety and health management in a variety of ways. Employees in oil and gas plants are consequently exposed to a wide range of health risks, including accidents involving heavy tools, fire, pipeline explosions, transportation mishaps and poor ergonomic circumstances. Every workplace has risk factors for injuries. Industrial and agricultural employees face the greatest dangers of any occupation (WHO 1983 & 1996). The Oil & Gas downstream sectors is mainly concerned with Crude oil and/or natural gas production and recovery. The term "downstream" refers to the refined petroleum hydrocarbons produced such as; crude oil and/or natural gas. Petroleum activities are carried out on land. The difficulty of remoteness, restricted layout designs, and significant hazard threats face downstream onshore oil and gas infrastructure. Onshore high-hazard plants frequently employ exposed worker groups who work and stay for longer periods. MHFs have higher-risk of catastrophic accidents, with tendency of serious outcomes (Comcare, 2007).

The depots are obsolete and haven't produced in 10–15 years, and Nigeria's pipelines aren't well-structured. The best storage option is tank farms, but no additional production is done. The Niger Delta's tank farms are poorly controlled and maintained, standing as threat to people. In Nigeria, tank-farm operation helps in resolving fuel crisis by storing extra petroleum for later consumption (Oluwatoyin, 2020). Tank farm operations are critical to the Nigerian system, and necessary precautions should be taken to decrease risk and dangers to workers and host communities, alongside safeguard lives and property.

Tank farm activities and operations have aided in economy improvement by preserving the country's supply chain. It has also ensured product flow to meet national and local petroleum product supply requirements. Nigeria, as Africa's "giant" and a key member of OPEC, can best sustain and meet the demands of her rising population of over 170 million people by conserving petroleum products for the future. It's worth noting that tank farms are the finest place to store Premium Motor Spirit (PMS), as they ensure a constant and reliable supply. Tank farms are moreso valuable and safe ways to store petroleum products if properly managed. The single most delicate economic operation in today's Nigerian economy is the storage of imported petroleum products. The cornerstone and lifeblood of Nigeria's existence is this storage depot, which houses over 200

tanks of explosive fuel and is held by about 50 private corporations. Prices, inflation, employment, food, education and life expectancy are dependent on energy and fuel availability for production. As a result, any disaster that occurs within that facility will have a nationwide impact. Within its borders, these tank farms house practically the entire Nigerian state's energy supply and distribution potential. It's also quite explosive, volatile and poorly regulated at the moment.
Because we lack maintenance culture to prevent the harm tank farms can pose to the nation, this makes the environment extremely unsafe for business and residential use. We lack good fire fighters who can assist in putting-out fires, which can wreak havoc on our economy because fire is the lifeblood of Nigeria's economy. Oil depots operations will always be a positive and welcome development, so long the tenets of OHS are adhered to, and this will help address the following: massive employment opportunities, government revenue, infrastructural development, petroleum product reserve and scarcity alongside its attendant issues. OLaosebikan (2017) claims that; "The Dossy oil and gas tank farm fire in Calabar, Cross River State, claimed the lives of 13 individuals and devastated equipment, houses, and the environment." On October 16th, 2018, over 200 persons died due to an oil pipeline fire at the Osisioma Aba (PPMC) Depot, which may have been caused by suspected oil thieves who hacked into the line to block the flow of petrol from Port Harcourt to Aba." In November 2020, a fire overtook Oando tank farm in Ijora Lagos, destroying many lives and properties.

Hypotheses for Research

The listed null hypotheses were developed:

H_o: There is no significance difference in the occupational hazards exposed among workers in the oil and gas facilities

Theories of Accident Causation

In today's world, occupational hazards and diseases are part and parcel of industrial processes following use of machines and high technology, so every person is exposed to various hazards in their occupation or environment. According to WHO, 59 million workers get exposed to hazard every day, worldwide. This happens to be a serious public health problem today that has drawn the attention at both national and global levels. Occupational hazards are those material substances, processes or circumstances that pose threat to workers health and wellbeing. Most often the exposure is simultaneous and the workers are not even acquainted with these hazards, until they fall sick. Safe execution of work in any facility is mostly impacted by the presence of hazards, hence the need to pay attention to the sources these accidents and their preventions at workplaces, which is premeditated by the uncontrolled hazards. The hazards when neglected invariably affects the health and wellbeing of the workforce, facility integrity, plants/machinery, environmental safety and reputation of the organization involved (Okoye, 2016).
"Accidents don't just happen but they are caused". According to Abdul *et al* (2008), "99% of accidents are either caused by unsafe acts and or unsafe conditions, out of which 90% of accidents are due to human error or behaviour. Odebola (2014) asserts that inevitable hazards are inherent in all workplaces of petroleum industries and facilities, several which contribute to minor injuries or disasters. The following are theories of accident causation which is interrelated with hazards at all times: Domino Effect Theory; Human factor theory; Accident/ incident theory; Epidemiology theory; Systems theory; Combination theory; Behavioural theory; Multiple causation theory; Swiss cheese model of accident causation theory.
From Domino-theory of accident causation, developed by W H. Heinrich who asserts that about 88% of accidents results from unsafe acts of people, 10% by unsafe condition and 2% by acts of God. The author proposed five factor accident sequences. This study is hinged on Domino theory by Herbert William Heinrich (1929) and Cognitive appraisal theory of Richard Lazarus (2000). Domino theory focuses on developing an understandable theory which can define and justify the accident factors. It also emphasizes the processes contributing to accident occurrence within the oil & gas at all levels of employees from general workers up to engineers and managers. In 1929, Herbert William Heinrich developed a theory called Domino theory. The theory has been expanded

many times during several years. The accident causations have five steps metaphorical dominos in the sequence, which is stated below;

1. Social Environment and Ancestry: Some characteristics such as carelessness, recklessness greed, and bad temper are originated from either inheritance or social environment. In other words, such traits can be raised nature and nurture contributing to fault of person.

2. Fault of Person: Some unpleasant manners or traits such as ignorance, recklessness, and bad temper can be innate. Also, such traits can appear due to life environments contributing to unsafe Acts or unsafe conditions.

3. Unsafe Acts or Unsafe Conditions: Unsafe acts and unsafe conditions are labelled on the domino at the center of sequences contributing to an accident. They are the major factor responsible for an accident. Lifting up this domino is the easiest and the most efficient option to prevent an accident.

4. Accident: The accidents are the undesirable and the unwanted events that happen and cause injury. Accident is an unplanned event that may result from unsafe acts or unsafe condition or both.

5. Injury: Injuries are the consequences suffering damage to someone's body, example cut during surgical procedure, needle pricks while giving injection, cut from a broken vial (OSHA, 2018).

The implication of the domino theory is that when the management refuses to comply to occupational health rules, it will trigger the events that may compromise safety of workers at the work place. This implies that workers get exposed to ailments, diseases and injuries, where safety is violated. This theory aligns-well with the thought that when management fails to comply with OHS regulations or laws, the perception of employees to safety, risk and hazard will be jeopardized.

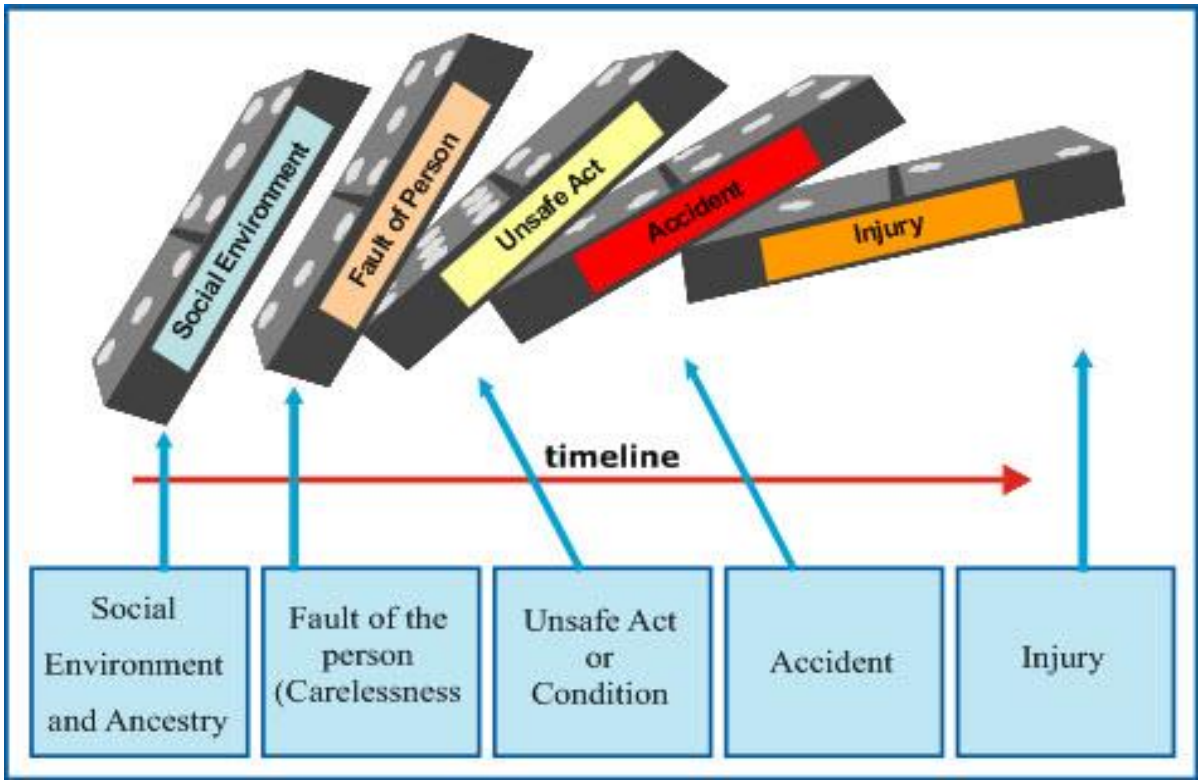

Figure 2.1: Domino-theory of accident causation (Ferrel, 1997)

Concept of Occupational Health (OHS)

OHS is 'a multi-disciplinary concerned with the safety, health and welfare of employees. The goal of all occupational health and safety programmes is to foster a safe work environment. As a secondary effect, it may also protect co-workers, nearby communities, and the entire public

impacted by the workplace environment' (Geller, 1996). 'Since 1950, the International Labour Organization (ILO) and the World Health Organization (WHO) have shared a common definition of occupational health. It was adopted by the Joint ILO/WHO Committee on Occupational Health at its first session in 1950 and revised at its twelfth session in 1995'. It is defined as: "Occupational health should aim at: the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from good health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, the adaptation of work to man and of each man to his job" (Ahmed *et al.,* 2012).

Health is a state of wellness of a person in all aspects. WHO, in 1948, defined health "as a state of complete mental, physical and social wellbeing and not merely absence of disease/ infirmity (Allen*,* 2008). Over the years the oil industry has contributed drastically to the Nigerian economy. Their impacts include the; creation of employment opportunities, local expenditure on goods and services, contribution to government revenue, contribution to gross domestic product (GDP), contribution to foreign-exchange reserves, supply of energy to industry and commerce (Amabye*,* 2016). Logically, the oil & gas industry is a high-risk industries in relalation to health/safety of employees. Interruptions in oil production caused by fires and accidents easily lead to significant economic losses, and potential hazards to humans and the environment (Andhra, 2018). Working in oil & gas facilities basically exposes employees to benzene and naturally occurring radioactive material (NORM), substances that are dangerous to health (Andhra, 2018).

Working in the oil & gas industry exposed individual to potential risks/hazards which are categorized into occupational, environmental and public health (Nnadi *et al.,* 2014). Hazard is defined as a condition that possess the potential to cause loss or harm (Johnson, 2000). Bello & Mijinyawa (2010) defined work related hazards as the risk to the health of a person usually arising from employment. According to Kalejaiye (2013), work-related hazards results from unsafe work-conditions and unsafe work-behaviors. Johnson (2000) also defines risk as the likelihood of occurrence of undesirable outcomes. Hence, risk is the likelihood that injury or harm will occur to specific individuals or groups exposed to hazard ((Erondu & Anyanwu, 2005). Occupational risks and hazards are the health problems employees' face in their work-environment and how those health problems affect the health status of employee and their family (Pauline & Kayode, 2010). It can likewise be defined as diseases, accidents and other hazards arising from the work-environment or situations that arise in the attempt to perform tasks in any occupation (Henderson *et al.,* 2007).

Universally, there are 2.9 billion employees exposed to hazardous risks at their work places. From reported, there has been annual mortality-rate of 1,249 per 100,000 employees in Nigeria in the previous era. Varieties of hazards exist including; biological agents, chemical and adverse-ergonomic conditions (Aliyu & Saidu, 2011). Yearly there are 2 million deaths accrued to occupational diseases/injuries and 4% loss of GDP. However, the significance of OHS practice is often overlooked. This is because, occupational Health level in Africa is low from the global view (Aliyu & Saidu, 2011). In Sub-Saharan Africa, public health problems of; child mortality, water quality, malaria, HIV/AIDS, etcetera, have dominated the region (Spee, 2006). From literatures, risk factors leading to injuries are dominant in all oil & gas industries (WHO, 1983 & 2009).

Developing nations are indifference to occupational health issues (Clarke, 2012), and stakeholders, including; management, employees and government do not take to heart the need to mitigated this issue via occupational health. Accidents can result to various forms of disabilities; loss of man-power; decreased productivity; and even death. Few companies in Nigeria, like the multinationals recognize the need for OHS and runs with their parent countries origin policies constituted (Okojie, 2010). Occupational health practice is still at infancy stage in most indigenous-organizations in Nigeria (Adeogun & Okafor, 2013).

Oil and Gas in Nigeria

The petroleum sector began to play a vital role in shaping the Nigerian economy and political destiny in early 1960s. The first National Oil Company, the Nigerian National Oil Corporation (NNOC) was created in 1971 and it later became the Nigerian National Petroleum Corporation (NNPC) in 1977. To take control of Nigeria's petroleum industry, Nigeria nationalized BP's holding completely in 1979, and shell-BP became Shell Petroleum Development Company of Nigeria (SPDC), (Asikhia & Emenike, 2013). Nigeria is Africa's largest fuel producer, with oil & gas exports and import totalling almost 2000 barrels a day in December, 2018 (DPR, 2020). Keeping stored fuel safe and in good condition is a priority for Nigerian operators, with number of storage and distribution option and security checks in place to minimize fuel loss. Underground fuel tanks do offer security and can reduced loss through evaporation. On the downside or underground tanks and fuel distribution systems are often in poor condition with inspection and maintenance difficulty and the cost of replacement significantly higher than the above ground storage options. Poorly maintained tanks add to the risk of fuel contamination, and spoilage as well as the risk of environmental leaks. Mega tank farms are capable of storing up to 300million litres of petroleum products, but safety and security remains a key issue for these operations, with theft through distribution systems and spills through poorly maintained storage. Depots and tank farms are under downstream operation which involves process of storing petroleum products, its supply and distribution alongside the retail marketing of the products (Olawoniyi, 2017). The history of storage operation started in 1979 with the establishment of PPMC, a subsidiary of NNPC.

METHODOLOGY

Research Design

This study utilized a combination of field measurements and analytical cross-sectional research design.

Study Area

The Niger Delta region is situated in the Gulf of Guinea between longitude 5^0E to 8^0E and latitudes 4^0N to 6^0N, as shown in Figure 3.1 (Opafunso, 2007). ERML (1997) defines the original Niger Delta region (about 29,900 square kilometres) as comprising the area covered by the natural delta of the River Niger and the areas to the east and west, which also produce oil.

Population for the Study

The population in this study revolves around oil and gas facilities in the Niger Delta Region and includes all the individuals whose daily work activities exposes them to hazards and risks. It comprises of a group of facility workers of depots and tank farms in the Niger Delta, Nigeria, male and female between the age range of twenty-one (21) years to sixty (60) years in the oil and gas facilities (Public and Private Depots) whose duties and day to day business are such that they are exposed to hazards and risk in their work place or environment. This individual comprises staff and contract staff gainfully employed loaders, safety officers, health personnel, production staff, maintenance staff, lab scientist, site surveyors, all managers and supervisor of all cadres. The sampling size was determined as a subgroup from the study population.

Nigeria has a total of 124 depots across the country with a total of 38 tank storage in the Niger Delta. Breakdown is as follows; NNPC/PPMC tank farms Warri, Calabar, Port Harcourt and Aba. Independent Marketers storage farms Port Harcourt 12, Calabar11, Warri 4 and 1 in Akwa Ibom, Major Marketer's storage farms, Port Harcourt 4 and Warri 1, giving a total of tank farm in Niger Delta. Most of the storage farms are not functional due to; the refineries are not producing products, pipeline vandalization and distance from the coast. However, in this study, six tank location companies were used, 3 public and 3 private Depots/tank farms. For confidential reasons as agreed with these companies, their names are not mentioned.

The study's inclusion criteria were staff who have spent one year and above in the facilities and are active in their respective duties and with no adverse health challenges. While those who have

history of psychotic (someone in a mental state of health that can exhibit abnormal behaviour) disorders based on personal declaration and from information obtained from their companies were excluded from the study.

Determination of Sample Size

The study adopted a non-probability purposive-sampling technique. Representative samples were collected via sound judgment from the study population (Black, 2010). Oil facility workers that have been duly employed as staff/locum that can provide dependable information were purposely selected for the study. The determined sample size was obtained by utilizing Taro Yamane's formula (1967) as shown in equation (3.1). It was determined on the estimated number of all the staff in the six tank farms which were given as N= 400

Methods of Data Collection/Instrumentation

The primary data collection here means obtaining information by administering copies of questionnaire to respondents in selected depots oil and gas facilities in Niger delta region of Nigeria. Personal interviews were engaged in with some workers, which will enhance the worth of information that were derived from the questionnaire concerning occupational hazards and health risks. Before undertaking the data collection process, an official letter was addressed to respective managements in the various studied facility seeking the study-population's consent. Each management of the designated depots and tank farms were assured of treating the information from respondents/participant confidentially. Hence, the data collection procedure of the study followed due process and study was done via; walk through survey, structured questionnaire, and review of documents, reports, secondary data, observations and an inspection checklist.

Structured Questionnaires

A questionnaire refers to a research instrument that consists of sets of questions for obtaining responses from respondents in a standardized way (Bhattacherjee, 2012). It is a technique used in collecting data from sampled population in which each individual responds to the same set of questions in a present order (Saunders *et al.,* 2012). The questionnaire was prepared in simple English language, so respondents can read and understand all the questions therein.

Methods of Data Analysis

Preceding the data analysis, the returned copies of questionnaire were properly cross-checked for completeness and the incomplete copies alongside those with incorrect responses were discarded. Here, quantitative and qualitative techniques were adopted to analyze questionnaire and interview data respectively. The analysis was centred on the provided information obtained through questionnaire, checklist auditing and documentation. The qualitative data gathered from different sources were assembled, summarized and categorized to suit the analysis method. Collected data from copies of questionnaire were processed, coded and analyzed utilizing XLSTAT 20l8 premium version software, developed by Addinsoft (2018). The percentage, mean and standard-deviation of respondents were determined. Contextual information of respondents was captured and presented in percentage. Qualitative data obtained from checklist auditing, notes and documents were systematically transcribed, coded and classified into broad descriptive categories before analysis.

Five-point Likert-Scale was used in analysing and evaluating sections B – E of the questionnaire. The individuals that constitute the sampled population were asked to respond to each question from their own degree of agreement or disagreement. They were directed to choose one of five responses of strongly agree, agree, disagree, or strongly disagree and undecided. To analyse the gathered data, each statement or item was coded and assigned weights as five (5) points were assigned to Strongly Agree (SA), four (4) points to Agree (AG), three (3) points to Disagree (DG), two (2) point to Strongly Disagree (SD) and one (1). The responses to the itemized statement were combined or summed to obtain a total pact score. Responses on each questionnaire were

considered high and agreed when the value mean is 3.00 and above and will be disagreed when its less than 3.00. It was calculated from the average weight of the response options,

That is, $\frac{SA+A+D+SD+U}{n}$ (3.2)

$\frac{5+4+3+2+1}{5} = 3$

It worth of note that the scale interval was equally distributed and for a statement to be considered significant the weighted mean is equal to (or) greater than the criterion which was 3.0.

ANOVA stands for analysis of variance. It's a statistical test developed by Ronald fisher in 1918 which has been used to identify differences in any statistical analysis between means of three or more independent groups. Pearson Product Moment Correlation (PPMC) coefficient is also called product moment correlation coefficient, the bivariate correlation is a measure of linear correlation between two sets of data. It shows the relationship between two (2) sets of data. The study considers assessment of occupational hazards, risks and facility integrity of Tank farms and depots in oil facilities in Niger Delta. As such the above PPMC is an appropriate correlation analysis for testing the relationship between occupational hazards exposure and the effect on workers. Health risk exposures affecting the workers, correlate significantly with the level of workers awareness and workers safety behaviour.

Results

Summary of means and grand means for Identification of Occupational Hazards in the depot/Tank Farm

Referents	Companies Weighted Mean						Grand Mean
	A	B	C	D	E	F	
1	2.45	2.92	4.54	4.78	4.85	4.86	4.00
2	2.84	3.00	2.46	4.44	3.23	3.29	3.26
3	2.95	4.00	4.92	4.56	4.08	4.43	4.09
4	3.10	4.00	4.54	4.72	4.69	4.50	4.20
5	2.50	3.25	4.62	4.22	4.23	4.14	3.76
6	3.80	4.00	4.46	4.39	4.50	4.00	4.17
7	2.90	3.50	4.62	4.44	4.23	4.43	3.97
8	4.11	4.33	4.31	4.28	4.15	4.36	4.25
9	3.16	3.00	3.20	4.41	3.23	2.64	3.32
10	3.70	3.25	4.08	4.44	4.46	4.21	4.03
11	4.10	4.42	4.38	4.33	4.42	3.07	4.11
12	2.65	2.83	4.46	4.33	4.25	2.71	3.51
13	2.65	2s.91	2.69	4.35	3.46	2.46	3.11
14	1.90	1.42	1.15	1.28	1.15	1.00	1.36
15	3.75	4.00	4.69	4.67	4.92	4.71	4.42
16	2.80	1.75	4.54	4.00	4.00	3.29	3.40
17	3.00	3.08	4.38	3.88	3.85	2.85	3.49
18	2.25	2.08	4.54	4.28	3.92	2.71	3.27

19	3.35	3.25	4.69	4.50	4.77	4.57	4.16
20	3.10	2.25	4.38	4.11	3.92	2.85	3.46
Total	**3.05**	**3.16**	**4.08**	**4.22**	**4.02**	**3.55**	**3.67**

Hypothesis Testing

Ho: There is no significant difference in the occupational hazard exposure among workers in oil & gas facilities

Table above depicts the different occupational hazards that workers in oil & gas facilities from the various companies. The table shows an F-score of 39.775, which is greater than (>) the critical value, 2.21 at 0.05 significance-level. This difference could not have happened by chance, with 0.000 significance level. Hence, the null hypothesis that; there are no significant variations in occupational hazards exposure among workers in oil and gas facilities, is rejected, whereas the alternative-hypothesis is accepted. This infer that the workers in selected oil and gas plants are exposed to different occupational hazards in the study area.

Table above illustrates the post-hoc test (Duncan statistics) for the variation in occupational hazards exposure among workers in the oil and gas facilities from selected companies in the area. It is evident from the table that respondents in companies A, B, and F recorded lower values, while companies E, C, and D recorded higher values, which indicates higher perceptions in the occupational hazard exposure among workers in these companies. Furthermore, this result indicates that respondents in companies A and B are similar in their perception level, while company F stand alone, and companies E, C, and D share similar perceptions in occupational hazard exposures.

Identification of Occupational Hazards in the depot/Tank Farms

ANOVA

Hazard Identification

	Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	20.283	5	4.057	39.775	.000
Within Groups	17.897	176	0.102		
Total	38.180	181			

Post-Hoc Test, Hazard Identification

Duncan Company	**N**	**Subset for alpha = 0.05**		
		1	**2**	**3**
A	34	3.0472		
B	30	3.1629		
F	28		3.5672	
E	28			4.0117
C	26			4.0941
D	36			4.2196
Sig.		.502	1.000	.258

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 14.4s87.
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Discussion of Findings

Identification of Hazards in Tank Farms/Depots

The result shows that almost all respondents agree that tank farms/depots are riddled with diverse safety/health concerns. Most machines are antiquated and perform below optimal, according to the respondents. These scenarios are hazardous to the facility's personnel and pose a significant danger. The finding is in line with Ogbuigwe (2018) study, who stated that machines and other service facilities are subject to deterioration due to their use and continuous exposure to process/environmental conditions. Given the flammability and high flash point of liquids and goods such premium motor spirit, household kerosene, and AGO, every responder said it was properly stored and monitored. In summary, most respondents acknowledged that some of their workplace's machines/equipment are not always in good working-order. The weighted mean results, which showed that each company's scores exceeded the criterion, mean of 3 and had a grand mean of 4.17, backed up these claims. At conclusion, the majority of respondents disagree that flammable compounds such as PMS, AGO, HHK, solvent, and other explosive chemicals are improperly stored or handled in their workplace. The weighted mean results, which showed that each company's scores were less than the criterion mean of 3 and a grand mean of 1.36, backed up these claims. As discovered in this study, petroleum products are highly flammable and very hazardous, therefore must be properly stored as seen in this research. The study tallies-well with Hassinger & Watson, (2021) study, who opined that liquid petroleum products like; gasoline, diesel and kerosene must be stored safely to prevent leaks and spills. This implies that petroleum tank farms pose a great hazard to the workers alongside the environment. This indicate poor state of most tank farms and conform to Uqwukah and Ohaji (2016) that the depots and tank farms integrities have been compromised because of the constant replacement and repair of the segment, which is responsible for the non-attainment of effective pumping rate of liquids in order to prevent pipeline leakage and consequent environment pollution

In conclusion, most respondents in firms A and B disagreed that there are loose electric cables, wires, and unprotected sockets, but majority of respondents in other companies agreed. The weighted mean result corroborated this, as the firm A and B scores were below the criterion mean of 3, while the weighted mean for the other companies was over 3. The grand mean of 3.40 indicates respondents' agreement that there are loose electric cables, wires, and unprotected sockets.

CONCLUSION

In conclusion, majority of tank farms and depots have outlived their useful lives and most of the equipment is antiquated and in bad functioning order. Workers at tank farms and depots face similar occupational risks, from the report. Hence, the occupational risks differ amongst the tank farms that have been chosen, which could be attributed to the fact the various tank farms store petroleum products with high flash points and their related carbon compounds, with relatively different level of harm to people, property and environment. Individual integrity statements are being reviewed; all the tank farms' loading arms are manually controlled. Due to frequent and continuous use, alongside exposure to the elements, machines and other service facilities deteriorate.

RECOMMENDATIONS

1. Government and supervising institution should enforce compliance to OHS in industries, especially oil & gas companies so as to minimize hazards and risks level.

2. Employers should improve working conditions of workers in the industries/companies and organize seminars, workshops, education-programmes and ergonomic interventions to ensure that workers remain healthy.
3. Audits and facility checks should be carried out since most tank farms are old with obsolete machines, besides there should be turn around maintenance of the facilities especially Public (government depots) to ensure asset integrity government.

REFERENCES

Adeogun, B.K., & Okafor, C.C. (2013). Occupational health safety and environment (HSE) trends in Nigeria. *Int. J. of Environmental Science, management and engineering research 2*(1), 24-29.

Ahmed, Z. A. M., Dosoki, M. I., & Nasr, S. A. A. (2012). Occupational hazards in fish industry. *World Journal of Fish and Marine Science, 4*(2), 201-210.

Aliyu, A.A., & Saidu, S, (2011). Pattern of Occupational Hazards and Provisions of Occupational Health Services and Safety among workers of Kaduna Refinery and petrochemical company ltd (krpc), Kaduna, Nigeria. *Continental Journal of Tropical Medicine. 5* (1), 1 – 5.

Alkilani, S.Z., Jupp, J., & Sawhney, A. (2013). Issues of construction health and safety in developing countries: a case of Jordan. *Australasian J of Cons Econ and Building, 13*(3), 141-156

Andhra, H.I. (2018) Hazards Analysis of Crude Oil Storage Tank Farm. *University International Journal of Chem Tech Research.* CODEN (USA):IJCRCC, ISSN:0974-4249 ISS vol11 NO 11 pp 300- 308

Asikhia, M.O., & Emenike, G.C. (2013). Occupational health and safety in the oil and gas industry in Nigeria *JORIND 11*(2), 61-72.

Bello, S.R., & Mijinyawa, Y. (2010) Assessment of injuries in small scale sawmill industry of south western Nigeria. Agricultural Engineering inter nation: *the CIGD Journal of scientific research and development manuscript, 1558* (3).

Clarke, E.E.K. (2012). Multidisciplinary occupational health services *African Newsletter of Occupational Health and Safety*, *14* (1), 3.

Erondu, E.S., & Anyanwu, P.E, (2005). Potential hazards and risks associated with the aquaculture industry. *African Journal of Biotechnology,* 4 (13), 1622-1627.

Henderson, VL., Enterline, PE., Marsh, GM., Esmen, NA., Callahan, CM., & Paik, M, (2007). Some effects of cigarette smoking, arsenic, and SO2 on mortality among US copper smelter workers. *Journal of Occupational Medicine, 29,* 831–838.

Hassinger, E. & Watson, J.E (2021). Storage of Petroleum Products. DOI: 015.11pdf. FARM*A*SYST. Farm/Ranch Self-Assessment System for Arizona.

Johnson, R.W. (2000). Risk management by risk magnitudes. *Unwin Company Integrated Risk Management*, 1–2.

Kalejaiye, P.O. (2013). Occupational Health and Safety: Issues; challenges and compensation in Nigeria. *Peak journal public Health and management*, *1*(2), 16-23.

Nnadi U., David, Z. E., Smyth, D. & Mooney, J. (2017) Lack of Proper Safety Management Systems in Nigeria Oil and Gas Pipelines. School of engineering. University of the West Scotland Paisley campus. PAI 2BE, UK.

Ogbuigwe, A. (2018) Refining in Nigeria History, Challenges and prospects. NNPC archives.

Okoye, A.C., Odumegwu, C.O., & Omuku, P.E. (2012). Evaluation of the level of safety consciousness in Municipal Waste Management in Anambra State, Nigeria. *Journal of Environmental Management and Safety, 3*(1), 90-96.

Oluwagbemi, B.F. (2011). Themes and Issues in Occupational Health and Safety, 2nd Edition, Vertext Media Limited, Ibadan, Nigeria pp 19. Ontario Ministry of Labour. https://www.labour.gov.on.ca/english/hs/faqs/hazards.php.

World Health Organization (1983). Recommended Health based occupational exposure limits for selected vegetable dusts (Report of a study group). *WHO Technical report series, 684,* 35-49.