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ASSESSMENT OF THE HUMAN FACTORS RESPONSIBLE FOR ACCIDENTS IN OIL AND GAS COMPANIES IN NIGER-DELTA

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Abstract

The study was conducted to assess the human factors responsible for accident causation in the oil and gas companies in the Niger Delta region. Human factors (HFs) were operationalized using personal level factors (PLF), management level factors (MLF) and National Level factors (NLF) while accident causation was conceptualized using rate of accidents (RA) and rate of incidents (RI). Cross-sectional and inferential designs were adopted and population comprised of field-workers of six sampled oil and gas companies in Niger-Delta from which 440 samples were obtained using Multi-stage sampling technique. Data were collected using questionnaire designed based on 5-point Likert and data analysis were done with descriptive statistics and regression model using XL-STAT version-20.1. The results of the descriptive statistics using weighted average (WA) revealed that human factors which include PLF. MLF and NLF are substantial accident causation factors with WA of 3.44. 3.18 and 3.09 > 3.00 respectively and there is high level of accident occurrence which includes RA and RI with WA of 3.92 and 3.99 respectively. The regression model analysis revealed that: there is positive and significant relationship between human factors and total accident prevalence in the oil and gas companies in the Niger-Delta (coefficient of determinant = 0.528, p-value = 0.000). The study concluded that human factors are substantial causalities of accident in oil and gas firms in Niger-Delta. The study recommended that Management of the oil and gas companies in this researched region should also be very intentional and also committed to designing and developing proper and flexible safety management practices such as safety training policies, safety awareness programs, safety rules and procedures etc. as such would also help workers to align with safety policies of the firms and by extension reduce accident occurrences.

Keywords: Human Factors, Accidents, Oil and gas Companies, Niger-Delta region.

Introduction

Nigeria is one of the largest oil and gas producing countries in the world (Ehiaguina & Moda, 2020). About 90% of the growth and development of Nigeria's economy is contributed by the oil companies located within the Niger Delta region (Ejiba *et al*., 2016), and Nigeria has also benefitted from these oil companies in terms of provision of employment, energy supply to industry and commerce, foreign exchange reserve, and local goods and expenditure (Elum *et al*., 2016). Unfortunately, in terms of health and safety of workers, oil and gas industry in Nigeria is said to be one of the dangerous industries, as workers are frequently exposed to diverse work-related health hazard (Anumadu *et al*., 2014; Ezejiofor *et al*., 2014).

There are two approaches to assessment of human errors-related problems in the industry, namely the individual approach and systematic approach (Reason, 2015). Traditionally, the individual approach focuses on unsafe acts, which are viewed as resulting primarily from abnormal psychological issues such as lack of attention, negligence, carelessness, shortage of motivation, and recklessness. the systematic approach views human errors as a consequence, rather than a cause (Rowlinson & Jia, 2015). In the systematic approach, human errors have roots not lying in the aberration of human nature but in "upstream and latent" factors of the system (Dekker, 2015; Reason, 2015). Compared to the systematic approach, the individual approach does not carry out the analysis of mishaps and near misses in detail. As a result, recurrent error traps will not be uncovered until the occurrence. Similarly, by revolving around the individual sources of human errors, the individual approach segregates unsafe acts from the systematic environment (Reason, 2015).

Wiegmann and Shappell (2013) suggested that HFACS (Human factors Analysis and Classification System), which was initially developed for aviation, was an open tool of systematic analysis and should be adjusted according to specific characteristics of different industries (Wiegmann & Shappell, 2013). However, Dekker suggested that there were some confusions between classification and analysis in HFACS. The simple categorization of failures does not have explanatory and persuasive power (Dekker, 2015). It is necessary to find the impact mechanism and interior structure of this framework. What is more, oil and gas projects are resource-consuming. Constrained by limited resources, managers and researchers have devoted to effective allocation and utilization of resources (Huang *et al.,* 2010). To solve the distribution problem with limited resources, it is essential to identify critical paths, key factors, and priorities for managers (Khattab & Søyland, 2016).

The majority of oil and gas work-related injury cases are simply related to human-factors (poor decision making), which can be prevented through adequate safety culture and sometimes these injuries are related to non-human factors which are, mostly unexpected (Stanley, 2010). It is necessary to determine the specific factors that are effectively important to successful implementation of safety programs to achieve desired predetermined goal. The elements of human factor are mainly associated with poor safety management, lack of education and training, lack of safety awareness, aversion of input safety measures and reckless operation (Tam *et al.,* 2014). Oil and gas work-related accidents commonly happen due to lack of knowledge or training, inappropriate judgment or carelessness and poor machineries (Coble *et al.,* 2014). The main obstructions of safety implementation are the shortage of skilled-workers, workers level, poor management commitment and nature of oil and gas industry (Smallwood, 2016). Poorly designed project schedule, disproportionate approval procedures, low management expertise, inappropriate planning, scarcity of skilled labor, variations and lack of coordination between projects participants are some major hazards associated to human factor that limits safety performance in an oil and gas project. (Husin et al, 2018). Contributory factors for accidents occurrence are 70% is of workers, 49% is of work place problems, 56% is of equipment shortcomings, 27% is of material conditions and 84% is of risk management (Haslam et al., 2015).

Oil and gas work-related accident statistics and data in Nigeria are not properly and regularly published. Therefore, they are not easily available and not easy to access. However, it is expected that many fatal and non-fatal accidents would be happening everyday due to its characteristics such as unique nature and less controlled over the working environment. But there is no system recommended for aggregating and recording this statistic across the country and that is one of the reasons for not conducting sufficient researches and literature on oil and gas work-related accident and safety in Nigeria. Hence. this study sets to bridge this lacuna by evaluating the human factors responsible for oil and gas work-related accidents in Nigeria with specific focus in the Niger-delta. In this study, the human factors considered in the study are national level factors, management level factors and personal level factors while accident prevalence was grouped into rate of accident, rate of incidents and total accident prevalence which is combination of rate of accident and incidents. Therefore, the objectives of the study are to; determine the rate of accident occurrences in oil and gas companies as well as the types of accidents prevalent in the oil and gas companies in the Niger Delta, identify the human factors responsible for occurrence of accidents in oil and gas companies in Niger Delta and determine the relationship between the human factors responsible for accident occurrence and accidents rate in oil and gas companies in Niger Delta

2. Methodology

2.1 Research Design

The study adopted cross sectional and inferential study designs to evaluate the non-human factors responsible for accident causation in selected Oil and Gas companies in the Niger Delta. The research designs were selected because they were most suited and effective in similar studies across many industries (Burk et al 2011). Cross-sectional design was adopted to determine the rate of accident occurrences in oil and gas companies as well as the types of accidents prevalent in the oil and gas companies in the Niger Delta, identify the human factors responsible for occurrence of accidents in oil and gas companies in Niger Delta while inferential design was used to determine the relationship between the human factors responsible for accident occurrence and accidents rate in oil and gas companies in Niger Delta

2.2 Study Area

The Niger Delta Region is located in the southern part of Nigeria. It is home to around 30 million people. Over 90% of Nigerian oil reserve are found in the Niger Delta region, thus most oil and gas companies have their operation base sited in the region which is the main reason for considering the region for this study. The states in the region are Rivers, Bayelsa, Akwa Ibom, Cross river, Edo, Abia, Imo and Ondo. The Niger Delta is biodiverse with mangrove providing carbon sequestration capacity and supporting a wide variety of plant, terrestrial and aquatic animal life;

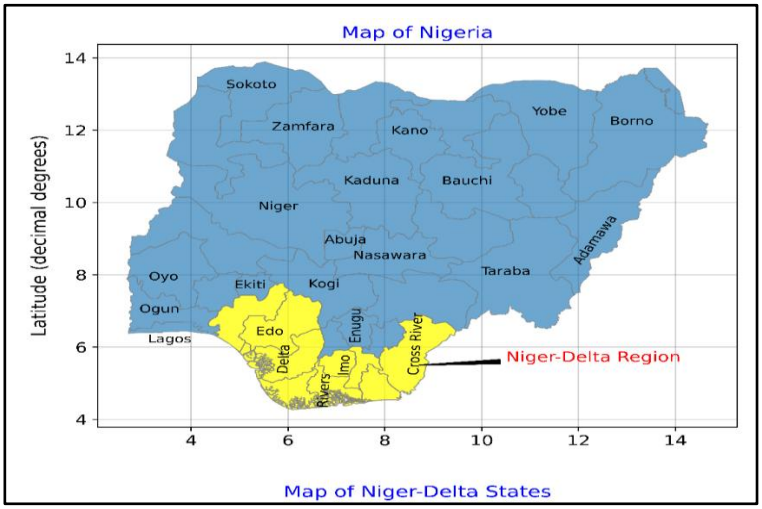

Figure 1 Map of Study Area

2.3 Population of the Study

Population of this study comprised of workers of the sampled oil and gas companies operating in Niger-Delta states of Nigeria which totaled at one thousand five hundred and thirty (1530) according to human resource department of the sampled oil and gas companies

2.4 Sampling technique

Due to the structure of this study, multi-stage sampling technique was used to sample six oil and gas firms operating in the Niger-Delta

2.5 Sample Size Determination

Taro Yamane sample size determination formula was used to determine the sample size for the study

$$n = \frac{N}{(1+N)(\varepsilon)^2} \qquad (1)$$

Where n is the Sample size, N is the Population under study (1530) and ε is the Margin error (which is conventionally be 0.05 at 5% level of significance respectively). Hence, the sample size for this study is 400. However, extra 10% of the samples size (40) was added to the sample size to cover error in filing the questionnaire. Hence total sample size is (440)

2.4 Method and instrument for data collection and analysis

The study adopted quantitative data collection method that uses questionnaire to gather data needed on assessing the human factors responsible for accident causation in the selected oil and gas companies. It employed questionnaire administration for this assessment which covers questions on human factors responsible for accidents, the rate of accident and incident and type of accident prevalent the selected oil and gas firms. The questionnaire comprises of items that are rated on a five-point Likert scale. The questionnaire was explained to the respondents by the research assistants before completion of the questionnaires. The questionnaire was designed based on Five-point Likert Scale of Strongly Agreed (SA), Agreed (A) Undecided (UN), disagreed (D) and strongly disagreed (SD) with weighted valued of 5, 4, 3, 2 and 1 respectively. The data collected were analyzed using descriptive statistics and multilinear regression model. The XL-STAT version 20.1 was used for the descriptive statistic and regression analysis.

2.4.1 Model development

The multi-linear regression models developed to capture the effect and impact of human factors on accident causation. The human factors are National level factors (NLF), Management level factors (MLF), personal level factors (PLF) while the Accident causation factors are rate of accident (RA), rate of incident (RI) and Total Accident prevalence (TAP) the overall form of mufti-linear regression model is present below

For accident causation indicators (dependent variables) and human factors (independent variables)

$$RA = \int NLF, MLF, PLF \quad 2$$

$$RI = \int NLF, MLF, PLF \quad 3$$

$$TAP = \int NLF, MLF, PLF \quad 4$$

Combining the indicator to form a unit human factor (HF) and Total accident prevalence (TAP) it was expressed as

$$TAP = \int HF \quad 5$$

Introducing the constant of linearity and formulating the model it was expressed as

$$RA = \beta_1 NLF + \beta_2 MLF + \beta_3 PLF + C \quad 6$$

$$RI = \beta_1 NLF + \beta_2 MLF + \beta_3 PLF + C \quad 7$$

$$TAP = \beta_1 NLF + \beta_2 MLF + \beta_3 PLF + C \quad 8$$

$$TAP = \beta_1 HF + C \quad 9$$

Where $\beta_1 \ldots \ldots \ldots \beta_n$ are coefficient of the independent factors and C is constant of the model

3. RESULTS AND DISCUSSION

3.1 Human factors responsible for accident in oil and gas firms in Niger-Delta

In this study, human factors responsible for accidents in oil and gas companies were grouped into three namely, personal level factor, management level factors and national level factors and the descriptive statistics results based on the response of the respondents on these factors were presented as thus:

3.1.1 Personal level factors responsible for accident in oil and gas firms in Niger-Delta

The personal level factors were operationalized using ten items. Table 1 shows the results of the response of the sampled oil and gas workers on the ten items covering the personal factors responsible for accident occurrences. The results show that the respondents agreed to all the ten items covering prevalence of personal factor responsible accident occurrence since the weighted average of ten items 3.95, 3.85, 3.79, 3.11, 3.17. 3.14, 3.28, 3.03, 3.61 and 3.50 were all higher than the 3.00 threshold for acceptance which means that the respondents sampled agreed to the items that suggest the prevalence of the personal factors responsible for accident occurrence in the sampled oil and gas firms. Overall, the mean of the weighted average, 3.44, also suggest that the respondents agreed to the prevalence of personal factors responsible for accident occurrence in their various companies.

The outcome of this study aligned with finding of Samarth and Kumar (2017) who carried out study centered on identifying the major human factors responsible for accidents in mega oil and gas projects in India. They focused on a survey of human practices which are responsible for the accidents at work and the unsafe acts/conditions at workplace that leads to incidents and accidents. The elements identified in the oil and gas process were factored and project safety culture cycle program was developed based on rock-bottom principles, rigorous approaches and rigid hazard management practices, which is suitable for the oil and gas industry. They discovered that the main issue of consideration in human factors are physical abilities, mental

abilities, motivation, safe behavior. They also uncovered that the important factors in motivating people to work safely include joint consultation in planning the work organization, the use of working parties or committees to define objectives, attitudes currently held, the system for communication within the organization and the quality of leadership at all levels. They opined that financially-related motivation schemes, such as safety bonuses, do not necessarily change attitude, because workers frequently revert to normal behavior when the bonus scheme finishes.

The work of by Ikramul *et al.* (2017) also aligned with finding of this current study in that they carried out study to identify factors that influence accidents occurrence in oil and gas sites in Bangladesh. This research focus on identifying the most crucial causes and analyzing statistical data of accident on oil and gas site and to understand their relative importance. The study found eighteen crucial factors that influence accident on oil and gas site and key causes of accident based on overall consideration were: lack of personal protective measures, lack of safety awareness among top management, lack of safety awareness among labour, lack of training, non -strict regulation against safety, management commitment and unskilled labour. These factors were all part of personal level factors and management level factors investigated in this current study

3.1.2. Management level factors responsible for accident in oil and gas firms in Niger-Delta

The management level factors responsible for accident occurrence were operationalized and captured in this study using ten items. Table 2 shows the results of the response of the sampled oil and gas workers on the ten items covering the management level factors responsible for accident occurrences. The results show that the respondents agreed to eight of the ten items covering prevalence of management factor responsible accident occurrence and they disagreed in two items. This is because the weighted average of eight items were higher than the 3.00 threshold for acceptance. This means that respondents accept the prevalence of the management level factors expressed by the eight items as a possible accident causation factors. The respondent disagreed with the second and third having weighted averages of 2.2 and 2.90 less than 3.00 threshold for acceptance which suggest that the respondent did not accept the prevalence of the management level factors captured by the two items as a possible accident causation factors. Overall, the mean of the weighted average, 3.18 is greater 3.00 also suggest that the majority of the respondents agreed to the prevalence of management factors responsible for accident occurrence in their various companies.

The result also concurred with outcome of Zakari et al. (2018) who carried out a study to asses Human Factors Analysis in oil and gas accident prevention and their findings showed that unsafe acts of a worker and unsafe working conditions are the two major causes of accident in the oil and gas industry. The most significant factor in the cause of site accident in the oil and gas industry is unsafe acts of a worker. The findings also show how the application of human factor assessment framework (similar to the one developed in this current study) in the investigation of accident will lead to the identification of common trends.

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3.1.3 National level factors responsible for accident in oil and gas firms in Niger-Delta

The national level factors responsible for accident occurrence were operationalized and captured in this study using ten items. Table 4.9 shows the results of the response of the sampled oil and gas workers on the six items covering the national level factors responsible for accident occurrences. The results show that the respondents agreed to five of the six items covering prevalence of national factor responsible accident occurrence and they disagreed in only one item. This is because the weighted average of five items were higher than the 3.00 threshold for acceptance This means that the respondents accept the prevalence of the natural level factors covered by the five item as possible accident causation factors. The respondent disagreed with the first item having weighted averages of 2.90 less than 3.00 threshold for acceptance which suggest that the respondents did not accept that the prevalence of the natural level factor operationalized by the item as a possible accident causation factors. Overall, the mean of the weighted average, 3.18 is greater 3.00 also suggest that the majority of the respondents agreed to the prevalence of management factors responsible for accident occurrence in their various companies.

This outcome aligned with work of Gui et al. (2018) who carried out a study in which they stated that human factors are one of the major contributors of accidents which must be addressed in order to improve the safety performance of any organization. They maintained that Human Factors Analysis (HFA) was developed as an analytical based on investigation of the part played by human errors in aviation accidents. Therefore, they proposed an improved Human Factors Analysis and Classification System in the oil and gas industry whose mechanism was designed to interpret how activities and decisions made by upper management lead to operator errors and subsequent accidents.

The result also concurred with outcome of Zakari et al. (2018) who carried out a study to asses Human Factors Analysis in oil and gas accident prevention and their findings showed that unsafe acts of a worker and unsafe working conditions are the two major causes of accident in the oil and gas industry. The most significant factor in the cause of site accident in the oil and gas industry is unsafe acts of a worker. The findings also show how the application of human factor assessment framework (similar to the one developed in this current study) in the investigation of accident will lead to the identification of common trends.

Table 1: Personal level factors responsible for accident occurrence in oil and gas firms in Niger Delta, Nigeria

S/N	Personal Level Factor Items	SD.	D.	UN	A.	SA	WA	Remark
1	Poor tidiness of the workplace could contribute to accident occurrence	26.00 6.50%	20.00 5.00%	73.00 18.40%	108.00 27.20%	170 42.80%	3.95	Agreed
2	Lack of personal protective measures could cause accidents	16.00 4.00%	41.00 10.20%	79.00. 19.90%	120.00 30.00%	141.00 35.50%	3.85	Agreed
3	Method and technique for performing some job tasks could trigger accidents occurrence.	37.00 9.30%	39.00 9.80%	83.00. 20.90%	49.00 12.30%	189.00 47.60%	3.79	Agreed
4	Slow pace of safety related information and document among workers could result to accident occurrence.	16.00 4.00%	90.00 22.70%	157.00. 39.50%	103.00 25.90%	31.00 7.80%	3.11	Agreed
5	Poor assessment of risks involve in work plan and job task could result to accident occurrence.	36.00 9.10%	79.00 19.90%	114.00 28.70%	118.00 29.70%	54.00 13.60%	3.17	Agreed
6	Consumption of hard drugs could cause accidents in the workplace	48.00 12.10%	76.00 19.10	101.00 25,40	118.00 29.70	81.00 19.65	3.14	Agreed
7	Poor awareness and health condition of workers could cause accidents	33.00 8.30%	38.00 9.60%	75.00 18.90	112.00 20.20%	139.00 35.00%	3.28	Agreed
8	Use of wrong dimension and defect materials during operation could trigger accidents.	49.00 12.30%	60.00 15.10%	147.00. 37,00%	111.00 28.00%	30.00 7.60%	3.03	Agreed
9	Improper treatment of material before use could cause accidents.	29.00 7.30%	42.00 10.60%	81.00 22.90	127.00 32.00%	108.00 27.20%	3.61	Agreed
10	Use of substitute materials during operation could cause accidents	24.00 6.00%	56.00 14.10%	102.00. 25.70%	126.00 31.70%	89.00 22.40%	3.50	Agreed
	Mean of weighted Average						3.44	Agreed

Table 2: Management level factors responsible for accident occurrence in oil and gas firms in Niger Delta

S/N	Management Level Factor Items	SD.	D.	UN	A.	SA	WA	Remark
1	The management structure of my company is contributing factor to accident occurrence	10.00 2.50%	47.00 11.80%	110.00 27.70%	122.00 30.70%	108.00 27.20%	3.68	Agreed
2	The system of cooperation of my firm with their subcontractors is a contributing factor to accident occurrence	147.00 37.00%	109.00 27.40%	75.00. 18.90%	34.00 8.60%	32.00 8.10%	2.12	Disagreed
3	The size of my company is a contributing factor to accident occurrence	162.00 41.10%	23.00 5.80%	74.00. 18.60%	27.00 6.80%	111.00 28.00%	2.90	Disagreed
4	Poor and inappropriate Safety culture, safety planning and OHS regulation are factors that could lead to accidents	17.00 4.20%	43.00 10.80%	81.00. 20.30%	120.00 30.10%	136.00 34.10%	3.79	Agreed
5	Poor salary structure and financial condition of a company could result in accidents occurrence	39.00 9.80%	43.00 10.80%	85.00 21.30%	46.00 11.50%	184.00 46.20%	3.74	Agreed
6	Poor work schedule policies and communication strategies are factors that could result to accidents	17.00 4.20%	96.00 24.10	153.00 38.90	98.00 24.60	33.00 8.30	3.09	Agreed
7	Poor maintenance, training, competence and hiring criteria standards are factors that could cause accidents.	38.00 9.70%	91.00 22.80%	106.00 26.60%	117.00 29.40%	45.00 11.30%	3.10	Agreed
8	Poor style of leadership, work allocation, manner of discipline decision-making processes could trigger occurrence of accidents	51.00 12.80%	78.00 19.50%	99.00. 24,80%	114.00 28.60%	55.00 13.80%	3.11	Agreed
9	Conflicting job-objectives, confused directions, unclear responsibilities, poor supervision could cause accident in workplace	29.00 7.30%	42.00 10.60%	81.00 22.90	127.00 32.00%	108.00 27.20%	3.23	Agreed
10	Poor workload and time management could equally trigger occurrence of accidents.	48.00 12.08%	62.00 15.50%	158.00. 40.10%	96.00 24.40%	33.00 8.30%	3.01	Agreed
	Mean of weighted Average						3.18	Agreed

Table 3: National level factors responsible for accident occurrence in oil and gas firms in Niger Delta

S/N	National Level Factor Items	SD.	D.	UN	A.	SA	WA	Remark
1	Poor national economy in terms of high unemployment rate, poor investment structure in oil and gas sector could trigger accident occurrence,	162.00 41.10%	23.00 5.80%	74.00. 18.60%	27.00 6.80%	111.00 28.00%	2.90	Disagreed
2	Poor policies by control agencies, trade union and other oil and gas related agencies could stimulate occurrence of accidents	36.00 9.10%	79.00 19.90%	114.00 28.70%	118.00 29.70%	54.00 13.60%	3.19	Agreed
3	Inadequate educational curriculum and inadequate actions and policies that promote safety work ethics could cause accidents	29.00 7.30%	42.00 10.60%	81.00 22.90	127.00 32.00%	108.00 27.20%	3.31	Agreed
4	Inappropriate legal framework and standard for oil and gas industry could trigger accidents occurrence	17.00 4.20%	96.00 24.10	153.00 38.90	98.00 24.60	33.00 8.30	3.08	Agreed
5	Poor enforcement of available technology and safety policies for oil and gas industry could cause accidents	49.00 12.30%	60.00 15.10%	147.00. 37,00%	111.00 28.00%	30.00 7.60%	3.04	Agreed
6	Lack of political will to initiate reforms and developmental policies in oil and gas sector are factors that could cause accidents	17.00 4.20%	96.00 24.10	153.00 38.90	98.00 24.60	33.00 8.30	3.05	Agreed
	Mean of weighted Average						3.09	Agreed

3.2 The accident causation and types of accidents prevalent in the oil and gas companies in the Niger Delta

The accident causation in the oil and gas companies were grouped into two rate accident occurrence and rate of incidents. In this study, ten items were used to captured the total rate of accident such the first five factors covered the rate of accident while the last five factors covered rate of incident. Also ten different accidents were investigated to ascertain the types of accidents prevalent in the oil and gas companies in the Niger-Delta. Table 4 shows the results of the response of the respondents on the total rate of accidents in the oil and gas companies in the Niger-Delta separated into rate of accident and rate of incidents. The results reveal that the respondents agreed to all the five items covering the rate of accidents in their various oil and gas companies as the various weighted averages of the fives items, 4.10, 4.40, 4.19, 3.09 and 3.80 are greater than 3.00 threshold value of weighed average for acceptance. Overall the mean of weighted average of 3.92 supposed that majority of the respondent sampled in this study agreed to majority of the items regarding the high rate of accident in their various firms since the mean of the weighted average is greater than the 3.00 threshold value for acceptance.

On the other hand, the last five item which captured rate of incident occurrence also show that the respondents also agreed to all the five items capturing the rate of incidents in their various companies because the weighted average of the last five items were, 4.30, 3.99, 4.19, 4.00 and 3,48 are all greater than 3.00 threshold value for acceptance. Also, the overall the mean of weighted average of 3.99 implied that majority of the respondent sampled in this study agreed to majority of the items regarding the high rate of incidents in their various firms since the mean of the weighted average is greater than the 3.00 threshold value for acceptance.

Table 5 shows the results on the response of the respondents regarding the type of accidents prevalent in the oil and gas companies in the Niger-delta. The accident investigated were Fire and explosion, Well Blow-out accidents, Accidents due to Equipment failures, Accidents due to Deck failure, Accident due to spillage of chemical, Slip and fall accident, electrocution, fall from height, Barges and tug boat accidents and drowning accidents. The results reveal that the respondent agrees that seven out of the ten accidents investigated are commonly witnessed in the oil and gas firms in the Niger delta. This is because the weighted average of the seven accident, namely Fire and explosion, Well Blow-out accidents, Accidents due to Equipment failures, Accidents due to Deck failure, Accident due to spillage of chemical, Slip and fall accident and fall from height were all greater than 3.00 threshold for acceptance while those of electrocutions Barges and tug boat accidents and drowning accidents were all less than 3.00 threshold for acceptance. Overall, it was observed that majority of the accidents investigated are commonly prevalent in oil and gas field operations in the Niger-Delta area.

These findings concurred with outcome of the study by Simutenda et al. (2022) on types of occupational accidents and their predictors at oil and gas sites in Lusaka city. The results revealed the types of oil and gas accidents included crane or hoist accidents, slips, and falls from heights, gas leaks, fires and explosions, forklift, trench, electrocutions, machinery, moving or failing object, caught-between and exposure to dangerous chemicals

Table 4: Accidents causation rate in the oil and gas firms in Niger Delta

S/N	Rate of Accident	SD.	D.	UN	A.	SA	WA	Remark
1	There is high number of accidents on site in the company	0.00 0.00%	39.00 9.80%	0.00 0.00%	238.00 59.90%	120.00 30.30%	4.10	Agreed
2	There is high number of call-in-sick due to work related accidents in the company	38.00 9.70%	0.00 0.00%	0.00 0.00	160.00 40.40	198.00 49.90	4.40	Agreed
3	There is high number of absenteeism due to work-related accidents in the company	40.00 10.10%	0.00 0.00	40.00. 10,10%	80.00 20.20.60%	237.00 59.60%	4.19	Agreed
4	There is high number of lost working hour due to work related accident in the workplace	17.00 4.20%	96.00 24.10	153.00 38.90	98.00 24.60	33.00 8.30	3.09	Agreed
5	The cost associated payment of compensation and other accident related cost are high	00.00 0.00%	79.00 19.90%	00.00 0.00%	238.00 59.90%	80.00 20.20%	3.80	Agreed
	Mean of weighted Average						3.92	Agreed
	Rate of Incident							
6	There is high number of incident on site in the company	0.00 0.00%	38.00 9.70%	0.00 0.00	160.00 40.40	198.00 49.90	4.30	Agreed
7	There is high number of call-in-sick due to work related incidents in the company	45.00 11.35%	0.00 0.00	0.00 0.00	233.00 59.90%	119.00 30.00%	3.99	Agreed
8	There is high number of absenteeism due to work-related near-miss that occurred in the company	40.00 10.10%	0.00 0.00	40.00. 10,10%	80.00 20.20.60%	237.00 59.60%	4.19	Agreed
9	There is high number of lost working hour due to work related incidents in the workplace	40.00 10.10%	0.00 0.00	0.00 0.00	238.00 59.90%	119.00 30.00%	4.00	Agreed
10	The cost incurred by the company in resolution of incident issues are high	64.00 16.10%	57.00 14.40%	33.00. 8.30%	107.00 27.00%	136.00 34.30%	3.48	Agreed
	Mean of weighted Average						3.99	Agreed

Table 5. Type of accident common in oil and gas operations

	Types of Accident	SD	D	UN	SA	A	WA	Remark
1	Fire and Explosion	88.00 22.20%	163.00 41.10%	0.00 0.00	106.00 26.70%	40.00 10.10%	3.38	Agreed
2.	Well Blow-out accidents	70.00 17.0%	32.00 8.10%	4.00 1.00	211.00 53.10%	80.00 20.20%	3.50	Agreed
3.	Accidents due to Equipment failures	90.00 22.70%	43.00 10.80%	27.00 6.80%	130.00 32.70%	107.00 27.00%	3.30	Agreed
4.	Accidents due to Deck failure	55.00 13.90%	33.00 8.30%	31.00 7.80%	192.00 48.40%	86.00 21.70	3.55	Agreed
5.	Accident due to spillage of chemical	70.00 17.0%	32.00 8.10%	4.00 1.00	211.00 53.10%	80.00 20.20%	3.50	Agreed
6.	Slip and fall accident	90.00 22.70%	43.00 10.80%	27.00 6.80%	130.00 32.70%	107.00 27.00%	3.30	Agreed
7	Electrocution	55.00 13.90%	192.00 48.40%	31.00 7.80%	32.00 8.30%	86.00 21.70%	2.55	Disagreed
8	Fall from height	39.00 9.80%	68.00 17.10%	37.00 9.30%	96.00 24.20%	157.00 39.50%	3.66	Agreed
9	Barges and tug boat accidents	47.00 11.80%	191.00 48.10%	13.00 3.30%	64.00 16.10%	82.00\20. 70%	2.49	Disagreed
10	Drowning	50.00 12.65%	192.00 48.40%	31.00 7.80%	37.00 9.30%	86.00 21.70%	2.53	Disagreed

3.3 Regression models for impact of human factors on accidents prevalence in oil and gas companies in Niger-Delta

Three sets of multi-linear regression analysis were conducted, the first set capture the cause-and-effect relationship between human factors and accident rate in which rate of accident (RA), rate of Incidents (RI) and total accident prevalence (TAP) are dependent variables while Personal level factors, management level factors (MLF) and national level factors (NLF) are independent factors. Then the last models capture the cause-and effect relationship between total accident prevalence (TAP) as dependent variables and human factors (HF) as independent variables Therefore, four different cause-and-effect models were developed in the study and they are:

3.3.1 Model of relationship between rate of accident and human factors in oil and gas companies in Niger-Delta

Table 7 show the multi-linear regression analysis carried out to ascertain the cause-and-effect relationship or the impact of human factors on rate of accident in the oil and gas companies in the Niger-Delta. The results in Table 6 shows that the model generated in Table 7 is suitable for predicting the rate of accident given the variation in the human factors (personal level factors (PLF), management level factors (MLF) and national level factors (NLF). The R-square value of 0.381 also showed that 38.10% change in the rate of accident due to change in the human factors variables considered in the study while 61.90% were as a result of change in other factors that were not captures in the present model.

Table 7 shows the model coefficient and their significance level to the model. The results revealed that the coefficient of personal level factors (PLF), management level factor (MLF) and national level factors (NLF) in the model are 0.815, 0.405 and 0.139 respectively. This means that one unit change in personal level factors (PLF), management level factor (MLF) and national level factors (NLF) will results to corresponding 0.815, 0.405 and 0.139 change in rate of accident which shows that personal level factor has the highest impact on accident rate followed by management factor while national level factor has the least effect. Equation 10 shows the mathematical equation for the model

$$RA = 0.815PLF + 0.405MLF + 0.139NLF + 3.707 \quad (10)$$

Where RA is Rate of Accident, PLF is personal level factors, MLF is management level factors and NLF is national level factors

Table 6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics
					Sig. F Change
RA	0.617[a]	0.381	0.377	0.430220	0.000

Table 7: Model coefficient factors

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
RA	(Constant)	3.707	0.273		13.594	0.000
	PLF	0.815	0.178	0.916	10.311	0.000
	MLF	0.405	0.154	0.604	9.085	0.000
	NLF	0.139	0.127	0.544	2.828	0.001

a. Predictors: (Constant), NLF, PLF, MLF

b. Dependent Variable: RA

3.3.2 Model of relationship between rate of incidents and human factors in oil and gas companies in Niger-Delta

Table 9 show the multi-linear regression analysis conducted to ascertain the cause-and-effect relationship or the impact of human factors on rate of incident in the oil and gas companies in the Niger-Delta. The results in Table 8 shows that the model generated in Table 9 is suitable in predicting the rate of incident given the variation in the human factors (personal level factors (PLF), management level factors (MLF) and national level factors (NLF) with model p-value equal to 0.000 which is less than 0.05 significant level. The R-square value of 0.286 also showed that 28.60% change in the rate of incident arise due to change in the human factors variables considered in the study while 71.40% were as a result of change in other factors that were not captures in the present model.

Table 7b shows the model coefficient and their significance level to the model. The results revealed that the coefficient of personal level factors (PLF), management level factor (MLF) and national level factors (NLF) in the model are 0.722, 0.314 and 0.071 respectively. This means that one unit change in personal level factors (PLF), management level factor (MLF) and national level factors (NLF) will results to corresponding 0.722, 0.314 and 0.071 change in rate of accident which also shows that personal level factor has the highest impact on incident rate followed by management factor while national level factor has the least effect. Equation 11 shows the mathematical equation for the model

$$RI = 0.722PLF + 0.314MLF + 0.071NLF + 4.028 \quad (11)$$

Where RI is Rate of Incidents, PLF is personal level factors, MLF is management level factors and NLF is national level factors

Table 8 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics	
					df2	Sig. F Change
RI	0.465[a]	0.286	0.283	0.34616	394	0.000

Table 9 Model Coefficients factors

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
RI	(Constant)	4.028	0.268		15.008	0.000
	PLF	0.722	0.547	0.824	9.459	0.000
	MLF	0.314	0.253	0.714	6.265	0.000
	NLF	0.071	0.047	0.001	0.022	0.302

a. Predictors: (Constant), NLF, PLF, MLF

b. Dependent Variable: RI

3.3.3 Model of relationship between total accident prevalence and human factors in oil and gas companies in Niger-Delta

Table 10 and Table 11 show the multi-linear regression analysis carried out to ascertain the cause-and-effect relationship and the impact of human factors on total accident prevalence in the oil and gas companies in the

Niger-Delta. The results in Table 10 shows that the model generated in Table11 is suitable for predicting the total rate of accident due to possible changes or variation in the human factors (personal level factors (PLF), management level factors (MLF) and national level factors (NLF). The R-square value of 0.316 also showed that 31.60% change in the total rate of accident is as a results of possible change in the human factors responsible for accident as considered in the study while 68.40% were as a result of change in other factors that were not considered in the present model.

Table 11 shows the model coefficient and their significance level to the variables. The results revealed that the coefficient of personal level factors (PLF), management level factor (MLF) and national level factors (NLF) in the model are 0.703, 0.505 and 0.159 respectively. This means that one unit change in personal level factors (PLF), management level factor (MLF) and national level factors (NLF) respectively will results to corresponding 0.703, 0.505 and 0.159 change in total accident prevalence which shows that personal level factor still has the highest impact on total rate of accident followed by management factor while national level factor has the least effect. Equation 12 shows the mathematical equation for the model

$$TAP = 0.703PLF + 0.505MLF + 0.159NLF + 3.868 \quad 12$$

Where TAP is total accident prevalence, PLF is personal level factors, MLF is management level factors and NLF is national level factors

Table 10 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics
					Sig. F Change
TAP	0.435[a]	0.316	0.303	.31616	0.000

Table 11 Model coefficients factors

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
TAP	(Constant)	3.868	0.948		15.624	0.000
	PLF	0.703	0.644	0.804	11.077	0.000
	MLF	0.505	0.449	0.705	8.097	0.000
	NLF	0.159	0.143	0.224	3.444	0.001

a. Dependent Variable: TAP

b. Predictors: (Constant), NLF, PLF, MLF

3.3.4 Model for the impact of human factors on total accident prevalence in oil and gas companies in Niger-Delta

Table 13 show the linear regression analysis carried out to ascertain the cause-and-effect relationship or the impact of human factors on total accident prevalence (TAP) in the oil and gas companies in the Niger-Delta. The results in Table 12 shows that the model generated in Table 13 is suitable for predicting the total accident prevalence given the variations in the human factors (HF). The R-square value of 0.427 also showed that 42.70% change in the total accident prevalence is due to change in the human factors considered in the study while 57.30% were as a result of change in other factors that were not captures in the present model.

Table 13 shows the model coefficients and their significance level to the model. The results revealed that the coefficient of human factors (HF) in the model is 0.528 which means that one unit change in human factors will trigger a corresponding 0.528 unit change in total rate of accident which shows that human factors have high impact on total rate of accident. Equation shows the mathematical equation for the model

$$TAP = 0.528HF + 2.775 \quad 13$$

Where TAP is total accident prevalence, HF is human factors

Table 12 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics
					Sig. F Change
TAP	0.653[a]	0.427	0.424	0.37539	0.000

Table 13 Model coefficient factors

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
TAP	(Constant)	2.775	0.196		14.141	0.000
	HF	0.528	0.155	0.655	11.142	0.000

a. Predictors: (Constant), HF

b. Dependent Variable: TAP

These findings aligned with the work of Simutenda et al. (2022) on the types of occupational accidents and their predictors at oil and gas sites in Lusaka city.and their results showed that predictors of oil and gas site accidents were mainly human factors and site conditions. Thus, they suggested that effective accident prevention policies need to be devised, adhered to and continuously reviewed.

This outcome also aligned with the studies by Kazan, (2013) which showed that the main predictors of occupational accidents at oil and gas sites are mainly human factors and site conditions and also a study in Detroit, Michigan Kazan by Mosly (2015) where it was found that the two factors responsible for accidents at oil and gas sites are human and environmental in nature. Also, a study in USA also found similar results that human elements are among major predictors responsible for oil and gas accidents (Radmin, 2018).

4. CONCLUSIONS

The assessment of Human-Factors responsible for accident occurrence in oil and gas firms in Niger Delta has been carried out and from the findings of the study, it was concluded that: firstly, Human factors such as personal attributes and behaviors towards safety, management policies on safety and national policies on occupational health and safety are substantial accident causation factors in oil and gas companies operating in the Niger-Delta region. Secondary, the findings showed that there is high rate of accident and incident occurrence in the oil and gas companies in the Niger-Delta such that most common accidents are fire and explosion, well blow-out accidents, accidents due to equipment failures, accidents due to deck failure, accident due to spillage of chemical, slip and fall accident and fall from height while the uncommon ones were electrocutions, barges and tug boat accidents and drowning accidents. Finally, it was observed that human

factors have positive and substantial connections to accident causation in the oil and gas companies in the Niger-Delta.

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