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Evaluation of non-human factors responsible for accidents in oil and gas companies in Niger Delta

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ABSTRACT:

The study was carried out to evaluate the non-human factors responsible for accident causation in the oil and gas companies in the Niger Delta region. These non-human factors (NHFs) were captured using natural occurrence factor (NOF) and site location factors (SLF) 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 using XL-STST version-20.1. The results of the descriptive statistics using weighted average (WA) revealed that the non-human factors which include NOF and SLF are substantial accident causation factors with WA of 3.82 and 3.55>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 analysisthere is positive and significant relationship between non-human factors and accident causation in the oil and gas firms (coefficient of determinant=0.292, p-value=0.000). The study concluded that non-human factors are substantial accident causalities factors in oil and gas firms in Niger-Delta. The study recommended that management of the oil and gas firms in Niger-delta should consider and use safer platforms that could withstand different level of weather adversity in order to assure safety of oil and gas workers in the platform especially deep-sea offshore oil and gas operations because the outcome of the current study has established that non-human factor like natural occurrences and site locations are substantial predictors of accident causation in the oil and gas firms operating in the Niger-Delta.

Keywords:

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

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1. Introduction

Globally, Oil and gas industries have recorded several work-related accidents and injuries for various causes in the site. Rate of injury to workers and physical properties in the oil and gas industry is much greater than any other industries in Nigeria. A great number of people fall victim to injury every year. Serious harm and even death are usually caused by accidents on oil and gas related project. Accidents in oil and gas companies, as an unexpected occurrence, distorts planned sequence of oil and gas project which result to loss of production, injury to personnel, damage to plant and equipment (Oladiran&Sotunbo, 2019). Oil and gas workers operating in offshore platforms have three times more chances of being injured and two times of dying compare to any worker of other economic activity (Suraji et al., 2011).

In Nigeria, the statistics reported that thousands of workers are being injured and killed each year due to the work-related accidents, where the oil and gas industry has recorded more than thirty percent of the occupational injuries and fatalities. It is necessary to understand that a significant proportion of workforce come out from the oil and gas industry that compared to other industrial areas. This indicates that a large population of global workforce is engaged in occupational injuries and fatalities.In America, fatal injuries of the private oil and gas sector were 937 in 2021, with 4 percent rise, which was the highest recorded since 2018, ranking first among the 16 industry sectors in the country (US Bureau of Labor Statistics, 2016). In Britain, the rate of fatal injuries in the oil and gas industry was more than 3 times the average mortality rate in all sectors in 2019 (Health and Safety Executive, 2021). This is especially a major concern in developing countries (Ofori, 2017). In 2016, the number of oil and gas work-related accidents in China rose 24.8% to 523. This has shown that the safety in oil and gas activities is severe and a significant challenge in China.

A study by Darbra et al,(2010) argue that external factors earthquakes and climate change events like flooding and high temperatures are key contributors to accident causation in oil and gas industry. A study by Katsakiori et al,(2018) suggests that the major reason why offshore accidents keep occurring is due to poor asset integrity, as well as inadequate operational discipline and training of staff. Knegtering and Pasman(2013) support this claim by asserting that although accidents could be stochastic and unpredictable in nature, the causal factors of most accidents in the oil and gas industry tend to be similar. Singh et al,(2010) suggests that a possible reason for this is the failure to properly learn and benchmark from previous accidents. Consequently, Skalle et al,(2014) are of the view that integrating human causal factors with technical or non-human factors could help in ascertaining root causes of accidents.

In Nigeria, the oil and gas sectors have the fourth highest occupational related morbidity with recorded 12% of occupational related deaths and Niger delta region has the highest occupational related accident and death with 49.1% (William *etal.*, 2021). This massive accident and death rate associated with occupation in Niger-delta region is due to the massive presence of both private and government owned oil and gas related and other engineering related companies in the region (William et al., 2021). With such massive and alarming levels of accidents. There is need to ascertain and evaluate the factors responsible for these accidents. There are several causes of accidents in oil and gas firms and they result from factors that occur in the working environment and its surroundings, as well as factors relating to workers' knowledge, attitude and state of mind. These factors, in favorable circumstances, can significantly increase the probability of a hazard becoming operational and leading to an occupational accident.literature relating to the human and non-human factors associated with accidents in oil and gas sites are still limited, particularly on the prevalent accident types and their causes in oil and gas Companies in Nigeria.

Therefore, this study is focused on evaluating the non-human factors responsible for accident in oil and gas companies operating within the Niger-delta region, Nigeria. This study is very important in that it will help in safety policy development needed to save lives of the oil and gas workers in Nigeria and especially in Niger Delta. The non-human factors considered in this study are natural occurrence factors and site location 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 non-human factors responsible for occurrence of accidents in oil and gas companies in Niger Delta and determine the relationship between the non-human factors responsible for accident occurrence and accidents rate inoil and gas companies in Niger Delta

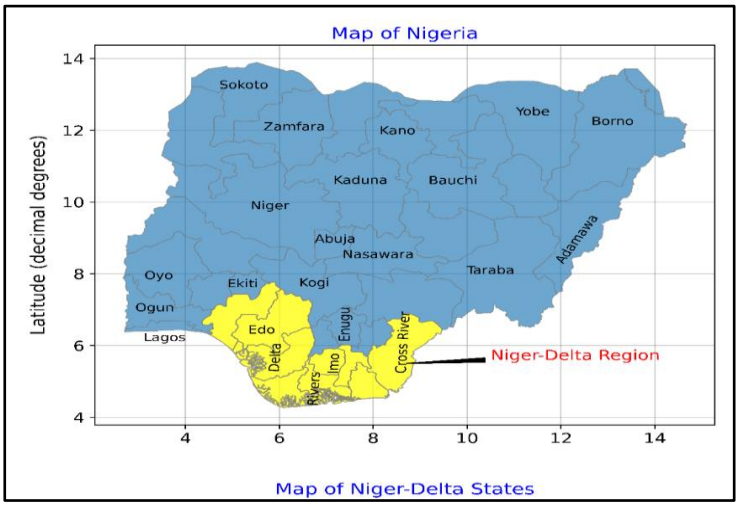
1.0 Methodology

2.1 Research Design

The study adoptedcross 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 non-human factors responsible for occurrence of accidents in oil and gas companies in Niger Deltawhile inferential design was used to determine the relationship between the non-human factors responsible for accident occurrence and accidents rate inoil 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, AkwaIbom, 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 and animal life; as well as the agriculture and fishing on which many in the region rely for their livelihood.



2.3 Population

Figure 1 Map of Study Area

The 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 evaluating the non-human factors responsible for accident causation in the selected oil and gas companies. It employed questionnaire administration for this assessment which covers questions on non-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 regression and structural equation model. The XL-STAT version 20.1 was used for the descriptive statistic and regression analysis.

2.4.1 Model development

multi-linear regression models were developed to capture the impact of non-human factors indicators on the accident occurrence. The non-human factors are natural occurrence factors (NOF) and site location factors (SLF) 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 as follows

For accident causation factors (dependent variables) and non-human factors (independent variables)

$$RA = \int NOF, SLF, \qquad 2$$

$$RI = \int NOF, SLF, \qquad 3$$

$$TAP = \int NOF, SLF \qquad 4$$

Combining the indicator to form a unit non-human factor (NHF) and Total accident prevalence (TAP)it is expressed as;

$$TAP = \int NHF \quad 5$$

Introducing the constant of linearity and formulating the model we have

$$RA = \beta_1 NOF + \beta_2 SLF + C \quad 6$$

$$RI = \beta_1 NOF + \beta_2 SLF + C \quad 7$$

$$TAP = \beta_1 NOF + \beta_2 SLF + C \quad 8$$

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

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

2.0 RESULTS AND DISCUSSIONS

3.1 Results of descriptive statistics

In this study, non-human factors responsible for accidents in oil and gas companies were grouped into two natural occurrences and site location factor factors and the descriptive statistics results based on the response of the respondents on these factors were presented as thus:

3.1Natural occurrences and site location factors responsible for accident occurrence in oil and gas firms in Niger-Delta

The natural occurrences and site location factors responsible for accident occurrence were operationalized in the study using four items. Table 1 shows the results of the response of the sampled oil and gas workers on the four items covering the natural occurrence and site location factors responsible for accident occurrences. The first two items captured natural occurrence while the last two covered site location factor responsible for accident occurrence.

The results show that the respondents agreed to two items covering prevalence of natural occurrence factor responsible accident occurrence. This is because the weighted average of the two items were higher than the 3.00 threshold for acceptance. Overall, the majority of the respondents agreed that those two natural occurrences contribute to accident occurrence in the oil and gas companies in the Niger-Delta because the mean of weighted average 3.82 is greater than the 3.00 threshold for acceptance.

The results also show the respondents agreed to the first and second item covering prevalence of site location factor as trigger for accidents occurrence in oil and gas companies in Niger-Delta because the weighted average of the items are greater than 3.00 threshold for acceptance. Overall, majority of the respondents agreed that site location is contributing factor to accident occurrence in the oil and gas companies in the Niger-Delta since the mean of the weighted average is 3.55 is greater than 3.00 threshold for acceptance

This result aligned with findings of Kamal et al. (2013) who carried out study on Accidents Related to Human and non-human factors at oil and gas site based on statistics of Malaysian Ministryof Human Resource which revealed that the number of mortality and disability cases involving oil and gas workers were the highest among the other sectors and most of the cases were caused byunidentified hazards around the oil and gas sites and environmental factors,which are natural occurrences, were responsible for most of the cases. The study also concurred with the position of the model developed by Ishikawa,(1976) and Ishikawa 1985)

cited by Arezes*et al.*, (2013) in which Ishikawa stated that a specific cause-effect pattern for accident causation. Ishikawa proposed that accident that occurs in production systems depends on many factors that can be divided into groups and these five grouped was expressed in the acronym 5M + E method, named from the first letters from the English names of the factors: manpower, methods, machinery, materials, management and environment. These factors are considered as the main sources of causes of accidents and are placed on the oblique axes of the diagram. The horizontal axes that come to them show the specific causes in each group of the main causes. Due to this structure, the diagram clearly shows the relations and dependences between the factors and also assigns them to the appropriate groups and supposed that natural occurrence and environmental factors are the least cause of accidents which is in line with findings of the current study.

Table 1: Non-human factors responsible for accident occurrence in oil and gas firms in Niger Delta

S/N	Natural Occurrence Items	SD.	D.	UN	A.	SA	WA	Remark
1	The seasons of the years such as rainy and dry seasons, are contributing factors to some accidents in my workplace	68.00 17.10%	29.00 7.30%	111.00. 28.00%	19.00 4.80%	170.00 42.80%	3.54	Agreed
2	Atmospheric condition such as water waves, storm, tsunami and hurricane can be a contributing factor for accident occurrence	79.00 19.90%	5.00 1.26%	0.00 0.00%	178.00 44.80%	124.000 31.20%	4.10	Agreed
	Mean of weighted Average						3.82	Agreed
	Site Location Items							
3	Working is an off-shore platform could be a contributing factor to accidents occurrence	119.00 30.00%	0.00 0.00%	0.00 0.00%	78.00 19.80%	200.00 50.20%	3.60	Agreed
4	Working is an on-shore platform could be a contributing factor to accidents occurrence	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						3.55	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 2 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 itemsare greater than 3.00 threshold value of weighed average for acceptance. Overall the mean of weighted average of 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 are all greater than 3.00 threshold value for acceptance. Also, the overall the mean of weighted average 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 3 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 bySimutenda et al. (2022)on the types of occupational accidents and their predictors at oil and gas sites in Lusaka city and the results revealed the types of oil and gas accidents included crane or hoist accidents, slips, andfalls from heights, gas leaks, fires and explosions, forklift, trench, electrocutions, machinery,moving or failing object, caught-between and exposure to dangerous chemicals.

Table 2: 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	45.00 11.35%	0.00 0.00	0.00 0.00	233.00 59.90%	119.00 30.00%	3.99	Agreed

	company							
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 3. 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\2 0.70%	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 non-human factors on accidents prevalence in oil and gas companies in Niger-Delta

The cause-and-effect relationship between non-human factors and accident rate was modelled using multilinear regression model. In these models, rate of accident (RA), rate of Incidents (RI) and total accident prevalence (TAP) are dependent variables while Natural occurrence factor (NOF) and site location factors (SLF) are independent variables. Then the last models capture the cause-and effect relationship between total accident prevalence (TAP) as dependent variables and non-human factors (NHF) as independent variables. Therefore, four different cause-and-effect models were developed in the study and they are presented as thus,

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

Table 4 and 5 show the multi-linear regression analysis carried out to ascertain the cause-and-effect relationship or the impact of non-human factors on rate of accident in the oil and gas companies in the Niger-Delta. The results in Table 4 shows that the model generated in Table 5is suitable for predicting the rate of accident given the variation in the non-human factors (natural occurrence factors (NOF) and site location factors (SLF)) l. The R-square value of 0.281 also showed that 28.10% change in the rate of accident due to change in the non-human factors variables considered in the study while 71.90% were as a result of change in other factors that were not captures in the present model.

Table 4b shows the model coefficient and their significance level to the model. The results revealed that the coefficient of natural occurrence factors (NOF) and site location factors (SLF) in the model are 0.282 and 0.433 respectively. This means that one unit change in natural occurrence factor and site location factors will results to corresponding 0.282 and 0.433 unit change in rate of accident which shows that site location factor has the higher impact on rate of accident than natural occurrence factor. Equation 10 shows the mathematical equation for the model

$$RA = 0.282NOF + 0.433\,SLF + 3.328 \quad (10)$$

Where RA is rate of accident NOF is natural occurrence factors and SLF is site location factors (SLF))

Table 4Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics
					Sig. F Change
RA	0.517[a]	0.281	0.277	0.43022	0.000

Table 5 Model coefficients factor

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
RA	(Constant)	3.328	0.089		37.254	0.000
	NOF	0.282	0.059	0.572	4.776	0.000
	SLF	0.433	0.046	1.127	9.410	0.000

a. Dependent Variable: RA
b. Predictors: (Constant), SLF, NOF

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

Table 6 and 7 show the multi-linear regression analysis carried out to ascertain the cause-and-effect relationship or the impact of non-human factors on rate of incidents in the oil and gas companies in the Niger-Delta. The results in Table 6 shows that the model generated in Table 7is suitable for predicting the rate of incident due to the variation in the non-human factors (natural occurrence factors (NOF) and site location factors (SLF)). The R-square value of 0.386 also showed that 38.60% change in the rate of incident is due to change in the non-human factors variables considered in the study while 61.40% 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 natural occurrence factors (NOF) and site location factors (SLF) in the model are 0.166 and 0.337 respectively. This means that one unit change in natural occurrence factor and site location factors will results to corresponding 0.166 and 0.337 unit change in rate of incident which also indicates that site location factor has the higher impact on rate of incident than natural occurrence factor. Equation 11 shows the mathematical equation for the model

$$RI = 0.166NOF + 0.337\,SLF + 2.970 \quad 11$$

Where RI is rate of incident NOF is natural occurrence factors and SLF is site location factors (SLF))

Table 6 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics
					Sig. F Change
RI	0.465[a]	0.386	0.383	.34616	0.000

Table 7 Model coefficients factors

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
RI	(Constant)	2.970	0.072		41.320	0.000
	NOF	0.166	0.148	0.135	1.383	0.001
	SLF	0.337	0.037	0.892	9.105	0.000

a. Dependent Variable: RI
b. Predictors: (Constant), SLF, NOF

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

Table 8 and 9 show the multi-linear regression analysis carried out to ascertain the cause-and-effect relationship or the impact of non-human factors on total accident prevalence (TAP) in the oil and gas companies in the Niger-Delta. The results in Table 8 shows that the model generated in Table 9is suitable for predicting the total rate of accident given the variation in the non-human factors (natural occurrence factors (NOF) and site location factors (SLF)). The R-square value of 0.561 also showed that 56.10% change in the total rate of accident due to change in the non-human factors variables considered in the study while 43.90% were as a result of change in other factors that were not captures in the present model.

Table 6b shows the model coefficient and their significance level to the model. The results revealed that the coefficient of natural occurrence factors (NOF) and site location factors (SLF) in the model are 0.174 and 0.385 respectively. This means that one unit change in natural occurrence factor and site location factors will results to corresponding 0.174 and 0.385 unit change in total rate of accident which shows that site location factor has the higher impact on total rate of accident than natural occurrence factor. Equation 12 shows the mathematical equation for the model.

$$TAP = 0.174NOF + 0.385\ SLF + 3.149 \quad 12$$

Where Total accident prevalence TAP is rate of accident NOF is natural occurrence factors and SLF is site location factors (SLF))

Table 8 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics Sig. F Change
TAP	0.749[a]	0.561	0.559	0.32868	0.000

Table 9 Model coefficients factors

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
TAP	(Constant)	3.149	0.068		46.140	0.000
	NOF	0.174	0.045	0.389	3.854	0.000
	SLF	0.385	0.035	1.104	10.953	0.000

a. Dependent Variable: TAP
b. Predictors: (Constant), SLF, NOF

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

Table 10 and 11 show the linear regression analysis carried out to ascertain the cause-and-effect relationship or the impact of non-human factors on total accident prevalence (TAP) in the oil and gas companies in the Niger-Delta. The results in Table 10 shows that the model generated in Table 11 is suitable for predicting the total rate of accident given the variations in non-human factors (NHF). The R-square value of 0.427 also showed that 42.70% change in the total rate of accident is due to change in non-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 11 shows the model coefficient and the significance level to the model. The results revealed that the coefficient of non-human factors (NHF) in the model is 0.292 respectively. This means that one unit change in nan-human factors will trigger a corresponding 0.292 unit change in total rate of accident which shows that non-human factor has substantial effect on accident prevalence in the firms. Equation 13 shows the mathematical equation for the model

$$TAP = 0.292\ NHF + 2.775 \quad 13$$

Where TAP is total accident prevalence, HF is human factors and NHF is non-human factors

Table 10Model 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 11 Model coefficient factors

Model	Unstandardized Coefficients	Standardized Coefficients	T	Sig.

		B	Std. Error	Beta		
TAP	(Constant)	2.775	0.196		14.141	0.000
	NHF	0.292	0.117	0.153	3.131	0.001

a. Predictors: (Constant), NHF
b. Dependent Variable: TAP

This result concurred with the finding of the study carried out by Simutenda et al. (2022)on the types of occupational accidents and their predictors at oil and gas sites in Lusaka city. In which their results revealed that the predictors of oil and gas site accidents were mainly human factors and site conditions and thy 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 sitesare mainly human factors and site conditions and also a study inDetroit, 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. Other studies carried out by Lubega, (2016) and Toole, (2012).on oil and gas accidents identified various human factors as well as non-human factors (site conditions) as the predictor of accident and these factors include: lack of enforcement of safety regulations, lack of awareness of safetyregulations, poor regard for safety by people involved in oil and gas projects; non-vibrant professionalism, engaging incompetent personnel, mechanical failure of oil and gas equipment,Chemical impairment, emotional and physical stress

4. CONCLUSIONS

This study examined the non-human factors responsible for accident occurrence in oil and gas firms in Niger-delta and based on the findings of this study, the following conclusions were drawn: one, non-human factors such as natural disaster, sea waves, flooding as well as location of oil and gas operations site are substantial accident causation factors in oil and gas companies operating in the Niger-Delta region. Two, 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. Lastly, non-human factors have positive and substantial connections to accident causation in the oil and gas companies in the Niger-Delta.

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