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Influence of Organizational Factors on Safety Performance in Oil and Gas Industry in the Niger Delta Region, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The aim of this study was to examine the influence of organizational factors on safety performance in oil and gas companies in the Niger Delta region of Nigeria. This is a cross-sectional study using questionnaires administered electronically to employees working in these companies to gather data on various organizational factors, including management commitment, communication, leadership, and worker involvement. The reliability of the instrument was assessed using Cronbach's alpha, and path analysis was used to examine the relationships between organizational factors and safety performance. The results of the study showed that positive organizational factors tend to significantly influence safety compliance and participation positively,

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while they influence accidents and near misses negatively. These findings suggest that organizations should focus on improving organizational factors in order to enhance safety performance in the oil and gas industry.

Keywords: Organizational factors; safety performance; oil and gas companies; Multinational companies; health and safety; path analysis.

1. INTRODUCTION

Organizational factors play a critical role in shaping the functioning and performance of organizations. These factors refer to the various elements of an organization that contribute to its culture, structure, processes, and overall functioning. Organizational factors can include things like leadership style, communication patterns, decision-making processes, reward systems, and power dynamics, among others. Hollnagel and Woods [1] attributed 30-40% of accidents in large complex systems to poor organizational factors. Hadikusumo et al. [2] stated that occupational accidents do not only lead to the loss of properties and company assets but also result in a decrease in employee morale, quality of products and services rendered, bad public image, poor customer relationship, and also destroy company reputation. Flin et al. [3] stated that organizational factors are the leading indicators of performance in evaluating occupational safety climate. Several studies have consistently demonstrated that organizational factors are significantly associated with safety performance, and that organizations with strong organizational factors tend to have better safety outcomes [4,5,6,7]. Hsu et al. [7], in their study found that high management commitment to safety significantly increases safety supervision by leaders which in turn results in good safety practices by the employee. Wu et al. [8] reported that safety leadership tends to influence the safety climate which in turn influences the safety performance.

Despite the importance of organizational factors, little research has been conducted on their impact on safety performance in the oil and gas industry. Further research is needed to understand the specific ways in which these factors impact safety in the oil and gas industry.

This study aims at understanding the influence of organizational factors on safety performance in the oil and gas industry in the Niger Delta region, Nigeria.

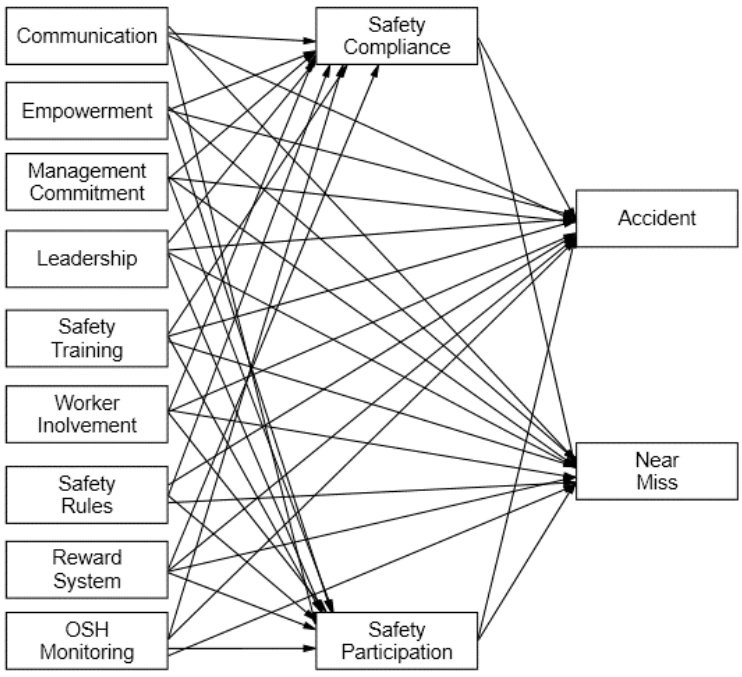

Fig. 1. Hypothesis relationship among constructs

1.1 Study Hypothesis

Several researchers have outlined the importance of the influence of organizational factors on the safety performance of workers in other industries. In other studies, limited organizational factors were considered, which gave a narrow understating of how key organizational factors affect safety performance. The hypothesis to be tested involve how 9 organizational factors affect safety performance, particularly in the oil and gas industry. Each of the organizational factors will be tested against the two leading safety performance indicators (safety compliance and participation). The organization factors used in this study include Communication, Empowerment, Management Commitment, Leadership, Worker Involvement, Safety Rules and Procedures, Safety Training, OSH Monitoring, and Reward Systems.

- H_1: Management Commitment significantly predicts safety performance.
- H_2: Communication significantly predicts safety performance.
- H_3: Empowerment significantly predicts safety performance.
- H_4: leadership significantly predicts safety performance.
- H_5: Worker Involvement significantly predicts safety performance.
- H_6: Safety Rules and Procedures significantly predicts safety performance.
- H_7: Safety training significantly predicts safety performance.
- H_8: OSH Monitoring significantly predicts safety performance.
- H_9: Reward System significantly predicts safety performance.

2. METHODS

2.1 Participants

A total of 400 questionnaires were distributed to two multinational companies and two local oil and gas production companies operating within the Niger Delta region of Nigeria, of which 350 were returned (ie Completely filled). Proportional stratified sampling was employed in distributing the questionnaires. Proportionate stratified sampling means that the size of sample strata is proportional to the size of the population strata; in other words, the probability of unit being selected from the stratum is proportional to the relative size of that stratum in the population. The formula applied was (sample size/population size) x stratum size. It included oil and gas workers in South-South, Nigeria who are involved in various job roles like HSE officers, project/field Engineers, human resources, and others (such as IT support, legal support, accountants, researcher/lab scientists, and administration workers). The sample size obtained for the study was 350, but a total of 400 questionnaires were distributed between the local and multinational companies in other to account for the questionnaires that would not be properly filled. 177 questionnaires were distributed to local oil and gas workers while 173 questionnaires were distributed to multinational oil and gas workers. Electronic means (Microsoft form) were used in administrating the questionnaires to the participants. Participants who took part in the survey were randomly selected from the employees obtained from the company employment list.

The participants included more of oil and gas workers within the ages of 30-39 years (49.4%), while just 2.6% of the participant were between the ages of 20-29. Majority of the participants were married (82.0%) and about 96% of the participants have obtained a tertiary degree. The role designation of the participants ranged from engineers, HSE officers, Human resources, and non-technical skill workers.

2.2 Instrument

The questionnaire used for the study was a four-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). The constructs for the organizational factors and safety performances were obtained from well-established organizational factors and safety performance questionnaires. The scales were further developed by rewording some items to blend with the practices in the oil and gas industry.

Communication: This measures the ease at which information flows between leaders and subordinates, and also among subordinates. Three items questions were used in evaluating the communication among workers in the oil and gas companies. The questions were adopted from Vecchio-Sadus [9].

Empowerment: This measures the extent to which employees are given the autonomy, authority, and resources to make decisions and take action within their scope of work. Three items were used in measuring the empowerment of workers in the oil and gas companies. The

questions under this construct were adopted from Spreitzer's [10,11].

Management commitment: This measures the extent to which leaders within an organization demonstrate a commitment to and support for the goals and values of safety in the organization. Three items were used to evaluate management's commitment to safety. The items used in the questionnaire were adopted from Vinodkumar and Bhasi [12].

Leadership: This measures the extent to which leaders in the organization align with safety rules and implement safety instructions to their subordinates. Three items were used to evaluate the leadership that is being practiced in the oil and gas companies.

Safety training: This measures the extent to which workers undergo safety training. A total of three items were used in measuring the safety training received by the employee. The items used in this construct were adopted from Fernandez-Muniz et al, [13].

Worker involvement: This measures the extent workers are allowed to contribute to decision-making regarding safety in the organization. Three items were used in evaluating worker involvement. The three items were adopted from Vredenburgh [14].

Safety rules and procedure: Three items were used in measuring the safety rules and procedures that are in place in oil and gas industry in the Niger Delta region. The three items were adopted from Mullen [15].

Reward system: This measures the extent the organization goes in rewarding good safety behaviour. Three items were used in evaluating the reward system and the items were adopted from Vredenburgh [14].

Safety compliance and participation: Three items each were used to evaluate safety compliance and safety participation. The items used from both constructs were adopted from Griffin and Neal [16].

Accident and near miss: Three items each were used in evaluating the accidents and near misses in the oil and gas industry. Example of an accident item was "In the past one year, one or more of the job factors have resulted in an accident: skill variety, task identity, task significance, autonomy and feedback".

2.3 Data Analysis and Procedures

The responses from the participants were entered into SPSS version 26 and the coding was done according to the Likert scale used for the questionnaires. Composite scores were computed for each of the constructs and reliability was done using Cronbach alpha. Descriptive statistics were done on the composite score to understand the general view of the participants on each of the organizational factors. Pearson correlation was used to establish the relationship between the organizational factors and safety performance indicators. Path analysis was used in modeling the relationship between the organizational factors and safety performance indicators.

3. RESULTS

3.1 Descriptives and Reliability of Constructs

The reliability of the organizational, job, and safety performance factors was assessed using Cronbach alpha, and the results are presented in Table 1. The results of the Cronbach alpha for the organizational factors indicate that most of the indicator variables used to measure the latent constructs were reliable. The Cronbach alpha ranged from 0.411 to 0.924, with safety training having the highest internal consistency at 0.924, while safety culture had the lowest reliability at 0.411. According to Nunnally [17], Cronbach alpha values above 0.70 are generally considered acceptable, although values above 0.80 are considered ideal. For the safety performance factors, both leading and lagging indicators were used. The indicator variables for the leading indicators (safety compliance and participation) had very high internal consistency, with Cronbach alpha values of 0.80 and 0.819 respectively. The lagging indicator (accidents and near misses) also had relatively high internal consistency, with Cronbach alpha values of 0.844 and 0.903, respectively. The only construct that was not considered reliable was communication, which had a marginally reliable Cronbach alpha value. The validity of the items under each construct was evaluated using content validity. Two academics and one field expert in the health and safety profession evaluated each item under the constructs for readability, clarity, and comprehensiveness. An agreement was reached by the experts based on a rating system on the suitability of items which was used in the questionnaire.

Table 1. Descriptive statistic and Cronbach alpha for all constructs (4-point Likert scale)

Groups	Constructs	Mean	Std. dev	Cronbach alpha	Standardized cronbach alpha
Organizational factors	Communication (Comm)	3.54	0.43	0.400	0.401
	Empowerment (Emp)	3.37	0.49	0.665	0.685
	Management commitment (MC)	3.45	0.65	0.924	0.930
	Leadership (Lead)	3.54	0.44	0.722	0.734
	Safety training (ST)	3.16	0.72	0.943	0.945
	Worker involvement (WI)	3.13	0.65	0.909	0.909
	Safety rules and procedures (SRP)	3.34	0.48	0.613	0.653
	Reward system (RS)	2.98	0.51	0.575	0.561
	OSH monitoring (OSH mon)	3.30	0.58	0.703	0.704
Safety behaviour	Safety compliance (SC)	3.64	0.42	0.800	0.806
	Safety participation (SP)	3.47	0.49	0.819	0.830
Safety outcomes	Accidents (ACC)	2.23	0.71	0.844	0.848
	Near Miss (NM)	2.34	0.73	0.903	0.909

The result from the descriptive statistics showed that majority of the respondents agreed that management is committed to the safety of the workers, leaders in the organization uphold and ensures safety rules/procedures are followed by their subordinate, and there is a good level of open communication about safety in their workplace. Most of the respondents stated that they have not been involved in near misses or accidents, but this value should be considered underreported as workers tend to hide from reporting accidents or downplay events such as near misses.

3.2 Pearson Correlation

The result of the Pearson correlation is presented in Table 2. All organizational factors had a positive linear relationship with both safety compliance and participation, which implies that an increase in the organizational factor will result in an increase in both safety compliance and participation. The Pearson correlation also showed that the organizational factor also had a negative relationship with the lagging safety performance indicators. An increase in organizational factors will result in a decrease in accidents and near misses. The result from the Pearson correlation also shows that there was a negative relationship between safety compliance and accidents. This relationship was also observed between safety participation and accident. The relationship between safety compliance and near misses was also negative. The general trend shown from the Pearson correlation is that the leading safety indicators (compliance and participation) have a negative relationship with the lagging safety indicators (accidents and near misses).

3.3 Path Analysis

The theoretical (initial) model as shown in Table 3 did not produce a good fit for the dataset. In other to obtain a good fit, a slight modification of the initial model was done. A correlation was added to the error terms for the accidents and near misses, which improved the model significantly. The modified model was named revised model 1 as shown in Table 3, and the goodness of fit showed improvement. The CFI, GFI, SRMR, and RMSEA were within the recommended values. The CFI and GFI were greater than 0.9, the RMSEA was less than 0.09 which signifies an adequate fit. The result from the path analysis is shown in Table 4. The result showed that management commitment had a positive relationship with safety participation and safety compliance. Communication had a positive relationship with safety compliance and participation. The relationship between management commitment and accidents showed a negative relationship. For the relationship between worker involvement and safety compliance, a significant positive relationship was established. There was also a significant positive relationship between empowerment and the leading safety performance indicators.

4. DISCUSSION

The findings from the result showed that an increase in the efforts of management and top executives towards commitment to safety in oil and gas companies in the Niger Delta region will significantly lead to an improvement in the safety compliance and participation of employees. Management commitment to safety tends to improve organizational safety policies which in

turn results in better employee compliance with safety rules and regulations as well as active participation in safety-related activities such as attending safety meetings and participating in safety campaigns. The finding, therefore, supports Hypothesis 1 which state that management commitment significantly predicts safety performance (Fig. 1). Moreso, the finding in this study aligns with the results from other studies on the influence of organizational factors on safety performance. Hsu et al. [7] reported that management commitment to safety influences the safe practice of employees through safety supervision. The result also showed that management commitment to safety has a diminishing effect on the number of accidents and near misses. Shang et al. [18] stated that both senior managers' safety management and supervisors' safety management are valuable sources for safety performance.

Open communication between the top executives and the subordinate showed a significant positive relationship which supports Hypothesis 2. Open communication about safety issues helps employees to be more engaged in safety issues and safety-related activities. Open communication also helps in understanding employee confusion about certain safety policies and rules set by management which in turn prevents the employees from breaking those sets of rules and regulations. There was a significant positive association between empowerment and safety compliance and participation which supports Hypothesis 3. When employees are given autonomy to take key decisions regarding their tasks, it leads to motivation, and employees are more engaged in their tasks which in turn results in a higher rate of compliance and participation. Giving autonomy to employees results in the workers being more likely to comply with safety policies and procedures due to the sense of responsibility that has been bestowed on them [19-22]. More so, considering hypothesis 4, the result showed that leadership has a more significant effect on employee compliance with safety rules and regulations than participating in safety meetings. The relationship between worker involvement and safety performance was not fully supported (Hypothesis 5). There was no significant relationship between worker involvement and safety participation, but a significant relationship was established between worker involvement and safety compliance. The findings also support hypothesis 6 and revealed that there is a significant positive association between safety rules/procedures, safety compliance, and safety participation. This suggests that the clearer and simplified safety rules /procedures become, the more the employees are likely to comply with such rules. The result showed that there was a significant positive relationship between safety training and safety compliance and participation which supports Hypothesis 7. Baryam [23] also stated safety training tends to significantly improve safety performance. Ashour et al. [24] suggested a conceptual framework for improving safety performance and argued that safety performance is influenced by safety training.

Furthermore, the result showed that OSH monitoring has a significant relationship with safety compliance and participation. Good OSH monitoring helps keep records of injuries, near-misses, and other safety performance indicators that have occurred in the past. Good record keeping enables workers to learn about the events and bad safety practices that brought about poor safety performance in the company [7].

Table 2. Pearson Correlation between organizational factors and safety performance

Variables	Comm	Emp	MC	Lead	ST	WI	SRP	RS	OSH mon	SC	SP	ACC	NM
Comm	1.00												
Emp	0.73	1.00											
MC	0.66	0.54	1.00										
Lead	0.65	0.68	0.22	1.00									
ST	0.67	0.46	0.65	0.42	1.00								
WI	0.83	0.76	0.63	0.69	0.74	1.00							
SRP	0.70	0.65	0.79	0.52	0.70	0.68	1.00						
RS	0.36	0.49	0.62	0.23	0.52	0.45	0.48	1.00					
OSH mon	0.57	0.66	0.85	0.32	0.62	0.63	0.85	0.61	1.00				
SC	0.69	0.69	0.38	0.67	0.44	0.73	0.56	0.25	0.40	1.00			
SP	0.51	0.72	0.27	0.49	0.07	0.48	0.24	0.22	0.25	0.52	1.00		
ACC	-0.55	-0.42	-0.51	-0.24	-0.13	-0.45	-0.29	-0.13	-0.37	-0.31	-0.37	1.00	
NM	-0.52	-0.43	-0.60	-0.19	-0.20	-0.48	-0.49	-0.14	-0.53	-0.32	-0.29	0.85	1.00

Values in bold are different from 0 with a significance level alpha=0.05

Table 3. Goodness of fit of the model

Models	χ^2	df	CFI	GFI	RMSEA	SRMR
Initial Model	435.917	2	0.916	0.899	0.791	0.0302
Revised Model 1	7.968	1	0.999	0.997	0.084	0.0053

χ^2= Chi-Squared, df = degree of freedom, CFI = Comparative fit index, GFI = Goodness of fit index, RMSEA = Root Mean Square Error of Approximation

Table 4. Relationship between the organizational factors and the safety performance from the path model

Path	Standardized regression weight	Regression weight	S.E.	P
SC <--- Comm	0.232	0.209	0.06	***
SC <--- Emp	0.357	0.284	0.049	***
SP <--- Emp	0.934	0.926	0.06	***
SP <--- MC	0.425	0.318	0.056	***
SP <--- Lead	0.091	0.099	0.058	0.089
SC <--- ST	0.154	0.083	0.029	0.004
SP <--- ST	0.327	0.22	0.035	***
SP <--- WI	0.026	0.019	0.052	0.71
SC <--- SRP	0.178	0.146	0.06	0.015
SP <--- SRP	0.396	0.404	0.074	***
SP <--- RS	0.06	0.057	0.04	0.149
SP <--- OSH mon	0.302	0.252	0.063	***
SP <--- Comm	0.164	0.184	0.074	0.013
SC <--- MC	0.552	0.331	0.060	***
SC <--- Lead	0.106	0.093	0.047	0.049
SC <--- WI	0.426	0.254	0.042	***
SC <--- RS	0.051	0.039	0.032	0.222
SC <--- OSH mon	0.267	0.179	0.051	***
ACC <--- Comm	-0.56	-0.917	0.129	***
NM <--- Comm	-0.495	-0.828	0.122	***
ACC <--- Emp	-0.291	-0.42	0.135	0.002
NM <--- Emp	-0.391	-0.576	0.129	***
ACC <--- MC	-0.928	-1.01	0.099	***
NM <--- MC	-0.65	-0.723	0.095	***
ACC <--- Lead	-0.132	-0.209	0.099	0.034
NM <--- Lead	-0.055	-0.09	0.094	0.34
NM <--- ST	-0.771	-0.772	0.06	***
ACC <--- SRP	-0.627	-0.93	0.131	***
NM <--- SRP	-0.114	-0.173	0.124	0.163
NM <--- RS	-0.33	-0.471	0.064	***
ACC <--- OSH mon	-0.017	-0.021	0.11	0.847
NM <--- OSH mon	-0.076	-0.095	0.105	0.367
ACC <--- ST	-0.644	0.631	0.063	***
ACC <--- WI	-0.349	-0.378	0.092	***
NM <--- WI	-0.599	-0.664	0.088	***
ACC <--- RS	-0.251	-0.35	0.067	***

*** represent that the p-value <0.001*

The information from OSH monitoring can then be used to develop and implement effective safety interventions and controls, which can reduce the risk of future incidents and improve overall safety performance. Hsu et al. [7] also reported that safety reporting positively affects employee safety practices; this is in line with and supports Hypothesis 8. Considering hypothesis 9, The result showed that there is a positive association between reward systems and safety behaviours (safety compliance, and safety participation); whilst this association was not statistically significant, the result showed that the reward system has a significant negative association with accident and near-miss. Manjula and De Silva [25] reported that incentives have always been a strong motivator for workers and that when incentives are awarded, the organization is giving the worker a good reason to behave safely at work.

5. CONCLUSION

The findings from this study which geared towards understanding the influence of organizational factors on safety performance showed that most of the organizational factors tend to significantly and positively influence leading safety performance indicators such as safety compliance and safety participation. It also revealed that positive organizational factors have a negative influence on the lagging safety performance indicators such as accidents and near misses. Therefore, organizational leadership in the oil and gas industry within the Niger Delta region of Nigeria are more likely to improve the general safety performance of their organizations by improving the organizational factors within their companies.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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