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Improving the Safety Performance of Workers by Assessing the Impact of Safety Culture on Workers' Safety Behaviour in Nigeria Oil and Gas Industry: A Pilot Study in the Niger Delta Region

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***Abstract*—**Interest in the development of appropriate safety culture in the oil and gas industry has taken centre stage among stakeholders in the industry. Human behaviour has been identified as a major contributor to occupational accidents, where abnormal activities associated with safety management are taken as normal behaviour. Poor safety culture is one of the major factors that influence employee's safety behaviour at work, which may consequently result in injuries and accidents and strengthening such a culture can improve workers safety performance. Nigeria oil and gas industry has contributed to the growth and development of the country in diverse ways. However, in terms of safety and health of workers, this industry is a dangerous place to work as workers are often exposed to occupational safety and health hazard. To ascertain the impact of employees' safety and how it impacts health and safety compliance within the local industry, online safety culture survey targeting frontline workers within the industry was administered covering major subjects that include; perception of management commitment and style of leadership; safety communication method and its resultant impact on employees' behaviour; employee safety commitment and training needs. The preliminary result revealed that 54% of the participants feel that there is a lack of motivation from the management to work safely. In addition, 55% of participants revealed that employers place more emphasis on work delivery over employee's safety on the installation. It is expected that the study outcome will provide measures aimed at strengthening and sustaining safety culture in the Nigerian oil and gas industry.

***Keywords*—**Oil and gas safety, safety behaviour, safety culture, safety compliance.

I. Introduction

NIGERIA is one of the largest oil and gas producing countries in the world. In Nigeria, oil was first discovered in the Niger Delta region [1]. The region forms one of the world's main provinces for hydrocarbon, with verified ultimate recoverable reserves of close to 26 billion barrels of oil [2]. About 90% of the growth and improvement of Nigeria's economy is contributed by the oil companies located within the Niger Delta region [3], [1]. 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 [3], [4]. 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 [5], [6].

Over the past few decades, there has been an increased accomplishment in improved work-related safety performance of workers in oil and gas industries in different geographical regions [7], [8]. This was achieved through improvements of workers safety behaviour across all levels in the organization [9], [10]. Unsafe behaviour has been acknowledged as a key contributor of occupational accidents [11], [12]. Previous studies [13]-[15] revealed that unsafe behaviour contributes about 85% of occupational accident. Unsafe behaviour is defined as any behaviour an employee exhibits that does not comply to organizational safety procedures, safety rules, instructions and criteria specific for managing their safety system (e.g. failure to use personal protective equipment) [16], [17]. On the other hand, safe behaviour refers to the absence of such behaviors [18], [17]. Giving to this definition, unsafe behaviour has a noticeable place in work related accidents, according to [19]-[21].

According to [10], preventive interventions for reducing work related risk and health problems among oil and gas workers require the identification of factors contributing to unsafe behaviour. This investigation has been carried out in oil and gas industries in different part of the world, including other related high-risk industries and safety culture have been identified to be the main factor that influence worker's safety behaviour [19], [22], [23]. It is described as the way organizations do things regarding safety [24]. Expressly, unsafe behaviour acts as a factor that mediates the impacts of some psychological, organizational and cultural insufficiencies on accidents and aiming to present such accidents in a way that is proactive, it should begin by finding and resolving such insufficiencies making workers vulnerable to unsafe behaviour [21], [8].

According to [25] data collated from the Department of Petroleum Resources (DPR) in Nigeria showed that fatalities of Nigerian oil and gas workers hit 217 from 2010 to 2015, which 54 of the death cases were work related fatal incidents. Though, it has been argued that primary data about occupational injuries or fatalities from operations in the Nigeria oil and gas sectors are most times hardly made public, underestimated or in non-existent [2], [6]. In the Nigeria oil and gas context, there is high volume of work that has been done on how the operational activities (exploitation and

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exploration) of the oil and gas companies impact on the environment. However, despite the significance in the fatalities and injuries of workers recorded, there is no pilot study that has looked at safety culture and worker's behaviour in the Nigeria oil and gas industry located in the Niger Delta region. Therefore, the aim of this study is to explore the relationship between safety culture and safety behaviour and how it affects safety performance of workers in Nigeria oil and gas industry.

II. Methodology

A. Survey Instrument

A close-ended questionnaire containing two sections consisting of 51 questions was used in the data gathering phase of the study. The contents of these 51 questions were obtained from former validated questionnaires of related safety literature and theories from [26], [27], also successfully used in [28]-[30] to achieve their study aim. The scales were further developed by rewording of some items to blend with local working culture and practices. However, care was taken to retain the theoretical meaning of the scales close to the operationalization's made by aforementioned studies. For facial validity, the content of the draft questionnaire was discussed with senior lecturers that are expert in the field and after they reflected in detail on each item, necessary changes were made by removing, rewording, simplifying, and substituting some of them. The first part of the questionnaire consists of questions 1 to 6; which asked questions about demographic information such as age, gender, work experience, employment type and job category. The second part consists of question 7 to 51, containing information to measure the perceptions of the workers about the existing safety culture practice in the organization, covering the organizational safety management practices and the impact on worker's safety behaviour, i.e. Safety compliance (8 items) and Safety participation (11 items). Each question in section two was based on a Likert-type scale of five points, where 1 refers to very low, and 5 refers to very high. Research work [29] successfully used organizational management practices as an indicator to assess the strength of safety culture in eight different high-risk industries and its impact of worker's safety behaviour. Safety management practices are an organizational function towards the assessment, identification and satisfactory mitigation of safety risks in the work place [31].

B. Ethical Considerations

Ethical approval was granted by the Research Ethics Committee of Manchester Metropolitan University. The study purpose and benefit were explained and attached to the first page of the questionnaire distributed through online survey, with the instruction that participants read and understand that participation is voluntary. The expected time to complete the questionnaire (20-30 minutes) was also indicated.

C. Pilot Study

Pilot studies are important part of research project because it helps researchers to recognize possible areas of problem and deficiencies in the research protocols and instrument before the implementation of the full study [32]. Although, conducting a pilot study does not guarantee success in the major study, it does escalate the possibility of success [32]. A pilot survey was carried-out by distributing questionnaires electronically through Bristol Online Survey (BOS) platform to Frontline employees in the selected oil and gas companies (both multinational and local) located in the Niger Delta region of Nigeria namely; Shell, NNPC, Schlumberger, Exxon-mobil, Chevron, Total, NLNG, Conocco, Oando, Transcorp OPL, Addex, Petrobras, Statoil and Nexen Inc. The criteria for selecting these companies include location, size and nature of the oil and gas activity undertaken. Selecting these companies will also help compare the existing safety culture between the multinationals and local oil and gas companies.

Front-line employees were selected for this study because they are said to be in direct contact with health and safety risk in the oil and gas industry and they should be able to provide relevant information how safety culture is promoted, perceived, utilized and potential lapses in the approach that affects their safety performance at work can be obtained. At the end of the allocated time for the survey, there were 503 questionnaire respondents. All questionnaires were exported in to SPSS spreadsheet where 41 uncompleted questionnaires by participants were deleted from the data set on SPSS spreadsheet, remaining a total of 462 completed questionnaires that was used for result analysis.

D. Data Analysis Method

SPSS software was first used to analyze descriptive statistics of demographic information such as age, gender, work-experience, employment type, and job category. The frequency of participant's different oil and gas companies was also analyzed. The reliability of measured items was tested using the Cronbach's alpha measure to know how closely associated the set items measured are as a group [33]. Tested items with Cronbach's alpha of 0.70 and above is known generally to be good [33]. The percentage of responses for each item used to measure safety management practices, safety compliance and safety participation, was examined in order to understand the extent to which participants agree or disagree with the question before the structural equation modelling was carried out.

E. Structural Equation Modelling

Using AMOS graphics software, Structural equation modelling (SEM) technique was used to conduct the path analysis to find the causal relationship among variables through parameters estimation, the identification of the path model and model modification. SEM is a multivariate statistical analysis technique, used to analyze structural link among measured variables (observed) and latent (unobserved) variables [34]. Demographics like age, gender work experience including safety management practices were added to the model as exogenous variables while, safety participation and safety compliance represented endogenous variables in the

model.

F. Safety Culture - Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) is an exceptional case of SEM that helps to determine if hypothesised statistical model represents the actual data set [34]. It also helps to evaluate hypothesis regarding the relationships among the measured variables of a study [34]. In this study, to examine the measurement model validity using the CFA, different "goodness of fit statistics" was assessed such as, the Root Mean Square Error of Approximation (RMSEA) where values less than 0.08 indicate model fit, while values greater than 0.1 justify the model to be rejected [35]. Other used fit statistics are Goodness fit index (GFI), Adjusted Goodness of Fit index (AGFI), Comparative fit index (CFI), Normal fit index (NFI), Tucker Lewis index (TLI) all with a value greater than 0.90 to indicate model fit. The chi square text and degree of freedom (< 5.0 value) were also examined [36].

III. Results

The 462 study participants were from 15 different oil and gas companies. In terms of frequency, Total Oil Company had the highest frequency (20%), followed by Oando (13%), Shell (11%), NNPC (9%), Chevron (8%), Exonn-Mobil (7%), Conoil (7%), Schlumberger (6%), NLNG (6%), Petrobras (4%) while, Statoil, NexenInc, Seplat, and Addex had the least frequency (2% each).

Table I describes the demographic information of the study participants. Looking at the percentage on the extent to which management agree or disagree to each item measured, some of their responses were of significance. Under safety management practices, over 50% of all participants were found to agree or strongly agree to Q13 "My supervisor puts pressure on me to get the job done on time" and again over 60% of all participants agree or strongly agree to Q16 "My supervisor has difficulty motivating the team to work safely". For items measured under safety compliance. Over 60% of all participants agree or strongly agree to Q4 "I ignore safety regulations to get the job done on time" and similarly over 60% of all participants agree or strongly agree to Q5 "In some instance I feel pressured to put production before safety in this installation" while for safety participation, over 60% of all participants agree or strongly agree to Q8 "I feel if I say too much about safety I might get fired".

The reliability test carried out revealed that items used to measure safety management practices (26 items) and safety participation (11 items) were higher than $\alpha > 0.7$ and items used to measure safety compliance (8 items) were below the $\alpha < 0.7$. However, the total Cronbach's Alpha for all 45 items ranges from moderate to high [33]. The first analysis in structural equation modelling was the path model identification. During model identification, the total number of estimated sample moment parameter (27), was more than the numbers of distinct parameters (23). The degree of freedom (*df*) is the differences between both parameters (27-23 = 4) and is greater than zero (*df* =>0), as a result the model was over identified. The maximum likelihood estimation was applied to yield optimal parameters of all studied variables, in order to assess the distributional properties.

TABLE I
PARTICIPANT'S DEMOGRAPHIC CHARACTERISTICS (n = 462)

Characteristics	Frequency	Standard deviation	Mean
GENDER			
Male	58.9%	*SD*= 0.497	*M* = 1.41
Female	40.9%		
Other	0.2%		
AGE			
18-25	18.4%		
26-35	28.8%		
36-45	27.5%	*SD* =1.105	*M* =2.62
46-55	22.9%		
56-65	2.2%		
66-75	0.2%		
EMPLOYMENT TYPE			
Contract	19.7%		
Part-time	11.9%	*SD* =0.799	*M* =2.49
Full-time	68.4%		
WORK EXPERIENCE			
0-5	30.7%		
6-10	35.1%		
11-15	22.7%		
16-20	10.0%	*SD* = 1.029	*M* =2.17
25-30	1.3%		
Others	0.2%		
JOB CATEGORY			
Production	5.8%		
Engineering	33.6%		
-Drilling	13.2%		
Maintenance	19.3%		
Crane Operator	5.2%		
Admin/management	18.6%	*SD* = 2.113	*M* = 4.15
Construction	2.4%		
Others	1.9%		

Although there was a significant ($p < 0.005$) direct estimated impact of safety management practices to both safety participation and safety compliance, safety management practices had a higher direct estimated impact on safety participation (0.37) than safety compliance (0.23). Work experience had a significant direct estimated impact of safety participation ($p < 0.005$) and a non-significant direct estimated impact on safety climate ($p > 0.005$). Age had a significant estimated impact on safety compliance ($p < 0.005$) and not significant to safety participation ($p > 0.005$). Gender does not have any significant impact on both safety compliance and participation ($p > 0.005$).

IV. Discussion

The aim of this study was to evaluate safety behaviour and its impact on safety performance of workers in the Nigeria oil and gas industry. A detailed literature review indicated that poor safety culture can influence employee's safety behaviour at work, which may consequently result in injuries and accident [37], [38], [24]. Strengthening such a culture can improve workers' safety performance [30], [39]. The study aim was achieved by distributing questionnaire to frontline employees measuring demographics, safety participation, safety compliance and management practices to safety in oil and gas industries in Niger delta region of Nigeria to obtain information on how employees in these industries perceive the current state of safety culture in their work place and in-turn

impact on their safety behaviour.

Following the survey, one of the key findings of this study was that, safety management practices was significant to both safety participation and safety compliance, which suggests that safety culture influences workers' safety behaviour in the Nigerian oil and gas industry. Previous study [29] affirmed that safety management practices, a measure of organizational safety culture, has indirect and direct significant relationship with workers' safety behaviour in eight different high-risk industries in India. Other studies [40], [41], [9] also establish enhanced safety culture and safety behaviour as a precursor to minimizing accident among employees in the oil and gas industry. Furthermore, this present study found that over 60% of participants acknowledged feeling pressured to put production before safety or sometimes ignore safety regulations to get their job done. This demonstrates the cultural expression that there is an ongoing and persistent trade-off among safety and productivity in the organizations, where production pressure and targets are seeming to have significance over safety actions. In this regard, [39], however, found that safety commitment by employee may be low when management neglects safety processes whenever production falls behind plan. As a result, [42] noted that to achieve an effective safety culture in the oil and gas industry, it is essential that the workers see that managers have the attitudes and endorse the behavior that upkeep safety.

It was also found that, over 60% of participants lack motivation to work safely and the confidence to report safety concerns. This may lead to a poor starting point to successfully prevent accident, for a good flow of safety information and motivation is important in reducing workplace accidents. In this vein, [43] posits that safety concern and safety motivation positively affected safety behaviour, which may in-turn affect workers reporting culture.

Thirdly, this study found that work experience (demographic factor) had a significant relationship with safety participation, but not with safety compliance, indicating that work experience is important for occupational safety improvement in Nigerian oil and gas workers. This is similar to [44]. In contrast, [45] found only age, work sector and activities of workers to be significant in the improvement of occupational safety culture.

The strength of this study rests in the magnitude of the cohort, the range of the organizations, its sectors and work groups included. The data analysis provides evidence concerning the link between safety culture and safety behaviour of workers in the Nigeria oil and gas industry. Nevertheless, a major limitation of the study was on how the questionnaire was designed. Not every piece of information is available on the mechanism linking safety culture and safety behaviour was measured and was unable to analyze the individual effect of each element of safety culture on safety behaviour of workers. Also, using a quantitative approach only (e.g. questionnaire), it was assumed that participants were open and honest when responding to the questions in the questionnaire and that their responses was a reflective of their reality at the time the questionnaire was completed.

V. Conclusion

The main conclusion of this study is that there is a relationship between safety culture and workers' safety behaviour and a poor safety culture can influence injuries and accidents of Nigeria oil and gas workers. These finding will also provide useful guidance for practitioners and researchers in identifying the mechanism on how to improve safety in the work place. Future research would look into how to develop more knowledge on the relationship between individual element of safety culture impact on safety behaviour of workers in the Nigeria oil and gas industry. In addition to the quantitative survey, there would be a qualitative method of data collection (face to face interview with supervisors/ manager/frontline employee) in order to broaden the scope of the study and to gain an in-depth understanding of safety culture within the sector.

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