Investigation of Accident Rates in the Oil and Gas Industry

Jude Osadolor, John N Ugbebor, Patricks-E Chinemerem

Abstract— **This study investigated accident rates among oil and gas operators in Rivers State, Nigeria. Using a quantitative method with a questionnaire designed of different categories of questions, weighted average was employed together with other statistical tools like,Duncan statistics, bar and pie charts, etc., using SPSS and Excel. The sample size and questionnaire distributed were 370, and 342 were returned, representing 93%. Company A, B, and C staff represented 24.6%, 28.9%, and 24% of the respondents, respectively. We selected 7.9% of respondents from the Directorate of Company E to evaluate the insight and experience of regulatory agencies. Table 2.0 (a) shows that 66.4% of respondents are drawn from the upstream sector, while 33.6% are from the downstream sector. The results showed that the rate of accident occurrence in the last five years in the selected companies was 14.9% (frequency of 51) (see Table 2.0 (b). The outcome of the ANOVA showed that the variation in perception for different categories of workers is significant at $p < 0.05$, F - 4.035, sig 0.014. Since the significance level is below 0.05 (p-value), it indicates that there is a statistically significant variation in the knowledge of the different categories of workers about safety regulations and compliance.**

Index Terms— **investigation, accidents, oil, gas, and operators**

I. INTRODUCTION

This study examines the rates of accidents in the chosen oil and gas companies from both the upstream and downstream sectors. Upstream activities involve the exploration and extraction of crude oil and natural gas, whereas downstream activities encompass the processes from extraction to delivering the final product to customers in various forms. The primary driver of the Nigerian economy currently is the oil and gas industry. It represents more than 80% of the country's yearly income. Activities in this sector involve exploration, drilling, and production. IOCs, NOCs, and local contractors primarily manage well intervention and maintenance (Anumadu et al., 2014). An IEA estimate from 2010 states that oil and gas supply 90% of the daily energy needs of the world's population of around 6.9 billion people (Anumadu et al., 2014). Despite the significant benefits this business offers to society, its intricate exploration and production procedures, if not handled properly, could lead to disastrous consequences. The intricate nature of oil and gas

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processes often classifies it as a high-risk business. The fallout among the essential elements of technological, organizational, managerial, environmental, and human variables can result in accidents.

II. RESEARCH METHODOLOGY

A. Research Design

A quantitative method was used in this research. A quantitative approach will afford a much broader study, which involves more people and will encourage objectivity and accuracy (Janice & Peggy, 1996). The views and perceptions of respondents will offer visions for different problems and also help in developing concepts for the quantitative evaluations. A quantitative approach will compare the results of this study with those of another research. The method will help realize the real safety problems and dangers of injuries that occur in the oil and gas industry.

The study is to investigate accident rates at the selected petroleum companies. To achieve this, primary data was collected.

B. Study Area

The study area covered some selected upstream and downstream petroleum companies in Rivers State. It is located between longitude 4.8156° N and latitude 7.0498° E. The topography is moderately flat in some areas and within the rainforest zone of Nigeria, which covers a total landmass of about 11,077 km2. (Udensi, 2017)

C. Data Collection

Data collection included the sampling of the target population, the design and distribution of the questionnaire, retrieval, collation, and tabulation of responses of respondents in frequency tables for analysis. The primary data for this study were obtained through a standardized five-point Likert-styled questionnaire while the secondary data came from literature, observations, and personal communication with the participants.

Data Collection Materials

The survey materials were collected and sorted, and the questions were tabulated against the responses from the respondents. The quantitative analysis in this study was based on SPSS for most of the questions to determine the accident rate and safety awareness level in the selected companies. The data obtained from the questionnaires was subjected to the following analyses: descriptive statistical tools (bar charts, pie charts, and weighted average), which were conducted in the environment of Microsoft Excel and the statistical package for the social sciences (IBM/SPSS). The weighted average was computed for each entry and, in the end, ranked to see the order of importance of each of the constructs within the constructs of each objective. It is

derived using the formula below:

$$w=(\varepsilon\_i{}^n{=}1 \cdot W\_i\, x\_i)/(\varepsilon\_i{}^n{=}1{}^\wedge w\, i)$$
Where W is weighted average

n is Number of terms to be averaged
Wi is the weights applied to x value
Xi is the data value to be averaged.

Source of Data Collection

The source of data collection in this study was primary. Questionnaires were used as research instruments for the assessment of safety performance in the upstream and downstream of the selected petroleum companies in Rivers State.

We designed the questions to suit the various parameters required from the different categories of respondents working at the selected oil and gas companies within Rivers State.

D. Data Analysis

A questionnaire and checklist were used as research instruments for the assessment of safety performance upstream and downstream of the selected petroleum companies in Rivers State.

The CheckMarket (Table 1.1) the easy sample size calculator was used. The targets for this were senior managers and safety officers. This was done to find out the realities on the ground in comparison to the questionnaire responses

Table 1.1: **Easy Sample Size Calculator**

| Population size | Confidence level=95% | | | Confidence level= 95% | | |
| | Margin error | | | Margin error | | |
	5%	2.5%	1%	5%	2.5%	1%
100	80	94	99	87	96	99
500	217	377	475	285	421	485
1.000	278	606	906	399	727	943
10.000	370	1.332	4.899	622	2,098	6,239
100.000	383	1.513	8.762	659	2,585	14, 227
500.000	384	1.532	9.423	663	2,640	16,055
1.000.000	384	1.534	9.512	663	2,647	16,317

III. RESULTS

The frequency of accidents occurring in selected oil and gas companies in River State, as demonstrated in Table 2.0, shows low compliance with regulatory standards by the staff of all the selected oil companies. 19.3 percent of the population sampled works for companies that have recorded more than fifteen accidents within the period under review. The magnitude of accidents is not unfurled in the table, but it demonstrates that some companies have made efforts to minimize the occurrence of accidents to less than five times.

Table 2.0 (a) Demographic distribution of respondents

Workplace	Frequency (%)	percentages (%)
Company A	84	24.6
Company B	99	28.9
Company C	82	24.0
Company D	50	14.6
Company E	27	7.9
Total	**342**	**100.0**

Operation type	Frequency	(%) percent (%)
Upstream	227	66.4
Downstream	115	33.6
Total	**342**	**100.0**

Table 2.0: Frequency of accident occurrence in selected companies in Rivers State

Number of times of occurrence in the last five years	Frequency	percent (%)
< 5 times	51	14.9
5-10 times	104	30.4
11-15 times	121	35.4
above 15 times	66	19.3
Total	342	100.0

Source: Authors field survey (2023)

The number of companies that have recorded over five (>5) events of accidents within the period of the study shows a lack of enforcement of safety guidelines in the state (see Figure 2.1).

Table 2.1 dissects the perception of workers in the selected oil and gas companies in River State on safety standards and procedures. 33.3(%) (%) percent attested that they are abreast with their right and responsibilities in workplace relations. Also conspicuous is that 30.4(%) (%) percent strongly agreed which shows the level of awareness. However, 2.6 % of the population is undecided.

Table 2.1: Respondents' perception to compliance level to the safety standard and procedure in selected oil and gas companies within Rivers State.

Constructs	U (%)	SD (%)	D (%)	A (%)	SA (%)	Total (%)	WM	Rank	Remark
I am clear about my rights and responsibilities in relation to workplace health and safe	9 (2.6)	73 (21.3)	42 (12.3)	114 (33.3)	104 (30.4)	342 (100)	3.7	8	agree
I am clear about my employers' rights and responsibilities in relation to workplace health and safety	14 (4.1)	57 (16.7)	86 (25.1)	116 (33.9)	69 (20.2)	342 (100)	3.5	9	Agree
I know how to perform my job in a safe manner	10(2.9)	22 (6.4)	75 (21.9)	136 (39.8)	99 (28.9)	342 (100)	3.9	6	Agree
If I became aware of a health or safety hazard at my workplace, I know who (at my workplace) I would report it to	3 (0.9)	36 (10.5)	15 (4.4)	177 (51.8)	111 (32.5)	342 (100)	4.0	5	Agree
I have the knowledge to assist in responding to any health and safety concerns at my workplace	27 (7.9)	88 (25.7)	99 (28.9)	98 (28.7)	30 (8.8)	342 (100)	3.0	10	disagree
I know what the necessary precautions are that I should take while doing my job	12 (3.5)	25 (7.3)	27 (7.9)	185 (54.1)	93 (27.2)	342 (100)	3.9	6	Agree
It is wrong to throw anything "overboard." Someone passing may be seriously injured.	3 (0.9)	0 (0)	15 (4.4)	194 (56.7)	130 (38)	342 (100)	4.3	2	Agree
Open fires are prohibited.	10 (2.9)	3 (0.9)	49 (14.3)	166 (48.5)	114 (33.3)	342 (100)	4.1	4	Agree
It is necessary to know what emergency procedures have been established for your job site.	0 (0)	0(0)	12 (3.5)	144 (42.1)	186 (54.4)	342 (100)	4.5	1	Agree
It is wrong to distract the attention of fellow workers or engage in any act which would endanger another employee	15 (4.4)	0 (0)	0(0)	174 (50.9)	153 (44.7)	342 (100)	4.3	2	Agree

Source: Authors field survey (2023)

a) Sex distribution of respondents
- Male
- Female

b) Age distribution of respondents
- 18-25
- 26-35
- 36-45
- above 45

c) familiarity with oil and gas safety
- Familiar
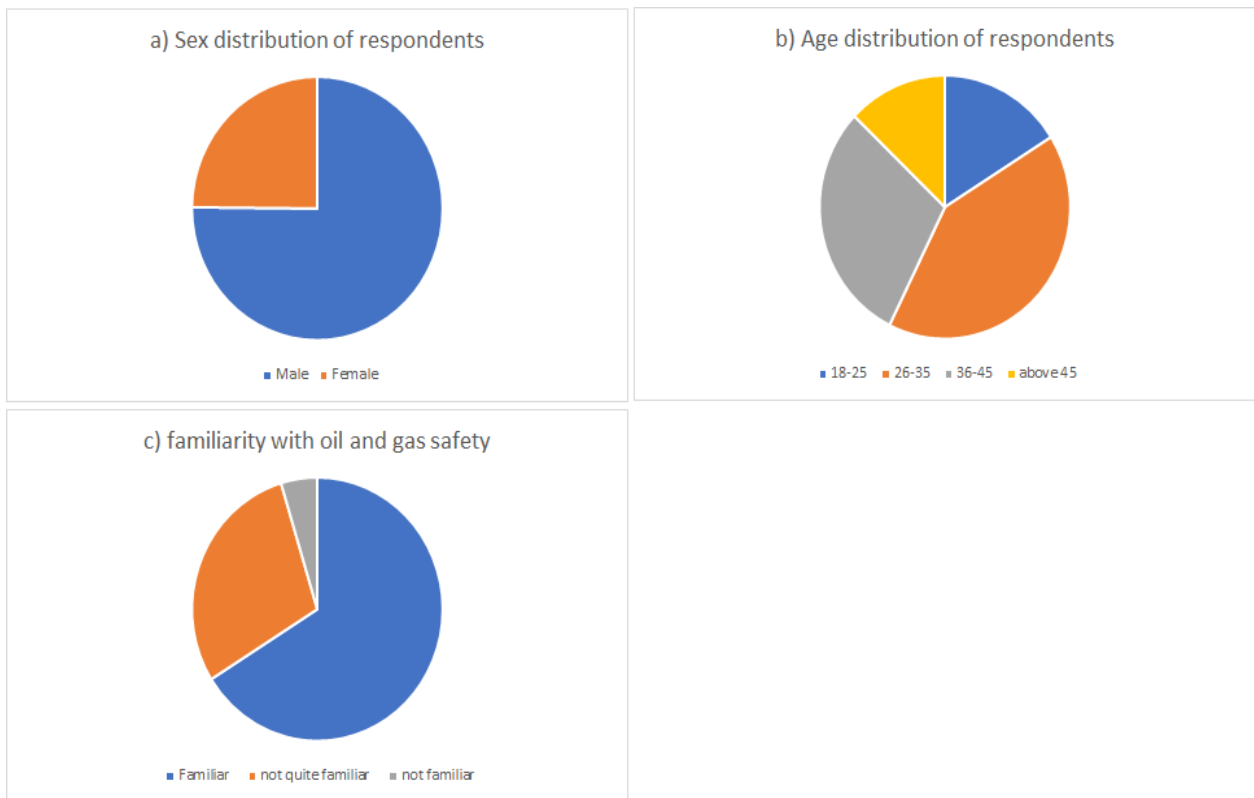- not quite familiar
- not familiar

Figure 2.0: pie charts showing: a) sex distribution of respondents; b) age distribution of respondents; c) familiarity of respondents with oil and gas industry.
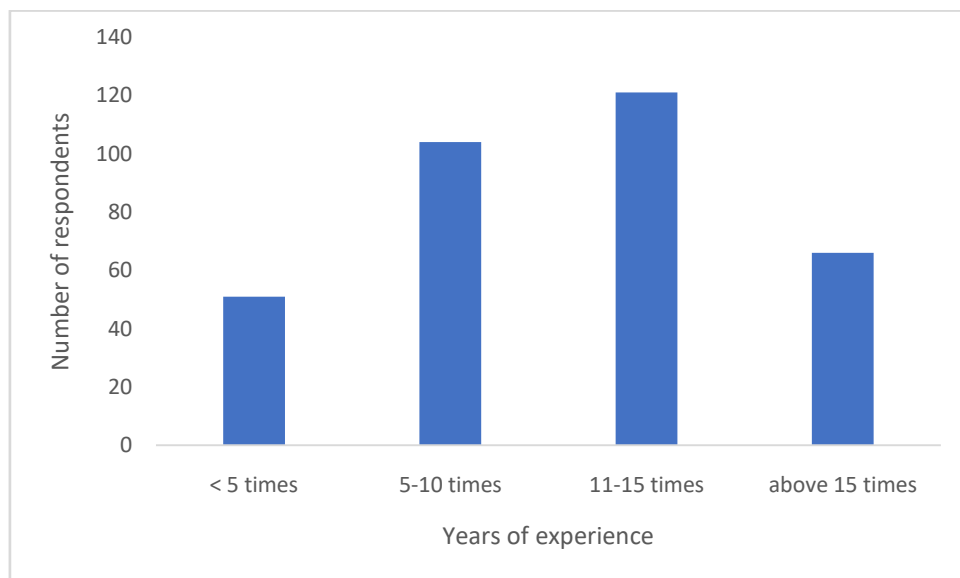

Figure 2.1 Years of experience of respondents

III. DISCUSSION

The oil and gas industry is well-known for the occurrence of accidents during operations (John, 2021). Given the nature of day-to-day activities, which include drilling, excavation, welding and fabrication, blasting, haulage, installation of heavy-duty equipment, and other volatile activities, some scholars in the literature have attempted to conceptualize the inevitability of accidents in the sector (Ilodiuba, 2021).

. In cases where welding and fabrication are carried out without protective eyeglasses and fire blankets and gas detectors are not prioritized, more accidents are bound to be recorded during the operation of sub-contractors in the oil and gas sector. Though every subcontractor is under compulsion to deploy medical practitioners and first aid boxes to the site, the level of compliance is still low in this

area. Given the rate of accidents of over 14.9% in some oil and gas companies, the framework for accident management is expected to be more proactive, with strong reactionary measures, but this study reveals that emergency responses to accidents need to be improved and the gap in communication between sites of operation and top management needs to be closed. The study also noticed that some workers do not know where to report emergencies and cannot provide immediate assistance or seek safety advice from another department during work. We can link this to the corporate culture of oil and gas companies. This finding agrees with the findings of Michael (2022).

IV. CONCLUSION

Compliance level with safety standards and procedures is a function of the investment in occupational safety as regards training, retraining, availability of personal protective equipment, internal communication mechanisms, emergency response for damage control, and other factors. If these are in place and implemented, they will reduce accident rates in the covered areas. drastically

However, for continuous improvement, the following recommendations will help:

1. The regulatory agency and other relevant organizations should institutionalize occupational safety training. The agencies will require oil and gas company workers to complete training courses before they can operate in the industry. It will alleviate organizational shortcomings in firms that lack serious attention to training.
2. The use of PPE by subcontractors should be improved upon and safety guidelines enforced. This study has observed a discrepancy in worker compliance within oil and gas companies' internal operations compared to that of contractors. This is because ad-hoc workers of subcontractors do not pass through the rudimentary safety training before they are mobilized to work with sophisticated equipment. The implication is that more accidents are recorded among subcontractors.
3. To reduce incidences of accidents, sub-contractors should be monitored for the utility of funds earmarked for safety equipment and the utility of the equipment during work.

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