Knowledge of Life-Saving Rules & Associated Socio-Demographic Factors Amongst Petroleum Industry Workers in Delta State, Nigeria

Andrew M. ABANUM, Ibidabo D. ALABERE, Patricks E. Chinemerem

Abstract— Safety rules and procedures, (SRPs) in any work place are established as a system barrier to prevent incidents and ensure business sustenance. Life-saving rules (LSRs) are integral of SRPs and are popular in the oil & gas (O&G) industry. The introduction of LSRs by the International Association of Oil and Gas Producers (IOGP) greatly improved safety performance for companies who adopted the set of rules. The study aim was to assess the knowledge and understanding of IOGP LSRs amongst workforce, with a view to ensure compliance, create a decent work and economic growth in line with No.8 of United Nations Sustainable Development Goals (UN-SDG 8). A cross-sectional study was carried out to ascertain awareness and knowledge level of LSRs and socio-demographic factors affecting workers knowledge of SRPs. The study was conducted among 317 sharp end workers recruited through a multistage sampling procedure in selected O&G companies in Delta State of Nigeria. The critical finding was a good knowledge level of 81.6% and socio-demographic factors associated with knowledge were: older age, higher educational level, religion, marital status and role performed. Consequently, recommendations were drawn from study findings to pursue the goal of incident prevention and drive sustainable development through safe work practices.

Index Terms— life-saving rules, IOGP, knowledge, oil and gas industry, incident prevention.

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INTRODUCTION

Safety rules are critical and invaluable aspect of safety managements systems and are numerous, especially in high risk industries (Weichbrodt, 2015; Hopkins, 2011). The workplace setting is such that safety rules are complemented with required or associated procedures (Brandhorst & Kluge, 2016) to ensure safety in the oil and gas (O&G) industry, which is a core value (Alhaldi et al., 2017; Azuike et al., 2017: Awodele, 2014). The existence of safety rules and procedures in any work environment mandates the need for knowledge of them by workers. Having knowledge of SRP can make the difference in the case of intentional and unintentional non-compliance (Dahl, 2013). Knowledge of SRPs in the industry is obtained by both formal and informal training and education (Weichbrodt, 2015). Formal training sessions blend learning of SRPs and absorbs other norms and values operational in the organization, hence, developing a better understanding to enable trainee's clear assumptions and deal with complacency tendencies (Weichbrodt, 2015; Grote, 2012). Due the acclaimed violation of SRPs, an adequate worker's knowledge of SRPs and safe work practices is invaluable to address the menace (Kvalhiem & Dahl, 2016). Kvalheim & Dahl (2016), in their work identified safety knowledge to be very significant to safety compliance as well as safety training.

It is therefore expedient to acquire the knowledge and understanding of safety compliance requirements to fully comply with what and how (Pilbeam et al., 2016). It is not only important for users to have adequate knowledge and understating of safety rules and procedures, workers should be involved and engaged in the development and approval of safety rules and procedures, which they use, as recommended by Hales et al., (2012). Vidal-Gomel (2017) opines that in occupational risk prevention, a lot of factors come into play which includes adequate training, that forms the foundation of knowledge, experience on the job, knowledge of safety rules and common knowledge of safe and efficient practices. Alper & Karsh (2009) also stated in their study that lack of information can be handled by providing knowledge through training to enhance compliance.

The IOGP Life-Saving Rules

The International Association of Oil & Gas Producers (IOGP) developed 18 Life-Saving rules (LSRs) in 2010, with a view to pursue Goal Zero in accidents and a drive to create a decent work place. There 8 core rules and 10 supplementary rules designed to control hazards and risks relating to personal safety, driving safety, work site safety, and control of work. From these OGP 18 life-saving rules, multinationals, national, and business owners have extracted from it to develop and tailor the rules as they apply to their business (OGP Report 459, 2013).

The Revised IOGP 9 Life-Saving Rules (LSRs)

The revised version of IOGP Life-Saving Rules (LSRs) is shown in figure 2. This latest version now has Nine (9) simpli-

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fied set of life-saving rules with corresponding icon. They are not different from the eighteen (18) published in version 2 of (OGP, 2013), but contains all rules in the 18 LSRs integrated and compressed into the present Nine (9). It comes with recommended actions necessary for industry workers to protect themselves and colleagues from fatalities. IOGP 9 LSRs aim is to standardize Life-Saving Rules across all O&G industry and address all risks and hazards in the industry. The objectives are to propagate common safety knowledge, share learning from incidents, LSRs awareness and integration of safety rules in all activities. The recommendation of IOGP is that all O&G companies should adopt the 9 life-saving rules, to achieve the aim of standardization of LSRs with uniformity across the O&G industry (IOGP, 2018). According to IOGP (2013), all operating O&G companies are expected to have these LSRs and associated procedures in place as a minimum, to ensure safety in the work place.
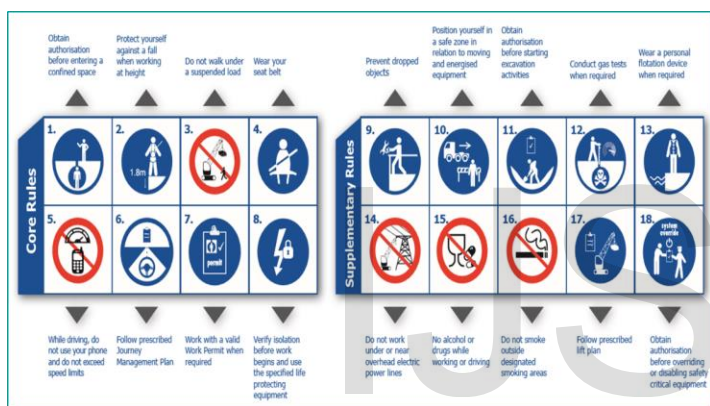

Figure 1: OGP Life-Saving Rules (OGP, 2013)

Figure 2: IOGP 9 Life-Saving Rules (IOGP, 2018)

Statement of the Problem

The petroleum industry being a major employer of labour in Nigeria and generates National income on which her economic growth is dependent (Alhkaldi, Pathirage, & Kulatunga, 2017; Adebola, 2014). The workers in this industry are constantly exposed to hazardous conditions and involved in high risk activities, with likelihood for accidents (Adebola, 2014; Eyayo, 2014; Hopkins, 2011). This mandates the establishment of SRPs to protect the workers and prevent incidents (Weichbrodt, 2015; Dahl, 2013; Adebola, 2014). But sad to note that the rate of incidents is on the increase across many industries and these occurrences are linked to non-compliances with SRPs (Jones, Phipps, & Ashcroft, 2018; Wang, Gao, Ruckert & Jiang 2017; Kvalheim & Dahl, 2016; IOGP 2018). If the purpose for establishing SRPs is far from being achieved, the it is a tell-tale that something is wrong. Consequently, what is fundamental is to determine worker's awareness, knowledge level and understanding of the SRPs to establish a basis for decision making and data for further studies.

Justification of the Study

The petroleum industry is a high-risk industry due to hazards inherent and the enormity of mishaps and consequences when things go wrong (Alkhaldi et al., 2017; Kvalheim & Dahl, 2016; Hopkins, 2011). Hence, the significance of adherence to established safety rules and procedures can never be overemphasized (Weichbrodt, 2015; Dahl, 2013; Adebola, 2014). To operate safely in the industry, safety rules and procedures are barriers put in place as last line of defense (Weichbrodt, 2015; Hudson et al., 1998), and so, breaching these barriers can become catastrophic (Kvalheim & Dahl, 2016; Umeokafor, Umeadi, & Jones, 2014). Maintaining the system barrier intents of SRPs, good knowledge and understanding of them becomes imperative, which necessitate the call for assessment of level of knowledge amongst the workers. It is imperative to ascertain whether workers have adequate knowledge level to enable the work safely (Aguwa, 2013) or otherwise, which directly impacts on safety performance, decent work and economic growth. Some studies in Nigeria have considered the knowledge and attitude of workers on use of SRPs (Afolabi & Gbadamosi, 2017; Adebola, 2014; Umeokafor, 2014; Aliyu & Saidu, 2011), but none has considered workers in the upstream sector of oil and gas industry. Also, previous research have not evaluated worker's knowledge of IOGP LSRs to the best of my knowledge. Hence, this study in the sector became imperative.

Study Aim

The aim was assess workers' knowledge of IOGG LSRs and determine the socio demographic factors that are associated with knowledge amongst petroleum industry workers in Delta State, Nigeria.

Objectives of the study were:

a. To establish the existence of IOGP LSRs in selected companies for the study.
b. To assess level of workers knowledge of IOGP LSRs and general safety SRPs.
c. To determine the socio demographic factors associated with worker's Knowledge of SRPs.
d. To discuss the implications of workers knowledge of IOGP LSRs in incident prevention.

MATERIALS AND METHODS

Study Area: Delta State is a major oil producing state and ranks second to Rivers State in Nigeria. The State supplies about 35% of Nigeria's crude oil and some considerable amount of natural gas and, known as the business destination for national and multi-national O&G companies in the Niger Delta. This industry provides gainful employment to many Nigerian youths and contractors in and outside Delta State. Petroleum industry operating in Delta State are into exploration and production, processing, marketing, oilfield services and logistics inter alia (NigeriaGalleria, 2017).

Study Design: A cross-sectional descriptive study was adopted in this research. The research was conducted amongst 317 sharp end workers recruited through a multistage sampling procedure (Nwaogazie, 2011; Creswell, 2009) in selected O&G companies in Delta State of Nigeria. Four (4) O&G companies out of about 12 operating in the state were selected by simple random sampling method of balloting. Sharpend workers were recruited via convenient sampling having satisfied selection criteria, while the leader who participated were recruited by means of purposive sampling technique.

Study Population: The study population was drawn personnel working in the 4 selected O&G upstream companies in Delta State. The 4 selected companies denoted by letters A, B, C and D have 1250 sharp end workers. The breakdown of staff strength is A = 600, B = 250, C = 280 and D = 120 This study was conducted amongst workers and selected leaders from the logistics department, core operations and maintenance staff and contractor staff. Inclusion criteria used are sharp end workers who have worked for 2 years or more in the oilfield upstream production operations. Excluded from this study are the company's senior management staff, staff of Safety and Environment (SE) department, workers unavailable at the time of study.

Sample Size Determination: Sample size estimation for the study was computed using the Cohran's formula (Nwaogazie, 2011), given as:

$$N_0 = \frac{Z^2 \, P(1-P)}{T^2}$$

where No = minimum sample size; Z = z-value (1.96) at confidence level value of 95%; P = Prevalence of 78% (0.78) compliance with safe practices from similar study carried out by Adebola (2014) in Lagos State, Nigeria; T = tolerance of 5%

Computed sample size is 264 from equation. To allow for non-response/invalid data 20% added to obtain 317 for the study.

Data Collection Instruments and Analysis Tools: Data was garnered with the aid of a self-developed checklist and semi-structured self-administered questionnaire. The checklist assessed the availability of LSRs as recommended by IOGP, while the questionnaire elicited information on SRPs awareness, socio-demography, occupational history and compliance evaluation questions on IOGP LSRs with provision for reasons where non-compliances occurred. Study instruments were pretested and validated before field work (Tsang, Royse & Terkawi, 2017; Bolarinwa, 2015). Data analysis applied descriptive and inferential statistics using the Statistical Package for Social Sciences (SPSS) version 22 and WinPepi version 11.5 applications.

Results and Discussions

A total of 317 questionnaires were administered to study participants. Three hundred (300 copies) were retrieved, and after data cleaning, 288 copies were considered valid and useful for analysis and interpretation. Out of the 317 copies administered, 29 copies were not used due to unreturned (17) and void/incompletely filled (12). Response rate was 94.64% and 96% of data completeness was recorded.

Socio Demographics (Tables 4.1): Respondents had mean age of 39.94 years with standard deviation of ± 8.61 and 19 (6.6%) out of 288 respondents were aged less or equal 25 years, while 87 (30.2%) were aged between 26 and 35 years, 114 (39.6%) respondents were aged between 36 and 45 years, 58 (20.1%) were between 46 and 55 years old, while 10 (3.5%) were 56 years and above. A total of 276 (95.8%) males and 12 (4.2%) females by sex. There were 60 (20.8%) singles, 225 (78.1%) married and 3 (1.0%) divorced /widowed/cohabiting. Two-hundred and 48 (86.1%) out of 288 respondents were Christians while 10 (3.5%) respondents were Islam and 30 (10.4%) indicated traditionalist/ other religion. Ninety-nine (34.4%) earned secondary education and 189 (65.6%) had earned degrees in tertiary education. Technicians who participated in study were a total of 202 (70.1%) while supervisors and engineers were 86 (29.9%).

Table 4.1: Study Population and Socio demographic Data

Socio-Demographics	Frequency (n=288)	Percentages (%)
Company		
A	136	47
B	59	21
C	64	22
D	29	10
Age (years)		
≤ 25	19	6.6
26 – 35	87	30.2
36- 45	114	39.6
46 – 55	58	20.1
≥56	10	3.5
Mean Age (39.94 years), Std.Dev. ± 8.61		
Sex		
Male	276	95.8
Female	12	4.2
Marital Status		
Single	60	21.0
Married	225	78.0
Divorced/ Widow/Widower/ Co-habitation	3	1.0
Religion		
Christianity	248	86.1
Islam	10	3.5
Tradition/Others	30	10.4
Highest Level of Education Completed		
Secondary/Technical	99	34.4
Tertiary	189	65.6
Highest Qualification		
O'Level	29	10.1
OND	57	19.8
HND	68	23.6
BSc/B.Tech	106	36.8
MSc/MEng/Ph.D	28	9.7
Role		
Technicians	202	70.1
Supervisors/Engineers	86	29.9

Table 4.3 showed that 94.9% of respondents in company A have significant level of awareness of safety rules and procedures, followed by company C (93.7%), company B (83.1%) and company C (79.3%) respectively. In general, 90.6% of respondents have significant level of awareness of safety rules and procedures. In-depth knowledge of IOGP LSRs was assessed on workers using information on these rulesand their applications. The results are in Figure 3 and Table 4.4

Table 4.4 has the knowledge assessment done by assessing workers in-depth knowledge on the 9 IOGP life-saving rules. Good knowledge was obtained to be 81.6% and poor knowledge was obtained to be 18.4% from the study population. In general, the level of respondent's knowledge on the 9 revised IOGP Life-saving rules was dichotomized to be of good and poor for bivariate analysis. Companies B and D demonstrated higher knowledge of LSRs while Companies A and C need to engage her workers for improvement on the knowledge of IOGP LSRs.

Figure 3 show that respondents have better knowledge of hot work safety precautions (74.9%), followed by safety rules and procedures in the workplace (62.7%), energy isolation (58.9%), confined space entry work (58.7%), working at height (56.6%), safe mechanical lifting safety procedures (54.3%), line of fire (51.4%), valid work permit (50.3%), safe driving rules (45.8%) and bypass safety controls/equipment (42.4%) respectively. Acroos the workers studied, poor demonstration

of good knowledge of "safe driving rules" and "bypass of safety critical control/equipment rule". This poor understanding is a threat to the operation of safety management system and process safety management.

Table 4.5 summarises the relationships between worker's knowledge of SRPs and their socio demographic factors. It was deduced that older workers are 5.48 times knowledgeable than younger workers. Married workers are 1.94 times more likely to have better knowledge that those who are unmarried.

The area is dominated by Christians and this was visible in that they were 10 times more likely to be knowledgeable than other religions. Educational level attained showed that participants with tertiary education are 2.35 times more likely to have better knowledge while role at work that signify hierarchy also, showed that the senior cadre (Supervisor/Engineers) had better knowledge of SRPs than the technicians with a 2.79 times margin.

Table 4.2: Awareness of General Safety Rules & Procedures

Statements (n=288)	SA (%)	A (%)	D (%)	SD (%)	Mean	Std.	Decision
Knowledge of safety rules & procedures around workplace.	215(74.7)	68(23.6)	2(0.7)	3(1)	3.72	0.53	Significant
Can identify and recognize the required safety rules & procedures.	178(61.8)	103(35.8)	3(1)	4(1.4)	3.58	0.59	Significant
Always review and share information about safety rules & procedures before starting a job.	159(55.2)	110(38.2)	16(5.6)	3(1)	3.48	0.65	Significant
Ability to intervene if a co-worker violates safety rules & procedures.	152(52.8)	122(42.4)	10(3.5)	4(1.4)	3.47	0.63	Significant
Knowledge of the consequences of not following safety rules & procedures.	193(67)	93(32.3)	0(0)	2(0.7)	3.66	0.52	Significant
Grand Total	897(62.3)	496(34.4)	31(2.2)	16(1.1)	3.58	0.59	**Significant**

Table 4.3: Summary of Awareness of SRPs

Companies	Awareness Level of SRPs		Total
	Poor Awareness Frequency (%)	Good Awareness Frequency (%)	
A	7 (5.1)	129 (94.9)	136 (100)
B	10 (16.9)	49 (82.1)	59 (100)
C	4 (6.3)	60 (93.7)	64 (100)
D	6 (20.7)	23 (79.3)	29 (100)
Total	**27 (9.4)**	**261 (90.6)**	**288 (100)**

Table 4.4: Level of Knowledge of SRPs

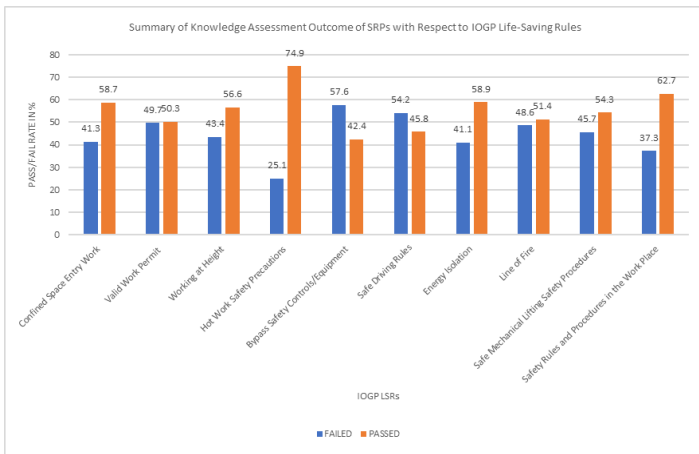| Companies	Knowledge Score of SRPs		Total
	Poor Knowledge (≤23) Frequency (%)	Good Knowledge (≥24) Frequency (%)	
A	19 (14.0)	117 (86.0)	136 (100)
B	0 (0.0)	59 (100.0)	59 (100)
C	13 (20.3)	51 (79.7)	64 (100)
D	1 (3.4)	28 (96.6)	29 (100)
Total	**53 (18.4)**	**235 (81.6)**	**288 (100)**

Fig. 3: Workers Knowledge Level Assessment of 9 IOGP LSRs

Table 4.5: Relationship between Knowledge of SRPs & Socio-Demography of Respondents

Variables	Knowledge Score of SRPs		Total	χ^2	p-value	OR (95% CI)
	Poor Knowledge < 24 Freq (%)	Good Knowledge ≥ 24 Freq (%)				
Age						
≤ 25	10 (52.6)	9 (47.4)	19 (100)	16.83	0.000	5.84 (1.98–17.16)
≥ 26	43 (19.0)	226 (81.0)	10 (100)			
Total	53 (18.4)	235 (81.6)	288 (100)	15.87		
Sex						
Male	53 (19.2)	223 (80.8)	276 (100)	2.824	0.093	**Not Applicable**
Female	0 (0.0)	12 (100)	12 (100)			
Total	53 (18.4)	235 (81.6)	288 (100)			
Marital Status						
Unmarried	17 (27.0)	46 (73.0)	63 (100)	3.955	0.047	1.94 (0.93-3.91)
Married	36 (16.0)	189 (84.0)	225 (100)			
Total	53 (18.4)	235 (81.6)	288 (100)			
Religion						
Christian	52 (21.0)	196 (79.0)	248 (100)	8.066	0.005	10.61 (1.70-437.64)
Islam/others	1 (2.5)	39 (97.5)	40 (100)			
Total	53 (18.4)	235 (81.6)	288 (100)			
Educational Level						
Secondary/Technical	27 (27.3)	72 (72.7)	99 (100)	7.904	0.005	2.35 (1.22 - 4.51)
Tertiary	26 (13.8)	163 (86.2)	189 (100)			
Total	53 (18.4)	235 (81.6)	288 (100)			
Role						
Technician	45 (22.3)	157 (77.7)	202 (100)	6.762	0.009	2.79 (1.22 - 7.18)
Supervisor/Engineer	8 (9.3)	78 (90.7)	86 (100)			
Total	53 (18.4)	235 (81.6)	288 (100)			

Summary of Findings

The existence of SRPs in the workplace provides a platform for information on what the norms and practices should be. Without the good knowledge of SRPs in the workplace, the intent would be compromised. This is because when the purpose of a thing is unbeknown, abuse becomes inevitable according to Munroe (2001). From the assessment carried out on the knowledge of SRPs with respect to the revised 9 IOGP LSRs, it was found that the knowledge of workers was quite high recording 81.6% as good knowledge and 18.4% with poor knowledge. This finding is in line with Adebola (2014) and Aliyu & Saidu (2011) studies in Nigerian petroleum downstream sector. The essence of good knowledge of SRPs can never be overemphasized. Dahl, (2013) explains the impact of the level of knowledge of SRPs in relation intentional and unintentional violation (non-compliance) and Kvalheim & Dahl (2016) high-

lighted the significance of good knowledge as a positive drive to compliance with SRPs. Generally, the workers in the petroleum industry in Delta State have good knowledge of SRPs. This is good and can be better though continuous learning, to better manage and prevent operational risks as opined by Vidal-Gomel (2017) and the study of Umeokafor et al., (2014) that believed in the role of knowledge of safety rules in the prevention of accidents.

Conclusions

This study presents useful information on the level of workers awareness and knowledge of safety rules and procedures and IOGP LSRs. The IOGP LSRs were used to assess workers knowledge and statistical analysis revealed the socio demographic factors associated with workers knowledge of SRPs. The selected companies have the expected safety rules and procedures covering their worksite activities and the recommended IOGP life-saving rules in place. It was discovered that workers awareness of general SRPs and consequences of non-compliance was relatively high. This high awareness was reflected in the level of workers' knowledge of SRPs, which recorded a good knowledge of 81.62% with respect to the IOGP LSRs. The socio demographic factors associated with workers' knowledge of SRPs and LSRs identified were older and experienced workers, marital status, religion (marginal), level of education attained and job role. With good knowledge of workplace SRPs and IOGP LSRs, the goal of incident prevention will be highly minimized if not eliminated. Knowledge is power!

Recommendations

a. The management of organisations should first comply with its obligation to ensure that all workers are aware and understand SRPs in the workplace.
b. Employees are obliged and should be encouraged to receive designed safety training and judiciously apply them to ensure incident prevention.
c. Safety training and retraining programmes and implementations should be considered as a fundamental part of business improvement measure for continual improvement. This guarantees good knowledge and understanding of SRPs. When workers have better understanding of SRPs in the workplace, it drives better compliance and aim at ultimately reducing incidents and improving performance with higher profitability.
d. The management of companies, parastatals, Government agencies, regulatory bodies, trade unions, Non-Governmental Organisations (NGO) should encourage lateral learning by creating avenues for both formal and informal learning opportunities in the workplace. This will positively impart and create of culture of knowledge sharing amongst the workforce.

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