

Evaluation of Fire Safety Management and Performance Among Workers in a Refining Company in Port Harcourt

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Abstract

This study assessed the fire safety management awareness and performance among workers at a typical refining company in Port Harcourt. Three research questions and two null hypotheses guided the study. A correlational cross-section survey design was employed. The target population was 301 staff members of a refining company in Port Harcourt. A sample size of 172 was calculated using Taro Yamene's formula. Data for analyses were obtained using a structured 4-point Likert scale questionnaire. The obtained data were analyzed using the Statistical Package for the Social Sciences (SPSS) Version 23.0. Data analyzed were presented as mean and standard deviation while the hypotheses were tested using inferential statistics of regression and correlations at 0.5 level of significance. With an aggregate mean score of $2.88 > 2.5$, the study identified a positive relationship between workplace fire safety management awareness and fire safety performance in the company under study. The study concluded that fire safety awareness and risk reduction can only be achieved when awareness translates to compliance. Thus, it is recommended that more should be done to enforce compliance with fire safety rules in the company under investigation.

Keywords: Safety awareness, Safety management, Risk reduction, Compliance performance

Received: 10th January, 2024

Accepted: 30th January, 2024

1. Introduction

Fire is critical for human, society and national development and it is an essential aspect of social development. Among several kinds of disasters, fire constitutes a significant threat to life, property, and the environment. The report from fire services department in 2018, shows a total of 51,400 fire calls and 934 fire death daily (NFPA, 2008). Building fire, particularly in public buildings remain a critical concern as the fire outbreak revealed between 2013 and 2018 indicate a significant increase in the fire incidents and number of deaths (Emmanuel et al., 2019).

The word fire refers to the natural phenomenon that occurs whenever a combustible fuel comes into contact with oxygen from the air and gives out light, heat and smoke. Fire is the by-product of a chemical reaction in which heat stored in a combustible fuel is converted to a heat and accompanied by light (Iodiuba et al., 2017). A fire's flame refers to the visual indication of light that occurs once the gas is heated, and is evidence that a fire has taken place (Tonui, 2019). Fire has been identified as the greatest challenge to the safety of not only industrial

plants but in all workplaces in worldwide (HSE, 2016). A fire can result in extensive damage and destruction of property as well as injuries and death to occupants of a given premise (DiGuiseppe et al., 2012). Even when fires do not injure workers, they can disrupt activities quite significantly and bring most operations to a standstill.

Fires can lead to the destruction of property and loss of important records and information hence the need for clear workplace fire safety management rules to minimize outbreaks and the loss that can result from such hazards (Schifiliti et al., 2015). Workplace fire safety management measures include those that are planned during the refining of a building or implemented in structures that are already standing, and those that are taught to occupants of the building. Workplace fire safety management system need to be considered as an inherent part of the building design and not as supplementary to others matters such as ergonomics, services or finishes (Schifiliti et al., 2015). Workplace fire safety management service is an important element of any development as people's lives, properties and investments are put at risk in

the event of fire outbreak. The main objective of workplace fire safety management efforts is to protect occupant from injury and to prevent loss of life or injuries during fire incidences and the second goal of workplace fire safety management is to prevent property destruction. By preventing fires and limiting damage we can assure that work operations will continue uninterrupted. Any fire must have three elements to ignite and maintain combustion: fuel, heat and oxygen. The strategy of fire prevention is to control or isolate sources of fuel and heat in order to prevent combustion (Kelvin, 2013).

In Nigeria, the awareness of workplace fire safety management in most public workplace, especially in the refineries, is generally poor. Therefore, workplace fire safety management awareness assessment can provide better approaches to improve refineries' fire safety performance. Determining the extent of workplace fire safety management and assessing the level of awareness are critical in achieving workplace fire safety management objectives. It is against this background that this study intends to assess the workplace fire safety management awareness and fire safety performance at a refining company in Port Harcourt. Specifically aimed to assess employees' compliance to workplace fire risk reduction rules and the international civil aviation organization (ICAO) standards, determine the effect of fire safety awareness on compliance to the fire risk reduction rules and ascertain the relationship between compliance to fire risk reduction rules and fire safety performance in a refining company.

2. Methodology

A correlational cross-section survey design was used in this study. The target population was made up of 301, comprising men and women from various departments such as administration (56), production (173), health and safety (28) and maintenance (44) personnel respectively in the Port Harcourt Refining Petrochemical Company studied. A purposive sampling technique was employed and the sample size of 172 was arrived at using Taro Yamane's formula. Information was collected from the workers in the refinery using a structured 4-point Likert scale questionnaire ranging from 4 to 1 as Strongly Agreed = (SA), Agreed = (A), Disagreed = (D), Strongly Disagreed = (SD) as instrument adapted from fire risk reduction rules and International civil aviation organization (ICAO) standards and OSHA 2007 workplace fire management guidelines titled "Assessment of fire

safety management awareness and performance in a typical refining company in Port Harcourt, Rivers State" (AFSMAPRCPH). To establish the reliability of the study, questionnaire items were subjected to the test-retest method. Copies of the research instrument (questionnaire) were administered to respondents in the company under investigation and out of 200 copies of questionnaire distributed, 172 copies were duly completed and returned. The returned copies were used for the analysis of the study. Answers to the research questions were presented with mean and standard deviations while the hypotheses were tested using inferential statistics of regression and correlations at 0.5 level of significance.

3. Results

3.1 Compliance to fire risk reduction

Table 1 showed in item 1 mean score of 1.85 and SD 1.2 which showed that respondents disagreed that trash/waste materials are properly managed and not left to litter around. In item 2 mean score of 3.20 and SD .41 implied that responded agreed that used electrical cables are industrial grade and properly grounded. In item 3 mean score of 2.86 and SD 1.24 showed that respondent equally agreed that all power stripes are utilized with built-in circuit breakers. In item 4 mean score of 1.81 and SD 1.14 showed that respondents disagreed that cigarette butts and containers are located far away from the buildings, shrubberies and flammable materials. In item 5 mean score of 2.70 and 1.15 which implied that respondents agreed that large installations for combustible materials, flammable liquids and gases are safely stored in designated areas in accordance with NFPA/OSHA regulations. In item 6 mean score of 3.40 and SD .65 showed that respondents agreed that electrical appliances are GFCI protected. In item 7 mean score of 1.82 and SD 1.15 implied that respondents disagreed that fire sprinkler piping/heads are always readily available and not used for other purposes. In item 8 mean score of 1.32 and SD .69 implied that respondents disagreed that fire pump/risers rooms are always 100% free of equipment other than fire protection equipment. Similarly, item 9 mean score of 2.36 and SD 1.24 implied that respondents disagreed that fire extinguishers are easily accessible. Thus, aggregate mean score of 2.38<2.5 implied that respondents disagreed that compliance rate of the company to workplace fire risk reduction rules and the international civil aviation organization (ICAO) standards.

Table 1: Mean and standard deviation of compliance rate of the company to workplace fire risk reduction rules and the international civil aviation organization (ICAO) standards

Descriptive Statistics				
S/N Items	N=250	Mean	Std. Deviation	Remark
1. Trash/waste materials are properly managed and not left to litter around		1.85	1.20	Disagreed
2. Used electrical cables are industrial grade and properly grounded		3.20	.406	Agreed
3. All power stripes are utilized with built-in circuit breakers.		2.86	1.24	Agreed
4. Cigarette butts and containers are located far away from the buildings, shrubberies and flammable materials.		1.81	1.14	Disagreed
5. Large installations for combustible materials, flammable liquids and gases are safely stored in designated areas in accordance with NFPA/OSHA regulations.		2.72	1.15	Agreed
6. Electrical appliances are GFCI protected		3.40	.65	Agreed
7. Fire sprinkler piping/heads are always readily available and not used for other purposes.		1.82	1.15	Disagreed
8. Fire pump/risers rooms are always 100% free of equipment other than fire protection equipment.		1.32	.69	Disagreed
9. Fire extinguishers are easily accessible		2.36	1.24	Disagreed
Grand Mean		2.38	.99	Disagreed

In Table 2 mean score of 1.84 and SD 1.11 which implied that respondents disagreed that they have an up-to-date fire safety policy in my workplace. In item 11 mean score of 1.39 and SD .49 implied that respondents disagreed that they have established and documented procedures in the event of fire or fire drills. In item 12 mean score of 3.24 and SD 1.32 showed that respondents disagreed that they periodically, we conduct fire safety drills. In item 13 mean score of 1.79 and SD 1.08 implied that respondents disagreed that fire risk assessment and resultant fire safety action plans are reviewed regularly. In item 14 mean score of 2.82 and SD 1.09 showed that respondents agreed that fire safety drills are reviewed for successes and failures and subsequent actions taken. In item 15 mean score of 1.33 and SD .47 which showed that respondents disagreed that findings from fire risk assessment are reported and published. In item 16 mean score of 1.86 and SD .34 implied that respondents disagreed that the wiring of electrical installations are inspected periodically by competent persons. In item 17 mean score of 1.16 and SD .37 showed that respondents disagreed that measures are in place to protect against arson. In

item 18 mean score of 3.53 and SD .86 showed that respondents agreed that plans and procedures are in place and rehearsed for assisting vulnerable persons, staff and visitors to evacuate during a fire event. Thus, aggregate mean score of 2.11<2.5 implied that respondents disagreed that the effect of non-compliance to the fire risk reduction rules.

Table 3 showed in item 19 mean score of 3.53 and SD .86 which implied that respondents agreed that smoking is prohibited in designated areas. In item 20 mean score of 2.80 and SD 1.59 showed that respondents agreed that fire alarms systems and extinguishers are periodically maintained. In item 21 mean score of 3.62 and SD .78 implied that respondents agreed that procedures are in place for liaison with local fire and rescue authorities. In item 22 mean score of 2.41 and SD 1.14 showed that respondents agreed that fire safety arrangement records are regularly maintained. In item 23 mean score of 3.04 and SD 1.73 implied that respondents agreed that the risks of fire and asphyxiation have been prevented following effective implementation of gas testing on the site. However, in item 24 mean score of 1.86 and SD .34 showed that respondents disagreed that there are procedures for routine

housekeeping inspection including checking fire doors and conditions of fire extinguisher. Thus, aggregate mean score of 2.88>2.5 implied that respondents agreed that there is a relationship between compliance to fire risk reduction rules and fire safety performance in the company under study.

Table 2: Mean and Standard Deviation of effect of non-compliance to the fire risk reduction rules.

Descriptive Statistics				
S/N Items	N=250	Mean	Std. Deviation	Remark
10. We have an up-to-date fire safety policy in my workplace		1.8440	1.11022	Disagreed
11. We have established and documented procedures in the event of fire or fire drills.		1.3960	.49005	Disagreed
12. Periodically, we conduct fire safety drills		3.2480	1.32117	Agreed
13. Fire risk assessment and resultant fire safety action plans are reviewed regularly.		1.7920	1.08880	Disagreed
14. Fire safety drills are reviewed for successes and failures and subsequent actions taken.		2.8280	1.09747	Agreed
15. Findings from fire risk assessment are reported and published		1.3360	.47329	Disagreed
16. The wiring of electrical installations are inspected periodically by competent persons		1.8640	.34348	Disagreed
17. Measures are in place to protect against arson		1.1680	.37462	Disagreed
18. Plans and procedures are in place and rehearsed for assisting vulnerable persons, staff and visitors to evacuate during a fire event.		3.5320	.86020	Agreed
Grand mean		2.11	.79	Disagreed

Table 3: Mean and Standard Deviation of the compliance to fire risk reduction rules and fire safety performance in the company under study

Descriptive Statistics				
S/N Items	N=250	Mean	Std. Deviation	Remark
19. Smoking is prohibited in designated areas		3.53	.86	Agreed
20. Fire alarms systems and extinguishers are periodically maintained		2.80	1.59	Agreed
21. Procedures are in place for liaison with local fire and rescue authorities.		3.62	.78	Agreed
22. Fire safety arrangement records are regularly maintained.		2.41	1.14	Disagreed
23. The risks of fire and asphyxiation have been prevented following effective implementation of gas testing on the site.		3.04	1.73	Agreed

24. There are procedures for routine housekeeping inspection including checking fire doors and conditions of fire extinguishers	1.86	.34	Disagreed
Grand Mean	2.88	.56	Agreed

3.2 Statistical analysis

Table 4 showed N-value of 250, correlation coefficient (Spearman rho) value of .039, p-value of .002<.05 which showed that fire safety awareness does not significantly influence compliance to fire risk reduction rules. The null hypothesis is

therefore rejected. Table 5 showed N-value of 250, coefficient value of .805, p-value of .001<.05 which showed that there is a significant relationship between fire safety performance and compliance to fire risk reduction rules in the company under study. The null hypothesis is therefore rejected.

Table 4: PPMC test of the safety awareness does not significantly influence compliance to fire risk reduction rules

Variables	Organizational Effectiveness				
Courage	Pearson Correlation	1	.083**	-.151**	.544**
	Sig. (2-tailed)		.002	.000	.000
	N	250	250	250	250
	Pearson Correlation	.083**	1	.600**	.475**
	Sig. (2-tailed)	.002		.000	.000
	N	250	250	250	250
	Pearson Correlation	-.151**	.600**	1	.039
	Sig. (2-tailed)	.000	.000		.150
	N	250	250	250	250
	Pearson Correlation	.544**	.475**	.039	1
	Sig. (2-tailed)	.000	.000	.000	
	N	250	250	250	250

** . Correlation is significant at the 0.01 level (2-tailed).

Table 5: PPMC test of the significant relationship between fire safety performance and compliance to fire risk reduction rules in the company under study

Variables	Organizational Effectiveness				
Integrity	Correlation Coefficient	1.000	.048	.613**	.805**
	Sig. (2-tailed)	.	.001	.000	.000
	N	250	250	250	250
	Correlation Coefficient	.048	1.000	.576**	.113**
	Sig. (2-tailed)	.001	.	.000	.000
	N	250	250	250	250
	Correlation Coefficient	.613**	.576**	1.000	.540**
	Sig. (2-tailed)	.000	.000	.	.000
	N	250	250	250	250
	Correlation Coefficient	.805**	.113**	.540**	1.000
	Sig. (2-tailed)	.000	.000	.000	.
	N	250	250	250	250

** . Correlation is significant at the 0.01 level (2-tailed).

4. Discussion

On the relationship between fire safety awareness and compliance to fire risk reduction rules, the result revealed a very strong relationship between the variables (compliance to fire risk reduction rules and fire safety awareness). A negative association factor (Pearson correlation) of 1 to -0.296 was observed, which is significant at p-value <0.001. A further analysis with regression revealed that the model is statistically significant and 8.8% of the dependent variable (compliance to fire risk reduction rules) can be predicted by the constant (fire safety awareness). The coefficients showed that a 1 unit increase in fire safety awareness will cause a -0.29 unit decrease in compliance to fire risk reduction rules and this is also statistically significant at $p < 0.0001$. This result implies that employee awareness of fire safety does not necessarily translate into compliance with the fire risk reduction rules.

Furthermore, on the relationship between compliance to fire risk reduction rules and fire safety performance, the correlation output reveals a positive relationship between the variables (fire risk reduction rules and fire safety performance). A moderate positive association factor of 1 to 0.385 was observed between the variables, which was significant at p-value <0.001. The regression output revealed that the model is statistically significant and that 14.8% of the dependent variable (fire risk reduction rules) can be predicted by the constant (fire safety performance). The coefficients revealed that a 1 unit increase in compliance to fire risk reduction rules will cause a 0.26 unit increase in fire safety performance and this is also statistically significant at $p < 0.0001$. This implies that the higher the compliance to fire risk reduction rules, the higher the fire safety performance.

5. Conclusion

This study aimed to assess workplace fire safety management awareness and fire safety performance among workers at a Refining Company in Port Harcourt. Based on qualitative and quantitative analysis of the results of the study, it can be concluded that some safety awareness gap exists among the workers in the refining company and thus, fire safety awareness programmes need to be done to sensitize workers. Emergency evacuation procedures were also found wanting and of concern was the absence of periodic safety inspection. Also, findings from risk assessment are not adequately reported and published in addition to the lack of plans/procedures in place for assisting vulnerable

persons, staff and visitors to evacuate during a fire event. The result indicates a poor fire safety performance in the company studied and shows that employee awareness of fire safety does not necessarily translate into compliance with the fire risk reduction rules.

References

- Ek, Å., Akselsson, R., Arvidsson, M., and Johansson, C. R. (2017). Safety Culture in Swedish Air Traffic Control. *Safety Science*, 45(7): 791-811.
- Emmanuel, A., Justice, W. & Frank, F., (2019). Health and safety improvement amongst Ghanaian communities as a corporate social responsibility of construction companies. *American Journal of Construction and Building Materials*, 3(2): 23-29.
- Iloidiuba et al, N., Nwaogazie, I. L., & Ugbebor, J. (2017). Awareness assessment of hazardous activities and effects on market fire in Nigeria. *International Journal of Health, Safety and Environments*, 3: 48-56.
- Kelvin, K. (2013). Occupational Health and Safety management in Kenya: Lessons from the Japanese Experience with OHSAS 18001/18002. NYCTP. (2006). NYCTP Hospital Evacuation Protocol Draft 3.16.2006. New York Centres for Terrorism Preparedness and Planning.
- Mat-Isa, N. and Kamaruzzaman, S.N. (2012) Review of facilities management functions in value management practices. *Architecture*, 8(5):830-840.
- NFPA (2008) 502 standard for road tunnels, bridges, and other limited access, highways. Natl Fire Prot Assoc
- Ong, W.C. and Suleiman, Z. (2015). Fire safety management problems in fire accidents in hospital building. *Advances in Environmental Biology*, 43-47.
- Orman, K. (2017). Fires in Hospitals – Causes and Solutions. <http://sacramento.legalexaminer.com/miscellaneous/fires-in-hospitals-causes-and-solutions/>
- Schifiliti, R.P., Meacham, B.J., and Custer, R.L.P. (2015). Design of Detection Systems. SFPE Handbook of Fire Protection Engineering. National Fire Protection Association, Quincy, MA. 4-1 – 4-29.
- Tonui, B. (2019). Responding to perinatal health and services using an intersectional framework at times of natural disasters: A systematic review. *International Journal of Disaster Risk Reduction*, 102958.