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Evaluating the Impact of Emergency Response Planning and ISO 14001 Certification on Environmental Sustainability in the Nigerian Oil and Gas Downstream Sector

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Abstract

The study focuses on evaluating the impact of emergency response planning and ISO 14001 certification on environmental sustainability in the Nigerian oil and gas downstream sector employing a descriptive survey approach and statistical analysis techniques. The research design for this study employed the use of structured questionnaire to systematically gather data on the perceptions and attitudes of respondents within the Nigerian oil and gas downstream sector. Data collection was facilitated through Google Forms. Sampling techniques encompassed both stratified and random sampling. Although, the target was 91 respondents, 85 responses were received, reflecting a substantial participation rate. The collected data underwent rigorous validation procedures to minimize errors. For data analysis, descriptive statistics using frequencies and percentages was adopted. Based on the results, the study reveals that a significant portion of respondents either agree or strongly agree (totalling 46.62%) that their facility possesses well-defined emergency response plans for various scenarios, including fire incidents. A smaller percentage expressed disagreement or strong disagreement (totalling 53.38%) with the existence of such plans. Most of participants either agreed (35.38%) or strongly agreed (46.08%) that post-incident assessments are conducted for these purposes. significant portion of respondents agreed or strongly agreed with having ISO 14001 certification, with 30.55% agreeing and 37.28% strongly agreeing. The impact of ISO 14001 certification on environmental performance, resource efficiency, and waste reduction shows that 25.73% agreeing, and 34.08% strongly agreeing with the notion of positive changes on post-certification. The study concluded by emphasizing the importance of ongoing efforts to enhance workplace safety and sustainability through

targeted interventions, comprehensive emergency response planning, and positive changes post-ISO 14001 certification which indicates an increased focus on environmental management and operational efficiency, that can indirectly contribute to fire prevention and mitigation efforts.

Keywords: Emergency, ISO 14001, Oil and Gas, Down Stream, Environmental Management Systems (EMS), Sustainability Practices, Occupational Health and Safety.

Introduction

The Nigerian oil and gas downstream sector, a cornerstone of the national economy, grapples with persistent safety challenges, including recurrent fire incidents, environmental non-compliance, and inadequate safety practices (Nseyen, 2023; Ambituuni et al., 2014). These issues not only pose risks to the lives of oil and gas workers but also have far-reaching consequences for the environment and the economy (Iduboe and Oisamoje, 2013). Environmental incidents, such as oil spills, have led to severe ecological consequences (Ukhurebor et al., 2021). The economic repercussions range from revenue loss due to production disruptions to legal liabilities for environmental damages and crude oil bunkering (Adishi and Hunga, 2017).

A crucial aspect of this study involves assessing the safety culture and leadership commitment within the Nigerian oil and gas downstream sector. Safety culture encompasses the shared values, attitudes, and behaviours related to safety within an organization (Hofmann et al., 1995). Leadership commitment is fundamental to shaping this culture and ensuring that safety is a top priority. By analyzing how leadership communicates, prioritizes, and implements safety measures, this study aims to uncover the factors influencing the safety culture within the downstream sector.

In a downstream sector prone to fire incidents, evaluating fire safety preparedness is crucial for minimizing risks. This includes examining the effectiveness of fire detection systems, evacuation protocols, and firefighting equipment (NFPA, 2013). Additionally, scrutinizing emergency response planning will provide information into the downstream sector's capacity to handle unforeseen events (Paton et al., 2000). Understanding these aspects is essential for ensuring the resilience of the downstream sector to fire incidents and emergencies.

Preventing accidents in the oil and gas downstream sector relies heavily on the identification and mitigation of hazards (Hallowell and Gambatese, 2010). This research will investigate the downstream sector's procedures for identifying potential risks, assessing their severity, and implementing effective mitigation strategies. A comprehensive understanding of how well the downstream sector anticipates and addresses hazards is crucial for sustainable workplace safety.

Recognizing the importance of psychological safety and employee well-being, this study will explore factors such as workplace stress

and mental health support programs. Ensuring a supportive work environment not only enhances employee well-being but also contributes to overall safety performance (Kelloway et al., 2005). Examining these psychological aspects is crucial for a holistic understanding of the conditions that influence the well-being of the workforce in the Nigerian oil and gas downstream sector.

The Nigerian oil and gas downstream sector is currently confronted with a complex and pressing problem marked by an array of safety deficiencies. These encompass a spectrum of issues, including recurring fire incidents, environmental violations, suboptimal emergency response procedures, and noteworthy concerns about psychological safety among downstream sector personnel. The gravity of these problems extends beyond the immediate risks to the workforce, reaching into the broader realms of environmental sustainability and the downstream sector's overall productivity and economic vitality. Environmental incidents, exemplified by oil spills, have inflicted substantial ecological damage, amplifying the downstream sector's environmental footprint. Concurrently, safety lapses have translated into tangible economic losses, manifesting through production interruptions and potential legal liabilities for the downstream sector (Adishi & Hunga, 2017; Ukhurebor et al., 2021).

This multiple-dimensional problem is intensified by the interconnectedness of its components, forming a obstacle that hinders the attainment of a safe, sustainable, and resilient workplace. The downstream sector's historical struggle with these safety deficiencies shows the need for an in-depth examination and targeted interventions to establish a robust safety framework. The absence of comprehensive studies addressing the various dimensions of this problem limits the downstream sector's ability to develop informed strategies and policies that can effectively mitigate these challenges, fostering an environment conducive to both worker well-being and downstream sector sustainability. The aim of this research is to evaluate the impact of emergency response planning and ISO 14001 Certification on Environmental Sustainability in the Nigerian Oil and Gas Downstream Sector**.**

RESEARCH METHODS

Population Sample and Sampling Design

The target population for this study consisted of individuals employed in various capacities within the Nigerian oil and gas sector, encompassing roles across the entire spectrum from exploration to dispensing or filling stations. Inclusively, individuals within the age range of 18 to 70 years were considered, with attention given to diverse demographic characteristics such as gender, educational background, and work patterns. To ensure the representation of the population, a combination of sampling techniques was employed. Initially, we applied stratified sampling, categorizing the sample population based on their respective roles in accordance with the framework outlined by Kumar (2017). This method facilitated the equal representation of each stratum within the sample. In addition to stratified sampling random sampling was implemented to afford every individual in the population an equal opportunity for selection. This random sampling approach enhances the reliability and representativeness of the research findings, enabling broader generalizations, as advocated by Kumar (2017).

The determination of the sample size from the overall population was achieved using Taro Yamane's formula:

$$n = \frac{\mathrm{N}}{1+Ne^2}$$

Where: N represents the population of the study (350), n is the sample size (to be determined), e signifies the level of significance at 9% (0.09), 1 denotes a constant. Using this formula, we calculated the sample size as follows:

$$n = \frac{350}{1+350(0.09)^2} = \frac{350}{1+350(0.0081)} = \frac{350}{1+2.835} = \frac{350}{3.835} = 91$$

Therefore, the correct sample size, based on the targeted population of 350, with a lower expectation of approximately 91 respondents.

Method of Data Collection

The research employed questionnaires as the primary tool for data collection, utilizing the convenience of Google Forms for distribution. The questionnaire structure was organized systematically, aligning with the study's objective and categorizing responses based on factors such as age, gender, and role. Respondents were afforded sufficient time to thoughtfully complete the questionnaires. Upon the lapse of two weeks from the initial distribution, proactive measures were taken to enhance response rates. Follow-up reminders were issued, reiterating the remaining days for questionnaire retrieval and offering replacements for any lost questionnaires. This strategic approach aimed at maximizing the response rate and ensuring a comprehensive dataset for analysis.

RESULTS AND DISCUSSION

Sociodemographic Distribution of Respondents

The age distribution of respondents in this study working within the oil and gas downstream sector are presented in Figure 1. A substantial portion of the workforce falls within the age range of 26-35 years (24.76%), followed closely by those aged 36-45 years (28.94%). The data also indicates a significant presence of respondents in the age brackets of 46-55 years (35.7%). However, the percentage drops for those aged 18-25 years (3.22%) and 56 and above (7.4%). This distribution showcases a concentration of mid-career professionals working within the downstream sector, with potential implications for safety performances and the development of sustainable workplace practices.

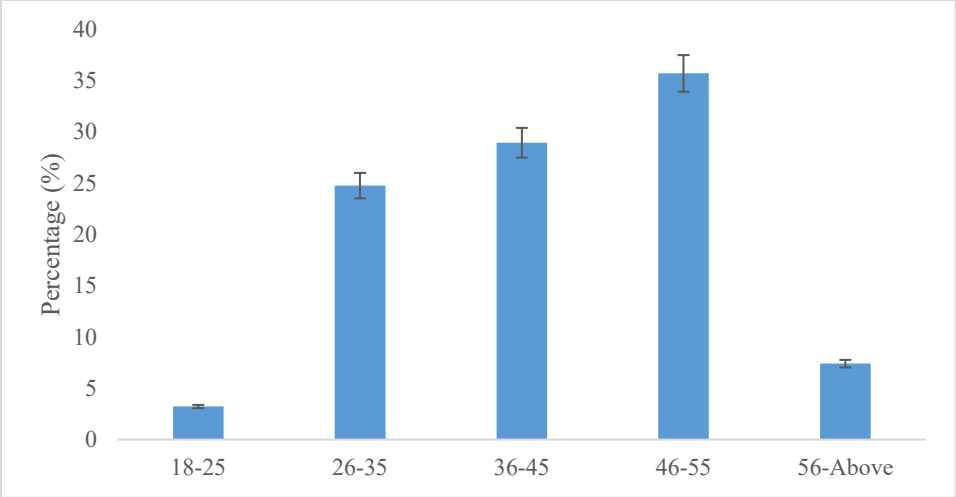


Figure 1: Distribution of Respondents Based on Age in the Oil and Gas Downstream sector.

The marital status breakdown of participants is presented in Figure 2, unveiling distinctive trends in the socio-demographic composition of the surveyed workforce. The majority of participants are married, constituting 38.62% of the surveyed population. Single respondents make up 25.72%, while divorced and widowed individuals represent 12.87% and 22.79%, respectively.

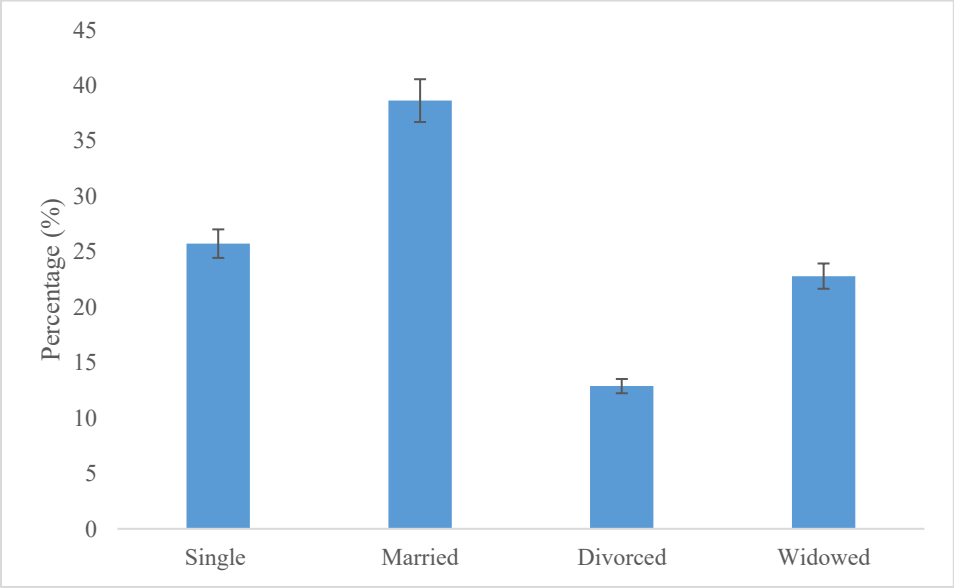


Figure 2: Distribution of Marital Status Among Participants in the Oil and Gas Downstream sector.

The survey responses pertaining to the qualifications of participants in this study are presented in Figure 3. This distribution across different qualification levels serves as a window into the educational profiles of the surveyed individuals, shedding light on the diverse academic

backgrounds prevalent in the workforce. A significant portion of the respondents holds Bachelor's/HND degrees (38.62%), followed by those with Master's degrees (38.62%). Individuals with High School qualifications constitute 4.82%, while 6.44% have earned Ph.D. degrees, and 11.58% possess other certifications.

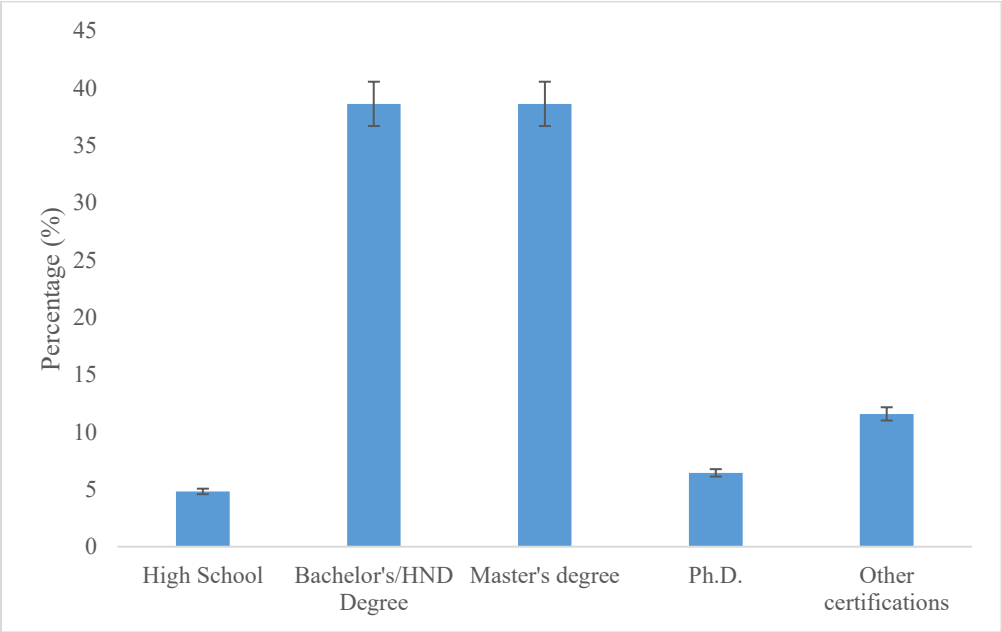


Figure 3: Distribution of Respondents Based on Educational Qualifications in the Oil and Gas Downstream sector.

The distribution of responses across various experience brackets as shown in Figure 4 serves as a valuable lens through which we can gain an understanding of the socio-demographic makeup of the surveyed workforce. This distribution gives us an exploration of the downstream sector's human capital, considering the diverse career trajectories and expertise present within the surveyed population. A substantial 28.84% of participants have 11-15 years of experience, while 25.72% have 6-10 years, and 19.29% have 0-5 years. The distribution shows a gradual decline in percentages as the years of experience increase, with 17.68% having 16-20 years and 8.35% having over 20 years of experience. This pattern indicates a workforce with a mix of early-career professionals and seasoned individuals, highlighting the need to consider this diversity when evaluating safety performances in the downstream sector.

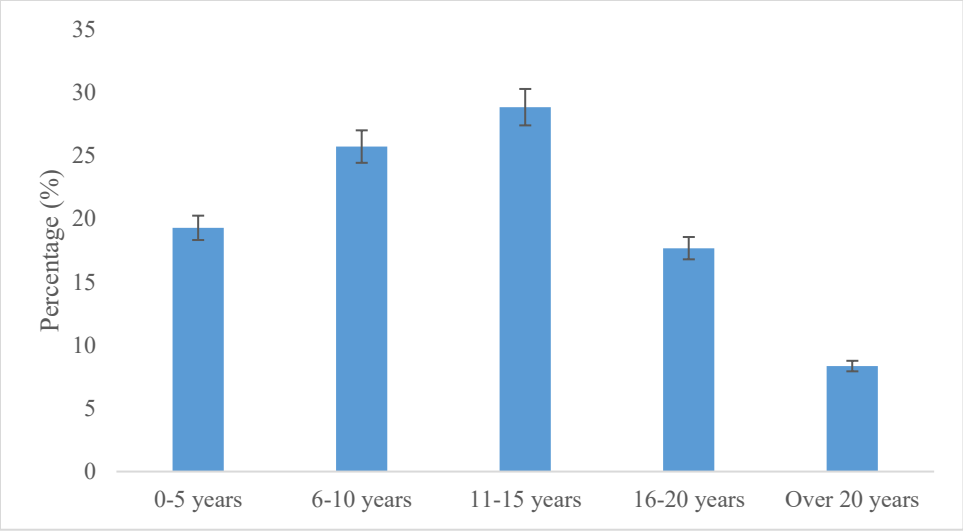


Figure 4: Distribution of Respondents Based on Years of Experience in the Oil and Gas Downstream sector

Emergency Response Planning

Participants' response to the question regarding the presence of well-defined emergency response plans, particularly concerning fire incidents, is shown in Figure 5. The survey reveals that a significant portion of respondents either agree or strongly agree (totalling 46.62%) that their facility possesses well-defined emergency response plans for various scenarios, including fire incidents. A smaller percentage expressed disagreement or strong disagreement (totalling 53.38%) with the existence of such plans. The relatively high percentage of agreement and strong agreement suggests that a substantial portion of facilities have adequately defined emergency response plans in place.

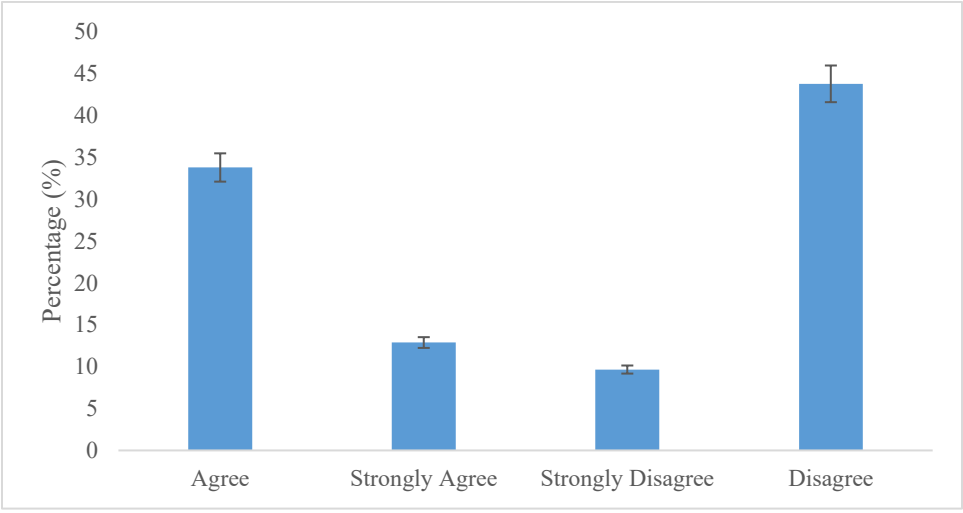


Figure 5: Distribution of Participants' Responses on the Presence of Emergency Response Plans.

Participants' response to designated roles and responsibilities during emergency situations, with trained personnel, are shown in Figure 6. The survey shows that most respondents either agree or strongly agree with the presence of designated roles and responsibilities, with 48.33% indicating agreement and 34.15% indicating strong agreement. A smaller percentage of respondents' express disagreement or strong disagreement, with 13.04% disagreeing and 4.48% strongly disagreeing. The high percentage of agreement and strong agreement suggests that there is a level of organization and preparedness in place, with trained personnel assigned specific tasks. This is crucial for effective emergency response planning, as clear roles and responsibilities can streamline communication and actions during critical situations, ultimately enhancing the overall safety performance and sustainability of the workplace.

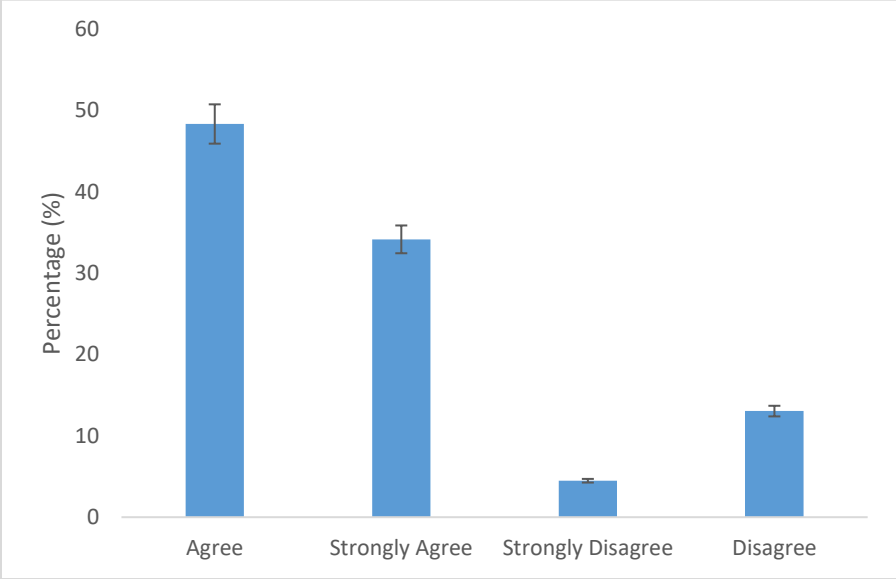


Figure 6: Distribution of Participants' Responses on Designated Roles and Responsibilities During Emergency

Participants' responses to the clarity of the communication system for relaying information and instructions during emergencies are shown in Figure 7. Most respondents (38.57%) indicated agreement with the presence of a clear communication system, while a smaller proportion (11.26%) strongly agreed. Equally, only 8.04% of participants strongly disagreed, and 42.12% disagreed with the effectiveness of the communication system. While a significant portion of respondents expressed agreement and strong agreement, a percentage disagreed or strongly disagreed. This highlights potential areas for improvement in emergency response planning within the oil and gas downstream sector. Enhancing the communication system's effectiveness, such as through regular drills, training, and technological advancements, could facilitate better coordination and information dissemination during critical situations.

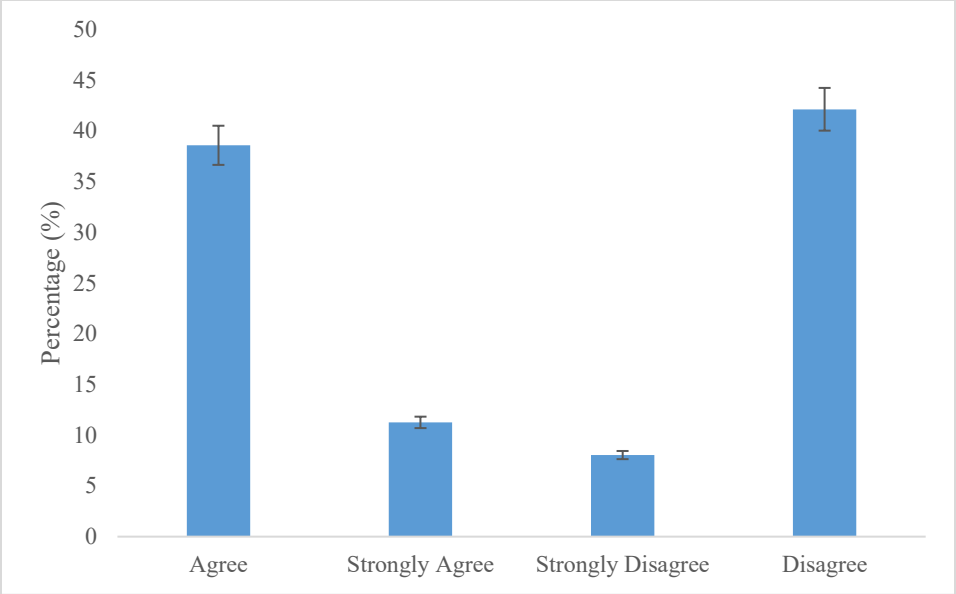


Figure 7: Participants' Responses on Clarity of Communication System for Emergencies

Participants' responses to emergency response planning measures in the oil and gas downstream sector are shown in Figure 8. Majority of respondents expressed agreement with the existence of measures to prevent re-entry into the facility until it is deemed safe after an incident, with 82.84% of participants either agreeing or strongly agreeing. Specifically, 33.55% of respondents agreed, while 49.29% strongly agreed with this statement. Additionally, 7.28% disagreed and 9.88% strongly disagreed with the notion of such measures being in place.

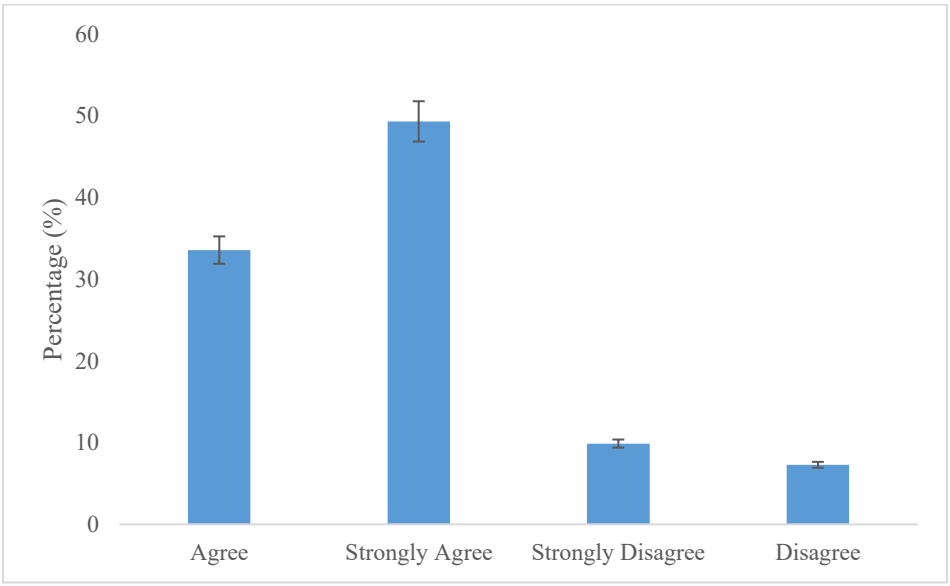


Figure 8: Distribution of Participant Responses on Measures to Prevent Re-entry into the Facility after an Incident

Participants' responses to post-incident assessment conducted to identify causes, response effectiveness, and areas for improvement are shown in Figure 9. Most of participants either agreed (35.38%) or strongly agreed (46.08%) that post-incident assessments are conducted for these purposes, while a small percentage disagreed (9.55%) or strongly disagreed (9%) with this statement. The high percentage of agreement and strong agreement indicates that there is a recognition of the importance of conducting thorough assessments to identify the causes of incidents, evaluate response effectiveness, and identify areas for improvement. This suggests a proactive approach to emergency response planning, which is crucial for enhancing safety performance and ensuring a sustainable workplace environment in the oil and gas sector.

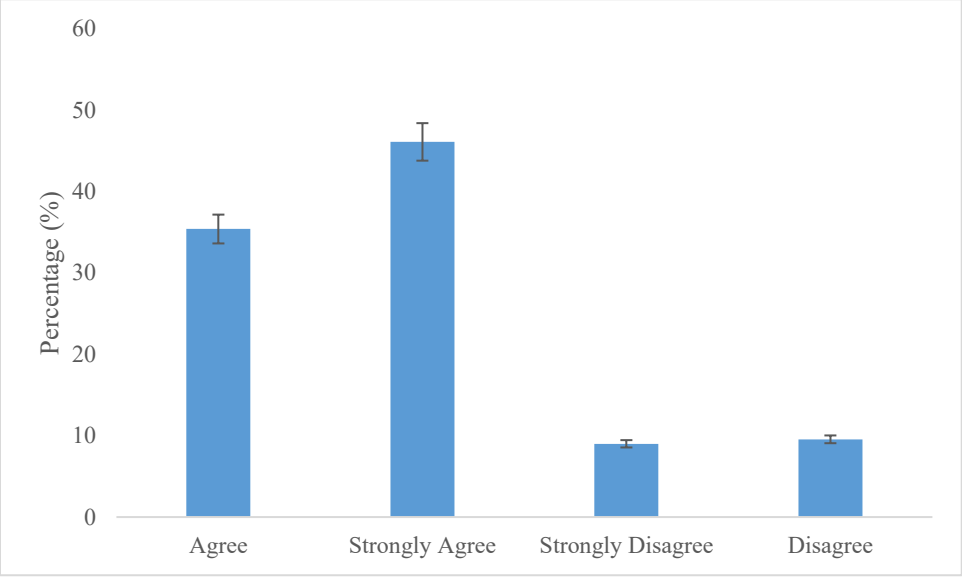


Figure 9: Distribution of Participants' Responses on Post-Incident Assessment Practices in the Oil and Gas Downstream sector

Participants' responses to the presence of mechanisms for providing medical assistance or counselling to affected personnel after incidents are shown in Figure 10. The survey reveals that a combined percentage of 53.07% (27.35% Agree and 25.72% Strongly Agree) acknowledge the existence of such mechanisms. Conversely, a total of 46.94% (17.68% Strongly Disagree and 29.26% Disagree) express reservations or disagreement regarding the provision of medical assistance or counselling post-incidents. The substantial percentage of participants agreeing or strongly agreeing with the existence of mechanisms for medical assistance or counseling indicates a significant level of preparedness and commitment to employee well-being following incidents. However, the presence of dissenting opinions highlights potential areas for improvement, suggesting a need for more comprehensive emergency response protocols and better communication regarding post-incident support services.

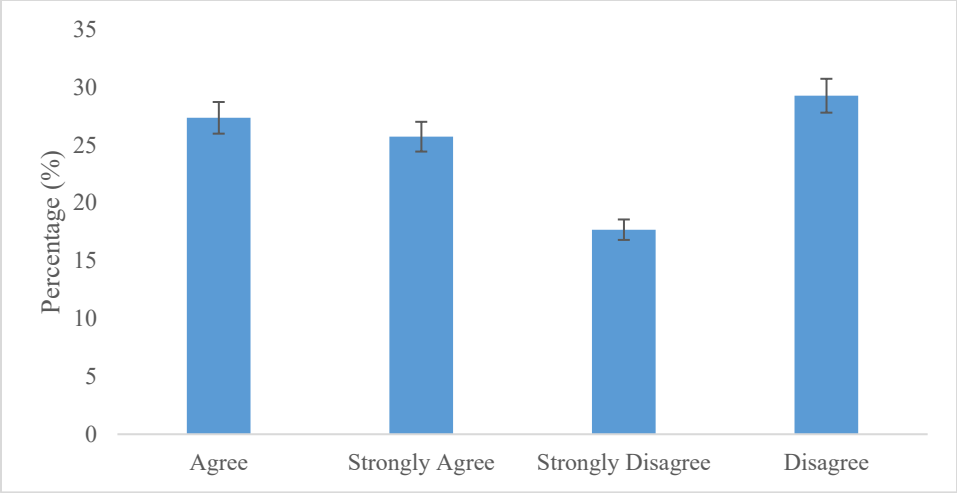


Figure 10: Distribution of Participant Responses Regarding Mechanisms for Medical Assistance or Counselling After Incidents

ISO 14001 Certification

Participants' responses to their facilities operating on ISO 14001 certification for environmental management are shown in Figure 11. The survey reveals that a significant portion of respondents agreed or strongly agreed with having ISO 14001 certification, with 30.55% agreeing and 37.28% strongly agreeing. However, it's noteworthy that a notable proportion of participants also indicated disagreement or strong disagreement, with 19.29% disagreeing and 12.88% strongly disagreeing. This certification signifies a commitment to sustainable practices and compliance with regulatory requirements, fostering a culture of environmental responsibility within organizations. Furthermore, the high percentage of participants agreeing or strongly agreeing with ISO 14001 certification suggests a positive trend towards environmental stewardship and sustainability in the downstream sector.

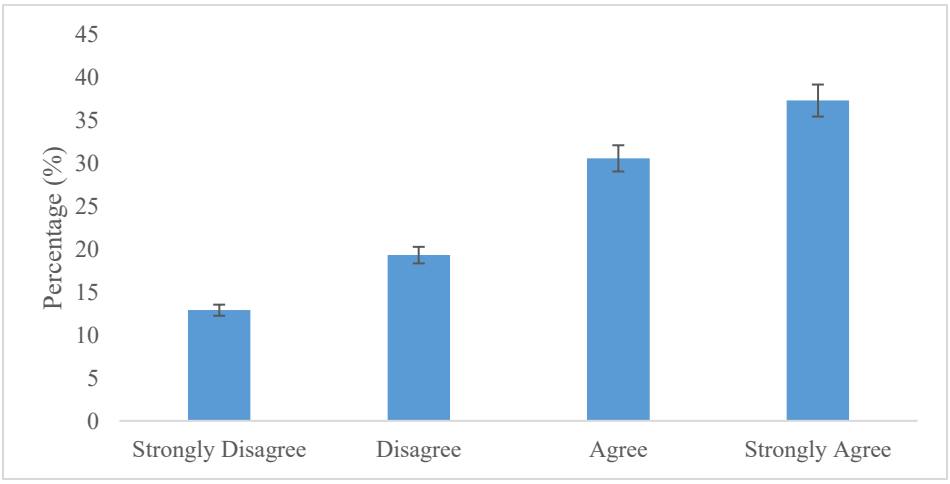


Figure 11: Distribution of Participant Responses on ISO 14001 Certification for Environmental Management

Participants' response to the impact of ISO 14001 certification on the performance of the facility's environmental sustainability and practices are shown in Figure 12. It was observed that a significant portion of respondents either agreed or strongly agreed with the statement, with 25.73% agreeing and 32.5% strongly agreeing. However, a significant proportion of participants also either disagreed or strongly disagreed, with 17.68% and 24.15% respectively. While a substantial portion acknowledged its positive influence, a considerable number also expressed skepticism or dissatisfaction. This distribution of responses suggests the need for further investigation into the effectiveness of ISO 14001 certification in driving environmental improvements and sustainability practices in the downstream sector.

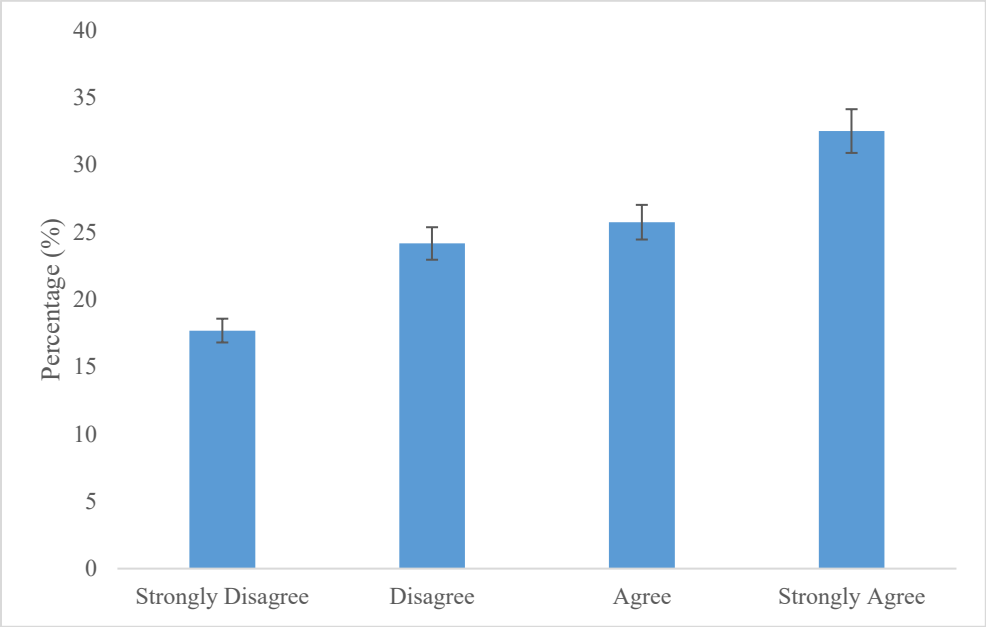


Figure 12: Participant Responses on the Impact of ISO 14001 Certification on Environmental Sustainability and Practices.

Participants' responses regarding the impact of ISO 14001 certification on environmental risk management within their facility are shown in Figure 13. The survey indicates that 19.29% of respondents strongly disagree, 22.51% disagree, 27.34% agree, and 30.87% strongly agree with the statement. These findings reveal a diverse range of perspectives among participants regarding the effectiveness of ISO 14001 certification in managing environmental risks. While a considerable portion of respondents acknowledge the positive influence of the certification, a notable proportion expresses reservations or outright disagreement.

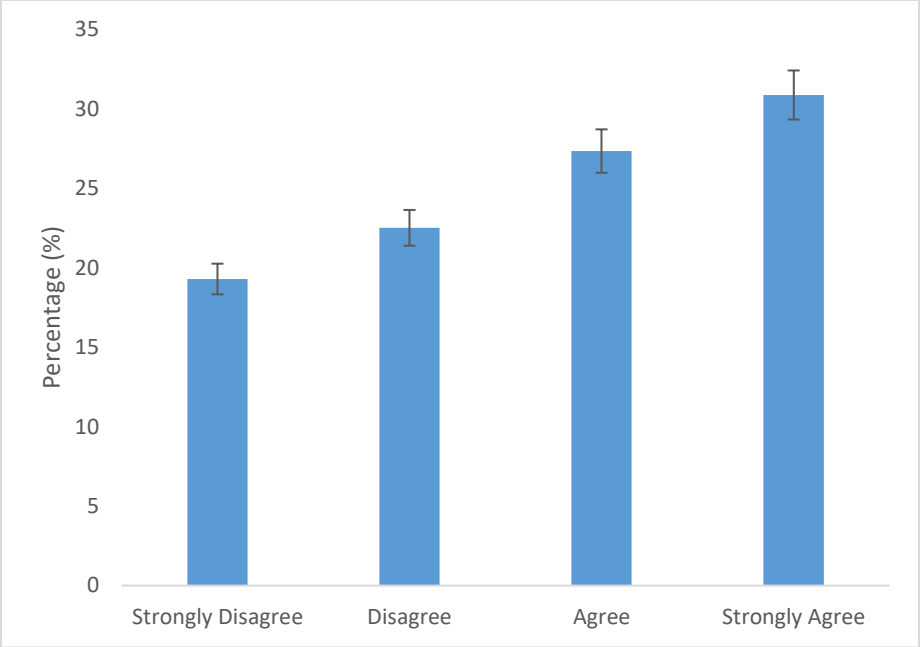


Figure 13: Distribution of Responses Regarding the Effect of ISO 14001 Certification on Environmental Risk Management

Participants' responses to the question regarding the impact of ISO 14001 certification on environmental performance, resource efficiency, and waste reduction are shown in Figure 14. The distribution of responses indicates a notable trend, with 24.15% strongly disagreeing, 16.08% disagreeing, 25.73% agreeing, and 34.08% strongly agreeing with the notion of positive changes post-certification. The distribution of responses reveals a significant proportion of participants acknowledging positive changes following ISO 14001 certification, with over half (59.81%) agreeing or strongly agreeing. This suggests that ISO 14001 certification plays a crucial role in driving improvements in environmental performance, resource efficiency, and waste reduction within the oil and gas downstream sector. Such findings highlight the effectiveness of ISO 14001 standards in promoting sustainable practices and enhancing overall operational performance.

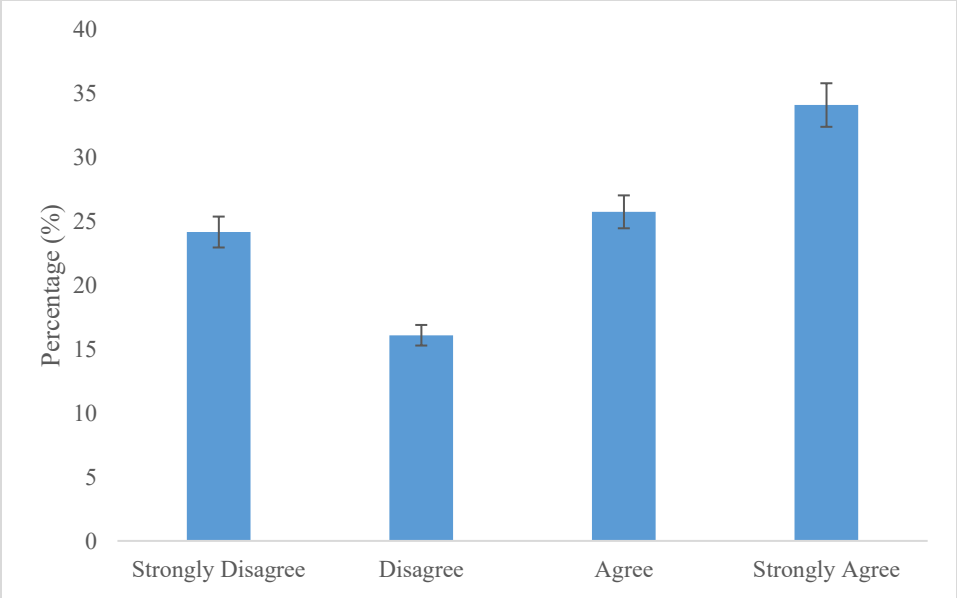


Figure 14: Participants' Responses to the Impact of ISO 14001 Certification on Environmental Performance, Resource Efficiency, and Waste Reduction

Participants' responses to the question regarding the presence of a designated team or individual responsible for maintaining ISO 14001 certification requirements within their organization are shown in Figure 15. The survey indicates a varied distribution of responses, with 20.9% strongly disagreeing, 19.29% disagreeing, 24.15% agreeing, and 35.67% strongly agreeing with the presence of such a designated team or individual. The distribution of responses regarding the presence of a designated team or individual responsible for maintaining ISO 14001 certification requirements highlights the importance of organizational structure and accountability in ensuring compliance with environmental management standards. While a significant proportion of respondents strongly agree with the presence of such designated roles, a notable percentage also express disagreement or uncertainty. This shows the need for clearer communication, training, and oversight mechanisms within organizations to effectively manage ISO 14001 certification requirements and uphold environmental sustainability standards.

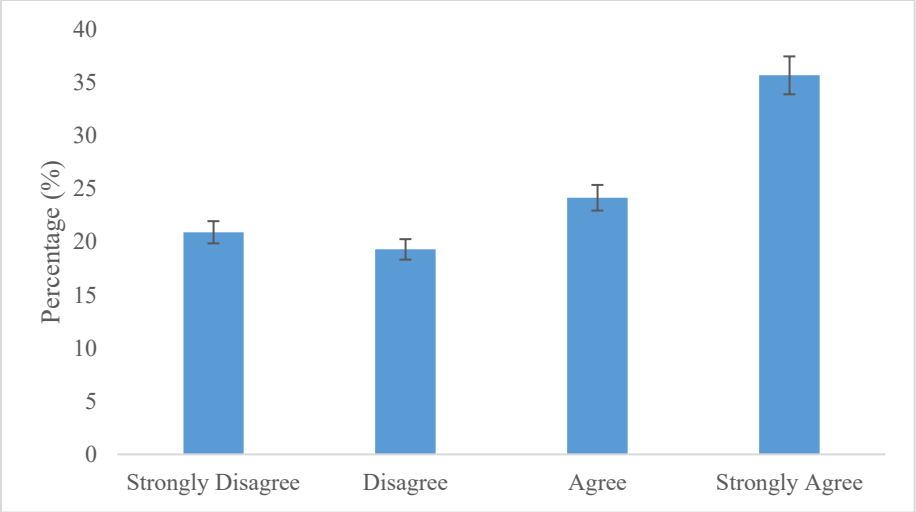


Figure 15: Distribution of Responses Regarding Designated Responsibility for ISO 14001 Certification Maintenance

Participants' response to the presence of a process for conducting internal audits and assessments to ensure ongoing compliance with ISO 14001 standards are shown in Figure 16. The survey shows that a significant portion of participants agreed or strongly agreed with the existence of such a process, with 25.73% agreeing and 30.87% strongly agreeing. However, a notable proportion also disagreed or strongly disagreed, with 22.51% disagreeing and 20.9% strongly disagreeing. While a considerable portion of participants acknowledged the presence of internal audit processes for ensuring compliance, a notable percentage expressed disagreement or uncertainty. This shows the importance of further investigation into the effectiveness and consistency of internal audit practices within the downstream sector, potentially indicating areas for improvement in sustainability initiatives and workplace safety protocols.

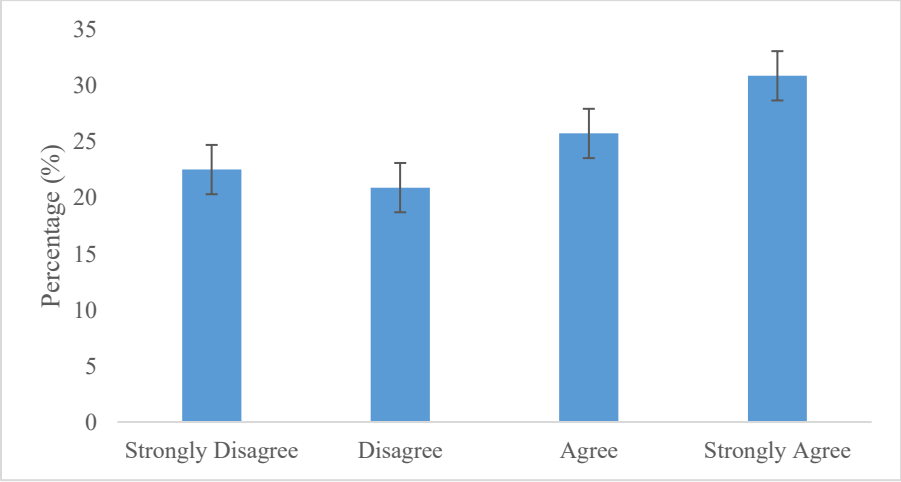


Figure 16: Distribution of Participant Responses Regarding the Presence of Internal Audit Processes for ISO 14001 Compliance

DISCUSSION

Younger employees (18-25 years) as observed in this study may require targeted training programs to address their specific safety needs, while those in the mid-career range (26-55 years) form a significant segment with the potential to contribute to the establishment and continuation of sustainable safety practices, prior research by Alroomi and Mohamed (2021) in occupational safety has explored the impact of marital status on safety performances in various industries which corroborate this study that married individuals may exhibit more cautious behaviours due to their increased sense of responsibility, with family considerations influencing their approach to workplace safety. The preparedness for emergency is crucial for mitigating potential risks and ensuring the safety of personnel, facilities, and the environment. However, the presence of respondents who disagree or strongly disagree highlights potential gaps in emergency planning and underscores the need for further improvements in this study, which further amplified the findings of Jennings, (2020)

The predominance of agreement and strong agreement suggests that organizations within the sector are actively addressing emergency response planning, which is paramount for managing fire-related risks. By ensuring that trained personnel are equipped with designated roles and responsibilities, companies can better mitigate the impact of fires and other emergencies, thereby safeguarding personnel, assets, and the environment as rightly observed by Jennings, (2020).

The overwhelmingly positive response suggests a robust emergency response framework, which is essential for effectively managing fire-related risks. These findings emphasize the importance of continual investment in emergency preparedness and underscore the need for ongoing evaluation and enhancement of safety measures in the oil and gas sector as also observed by Koshiba and Nakayama, (2021).

This proactive approach as indicated in this study, not only enhances safety within the workplace but also contributes to the overall sustainability of operations by minimizing the risk of catastrophic events and their associated impacts on personnel, the environment, and assets as corroborated by Tang et al., (2017). Ensuring adequate provisions for post-incident medical support and counseling can not only enhance employee well-being but also contribute to more effective emergency response and mitigation strategies, ultimately fostering a safer and more sustainable workplace environment as also observed in the study of Brooks et al., (2019).

Facilities with ISO 14001 certification are more likely to have robust environmental management systems in place, including measures for fire prevention, detection, and response as shown in this study and reflects the works of Waxin et al., (2023). Despite the certification's aim to improve environmental sustainability and practices, the existence of dissenting opinions raises concerns about the comprehensiveness and effectiveness of current safety measures which was not in line with the study of Olaniyi and Lamighan, (2023). A significant proportion of participants recognizing positive changes post-ISO 14001 certification indicates an increased focus on environmental management and operational efficiency, which can

indirectly contribute to fire prevention and mitigation efforts as observed by Chountalas et al., (2020).

Organizations with designated teams or individuals responsible for maintaining ISO 14001 certification requirements as shown in this study are likely to demonstrate better preparedness and adherence to environmental safety protocols, thereby reducing the risk of environmental incidents such as fires and minimizing their potential impact on operations, personnel, and surrounding communities which corroborate the studies of Grotta et al., (2020) and Aksoy and Aksoy, (2020).

CONCLUSION

The findings in this study shows the importance of ongoing efforts to enhance workplace safety and sustainability through targeted interventions, comprehensive emergency response planning, and positive changes post-ISO 14001 certification indicates an increased focus on environmental management and operational efficiency, which can indirectly contribute to fire prevention and mitigation efforts. By addressing discrepancies, fostering a cohesive safety culture, and leveraging downstream sector experience, the Nigerian oil and gas sector can strengthen its resilience against fire incidents and promote a safer and more sustainable working environment.

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