Safety Culture Self-Assessment for the Nigerian Nuclear Regulatory Authority

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1. Introduction

The 2011 Fukushima Daiichi nuclear disaster underscored the vital role of regulatory bodies in protecting public safety and the environment from the hazards of ionizing radiation [1]. In response, the International Atomic Energy Agency (IAEA) emphasized the importance of cultivating a robust safety culture within regulatory frameworks globally. A strong safety culture promotes an organizational environment where human interactions with technology and processes minimize errors and prioritize crisis management. The IAEA's safety culture framework, outlined in documents such as GS-G-3.5[2] and GS-R-3[3], provides a comprehensive approach to assessing and enhancing safety culture within nuclear organizations. This study aims to apply these frameworks to the Nigerian Nuclear Regulatory Authority (NNRA), examining key aspects of their safety culture to identify strengths and areas for improvement.

2. Methods and Results

2.1. Survey Design and Data Collection

The study aimed to assess the safety culture within the Nigerian Nuclear Regulatory Authority (NNRA) using a structured survey. The survey was designed based on the International Atomic Energy Agency (IAEA) safety culture framework and covered key dimensions such as leadership actions, regulatory independence, responsibility and accountability, continuous learning and improvement, and psychological safety, etc. The 71 survey items used to assess the safety culture within NNRA were adopted from those developed by a panel of IAEA safety culture experts [4].
The survey items were evaluated using a 5-point *Likert scale* - from strongly disagree (1 point) to strongly agree (5 point) - allowing a total of 88 respondents from various departments within NNRA to express their level of agreement with statements related to the organization's safety culture (Table 1). Data were collected over a two-week period, ensuring a high response rate and reliable data for analysis.

Table 1. Summary Respondents by department

Department	Frequency	Percentage
Radiological Safety	32	36%
Administration and Finance	10	11%
Nuclear Safety, Physical Security, and Safeguards	20	23%
Authorization and Enforcement	19	22%
Medical Application Safety	7	8%
National Institute of Radiation Protection and Research	1	1%
Total	88	100%

2.2. Reliability Analysis

To ensure the reliability of the survey results, a Cronbach's alpha analysis was performed on the data. The reliability scores for all survey dimensions were above 0.7, indicating a high level of internal consistency across the responses. The reliability scores for the key dimensions were as follows:

- Leadership Actions: 0.855
- Independence of the Regulator: 0.817
- Responsibility and Accountability: 0.766
- Continuous Learning, Improvement, and Competence: 0.900
- Psychological Safety: 0.877
- Decision Making: 0.859
- Inter-Disciplinary Internal Cooperation: 0.768
- Openness, Transparency, External Cooperation, and Communication: 0.766

These scores confirm that the survey instrument was reliable and the data collected were suitable for further analysis.

2.3. Factor Analysis

A factor analysis was conducted to explore the underlying structure of the survey items and to identify key factors contributing to the safety culture at NNRA. This method also determines whether the predefined dimensions adequately represent the safety culture and to assess how well each survey item reflects the content of its corresponding dimension. The analysis involved testing from one to eleven factors to evaluate the clustering of items.

When attempting to perform factor analysis, all the results showed that clustered items were mixed across the factors, indicating poor clustering. Several reasons could explain this outcome: "The dimensions that constitute safety culture may not be clearly defined", "If the dimensions are clear, there may be a lack of strong connection between the survey items and their intended dimensions", "The items might be related to multiple dimensions, leading to overlap", "Respondents may have had difficulty understanding the survey items, which could have affected their responses".

2.4. Results

Table 2 summarizes the mean scores and standard deviations for each safety culture dimension assessed within NNRA.

Table 2. Summary Statistics for Overall Safety Culture

Dimension	No. items	Mean	Standard Deviation
Leadership Actions	8	4.005	0.950
Independence of the Regulator	5	3.912	0.988
Responsibility and Accountability	3	4.130	0.810
Continuous Learning Improvement and Competence	11	4.001	0.925
Questioning Attitude	6	4.012	0.852
Ethics and Moral Courage	5	3.960	0.990
Psychological Safety	5	3.834	1.014
Systematic Regulatory Approach	7	4.149	0.836
Decision Making	7	4.181	0.811
Inter-Disciplinary Internal Cooperation	7	3.991	0.856
Openness Transparency External Cooperation and Communication	7	4.070	0.827

3. Conclusions

This study provided a simple and overall assessment of the safety culture within the Nigerian Nuclear Regulatory Authority (NNRA), highlighting strengths such as strong leadership, effective decision-making, and a systematic regulatory approach. These positive aspects demonstrate that NNRA is in a solid position to maintain and improve its regulatory effectiveness.

However, challenges were identified especially in ***regulatory independence*** and ***psychological safety***. Working staff expressed concerns about insufficient resources to fulfill the NNRA's mission, and about feeling unable to raise issues without fear of retaliation. Addressing these concerns is critical for building a more open and supportive work environment. Initiatives such as non-punitive reporting mechanisms and better resource allocation can significantly enhance the NNRA's safety culture.

Additionally, *factor analysis* revealed that the survey dimensions were not clearly defined, with survey items clustering poorly across multiple dimensions. This suggests a need for refining the safety culture framework and survey environment in future research to ensure a clearer alignment of items with their respective dimensions.

By improving regulatory independence, psychological safety, and refining the assessment tools, NNRA can strengthen its safety culture further, ensuring its success in regulating nuclear activities and serving as a model for other regulatory bodies.

REFERENCES

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