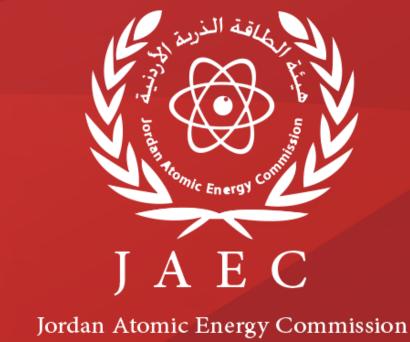
TECHNICAL MEETING ON RESEARCH REACTORS:

Integrated Management Systems for the Sustainable Safe Operation and Effective Utilization of RRs





Validation of Contributing Factors (CFs) Analysis for Conditions Adverse to Quality (CAQs) at the Jordan Research and Training Reactor (JRTR)

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Abstract

Ensuring high standards of quality and safety is paramount in nuclear facilities, where minor deviations can lead to significant operational or safety consequences. Conditions Adverse to Quality (CAQs) represent significant quality issues, including failures, malfunctions, deficiencies, deviations, defective items, and non-conformance. Lots of factors can worsen a CAQ, known as Contributing Factors (CFs). To maintain a solid Quality Management System (QMS) at the Jordan Research and Training Reactor (JRTR), these CFs are annually collected, analyzed, and resolved. This study develops a comprehensive questionnaire for assessing and validating 10 cumulative CFs over the past few years which supports the Root Cause Analysis (RCA) of these CFs at the JRTR. A standardized methodology was used to develop this questionnaire, including item generation, content and face verification, and pilot testing. A final set of 37 questions was formulated targeting the collection of quality issues focusing on their potential severity and frequency of occurrence. Data from 94 JRTR participants were analyzed using SPSS. Pareto analysis (mean and cumulative percentage) was used to rank contributing factors (CFs) of CAQs by severity and frequency. Results showed strong alignment between the questionnaire and JRTR's cumulative database in identifying the top four CFs. This confirms the database's reliability, supports targeted quality improvements, and validates the questionnaire as a consistent assessment tool.

Keywords: Conditions Adverse to Quality, RCA, Contributing Factors, Pareto Analysis, JRTR, QMS

Introduction

To ensure consistency in analyzing the CFs of CAQs at the JRTR, this study develops and validates a newly developed questionnaire for Root Cause Analysis (RCA).

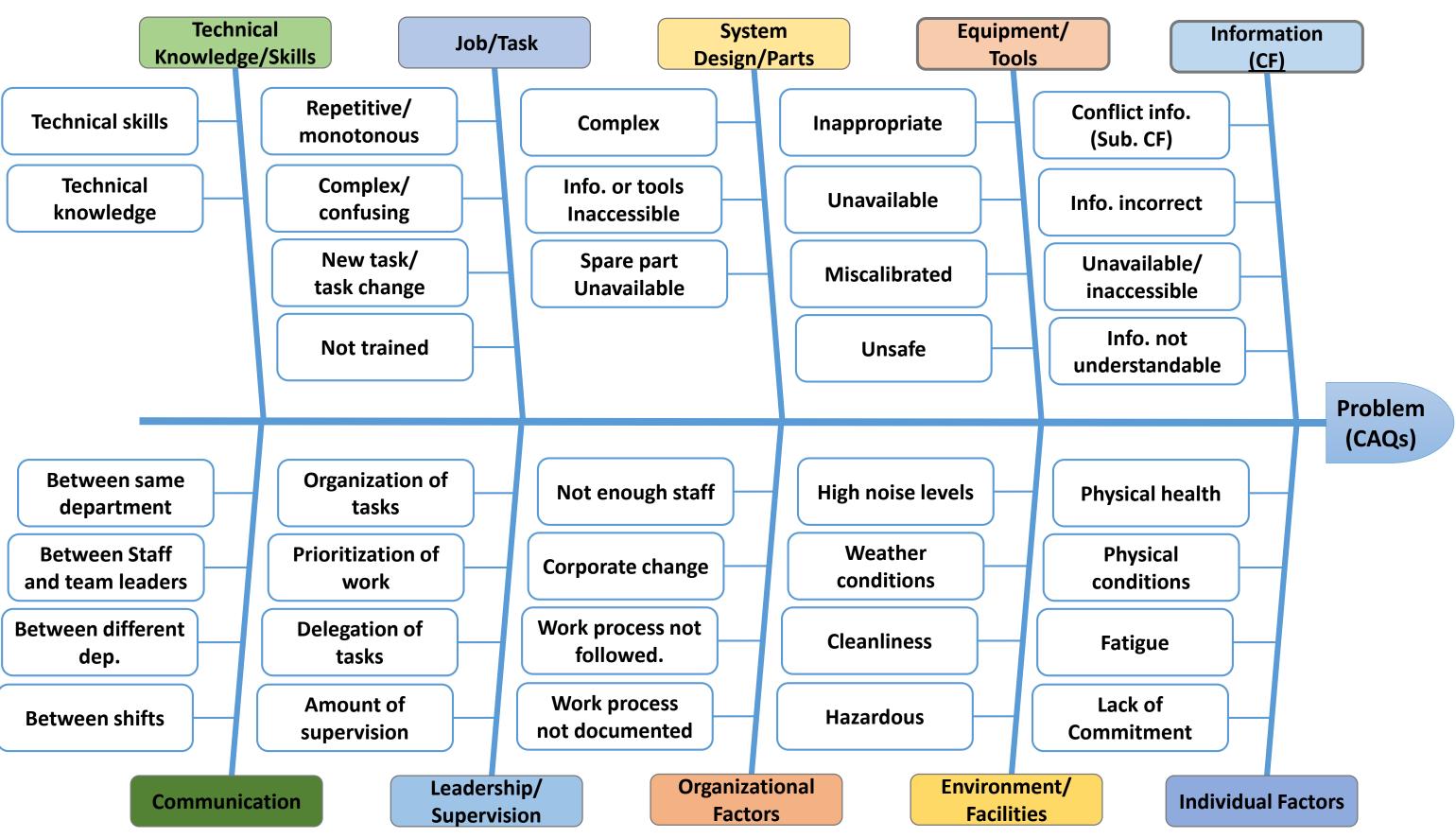


Fig. 1 Ten major CFs and 37 Sub. CFs for CAQs at the JRTR using Fishbone Diagram

Methodology

- ✓ What: Validation of 10 CFs Analysis for CAQs at the JRTR
- ✓ Whom: JRTR employees ~ 120
- ✓ How: Questionnaire method (based on Likert scale)
- ✓ Tool: Google form and SPSS software

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✓ Target: 94 employees as shown in Table 1

Table 1: Characteristics of Participants

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No.		JRTR Directorate		Gender		Experience (Years)				Position	
	Ο.			Male	Female	< 3	3-6	6-9	> 9	Employee	Supervisor
1	L	Reactor Operation	18	16	2	4	5	4	5	14	4
2	2	Administration & Logistics	10	6	4	4	1	2	3	7	3
3	3	Utilization Technology	4	4	0	2	0	0	2	2	2
	1	Nuclear Safety and Licensing	4	2	2	2	2	0	0	2	2
5	5	Compliance and Assurance	7	3	4	1	3	1	2	5	2
6	5	Nuclear Security	8	7	1	2	4	1	1	7	1
	7	Facility Maintenance	18	17	1	3	9	4	2	14	4
8	3	Radiation and Occupational Safety	12	10	2	5	3	3	1	8	4
g	9	Radioisotopes	13	12	1	4	2	6	1	9	4
		Total	94	77	17	27	29	21	17	68	26

Conclusion

✓ The research found a strong alignment between the questionnaire responses and the JRTR's old database for identifying top CFs, confirming the database's reliability. This work validates the questionnaire as a consistent assessment tool and supports targeted quality improvements.

Acknowledgement

The author is grateful to the Jordan Research and Training Reactor (JRTR) team for their valuable participation in the questionnaire of this study. In addition, the author would like to extend his sincere gratitude to the JRTR Manager, **Dr. Majd Hawwari**, Compliance and Assurance Manager, **Eng. Reem Alsous**, and Neutron Beams Section Head, **Eng. Mahmoud Suaifan**, for their precious contribution to the success and facilitation of this study.

Validation Technique

In this work, the study was done using Pareto analysis to compare 10 CFs based on questionnaire responses (A) vs JRTR's old database (B). The detailed analysis of both results are tabulated in Table 2.

Table 2: Comparison of 10 Contribution Factors (Questionnaire Responses vs Old Database)

		A D .										
	A. Pareto Analysis of CFs					B. Pareto Analysis of CFs						
		Based on Questionnaire Responses					Based on Old Database					
	Rank	Contribution Factor	SPSS Mean [M]	Weight% [M/Sum]	Cumulative [M/Sum]n + [M/Sum]n-1	Rank	Contribution Factor	Count of CARs No. [C]	Weight% [C/Sum]	Cumulative [C/Sum]n + [C/Sum]n-1		
	1	Information	2.19	12.71%	12.71%	1	Organizational Factors	328	35.62%	35.62%		
	2	Job/Task	1.94	11.25%	23.96%	2	Information	184	19.98%	55.6%		
	3	Leadership/ Supervision	1.92	11.14%	35.11%	3	Job/Task	94	10.21%	65.81%		
	4	Organizational Factors	1.85	10.72%	45.83%	4	Leadership/ Supervision	83	9.01%	78.82%		
	5	Technical Knowledge/ Skills	1.68	9.75%	55.58%	5	Communication	76	8.25%	83.07%		
	6	Communication	1.61	9.35%	64.93%	6	Individual Factors	74	8.03%	91.1%		
	7	System Design/ Configuration	1.60	9.30%	74.22%	7	Equipment/ Tools	52	5.65%	96.75%		
	8	Equipment/ Tools	1.53	8.89%	83.11%	8	Technical Knowledge/Skills	15	1.63%	98.38%		
	9	Environment/ Facilities	1.52	8.81%	91.92%	9	Environment/ Facilities	9	0.98%	99.36%		
	10	Individual Factors	1.40	8.08%	100%	10	System Design/ Configuration	6	0.65%	100%		
		Sum	17.24					921				

Results

- Figure 2 presents a Pareto analysis comparing CFs identified by both the newly developed questionnaire and an existing database. The database attributes 80% of CFs to organizational factors, information, job/task issues, and leadership/supervision.
- The questionnaire results largely align with this, identifying the same CFs while also highlighting technical knowledge/skills, communication, and system design/configuration.

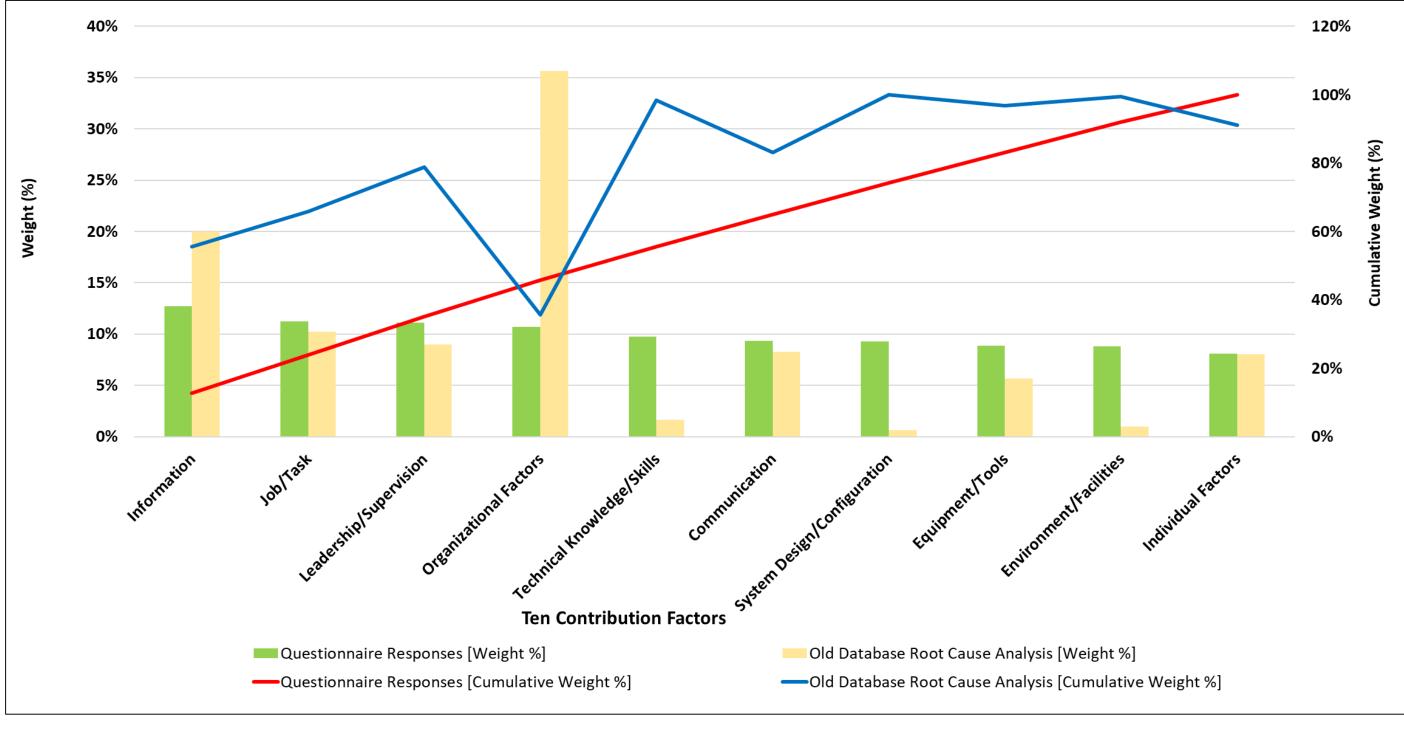


Fig. 2 Comparison of 10 CFs based on Questionnaire Responses (Green) vs. Old Database (Orange)

References

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- [1] ASME NQA-1–1994, Quality Assurance Requirements for Nuclear Facility Applications
- [2] IAEA-TECDOC-1756, Root Cause Analysis Following an Event at a Nuclear Installation
- [3] IAEA Technical Reports No. 317 Implementation of Quality Assurance Corrective Actions
- [4] How to Test the Validation of a Questionnaire/Survey in a Research
- [5] J. Juran, and A.B. Godfrey, "Quality handbook," Graw-Hill, 5th ed., 173, 8, 1998
- [6] J. Knezevic, D. A. Kadi, and A. Raouf, "In hand book of Maintenance Management and Engineering"