Application of Safety Maturity Model and 4P-4C Model in Safety Culture Assessment

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1. Introduction

Korean government and utility have made efforts to enhance the nuclear safety culture and the development of quantitative index of safety culture was promoted for past several years. Quantitative index of safety culture and the past efforts to understand safety culture need insight into the concept of culture [1].

This paper aims to apply new method of measuring nuclear safety culture through the review of approaches of evaluating safety culture in non-nuclear industries. Scoring table has been developed based on new models and example of result of interviews evaluating the nuclear safety culture is also shown.

2. Methodology

The concept of nuclear safety culture was originally defined in the IAEA's INSAG-4 document in 1991. It defined the safety culture as the assembly of characteristics and attitudes in organizations and individuals. However, safety culture could be understood as the subculture within an organizational culture related to the safety. Evaluating the safety culture of a particular organization poses some challenges. Edgar Schein[1] helped in understanding how the concept can be assessed. He suggested the levels of culture from very visible to the tacit and invisible as following diagram which shows a multilevel model of culture in 1992 [1].

Table 1: Schein's Multilevel Model of Culture

Level	Concept
Artifacts	Architecture, Behavior – visible
Espoused values	Strategies, Goals, Philosophies – can be elicited
Basic assumptions	Human nature, Basis on which people are respected – unconsciously held and usually tacit

IAEA have stressed the role of safety culture and aims to make safety culture strong and sustainable through SCART (Safety Culture Assessment and Review Team) service for safety culture assessment of Member States. SCART directly relates to the IAEA

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[1] He is a professor at the MIT Sloan School of Management and investigates organizational culture.

Safety Guide GS-G-3.1 of "Application of the Management System for Facilities and Activities", which provides guidance for all of the areas covered in Safety Requirements GS-R-3 and incorporates behaviors, attitudes, value and basic beliefs that came from Schein's multi-level model. The framework identified in GS-G-3.1 consists of five key safety culture characteristics listed as follows [2];

- Safety is a clearly recognized value
- Leadership for safety is clear
- Accountability for safety is clear
- Safety is integrated into all activities
- Safety is learning driven

The limitation of these approaches to evaluate safety culture is that it does not enable evaluators to quantify the culture and to measure the invisible basic assumption.

This paper tried the application of the indicators developed by other risky industries (e.g. oil and aviation) measuring safety culture quantitatively. The first model often referred is the Safety Maturity Model developed by Professor Patrick Hudson of Leiden University (Holland) [3]. It describes continuous improvement of safety management like a ladder with five steps in shown Fig. 1.
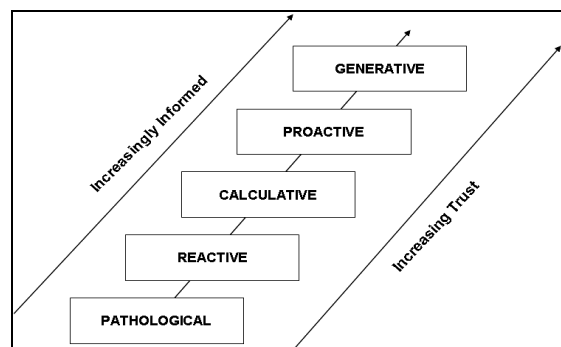

Fig. 1: Hudson's Safety Culture Ladder

In a **pathological** level, safety is not cared and bad news is ignored and not welcome. In a **reactive** stage, safety is seriously considered and systems are in place, but bad news is kept hidden. **Calculative** level is where systems are working. Organisations are satisfied with their systems and bad news is tolerated, but still unwelcome. **Proactive** is where a safety management system starts to be effective. It is starting to consider what might go wrong in the future and to be involved in practice. **Generative** organizations set very high

standards and they are honest about failure, but use it to improve, not to blame. Generative organisations are High Reliable Organisations (HRO) [3].

The second model is the assessment structure, called 4P-4C developed by Dublin Trinity University. The 4Ps stand for Philosophies, Policies, Procedures, Practices. These 4 elements represent the organisational management elements. Philosophies are principles, beliefs, or espoused values of the organisation. Policies need to reflect the philosophies of the organisation. Procedures are designed and agreed by workforce and they should be matched with the goals and principles of the organization. The practice is the real situation and the fulfilment of the intentions.

The 4Cs represent the categories of the assessment as Culture, Continuous Learning, Competence, and Comprehensive Human Factor [4].

3. Sample Case Study

The next approach scoring safety culture is the combination of Hudson's Ladder and 4P-4C model. The five key safety culture characteristics, used in SCART mission as international guidelines, were considered. After making 4P-5C matrix for nuclear safety culture, 5 steps of ladder according to the improvement of safety culture can be assumed as 5 points from 1 of pathological level to 5 of generative level. For example, if a company has a procedure on leadership for safety and it is working, it could be told that its safety level is **calculative**.

Table. 2: Example of Scoring Table

4P / 5C	Philosophies	Policies	Procedures	Practices
Safety is a clearly recognized value	Pro-active (4)	Calculative (3)	Calculative (3)	Calculative (3)
Leadership for safety is clear	Pro-active	Calculative	Calculative	Calculative
Accountability for safety is clear	Calculative	Pro-active	Calculative	Calculative
Safety is integrated into all activities	Calculative	Calculative	Calculative	Reactive
Safety is learning driven	Pro-active	Calculative	Calculative	Reactive

Scoring results of the interviewer's for 10 imaginary interviewees for measuring the safety culture is shown as the diagram is more illustrative than the table. It is noted that the score of each interviewee is set as arbitrary constants and the result shown is therefore just one sample expression from the application of Hudson's ladder and 4P-5C matrix model.

In Fig. 2 showing the distribution of answer to question of "Safety is a clearly recognized value", the gray bar is the upper and lower band of average with 10% deviation and line length means the difference between highest and lowest value among the interviewees. It shows that philosophy is slightly small steps ahead and it suggests more discussion is needed on why safety is recognized less clearly in procedures.

Fig. 2: Example of Scoring Chart

The development of appropriate methodology to measure the culture is important; however, interview skill of inspectors is as much critical as methodology. Because interview is not an audit, inspectors are requested to stand at a "tell me" approach instead of loaded question. Openness or frankness of the interviewees should come before other considerations.

4. Conclusions

Safety culture of organization has been considered as one of the important elements in organizations in assuring safety. Measuring safety culture is a valuable supplement to understand what they do in safety management point of view.

The application of 4P-4C matrix and the maturity culture ladder to nuclear safety culture could be considered as one tool for assessing quantitatively invisible value as well as visible system.

This approach needs further study on how to improve the inspector's interview skill and integrate the assessment results effectively in organization's management system.

REFERENCES

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