



Contents lists available at ScienceDirect

Nuclear Engineering and Technology

journal homepage: www.elsevier.com/locate/net

Original Article

Development of the nuclear safety trust indicator

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ARTICLE INFO

Article history:

Received 29 March 2018

Received in revised form

19 June 2018

Accepted 6 July 2018

Available online xxx

Keywords:

Nuclear safety

Trust

Safety schema

Risk communication

Indicator

Q methodology

ABSTRACT

This study went beyond making an indicator simply based on theoretical arguments, and explored a wide spectrum of different types of perceptions about energy safety to make a concept of energy safety for the Korean society. The energy safety schemata of people can be divided into three types. Type1 is concern about multi-level risks-responsibility-centric, type2 is concern about security and personal burden-expertise-centric, and type3 is concern about health and personal burden-responsibility-centric. Questions were designed on the basis of the characteristics, differences and commonalities of the three types of perceptions, explored through the Q methodology, and Koreans' perception of nuclear safety was examined. Based on the results of this research the following components of trust in nuclear safety were derived, risk perception, responsibility, honesty, expertise and procedural justification. The items for specifically evaluating them were developed, and factor analysis was conducted, and as a result, the validity of each item was proven. The components of the nuclear safety trust indicator do not exist independently, but influence each other continuously through interactions. For this reason, rather than focusing on any one of them, laws and systems must be improved first so that they can move together in one big frame.

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1. Introduction

Due to the continued controversies and anxiety about nuclear safety, social conflicts cannot be avoided but be spread in the process of formulating and pursuing related policies. These social conflicts will deplete limited human and economic resources in the course of arguments, and produce a concern that they will have negative impacts on enhancing actual safety. It is aggravated as the gaps, resulting from the essential differences between experts' approach to nuclear safety or nuclear risks and citizens' approach, grow.

Public interest in safety is increasing, and the demand for a higher level of safety is getting stronger. Nuclear safety is at its core. The boundary between perception of safety and risk is ambiguous, and it is true that there are controversies over the numbers elaborately calculated in scientific and technological terms. However, trying to unconditionally meet diverse safety demands from various directions with ambiguous principles may rather endanger safety. Accordingly, it is very meaningful to secure the standards for mediating emotional or ideological disputes that destroy healthy disputes by developing a nuclear safety trust indicator that the society can relate to. Also, as the minimum mechanism for

controlling the social side effects of handling the nuclear safety issue politically, the nuclear safety trust indicator can play its part.

Accordingly, to measure the trust in nuclear safety, this study attempts to develop an indicator that can measure citizens' perception of the safety of nuclear power plants and their demand for it, and propose a method of contributing to the policy process based on the measurement and result analysis of the developed indicator.

2. Research methodology

To develop a nuclear safety trust indicator, various kinds of literature on safety and trust were reviewed. Media coverage focused on nuclear safety issues was explored, and the data, which were officially utilized during the public opinion poll regarding Shin-Kori 5 and 6 nuclear power plants, were analyzed in a variety of ways. Additionally, various data was investigated to understand overseas energy policy decision-making processes and the laws and institutions related to the information disclosure concerning nuclear safety.

To understand the concept of safety in people's perception on this basis, the Q methodology was used to explore different types of energy safety schemata. 57 citizens were selected as the through P sampling, and the answers to Q questions were collected online

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<https://doi.org/10.1016/j.net.2018.07.002>

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Please cite this article in press as: S. Cho, Development of the nuclear safety trust indicator, Nuclear Engineering and Technology (2018), <https://doi.org/10.1016/j.net.2018.07.002>

from November 14, 2017 to November 15, 2017. In the Q methodology, the P sample itself is a variable, and unlike the general statistical method, it is not intended to generalize the research results, but to understand the phenomenon, so the number of samples and the method of selecting the samples are not fixed. Here, citizens are defined as subjects for research, and the panel of Korean research is used to extract proportional allocation based on gender, age, and educational background. To ensure the reality of the different type of energy safety schemata, unforced sorting was used to measure the degree of consent on an 11-point scale. And the result of Q sorting was analyzed using the CENSORT program. For the CENSORT program used here, the maximum number of P samples is 80.

Meanwhile, to develop a nuclear safety trust indicator, a survey was conducted. The proportional allocation method by region, gender and age was used to receive responses to the survey from 1023 people. The online survey through e-mail was conducted for 4 days from November 21, 2017 till November 24, 2017, and the sampling error is $\pm 3.1\%$ (95% confidence level). Also, factor analysis was conducted based on the survey result to develop the nuclear safety trust indicator.

3. Theoretical discussions

The concept of trust can be interpreted multi-dimensionally depending on targets, and diverse viewpoints can be verified with regard to components. Information, influence and control are presented as components of trust [1], and consideration, respect, risk calculation and control ability, a sense of calling, ability and the order of the civil society are presented as components of trust [2]. Also, some scholars conceptualizes trust with focus on responsibility, trustworthiness and ability [3]. Similarly, ability, openness, consideration and consistency are presented as the basic concepts of trust [4]. Some scholars regard expectations of performance, a sense of duty and a sense of responsibility as important attributes of trust [5]. Others present, as components of trust, ability, sincerity, openness, utilizability, acceptance, consistency, fairness and discrimination [6]. It can be said that these conceptual definitions are focused on the characteristics and expectations of the targets of trust. Meanwhile, some scholars define trust as a subjective probability based on predictability while viewing trust in relation to uncertainty [7]. Some argue that the risk concept must be explicitly included in the concept of trust [8]. It means that trust is also subjective and judgmental like risk. Also, some argue that it is desirable to measure trust in the institutions that are targets of trust on another level [9].

Although trust is a concept frequently used in our daily lives, it tends to be defined differently depending on dimensionality and function. nevertheless, what many researchers accept is that trust can be defined as a psychological state of accepting vulnerability based on positive expectations about others' intentions or behavior [10]. Rousseau et al. divided trust into two types based on various grounds. One is the relational trust based on the relationship between the truster and the counterpart, and the other is the calculative trust based on the restrictions of the counterpart's past or future behavior. In general, the former is classified as trust, and the latter as confidence. Meanwhile, Luhmann [11] conceptualizes the trust function as reducing present uncontrollable complexity in return for future benefits resulting from cooperation. Based on these universal views, trust will be explained here as giving a positive value through subjective value judgment in a social relationship.

According to the analysis of studies on trust in the risk management area, antecedents of trust belong to one of the following categories [12]. Most of the items used for measurement are ordinarily related to the attributes of trustworthiness, that is, honesty,

concern, competence, transparency and responsibility, etc. Antecedents related to ability, including expertise and experience, are also used. In addition, situational attributes like procedural fairness are used as antecedents. Meanwhile, the categories of consequences can be summarized as risk perception, benefit perception, policy support, risk acceptance, affective responses & intention, etc.

Viewed in this context, trust in nuclear safety is differentiated from the targets of trust that were handled previously. That is, 'nuclear safety,' the target of trust, can hardly be specific as a target. Accordingly, it is necessary to specify the target as the main agent that judges nuclear safety with authority. This study attempts to conceptualize trust in nuclear safety as giving a positive value to nuclear safety in the relationship with the main agent that judge nuclear safety with authority although it cannot fully understand nuclear safety rationally.

4. Analysis of energy safety schema types

The energy safety issue starts with scientific, technological and engineering discussions. However, the issues derived from there have value-judgmental characteristics in essence. It can be said that the subjectivity of the main agent of judgment is a very important factor. An appropriate method of measuring subjectivity scientifically and statistically is the Q methodology [13].

Concern about risks, concern about burden, Trust in main agents responsible for safety, including government, operators, regulators and experts, and risk assessment were selected as the criteria for designing Q questions. Concern about risks refers to people's concern about the several risks likely to occur in the process of producing electric power from energy sources. That is, concern about health, concern about the environment, concern about security, concern about accidents, concern about climate change and concern about changes in the ecosystem are examples. Concern about burden refers to concern about the various types of costs that must be paid because a certain energy source is selected. It includes concern about personal burden, concern about social burden and concern about the burden of the next generation. The trust in the main agents refers to the level of trust on the main agents who makes energy-related policy decisions, and the main agents who assesses the risks occurring in the process of utilizing the energy source. That is, it can be divided into trust in the policy decision makers and trust in the risk assessment main agents. Risk assessment means according to which criteria risks are assessed, and whether it is possible to manage risks so that the inherent risks will not take place. Expectations about risk controllability and the criteria for judging risks are included.

As shown in Table 1, the energy safety schemata of people can be divided into three types. 26.3% is type 1 (concern about multi-level risks-responsibility-centric), and 19.3% is type 2 (concern about security and personal burden-expertise-centric), and 1.8% is type 3 (concern about health and personal burden-responsibility-centric). 52.6% of people do not have any energy safety schema. It means that a considerable number of people do not have any socio-culturally structured frame of consciousness about the energy safety issue. That is, it can be concluded that the experience of the energy safety issue, information on it, knowledge of it and interaction with the outside are quite minimal. Interaction with the outside means communication with others and perception and judgment in a given context. Accordingly, it can be regarded as a natural phenomenon that controversies over the energy safety issue are frequent, and diverse arguments are at loggerheads.

The concern about multi-level risks-responsibility-centric energy safety schema looks at energy safety based on a strong concern about risks. In particular, it pays attention to health and environment, and examines various aspects of accidents from probability

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