A study on Impact of Safety Culture on Safety Behavior: Moderating effect of Prevention Focus

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1. Introduction

In modern society, it has been acknowledged that disasters caused by civilization became inevitable. With growing attention to role of human as one component of the system to cope with accident to prevent disasters, various efforts have been deployed to keep safety. In the nuclear industries, after the Chernobyl accident in 1986, 'safety culture' has been emphasized for last 30 years as a prerequisite to ensuring high level of nuclear safety. And most of the industries with high hazard have adopted the term as their banner in the efforts to promote safety in their installations and operations [1]. Recently, the Fukushima nuclear power plants(NPPs) accident happened in Japan in 2011 resulted in great impact over the world and have highlighted the importance of safety culture again.

1.1. Safety Culture and Safety Behavior

Safety culture presents a great diversity of meanings and the definition of safety culture is numerous. According to Pidgeon(1991), safety culture is "the set of beliefs, norms, attitudes, roles, and social and technical practices that are concerned with minimizing the exposure of employees, managers, customers, and members of the public to conditions considered dangerous or injurious" [2]. The most widely adopted definition of safety culture of IAEA is "that assembly of characteristics and attributes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance" [3]. Reason(1997) proposes that safety culture comprises of five sub-culture; information culture, reporting culture, just culture, flexible culture, learning culture [4]. Sub-culture is a term that can be used interchangeably to refer to a sub-group of people but it is more widely used as an aspect of culture itself. Griffin & Neal(2000) proposes five dimension as sub-factors of safety culture; management values, safety communication, safety practices, personal training, safety equipment [5]. In Korea, Korea Institute of Nuclear Safety(KINS) developed safety culture model for regulatory oversight purpose that is composed of 13 factors and verified the construct validity of the KINS model [6].

The validation of presumption that 'healthy safety culture leads good safety performance' needs more research. There are a few researches exploring the relationship between the safety culture of the organization and safety behavior of individuals. Griffin & Neal's study supported that safety culture is positively related to safety behavior(safety compliance behavior and safety participation behavior). It is also shown that CEO's commitment to safety(safety education) and safety participation are negatively correlated to the injury frequency of the organization.

1.2. Prevention Focus and Safety Culture

Regulatory Focus Theory(RFT) stems from the notion that "people are motivated to minimize discrepancies between actual and desired end states(i.e., seek pleasure) and maximize the discrepancy between actual and undesired end states(i.e., avoid pain)" [7]. According to Crowe & Higgins(1997), people use two different strategies to accomplish desired outcomes, which are promotion focus and prevention focus. Prevention focus(PF) is evoked when needs for security, attention to losses, or the fulfillment of duties and obligations are emphasized, whereas promotion focus is evoked when needs for growth, attention to gains, or the attainment of aspirations and ideals are emphasized [8]. Some researches empirically proved that within organization, PF of individual positively relates to safety behavior and safety culture is also positively related to prevention focus, and individual's PF related significantly to safety attitude [9, 10].

1.3 Purpose of the study

This study investigates the impact of the safety culture of NPP operating organization on safety behavior of individuals. In addition, the moderating role of individual's prevention focus in the relationship between safety culture and safety behaviors will be verified. Two hypotheses are developed as follows;
Hypothesis 1: The effect of each sub-factor of safety culture on individual's safety behavior are different.
Hypothesis 2: Prevention focus of individual has moderating effect on the relationship between all of the sub-factors of safety culture and safety behaviors.

In this study, 5 factors of KINS safety culture model are used in the verification of the hypotheses. These are selected considering organizational behavior relatedness as follows; information sharing, decision making, safety leadership, organizational competency and just culture.

2. Methodology

2.1. Sampling and Procedure

A survey is developed, planned and administered in seven nuclear power plants of Korea from March to April 2015. The safety culture survey items are verified with pilot validation study [11]. Researchers of KINS visited the plants and introduced the purpose and manner of the survey and anonymity was emphasized. Among 700 survey data of the respondents, 450 data are used in the analysis. Plant work tenure of participants is that 40.2% are less than 5 years, 40.0% are between 6 years and 20 years, and 19.8% are over 20 years.

2.2. Measures

Safety Culture and Safety Behavior: The data are collected using validated questionnaires which are developed by KINS[6]. Safety leadership(six items), organizational competency(five items), information sharing(five items), decision making(five items), justice culture(five items) and safety behaviors(five items) are measured. Survey participants were asked to rate their degree of agreement with each statement using a 7-point Likert scale ranging from strongly disagree to strongly agree.

Prevention Focus: Self-reported prevention is assessed using questionnaires of three items developed by Neubert et al. [12]. 7-point Likert scale was used to measure the prevention focus.

3. Results

3.1. Descriptive Analysis

Descriptive statistics and correlations of all variables are described in Table 1. The mean values obtained from average of responses of survey items representing prevention focus, safety behavior are high, and those of safety leadership, organizational competency and just culture are comparatively low. Correlations among sub-factors of safety culture are high and positive. Cronbach's coefficient alpha(α) values which represents internal consistency of each variable are all over 0.7, which is minimum criterion for acceptable reliability.

Table 1. Descriptive statistics, Cronbach's alpha and correlations

Variables	M	SD	α	1	2	3	4	5	6
1. Safety Leadership	5.06	1.28	.90						
2. Organizational competency	5.21	1.15	.88	.82**					
3. Information sharing	5.40	1.03	.82	.85**	.79**				
4. Decision making	5.58	1.01	.84	.78**	.78**	.82**			
5. Just culture	5.32	1.07	.87	.81**	.84**	.82**	.79**		
6. Prevention Focus	6.31	0.73	.81	.41**	.40**	.49**	.50**	.43**	
7. Safety behavior	5.99	0.81	.90	.63**	.66**	.73**	.71**	.70**	.73**

*p < . 05, **p < . 01

3.2. Hypothesis Testing and Discussion

To test hypothesis 1, "the effect of each sub-factor of safety culture on individual's safety behavior are different", multiple regression model assuming safety behavior as dependent variable is used. The multiple regression analysis result is depicted in Table 2. It is shown that there are differences in the effect of the sub-factors of safety culture on safety behavior as follows; information sharing(β=.373), decision making(β=.283), and just culture(β=.220) have higher positive impact on safety behaviors than others where β represents standardized coefficient of the multiple regression. This result can be interpreted that to enhance the safety behavior of members, it is important that the management is actively sharing safety-related information, encouraging to present a dissenting opinion, having a safety first decision-making processes. And, the perception of justice culture is shown to affect safety behavior of members, which also shows that there is a need to design the fair administration management system throughout the organization.

Table 2. Multiple regression analysis of sub-factors of safety Culture on Safety Behavior

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	β	S.E.	β		
(Constant)	2.425	.150		16.134	.000
Safety Leadership	-.090	.042	-.142	-2.129	.034*
Organizational competency	.053	.046	.075	1.161	.246
Information sharing	.293	.054	.373	5.451	.000***
Decision making	.229	.048	.283	4.787	.000***
Just culture	.168	.051	.220	3.289	.001**
R=0.764 R^2=0.584, AdjR^2=0.579 F=124.672 p=.000					

*p < .05, **p < .01, ***p < . 001

Table 3. Moderating effect of Prevention Focus between safety leadership and safety behavior

		Dependent Variable : Safety Behavior					
		Model 1		Model 2		Model 3	
		β	t	β	t	β	t
Independent variable	Safety Leadership	.595	15.533***	.381	12.352***	.381	12.697***
Moderator	Prevention Focus			.563	18.759***	.508	16.263***
Interaction term	Safety Leadership x Prevention Focus					-.143	-5.044***
R^2		.421		.677		.695	
$\triangle R^2$				.256***		.018***	
F		64.577***		351.917***		25.439***	

*p < . 05, **p < . 01, ***p < . 001

To test hypothesis 2, "prevention focus of individual has moderating effect on the relationship between all of the sub-factors of safety culture and safety behaviors",

hierarchical moderated regression analysis is used. In the analysis result, it is found that PF moderates the relationship between all of the sub-factors of safety culture and safety behaviors. For example, moderating effect of PF between safety leadership and safety behavior is significant as depicted in Table 3. It is also shown that organizational competency(β=-.120, p<.001), information sharing(β=-.114, p<.001), decision making (β=-.130, p<.001) and just culture (β=-.125, p<.001) are all significant.

Figure 1 shows that individuals having high PF shows absolutely high safety behavior. And individuals having low prevention focus(PF) seem to show relatively higher increase in safety behavior compared to those having high PF when safety leadership is high. This finding is very important because safety leadership; managements' effort to improvement safety culture; can improve actual safety behaviors of individuals, especially who have low prevention focus.

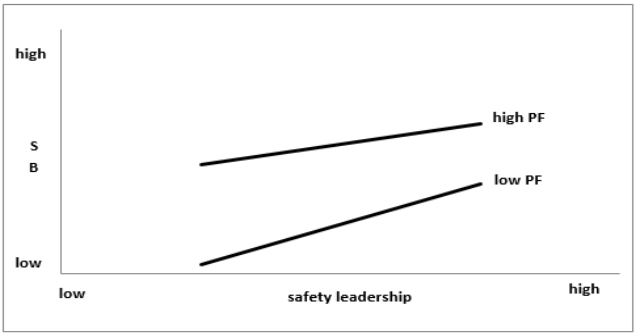

Figure 1. Moderating effect of PF between safety leadership and safety behavior
(SB : Safety Behavior, PF : Prevention Focus)

According to previous studies, prevention focus may be internalized from an early age and be affected by the circumstances. Combined with results of hypotheses testing and Figure 1, it can be concluded that it is necessary to increase the prevention focus of individuals in the NPP operating organization by strong safety leadership and safety culture. And it is preferred to select new staffs having high PF, educate and train constantly existing staff focusing on safety, and select and train the prevention focus-oriented managements.

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