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The Effects of Knowledge Management System for Earthquake Disaster Management Job Performance

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Abstract: Purpose: The purpose of this study is to verify the effects of assessment and compensation system, information technology, knowledge quality, and knowledge management activities on the earthquake disaster management job performance. **Method:** Questionnaire survey was performed for the fire officials, and the multi-regression analysis for surveyed data was statistically performed by using SPSS 25.0 program. **Result:** Information technology, knowledge quality and knowledge management activities among the factors of the knowledge management system related to earthquake disasters have had significant positive effects on the earthquake disaster management job performance, but assessment and compensation system are found to have no significant effects on the earthquake disaster management job performance. **Conclusion:** It was confirmed that the higher the level of information technology, knowledge quality and knowledge management activities related to earthquake disasters, the higher the disaster management job performance.

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I. INTRODUCTION

Knowledge management in public institutions seeks to efficiency of tasks from the corresponding office through knowledge management activities and knowledge learning activity (Sim, 2010). The National Emergency Management Agency (NEMA) in South Korea, the agency in charge of disaster management including earthquake, also established a knowledge management system and operated a knowledge management system related to disaster management. In disaster management task including earthquake, a mutual cooperation system is absolutely necessary, along with the sharing of knowledge and information related to disaster management, in order to manage disasters in a mutually cooperative manner between the organization of disaster management and the related agencies. As a prerequisite for achieving this, the establishment of a disaster management information system is most necessary (Choi and Ryu, 2006). The disaster management information system enables rapid decision making and disaster response in the event of disaster such as earthquake (Lee and Kim, 2005). In addition, it is required related expertise of fire prevention officials in charge of disaster management above all else, disaster management work as an expert with sufficient edge and skills in earthquake disaster management shall be carried out. These NEMA officials, as disaster management specialists, are able to minimize the damage by preventing repeated disasters every certain period of time or by effectively responding to and coping with disasters, focusing on their own knowledge of disaster management, response techniques and related know-how (Han, 2002).

Therefore, it was necessary to enhance the performance of disaster management such as earthquake by strengthening the knowledge management activities of fire prevention officials in charge of management of knowledge and disaster related to disaster management. Thus, research regarding the knowledge management of the organization has been carried out internally and globally. Devenport et al. (1998) presented a case study of the organizational knowledge management by deriving and presenting the factors for the success of the knowledge management. Lee and Choi (2003) found that the capabilities of knowledge management have a positive impact on the organizational management have a positive impact on the organizational production of intermediate outputs through knowledge management activities. It is also said that these interim outputs ultimately have a positive impact on the organizational performance. Furthermore, Uday et al. (2007) study suggested factors such as information quality, system quality and use of information system as success factors for knowledge management system. However, these previous researches are not focused on disaster management, but on general organizational knowledge management, and the research on knowledge management system in disaster management is very insufficient.

As a result, an empirical analysis is required on the success factors of knowledge management that affect the performance of disaster management tasks in the organization of the NEMA and local disaster management organization who is organization of disaster management. It is also necessary to investigate the impact of the characteristics of the knowledge management system on the performance of disaster management on fire prevention officials who are the actual users of the knowledge management system related to earthquake disasters.

Aim and objectives

This study aims to investigate and empirically verify the impact of factors of knowledge management system related to earthquake disaster, factors of assessment and compensation system, factors of information technology, factors of knowledge quality and factors of knowledge management activities on the performance of earthquake disaster management. The detailed research objectives are as follows: First, to verify the impact of the evaluation and compensation system of the knowledge management system related to earthquake disaster on the performance of disaster management. Second, determine the impact of information technology of knowledge management system related to earthquake disaster on the performance of disaster management. Third, verify the impact of the knowledge quality of the knowledge management system related to earthquake disasters on the performance of disaster management. Fourth, investigate the impact of knowledge management activities of the knowledge management system relevant to earthquake disaster management on the performance of disaster management.

II. MATERIALS AND METHOD

In this study, out of about 50,000 national and local fire officials in South Korea, 230 fire officials from the Gyeonggi Provincial Fire Agency who expressed their cooperation in the survey of this study were visited in person. After fully explaining the aim and objectives of the survey to the fire officials who agreed to and cooperated with the survey responses, the questionnaire was prepared in accordance with the self-written law under an anonymous. A total of 218 of the survey was used for final statistical analysis excluding 12 response that was missing or showed unfaithful responses.

Research model and hypothesis

Based on prior research, the work performance of earthquake disaster management was deduced to be different depending on the characteristics of the knowledge management system related to earthquake disasters, and the following research models and theories were designed (McDermott and O'Dell, 2011; Kim and Kim, 2007; Sim, 2010). In this study, independent factors set factors of earthquake disaster-related knowledge manage system including the factors of assessment and compensation system, information technology factor, knowledge quality factor and factor of knowledge management activities. Also, the variable and seismic disaster management performance are set as subordinate variables.

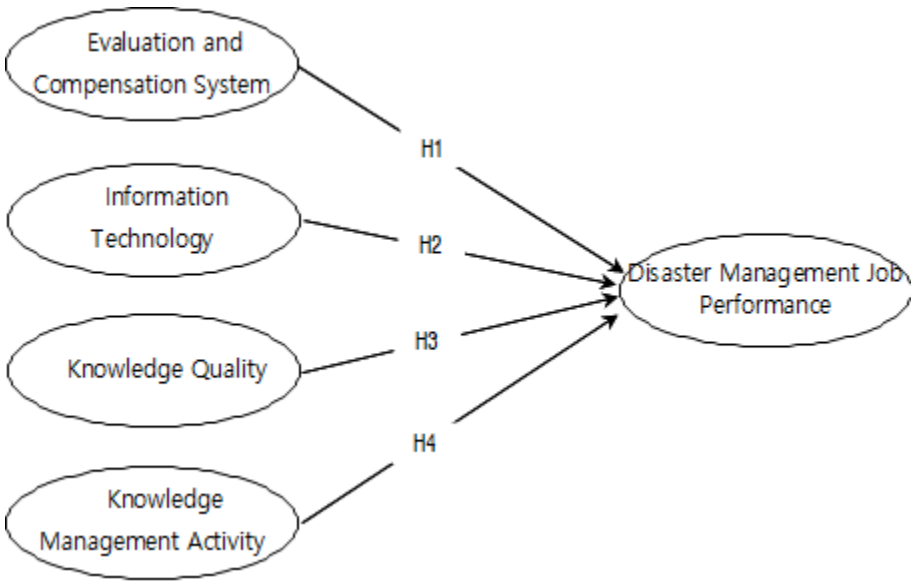

Fig no 1. Research model of the study

H1. The evaluation and compensation system of knowledge management system related seismic disaster will have a positive effect on the performance of seismic disaster management.
H2. Information technology of the knowledge management system related seismic disaster will have a positive effect on the performance of earthquake disaster management.
H3. The knowledge quality of the knowledge management system related to earthquake disaster will have a positive effect on the work performance of earthquake disaster management.
H4. Knowledge management activities of the knowledge management system related to seismic disasters will have a positive impact on the performance of earthquake disaster management work.

This study was analyzed statistical processing of data using the SPSS 25.0 program. First, frequency and percentage were calculated to identify the distribution of demographic characteristics of fire officials under investigation. Second, knowledge management system related to earthquake disaster and performance of earthquake disaster management were set as variables for this study. To verify validity and reliability of the variables, an exploratory factor analysis (EFA) and the Cronbach's α coefficient were calculated for reliability verification. Third, the study conducted Pearson correlation analysis to identify the correlation between seismic disaster-related knowledge management system and seismic disaster management performance and variables. Finally, multiple regression analysis was conducted to verify the research theory to examine the impact of knowledge management system factors related to seismic disaster management. The significance level of statistical analysis and hypothesis verification is based on α=.05.

III. RESULT

Demographics characteristics of the subject

The following Table 1 has shown the demographic characteristics of 218 fire officials in Gyeonggido. Regarding affiliation, 141 officials (64.7%) belonging to municipal and provincial affiliation, followed by 61 officials (28.0%) from the county and 16 officials (7.3%) from the NEMA. In terms of position, the highest number of position consisted of 58 officials (26.6%) in rank 9, 77 officials (35.3%) in rank 7, 28 officials (12.8%) in rank 6, 31 officials (14.2%) in rank 5 and 24 officials (11.0%) in rank 4 or higher rank. The work period consisted of 13 officials (6.0%) under one year, 49 officials (22.5%) under one to three years, 50 officials (22.9%) under three to five years, 52 officials (23.9%) under five to ten years and 54 officials (24.8%) over 10 years. In main tasks, establishment of countermeasures and field response shows the largest with 95 officials (43.6%), followed by 46 officials (21.1%) for establishment of plan and guidelines, 39 officials (17.9%) for performing education and training and 38 officials (17.4%) for recovery plan and performance.

Table no 1: Shows demographic characteristics of the surveyed objects

Variable		Number(Man)	Percentage(%)
Affiliation	National Emergency Management Agency	16	7.3
	City/Province	141	64.7
	Gun/Gu	61	28.0
Position	Grade 9	58	26.6
	Grade 7	77	35.3
	Grade 6	28	12.8
	Grade 5	31	14.2
	Grade 4	24	11.0
Job Period	<1 year	13	6.0
	1 year ~3years	49	22.5
	3 years ~5 years	50	22.9
	5 years ~10 years	52	23.9

	≥10 years	54	24.8
Main Responsibilities	Planning and guidance	46	21.1
	Establishing countermeasures and responding on-site	95	43.6
	Performing education and training	39	17.9
	Establishing and implementing a recovery plan	38	17.4
Total		218	100.0

Evaluation of reliability and validity

This study conducted an exploratory factor analysis to verify the conceptual validity of the measurement tool in this study, and the principal component analysis was performed for each independent and dependent variable using Varimax method for factor rotation. The study excludes the components which is lack of validity to ensure conceptual validity. Examples of components that lack of validity include: the measured component with a factor loading of 0.5 or less; two or more factors with a higher factor loading rating of 0.5 or higher; and questions that show high factor loading due to different research concepts. In addition, the Cronbach's α coefficient was calculated to verify the reliability of the times that constitute the variables extracted from the factor analysis. The Table no 2. presents the factor analysis and reliability verification results of 36 measurements items of knowledge management system related to seismic disaster. First, Kaiser-Meyer-Olkin's (KMO) measure of sample was also high at 0.895 and as a result of Bartlett's test of spherically, which verifies whether there is unit matrix between measurement components for factor analysis, Approximated 1478.744(df=66, p<.001) indicating the collected data and measured component are suitable for performing a factor analysis. The results of the analysis presents as following: two factors related to the assessment and compensation system of seismic disaster deemed to be lacking in validity; two component of information technology factors related to seismic-related disaster; one knowledge quality factor related to seismic disaster; three factors related to knowledge management activities related to seismic disaster which are excluded eight components resulting four components. The total variance R-squared of the four factors related to the knowledge management system relevant to seismic disasters extracted through factor analysis is 64.581% of the total variance determinant of the four factors related to the knowledge management system related to earthquake disasters extracted through analysis. The conceptual validity of the measurement components of these study variables has been confirmed. Specifically, factor 1 shows 20.314% of variance R-squared as a factor of the knowledge quality related to seismic disaster; factor 2 is the seismic disaster assessment and compensation system factor, with 16.480% variance R-squared; factor 3 is an information technology factor related to seismic disaster with 14.674% variance R-squared; and factor 4 is a factor in knowledge management activities related to seismic disaster with 13.113% variance R-squared.

The study verified the reliability of the components of the knowledge management system related to seismic disaster and results of the Cronbach's α coefficient present the following factors have high value of internal consistency: the knowledge quality factor for seismic disaster is 0.916; The seismic hazard assessment and compensation system factors are 0.900; The seismic-related information technology factors is 0.906; and the factor of knowledge management activities related to seismic disaster is 0.838.

Table no 2: Shows exploratory factor analysis and reliability for the variable of earthquake disaster-related knowledge management system

Factor	Measuring Item	Factor Loading	Eigen Value	Variance (%)	Cronbach's α
Knowledge Quality	KP_2	.747	5.688	20.314	.916
	KP_1	.686			
	KP_7	.684			
	KP_6	.676			
	KP_3	.663			
	KP_8	.655			
	KP_10	.615			
	KP_4	.613			

	KP_9	.595			
Evaluation and Compensation System	ECS_2	.818	4.614	16.480	.900
	ECS_1	.816			
	ECS_4	.729			
	ECS_5	.668			
	ECS_6	.656			
	ECS_3	.610			
	ECS_7	.505			
Information Technology	IT_8	.729	4.109	14.674	.906
	IT_7	.636			
	IT_2	.621			
	IT_9	.600			
	IT_6	.588			
	IT_1	.579			
	IT_5	.568			
Knowledge Management Activity	KMA_8	.757	3.672	13.113	.838
	KMA_3	.725			
	KMA_1	.607			
	KMA_4	.556			
	KMA_7	.555			

KMO=.895, Bartlett: χ^2=4652.781(*df*=378, *p*<.001), Total Variance=64.581%

The Table no 3. below presents the exploratory factor analysis of seismic disaster management performance and 12 measurements components which are the dependents of this study. The results of factor analysis, KMO measures for 12 measurement components were found to be 0.883, and Bartlett's test for sphericality shows Approximated 1478.744(df=66, p<.001). The factor loading was ranging from 0.807 to 0.587 which is derived from a single factor and variance is R-squared is 52.779%. The result of verification of seismic disaster management performance and reliability of components confirmed that the Cronbach's α coefficient was at 0.917 indicating that it is consisted of high internal consistency.

Table no 3: Shows exploratory factor analysis and reliability for the variable of disaster management job performance

Factor	Measuring Item	Factor Loading	Eigen Value	Variance (%)	Cronbach's α
Disaster Management Job Performance	DMJP_4	.807	6.333	52.779	.917
	DMJP_11	.800			
	DMJP_10	.790			
	DMJP_1	.772			
	DMJP_3	.764			
	DMJP_12	.749			
	DMJP_2	.740			
	DMJP_9	.699			

	DMJP_5	.689			
	DMJP_8	.658			
	DMJP_7	.624			
	DMJP_6	.587			

KMO=.883, Bartlett: χ^2=1478.744(*df*=66, *p*<.001), Total Variance=52.779%

Table no. 4 shows the results of reviewing the technical statistics by evaluating the research variables established through validity and reliability verification on five-point scale. Firstly, the average of the study variables are as follows in the order of: Knowledge quality related to seismic disaster (3.19); Information technology related to seismic disaster (3.11); The assessment and compensation system for seismic disaster (3.10) that not all factors were higher than average. The perception of seismic disaster management performance also showed an average of 3.21 and was not high enough to be slightly above normal. Then, the skewness and kurtosis were investigated to examine normality. In general, if the absolute value of skewness is 3.0 or less and the absolute value of kurtosis is 10.0 or less, the Test for Normality is satisfied. The absolute value of skewness and kurtosis are 1.0 or less from factors of seismic disaster-related knowledge management system, performance of seismic management and variable that indicates the Test for Normality is satisfied for these components.

Table no 4: Shows descriptive statistics of the variables

Variables		Min.	Max.	Mean	SD	Skewness	Kurtosis
Knowledge Management System	Evaluation and Compensation System	1.29	4.57	3.10	.66	-.58	.31
	Information Technology	1.43	4.71	3.11	.68	-.24	-.12
	Knowledge Quality	1.78	4.78	3.19	.62	-.09	.01
	Knowledge Management Activity	1.40	4.80	3.07	.63	-.08	.29
Disaster Management Job Performance		1.58	4.58	3.21	.54	-.36	.82

Correlation between variables

The results of investigating the correlation between seismic disaster-related knowledge management system factors and seismic disaster management work performance and variable are as shown in Table 5. As a result of Pearson correlation analysis, the factors of knowledge management system related to seismic disaster show a significant positive correlation with the performance of seismic disaster management, indicating a direction consistent with the research theory. The value of correlation analysis are as follows: seismic disaster-related assessment and compensation system (r=0.632, p<0.001); Seismic disaster-related information technology (r=0.784, p<0.001), Knowledge quality related to seismic disaster (r=0.745, p<0.001); and Knowledge management activities related to seismic disaster (r=0.765, p<0.001).

Table no 5: Shows Pearson correlations of the research variables

Variables		Knowledge Management System				Job Performance
		F1	F2	F3	F4	
Knowledge Management System	Evaluation and Compensation System(F1)	1				
	Information Technology(F2)	.700***	1			
	Knowledge Quality(F3)	.619***	.763***	1		

	Knowledge Management Activity(F4)	.614***	.694***	.702***	1	
Disaster Management Job Performance		.632***	.784***	.745***	.765***	1

***p<.001

Hypothesis verification

Multiple regression analysis was conducted to verify the research theory established to examine the impact of the knowledge management system on the performance of seismic disaster. The results are shown in Table 6. As the result of the co-linearity among the knowledge management system factors related to seismic disaster, which are independent variables, the variance inflation factor (VIF) was lower than 4.0 in all factors, indicating the problem of multi-collinearity was not significant.

Table no 6: Showsthe effects of earthquake disaster-related knowledge management system on disaster management job performance

Variables	Non-standardized coefficient		Standardized coefficient	t	Co-linearity	
	B	*SE*	*β*		Tolerance	VIF
(constant)	.734	.111		6.610***		
Evaluation and Compensation System	.034	.043	.041	.784	.473	2.113
Information Technology	.289	.051	.362	5.647***	.315	3.174
Knowledge Quality	.172	.052	.197	3.278**	.357	2.803
Knowledge Management Activity	.301	.047	.350	6.378***	.430	2.327
R^2=.724, Adjusted R^2=.719, F=139.931***						

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

The analysis showed that the factors of knowledge management system related to seismic disaster showed relatively high explanatory correlation coefficient, accounting for the performance and variables of seismic disaster management by 72.4% and the regression model was significant meaningful (F=139.931, p<0.001). Among the factors in the knowledge management system relevant to seismic disasters, information technology related to seismic disaster (β=0.362, t=5.647, p<0.001), Knowledge quality related to seismic disaster (β=0.197, t=3.278, p<0.001) and knowledge management activities related to seismic disaster (β=0.350, t=6.378, p<.001) have a significant positive effect on performance of seismic disaster management. However, the factor of evaluation and compensation of seismic-related disaster (β=.041, t=.784, p>.05) has no significant impact on the performance of seismic disaster management. The performance of seismic disaster management and the relative influence were predicted to be influential in order of information technology related to seismic disaster, knowledge management activities related to seismic disaster and knowledge quality relevant to seismic disaster.

Among the knowledge management system factors related to seismic disasters, the assessment and compensation system factors related to seismic disaster have shown no significant impact on the performance of seismic disaster management. It is believed that this may aid in activating the operation activities of the members' knowledge management systems by granting them to know-how and compensation system based on the disclosure of information held by fire prevention officials. However, it does not directly affect the performance of seismic management, such as the accurate and rapid establishment of disaster measures, rapid decision-making, needed for field response work, and the ability of fire officials to respond. These results present that information technology related to seismic disaster and knowledge quality relevant to seismic disaster are high, and that the knowledge management activities related to seismic disaster are carried out properly, the performance of seismic disaster management work will enhance. Therefore, it can be seen that the following factors among the factors of the knowledge management system are the major factors leading to positive effects on the performance of seismic disaster management including: Information technology related to seismic disasters, knowledge quality related to seismic disasters and knowledge management activities related to seismic disasters. As a result, hypothesis 2, 3 and 4 were adopted but hypothesis 1 were rejected.

IV. CONCLUSION

In this study, the following components which impact on performance of seismic disaster management was analyzed through a survey of fire prevention officials including the impact of factors of knowledge management system related to seismic disaster, factors of assessment and compensation system, information technology, knowledge quality and knowledge management activities. The main results from the empirical analysis are as follows: First, evaluation and compensation system of knowledge management system related to seismic disaster (β=.041, t=.784, p>.05) does not present significant impact on seismic disaster management performance. Second, information technology (β=.362, t=5.647, p<.001) of knowledge management system related to seismic disaster have a significant positive effect on disaster management performance. These results mean that the higher level of information technology in the knowledge management system related to seismic disaster, the more positive the performance of disaster management can be. Third, knowledge quality of knowledge management system related to seismic disaster (β=.197, t=3.278, p<.01) was found to have a significant positive effect on disaster management performance. These results indicate that the higher the level of knowledge quality of knowledge management system related to earthquake disasters, the more positive the performance of disaster management can be. Lastly, knowledge management activities of the knowledge management system related to seismic disaster (β=.350, t=6.378, p<.001) was found to have a significant positive effect on disaster management performance.

These results indicate that the higher the level of knowledge management activities in the knowledge management system related to seismic disasters, the more positive the performance of disaster management can be. The above results confirmed that information technology and knowledge quality related to seismic disasters are high, and that the more well knowledge management activities related to earthquake disasters are carried out, the higher performance of seismic disaster management work is. These results are the same as the prior research that suggested the success factors of the operation of the knowledge management system (Devenport et al, 1998) and the prior research that demonstrated that the competencies of knowledge management have a positive impact on the performance of the organization (Lee and Choi, 2003).

Furthermore, the study by Uday et al. (2007) presented factors such as information quality, system quality, and use of information system as success factors for enhancing the performance of the knowledge management system and supports the results of this study. Despite these key implications of this study, this study has limitation of an empirical analysis to some fire officials from the Gyeonggi Provincial Fire Agency and may have limitation in generalizing the results of this study. Therefore, extensive research requires to be carried out including fire prevention officials belonging to other regional fire department. This will provide important policy implication for knowledge management of seismic disaster management that can enhance the performance of disaster management in South Korea.

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