

Effects of Legal Structure on the Government's Capabilities of Disaster Management System and 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

The primary function of the nation is to protect the people's lives and property from various disaster and dangers. According to Subsection 34, Article 6 Constitution, South Korea, it is clear that the nation has an obligation to protect its people from disaster by stating, "The nation should strive to prevent disasters and protect its people from their dangers". Therefore, the nation should take measure to reduce the possibility and ripple effects of a disaster before seismic or other disaster occurs. In addition, measures should be taken to minimize the ripple effects of the disaster, such as damage caused by the disaster, through prompt and immediate response (Kim and Yoo, 2013). In this regard, it is provided a limitation for the disaster management system against earthquakes in South Korea when the earthquakes occurred in Gyeongju on 12th September 2016 and in Pohang on 15th November 2017. This is because the perception that South Korea is a safe zone for earthquakes has spread very strongly. However, the earthquake in Gyeongju was the largest magnitude (5.8) earthquake in South Korea since it was observed, causing enormous damage to the local community with more than 500 after-shocks, and the total amount of damage was estimated to be about 11 billion won (South Korean currency, ₩) with 23 people injured and 9,368 cases of property damage such damage to various cultural assets and houses. The social interest in seismic disaster and the need for earthquake preparedness have greatly expanded. In response to these social demands, the government has formulated comprehensive seismic prevention measures and has promoted plans for seismic prevention at the overall government level (Ko, 2015). The government intended to establish a mutual cooperation system between related ministries by abolishing the existed Ministry of Public Safety and Security and re-establishing the National Fire Agency and the Korea Coast Guard. In addition, the government has established comprehensive seismic prevention measures and promoted the plan of seismic earthquake prevention at the overall government level, but there is also distrust in the ability of government to respond to disasters systematically.

Therefore, this raises the need to upgrade the disaster management system against earthquakes by using the government as a control tower. In particular, considering the characteristics of more than 80percent (%) of the population living in apartments, such as apartments located in large cities, the reality is that the risk of the earthquake-caused disasters is higher (www.index.go.kr). Thus, it is very important to secure disaster response capability of the government against earthquake. In addition, even if the disaster response capability is excellent, it is difficult to expect positive results in disaster management if the disaster management system has legal and institutional problems. As a result, it is necessary to find out not only the ability of the government to response to earthquakes but also the legal and institutional relevance of the seismic disaster management system on the actual operational performance of disaster management.

Aim and objectives

The study identifies the ability of government to response to earthquakes and the level of legal and institutional relevance of the seismic disaster management system for fire officials who are the main agents of disaster management. Furthermore, it aims to verify the impact of these factors on the operational performance of disaster management. The specific research objectives are as follows: i) To verify the impact of the ability of government to respond to earthquakes on the operational performance of disaster management including pre-disaster prevention preparation and disaster follow-up management. ii) To investigate the legal and institutional relevance of the earthquake disaster management system by verifying the impact on the operational performance of disaster management including pre-disaster prevention preparation and disaster follow-up management.

II. MATERIALS AND METHOD

In this study, fire officials belonging to Seoul Fire and Disaster Headquarters were selected as a sample group and conducted for about two weeks from the first to the second week of December 2019. A total of 150 copies of the questionnaire were used for statistical analysis, except for 15 out 165 copies of the questionnaire that were distributed that were either missing or showed unfaithful responses. During the survey, fire officials who cooperated with the survey responses were required to prepare a questionnaire based on their own registration method after obtaining the purpose and consent of the investigation. Table no 1.is shown the demographic characteristics of the fire officials surveyed in this study. In the case of affiliated agencies, it is found that 149 local fire officials (99.3%) and 1 national fire officials (0.7%). In terms of experience of disaster field, it is shown that 136 (90.7%) had experience in disaster sites and 14 (9.3%) had no experience in disaster sites. Regarding the experience of disaster management, 40 officials (26.7%) responded with this experience for more than 5 to 10 years and less than 10 to 20 years, respectively. Followed by 34 officials (22.7%) for more than 20 years, 20 (13.3%) officials for more than 2 to 5 years and 16 officials (10.7%) for less than 2 years.

Table no 1: Showsdemographic characteristics of surveyed objects

	Classification	Frequency	%
Affiliated agency	Fire-fighting officials (Local)	149	99.3
	Fire-fighting officials (National)	1	0.7
Experience of disaster sites	Yes	136	90.7
	No	14	9.3
Experience of disaster management tasks	Less than 2 years	16	10.7
	Over 2 years, less than 5 years	20	13.3
	Over 5 years, less than 10 years	40	26.7
	Over 10 years, less than 20 years	40	26.7
	Over 20 years	34	22.7
Total		150	100.0

Research model and hypothesis

Based on prior research, it can be inferred that the performance of earthquake disaster management may vary depending on the government's ability to respond to earthquake and the legal and institutional relevance of the earthquake disaster management system (Bae et al, 2014; Byun, 2018). The following research model and hypotheses were established. The study set independent variables for the government's earthquake-related disaster response capability variables and seismic disaster management system law and institutional relevance variable, and the operation performance of earthquake. The operation performance of earthquake disaster management was set as subordinate variables. In the case of ability of the government to response to earthquake and the legal institutional relevance of the seismic disaster management system, the research model was designed with a single factor, and in the case of the operational performance of the earthquake disaster management, the research model designed with two factors which includes pre-preventive preparation factors and post-response management factors.The following hypotheses were derived based on the preceding study and the model of this study. (Fig no 1.)

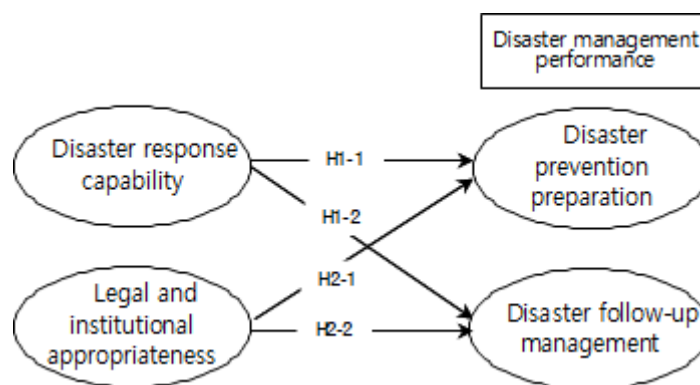


Fig no 1. Research model of the study

H1. The government's ability to respond to earthquakes will have a positive impact on the operational performance of disaster management

H 1-1. The government's ability to respond to earthquake and disasters will have a positive impact on preparation for prevention.

H 1-2. The government's ability to respond to earthquakes will have a positive impact on follow-up management.

H2. The legal and institutional relevance of the seismic disaster management system will have a positive impact on the operation performance of disaster management.

H 2-1. The legal and institutional relevance of the seismic disaster management system will have a positive effect on the preparation for prevention.

H 2-2. The legal and institutional relevance of the seismic disaster management system will have a positive effect on follow-up management.

In this survey, fire officers were targeted for investigation who are belonging to the Seoul Fire and Disaster Headquarters. These fire officials were sampled for about two weeks from the first to the second week of December 2019. Total of 165questionnaire were distributed, 150 were finally used for statistical analysis, except for 15 which were missing or showed insincere responses. During the survey, fire officials who cooperated with the survey response were required to prepare a questionnaire based on their own registration method after obtaining the purpose and consent of the investigation.

Analysis tools

The composition of each variable's questionnaire is as given in Table no 2, which identifies the impact of the ability of the government to respond to earthquake and the legal and institutional relevance of the seismic disaster management system on the operational effects of disaster management in preparation for earthquakes. The government's seismic response capability variables consisted of three questions, and the seismic disaster management system law and institutional relevance variables consisted of three questions. In addition, for the operational effects of disaster management in preparation for earthquakes, a total of 11 questions were composed, of which four were pre-preventive preparation factors and seven were post-response management factors.

Table no 2: Showsconstitution of questionnaire

Classification	Component of questionnaire	No.	References	
Independent variable	Government's seismic response capacity to earthquake	3	Byun (2018)	
Independent variable	Legal and institutional relevance of the disaster management system	3	Byun (2018)	
Dependent variable	Effect of disaster management operation	Pre-preventive preparation	4	Byun (2018)
		Post-response management	7	Byun (2018)
Demographic characteristics	Affiliate agencies, experience in disaster sites and experience in disaster management	3		

Analysis method

This study collected statistical processing of data using the SPSS 25.0 program. First, frequency analysis was conducted to identify demographic characteristics such as the affiliated agencies of fire officials under investigation, their experience in disaster sites and in disaster management. Technical statistical analysis was conducted to analyze the government's perceived ability to respond to earthquakes, the legal and institutional relevance of the seismic disaster management system, and the level of operational performance of disaster risks. Second, an exploratory factor analysis was conducted to verify the validity and reliability of measurement to measure the government's ability to respond to earthquakes, the legal and institutional relevance of the earthquake disaster management system, and the operational performance of disaster risks. The Cronbach's α coefficient was calculated. Third, the Pearson Correlation analysis was conducted to determine the correlation between the government's ability to respond to earthquakes, the legal and institutional adequacy of seismic disaster management system, and the operational performance of disaster risks. Last, a Regression analysis was conducted to verify the impact of the government's ability to respond the earthquakes and the legal and institutional relevance of the seismic disaster management system on the operational performance of disaster risks.

III. RESULT

Verification of reliability and validity

The study conducted the exploratory factor analysis and reliability analysis as preliminary analyses for hypothesis verification. The factor analysis was performed in a Varimax method for each variable question. The eigenvalue, the reference value for factor extraction, was set at 1.0 or higher, the factor loadings at 0.5 or higher, and the questions that did not exceed 0.4 were removed while repeating the factor analysis. The reliability analysis was also performed on the questions bound for each factor, and the Cronbach's coefficient was measured and verified. The results of the exploratory factorial analysis of the items measuring the government's seismic disaster response capability are shown in Table 3. KMO measurement is 0.679 and the results of Bartlett's test for spherically show that $\chi^2=119.653(df=3, p<.001)$ indicating that it is a significant and suitable for performing a factor analysis. The factor loading was derived from a single factor, which is distributed between 0.776 and 861, with a variance R-squared was 68.498%. The reliability verification of the seismic disaster response capability of the government confirmed that the Cronbach's α coefficient was 0.770 and consisted of internal consistency components.

Table no 3: Showearthquake disaster response capability of government

Factor	Questionnaire	Factor loading (item.1)	Cronbach's α
Government's disaster response capacity	Safety management of public housing for the prevention and preparation of seismic disaster	.861	.770
	Level of response by government organization in earthquake occurrence	.844	
	Disaster response capacity of the government against earthquake	.776	
	Eigen value	2.055	
	Variance (%)	68.498	
	Accumulated variance (%)	68.498	
Kaiser-Meyer-Olkin measurement =.679, Bartlett, Spherically test: $\chi^2=119.653, df=3, p<.001$			

The results of the exploratory factorial analysis of items measuring the legal and institutional relevance of the seismic disaster management system are as shown Table 4. The KMO measurement was 0.662, the result of Bartlett's test of spherically showed that $\chi^2=154.926(df=3, p<.001)$ indicating it is a significant and suitable for performing a factor analysis. A single factor was extracted, that distributed between 0.755 and 0.889, with a 71.320% variance R-squared. The reliability verification of the legal and institutional adequacy components of the seismic disaster management system confirmed that the Cronbach's α coefficient was 0.793 consisting of internal consistency components.

Table no 4: Shows legal and institutional appropriateness earthquake disaster management system

Factor	Questionnaire	Factor loading (item.1)		Cronbach's α
Legal and institutional relevance	Safety of Housing Safety Measurement Regulations and Guidelines in preparation for earthquakes relevance to social demand level	.889		.793
	Adequacy of House safety evaluation and inspection standards for earthquakes	.882		
	The degree of systematic establish of legal and institutional infrastructure	.755		
Eigen value		2.140		
Variance (%)		71.320		
Accumulated variance (%)		71.320		
Kaiser-Meyer-Olkin measurement =.662, Bartlett;s spherically test: $\chi^2=154.926$, $df=3$, $p<.001$				

The results of the exploratory factorial analysis of seismic disaster management operational performance and measurement components are as shown in Table no 5. The KMO measurement was 0.885 and Bartlett's test for spherically showed $\chi^2=1006.308$ ($df=55$, $p<.001$) indicating that it is suitable for performing a factor analysis. The analysis results showed that three times lacking validity were removed, two factors were derived, and the total distributed explanatory R-squared of the two derived factors was 65.435%. Specifically, factor 1 was a 'pre-preventive preparation' factor with distributed explanatory R-squared of 38.146%, and factor 2 was a 'post -response management' factor of 27.289%, respectively, confirming the conceptual validity of the measured items of study variables. The reliability verification of seismic disaster management operational performance and factor components confirmed that 'pre-preventive preparation' factor was 0.863 and the 'post-response management' factor was 0.841, respectively, indicating that all factors were more reliable than 0.80 and were composed of internally consistent items.

Table no 5:Shows earthquake disaster management performance

Factor	Questionnaire	Factor loading		Cronbach's α
		item 1	item 2	
Pre-preventive preparation	Pre-detection of the possibility of earthquake disaster	.825	.165	.863
	Prepared planning and means for disaster response	.804	.259	
	Eliminating seismic hazards and checking regularly	.705	.241	
	Accurate investigation and review of existing disaster cases	.668	.413	
Post-response management	Success of cost effectiveness in disaster management activities	.127	.839	.841
	Success of damage reduction in disaster management activities	.324	.821	
	Success of disaster response results	.375	.769	
	Long0term support for post-disaster recovery	.463	.592	
Eigen value		4.196	3.002	
Variance (%)		38.146	27.289	
Accumulated variance (%)		38.146	65.435	
Kaiser-Meyer-Olkin measures =.885, Bartlett's spherically test: $\chi^2=1006.308$, $df=55$, $p<.001$				

Descriptive statistics of variables

The average and referenced deviation were calculated by conducting a technical statistical analysis of the seismic disaster response capability of the department, legal and institutional relevance of the earthquake disaster management system, and the operational performance and variables of disaster management, and the results are shown in Table 6. In this study, the Likert 5-point scale was measured. The government's disaster response capacity averaged 2.94 and the legal and institutional relevance of the disaster management system averaged 2.74 and 2.88 for the disaster management operational performance. In terms of the operational performance of disaster management by sub-factor, the pre-preventive preparation factor was 2.90 on average and the reactive management factor was 2.87. These results indicate that the government's ability to respond to

disaster, the legal and institutional relevance of the disaster management system and the operational performance of disaster management are more or less below the normal level.

Table no 6:Shows descriptive statistics of the variables

Variable	Average (M)	Standard deviation (SD)
Government's disaster response capability	2.94	0.67
Legal and institutional relevance	2.74	0.63
Operational performance of disaster management	Pre-preventive preparation	2.90
	Post-response management	2.87
	Total	2.88

Hypothesis verification

Pearson correlation analysis was conducted to find out the relationship between the government's ability to respond to earthquakes, the legal and institutional relevance of the seismic disaster management system, and the operational performance of disaster management of disaster management, and the results were presented to Table 7. Subsequently, the hypothesis that the government's ability to respond to earthquakes and the legal and institutional relevance of the seismic disaster management would affect the operational performance of disaster management was verified. First, the overall positive correlation between the factors of the government's ability to respond to earthquakes and the operational performance of disaster management ($r=0.640$, $p<0.001$), pre-preventive preparation ($r=0.572$, $p<0.001$) and follow-up management ($r=0.588$, $p<0.001$) also showed a positive correlation, which are a subfactor in disaster management. The overall positive correlation ($r=0.667$, $p<0.001$) was shown between the legal and institutional relevance factors of the seismic disaster management system and the operational performance of disaster management. As subfactor in operational performance of disaster management, pre-preventive preparation ($r=0.628$, $p<0.001$) and follow-up management ($r=0.581$, $p<0.001$) has shown a positive correlation. Also, other variables show significant positive correlation between variables.

Table no 7: Shows correlation analysis between the variables

Classification	Disaster response capability	legal and institutional relevance	Operational performance of disaster management	
			Pre-preventive preparation	Post-response management
Disaster response capability	1			
legal and institutional relevance	.592***	1		
Operational performance of disaster management	Pre-preventive preparation	.572***	.628***	1
	Post-response management	.588***	.581***	.641***
	Total	.640***	.667***	.911***

*** $p<0.001$

Verification of hypothesis 1

H 1. The government's ability to respond to earthquakes will have a positive impact on the operational performance of disaster management.

H 1-1. The government's ability to respond to earthquakes will have a positive impact on preparation for disaster prevention.

H 1-2. The government's disaster response capabilities will have a positive impact on disaster follow-up management.

Table no 8: Showsthe effect of government's disaster response capability on disaster management performance

Classification	non-standardized regression coefficient		standardized regression coefficient	t	P
	B	SE	β		
Constant	1.270	.163	β	7.784	.000

Disaster response capability	.548	.054	.640	10.136***	.000
R^2 (Adjusted)=.410(.406), F(p)=102.733***(.000)					

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

The impact of the government's seismic disaster response capabilities on disaster prevention preparations are shown in Table no 9. The degree to which the government's ability to respond to earthquake explains the preparation for disaster prevention is = 0.327 was shown with 32% of R-squared and presents F=72.05 indicating the regression model is suitable in a significance level =0.001. Disaster response capabilities (=0.572, p<0.001) has a significant positive effect on disaster management operational performance and the pre-disaster preparedness. Therefore, the hypothesis 1-1 has been adopted.

Table no 9:Shows the effect of government's disaster response capability on disaster prevention preparation

Classification	non-standardized regression coefficient		standardized regression coefficient	t	P
	B	SE	β		
Constant	1.257	.198		6.335	.000
Disaster response capability	.558	.066	.572	8.488***	.000
R^2 (Adjusted)=.327(.323), F(p)=72.053***(.000)					

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

The results of verifying the impact of the government's disaster response capabilities on disaster follow-up management are shown in Table no 10. The government's ability to respond to disaster has =.34 on coefficient of determination and it has shown F=88.46 indicating that it is suitable for the regression model in a significance level =0.001. Disaster response capabilities (=0.588, p<.001) has a significant positive effect on disaster follow-up management, a factor in disaster management operational performance. Therefore, the hypothesis 1-2 has been adopted.

Table no 10:Shows the effect of government's disaster response capability on disaster follow-up management

Classification	non-standardized regression coefficient		standardized regression coefficient	t	P
	B	SE	β		
Constant	1.281	.184		6.964	.000
Disaster response capability	.539	.061	.588	8.846***	.000
R^2 (Adjusted)=.346(.341), F(p)=78.246***(.000)					

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

Verification of hypothesis 2

H 2. The legal and institutional relevance of the seismic disaster management system will have a positive impact on the operational performance of disaster management.

H 2-1. The legal and institutional relevance of the seismic disaster management system will have a positive effect on disaster prevention preparation.

H 2-2. The legal and institutional relevance of the seismic disaster management system will have a positive effect on disaster follow-up management.

The legal and institutional relevance of the seismic disaster management system presented in Table no 11 to verify its impact on the operational performance of disaster management. The degree to which the legal and institutional relevance of the seismic disaster management system has the operational performance of disaster management with =0.395 on coefficient of determination and it has shown 39.5% R-squared and presents F=96.61 indicating it is suitable for regression model in a significance level =0.001. Disaster response capabilities (=0.628, p<.001) have a significant positive effect on the operational performance of disaster management. Therefore, the hypothesis 2 has been adopted.

Table no 11: Shows the effect of legal and institutional appropriateness on disaster management performance

Classification	non-standardized regression coefficient		standardized regression coefficient	t	P
	B	SE	β		
Constant	1.110	.187		5.943	.000
Legal and institutional relevance	.652	.066	.628	9.829***	.000
R^2 (Adjusted)=.395(.391), F(p)=96.611***(.000)					

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

The results of verifying the impact of the legal and institutional relevance of the seismic disaster management system on the preparation for prevention of disaster management are as shown in Table no 12. The degree to which the legal and institutional relevance of the seismic disaster management system explains the pre-disaster prevention preparation with $=0.338$ on coefficient of determination and it has shown 33.8% R-squared and presents $F=86.93$ indicating it is suitable for regression model in a significance level $=0.001$. Legal and institutional relevance of the seismic management system ($=0.581$, $p<.001$) have a significant positive effect on the disaster management operational performance and the pre-disaster preparedness. Therefore, the hypothesis 2-1 has been adopted.

Table no 12: Showsthe effect of legal and institutional appropriateness on disaster prevention preparation

Classification	non-standardized regression coefficient		standardized regression coefficient	t	P
	B	SE	β		
Constant	1.312	.184		7.141	.000
Legal and institutional relevance	.567	.065	.581	8.693***	.000
R^2 (Adjusted)=.338(.334), F(p)=75.574***(.000)					

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

The results of verifying the impact of the legal and institutional relevance of the seismic disaster management system on the post-response management of disaster management are as shown in Table 13. The degree to which the legal and institutional relevance of the seismic disaster management system explains the disaster follow-up management with $=0.444$ on coefficient of determination and it has shown 44% R-squared and presents $F=108.77$ indicating it is suitable for regression model in a significance level $=0.001$. Legal and institutional relevance of the seismic management system ($=0.667$, $p<.001$) have a significant positive effect on the disaster management operational performance. Therefore, the hypothesis 2-2 has been adopted.

Table no 13: Showsthe effect of legal and institutional appropriateness on disaster follow-up management

Classification	non-standardized regression coefficient		standardized regression coefficient	t	P
	B	SE	β		
constant	1.217	.157		7.745	.000
Legal and institutional relevance	.607	.056	.667	10.877***	.000
R^2 (Adjusted)=.444(.440), F(p)=118.304***(.000)					

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

IV. CONCLUSION

This study empirically verified the impact of the government's ability to respond to disasters and the legal and institutional relevance of the disaster management system on the operational performance of disaster management. The main results of this study are as follows:

First, the government's ability to respond to earthquake is the operational performance of disaster management ($\beta=0.640$, $p<0.001$) has a significant positive effect. In terms of operational performance of disaster management, the capacity of seismic disaster response has positive impact on both the seismic disaster prevention preparation ($\beta=0.572$, $p<0.001$) and disaster follow-up management ($\beta=0.588$, $p<0.001$) which are factors in disaster management operational performance. These results indicate that the higher the government's ability to respond to earthquakes, the more thorough the preparation for disaster prevention and the systematic management of disaster follow-up management.

Second, the legal and institutional relevance of the seismic disaster management system has a significant positive impact on the operational performance of disaster management ($\beta=0.628$, $p<0.001$). In terms of operational performance of disaster management, the legal and institutional relevance of the seismic disaster management system has a significant positive impact on both the pre-preparation prevention of disaster ($\beta=0.581$, $p<0.001$) and disaster follow-up management ($\beta=0.667$, $p<0.001$) which are factors in disaster management operational performance. These results indicate that the more legally and institutionally appropriate the seismic disaster management system is, the more positively it has a positive effect on disaster prevention preparation and disaster follow-up management.

The previous study empirically analyzed the impact of the government's disaster response capabilities and the legal and institutional relevance of the seismic disaster management system on the operational effectiveness of disaster management on the people across the country (Byun, 2018). The study found that the higher the government's ability to respond to disasters and the better the legal and institutional relevance of the seismic disaster management system, the higher the effectiveness of disaster management operations. This presents a tendency similar to the results of this study and thus supports the results of this study. On the other hand, Osborne and Gabler (1992) stated that in order to maximize the efficiency of disaster management administration, the government's ability to respond with a prior emphasis on prevention rather than follow-up treatment was preceded. This step-by-step attempt to measure the operational effectiveness of disaster management shows that it is important to focus on the effectiveness of prevention and preparedness before a disaster rather than the effectiveness of response and recovery after it occurred.

This study is mainly focused on the establishment of a disaster management system and the actual condition of the existing prior research related to disaster management. In addition, there are few studies that analyzed the impact of factors of the government's ability to respond and the legal and institutional relevance of the disaster management system by dividing them into preliminary and post-performance. In this regard, this study highlighted the significance of those differences. This study is an empirical analysis study limited to some fire officials from the Seoul Fire and Disaster Headquarters, and there may be limitations in generalizing the results of the study. Therefore, a comprehensive empirical study needs to be carried out in the follow-up study, which includes fire officials from other regional fire-fighting departments.

Through the outcomes of this study, it is possible to secure additional high-tech equipment for early warning against earthquakes, which is an important policy implication that can improve the operational performance of disaster management in South Korea. In addition, the study propose improvement of the legal system, including the improvement of the government's ability to respond to disasters, such as the ability to collect information on seismic signs using wide-area communication networks, and the mandatory installation of gas valves with automatic shut-off functions in the event of an earthquake.

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