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A Study on the Establishment and Utilization of Electronic Manual for Disaster Response

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Abstract: *In order to respond quickly and accurately to disasters, an initial response is essential in accordance with the disaster response manual. The existing disaster response manual consists of a booklet of paper documents. Therefore, there is a limit to use in the event of a sudden disaster. This study makes existing disaster response manuals into electronic documents and suggests ways to respond according to the contents of the manuals in the event of a disaster. In addition, the application plan was proposed in the event of an earthquake disaster. The system for making disaster response manuals into electronic documents and the system for operating them were divided and the necessary detailed functions were presented.*

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I. Introduction

Disaster has the dictionary meaning of "unexpected misfortune", "liquefaction", and "damage caused by fire". The U.S. Federal Emergency Management Agency (FEMA) defines it as "a serious and large-scale event that usually results in death, injury, property damage and cannot be managed by routine procedures or government resources, which usually occurs unexpectedly, requiring immediate, systematic and effective action when governments and private organizations want to meet basic human needs and rapid recovery". In South Korea, the Framework Act on the Management of Disasters and Safety defines it as "something that can harm or damage the lives and bodies of the people, property and the state". As defined, the occurrence of a disaster will result in many human and physical damage. The loss of life due to human damage is irreparable, and property damage due to physical damage requires enormous cost and time to recover. In particular, disaster are becoming larger, more complex and more diverse due to natural disaster caused by climate change and human disaster caused by urbanization, industrialization and sophistication.

It is important to prevent disasters that occur in order to reduce the damage to these disasters. However, since prevention of all unpredictable disaster is impossible, a systematic response to disaster is critical to minimize damage in the event of a recurrence. In particular, initial response within the so-called "golden time" to reduce damage caused by disaster is seen as important factor in preventing and reducing disasters. However, in the event of a disaster, confusion and urgency lead to the loss of opportunities for initial response if the plan is made after the disaster. Therefore, it is necessary to establish a response plan for who, when, where, what and how to do in the event of a disaster, and it is called the "Manual" that documents above contents. In the case of South Korea, the Framework Act on Disaster and Safety Management requires such manuals for disaster response. It is important to activate during the disaster situation not just the manual itself.

In the case of the Ferry Sewol incident in 2014, which killed more than 300 people, the manual didn't activate properly while responding the sinking accident stigmatizing as the "Cabinet Manual". Since then, the importance of utilization of manual, as operability in the disaster site, became much more important component. In the past, disasters that causes the greatest damage to South Korea are mainly "damage by storm and flood", and the forecasts are made by the Korea Meteorological Administration, enabling systematic preparation and response according to the manual. However, it is very difficult to find the information in the manual and to understand one's duties, since most disaster occur suddenly without forecasts and warning. It is in the form of a booklet to be confused by the sudden situation at the disaster occurrence.

In particular, earthquake disasters are representative natural disasters that occur suddenly without prior indications. In South Korea, until 2016 Gyeongju earthquake and 2017 Pohang earthquake, it is believed that South Korea is seismic safety zone and even the risk awareness of seismic disaster was insufficient. In order to reduce damage in the event of a disaster, it is necessary that the personnel involved in disaster responses are aware of the disaster-specific behavioral guidelines and take appropriate and prompt responses according to the

situation. To achieve this, it is important to establish a system that enables integrated disaster response based on manuals to ensure rapid spread of situations and personalized mission delivery.

II. Previous studies

Previously, there are various studies conducted to investigate the improvement on disaster response manuals. Kang (2019) presented the overall direction of improvement of the manual, including the disaster management system through analysis of the status of the crisis management menu, while Song et al. (2019) suggested specific improvement plans for each content of the behavioral manual focusing on local government. In addition, studies were conducted that suggested measures to improve the manual through an analysis of disaster response missions, which are the main contents of the manual. Yang (2012) studied the direction of improving the disaster response management system focusing on the Central Disaster and Safety Countermeasures Headquarters, while Lee (2017) investigated the simplification of the manual through task analysis. Lee et al. (2014) presented the improvements by analyzing and modelling the existing crisis response manual. In particular, a study was conducted on improvement on manuals focusing on specific disasters, and Yoon et al. (2018) studied regarding the improvement of manual highlighting the water supply facilities in the event of a volcanic disaster. Lee et al. (2017) conducted research on improving the seismic manual after the 2016 Gyeongju earthquake and 2017 Pohang earthquake.

Table no 1: Shows existing research trends - manual

Researcher	Title of research	Contents
Kang (2019)	A study on the improvement of disaster and safety crisis management manual	Analyzes the status of the crisis management manual and suggests improvement measures such as disaster management system, crisis monitoring assessment system and crisis alert system.
Song et al. (2019)	A study on the improvement plant for the utilization of local governments "on-site action manual	To improve the manual, specific improvement measures such as the composition of the integrated support headquarters, response procedures, step-by-step action tips, and appendix composition are presented.
Yang et al. (2012)	Re-establishment of the role on the Central disaster and safety countermeasures headquarters for integrated disaster response- focused on disaster management of Foot and Mouth Diseases virus	Analyzing the problems of the existing integrated disaster response and presenting the improvement directions for the establishment, composition, system construction and utilization of the role, focusing on the Central Disaster and Safety Countermeasures Headquarters.
Lee et al. (2017)	A study on the simplification of crisis management manual through unit task analysis	Extract standardized unit duties through analysis of unit tasks in the existing extensive and complex disaster response manuals
Lee et al. (2014)	A study on the improvement plan through analysis of crisis response manual	Analyze the existing crisis response manual and perform modelling to present improvements
Yoon et al. (2018)	A study on the improvement of water supply system response manual to reduce volcanic damage	present the scope of application on the waterworks manual and major tasks and systems, and crisis scenarios, in the event of a volcanic eruption
Lee et al(2017)	A suggestion on the status of earthquake manuals and the improvement plan	Analysis of problems and suggestion for improvement on national behavior of earthquake manuals through the comparison on domestic and foreign

Related to the research on electronic documentation of disaster response manuals, Moon et al (2009) suggested the need for electronic manuals, referring to the possibility of efficient disaster task management as they can receive integrated and comprehensive information on technical and administrative needs related to disaster from disaster management operators. In this regard, the standardization system for electronic manual on the facility disaster management, methods for implementing functions, and plans for establishing systems are presented. Hong et al. (2017) defined electronic manuals as eSOPs and used them to investigate the ways to establish systems for disaster response and situation management.

Table no 2: Shows existing research trends – electronic manual

Researcher	Title of research	Contents
Moon et al. (2009)	A study on the establishment of the disaster management on electronic manual for efficient management of disaster in a facility	Establish a disaster information classification system and construct a standard XML schema for disaster management tasks. Based on this, electronic manual system is established, and the methodology is verified.
Kang et al. (2004)	A study on the construction electronic manual to the facility maintenance phase	Propose a methodology for applying IETM in the form of an electronic manual to the facility maintenance phase
Hong et al. (2017)	A study on the utilization of eSOP system for planning-based disaster response and situation management	Proposing a plan for establishing a response plan in the form of a standard action procedure (SOP) to enhance the usability of a disaster response plan

Previous research mainly focuses on improvement of the manual, the studies on the establishing and using the manuals as digital contents are partially conducted in the facility management field and recently conducting in disaster response field.

Scope of the research

In this study, the existing brochure-type disaster response manual is established as contents in the form of electronic documents in order to enable disaster response in the site based on manuals in the event of a disaster. The study also proposes a plan to establish a system to enable efficient and practical use of it at disaster sites. In particular, the study presents a plan to utilize the disaster response manual established as an electronic document focusing on earthquakes, which are the representative disasters that occur suddenly without notice.

III. Methods

Overview of the electronic manual for disaster response

To build and utilize the existing disaster response manuals as electronic documents, the system consists largely of an implementation system for generation electronic manuals and a system for using them to deliver tasks according to disaster situation and the circumstance. In addition, in the event of a disaster, a different disaster response organization is formed, therefore a system is required to manage information about the operators in order to propagate the situation and deliver the mission. The composition and main functions of these disaster response e-manuals are shown in the following figure.

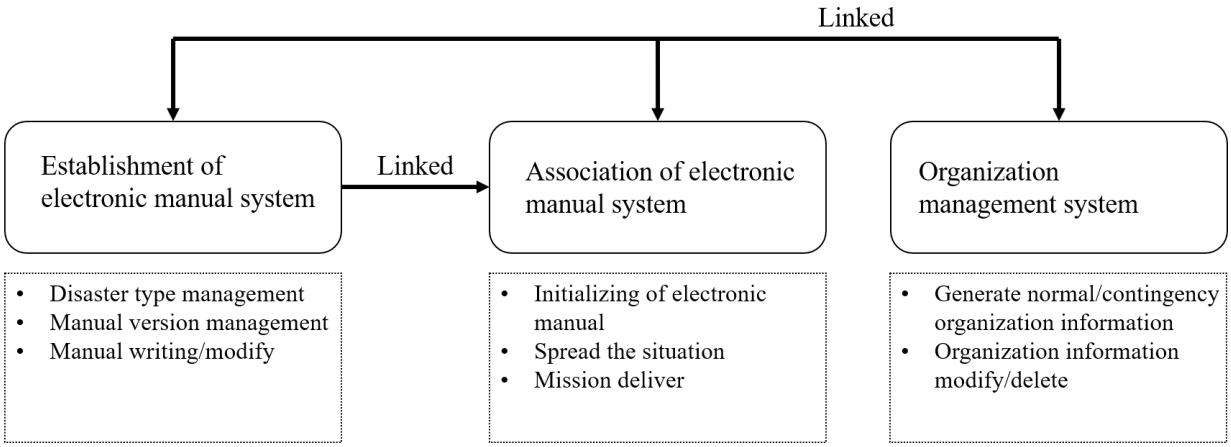

Fig no 1. Key functions for generating and utilizing electronic manual

E-document DB in the disaster response manual

In order to organize disaster response manuals existing in paper documents into electronic documents, a system is required that allows manual manager to create electronic documents and easily update them as needed. The manual is organized by type of disaster, and since a person in charge of performing the duties is designated for each stage of disaster response, it presents the following measures to organize electronic

documents reflecting the characteristics of the manual, such as the need to be linked to organizational information.

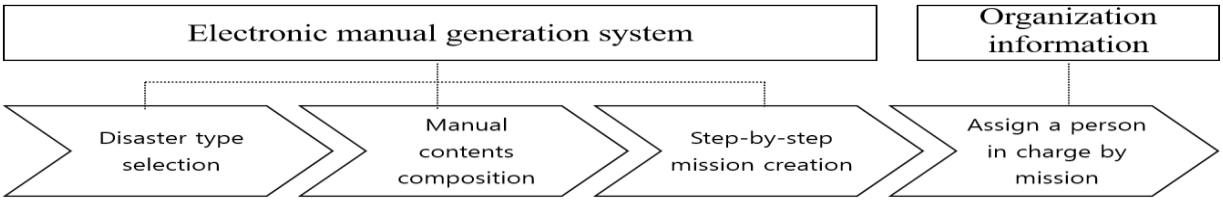

Fig no 2. Key functions of electronic manual

Classification function according to disaster type

Disaster is various dependent on the types including earthquakes, fires, terrorisms and typhoons and the respond can be differ depending on the type of disaster. The types of disaster shall be classified into natural and social disasters under Article 3 of the Framework Act on the Management of Disasters and Safety, and each type of disaster shall be defined as follows:

Table no 3: Shows disaster type

Classification	Types of disaster
Natural disaster	• natural cosmic objects such as typhoons, floods, heavy rains, strong winds, storms, tidal waves, heavy snow, cold wave, lighting, drought, heat waves, earthquakes, yellow dust, volcanic activities, asteroids and meteoric bodies fall and crash • other disaster caused by natural phenomena
Social disaster	• Fire, collapse, explosion, traffic accident including air accidents and maritime accidents, fire prevention accidents and environmental pollution accidents • paralysis of national-based systems such as energy, telecommunications, transportation, finance, medical services, and water supply • infectious diseases, livestock disease, and fine dust

Disaster response manuals are prepared and managed by individual manuals according to these types of disasters, it is required the functions that can be classified and managed according to disaster types to be established as electronic manuals. In addition, since the manual requires the revision of the regulations to record and manage contents and reasons, the electronic manual should also include a function to manage information on the revision history of the manual. The revision history can be managed through version control and history management when modifying or supplementing an electronic manual previously prepared by the writer.

Preparation function of disaster response manual

The disaster response manual consists of responding tasks sequentially depending on the situation, and a person in charge of each response is designated. In this study, each manual has a single process of action that must be performed at different stage of the situation, and each process is defined in a way that conveys the details of the missions, the person in charge of the missions, and the details of the missions.

The details of the mission are recorded and the message is included when delivered to operator via SMS or SNS, Missionary manager may receive action messages and select or designate "teams" or "individuals" as on-site conductors as defined in Organizational Information Management. The method of propagation is chosen by SMS or SNS. Basic manager can write in a manner defined in the process, but it is necessary to define the situation through internal broadcasting in a different way than the existing "process" because no receiver is designated. Define the behavioral knack for delivering the main message through internal broadcast links as "situation propagation" and allow "message content" to be entered. Entering the basic message when

operating the electronic manual and allowing the message to be partially modified when operating in the response phase, thereby increasing the convenience of rapid execution and message modification.

Organizational information management function for disaster response

Action tact by disaster situation is assigned a person who in charge of the task for the detailed mission. In order to deliver the mission contents of the e-manual to the person in charge, it is necessary to manage the disaster response organization information and to be linked to the document of e-Manual so that the mission can be disseminated. Due to the fact that contextual response organization in disaster is different from usual circumstance, organizational information under peacetime and its organization in a disaster should be managed by same person. Since the main reason for managing disaster response organization information is to disseminate the situation and mission details, the organization information of disaster response shall consist of the name, team (affiliated), position, and telephone numbers of the person in charge, and the team (affiliated) shall be classified into normal and disaster situation.

Operative measure of electronic manual on disaster response

In order to utilize disaster response manuals established by electronic documents, it is required to have a system that can operate and activate them. The e-manual drive system utilization process which enables the implementation of an established e-manual to respond to disaster situation.

Disaster response capabilities using electronic manuals

When the disaster circumstance is recognized and e-manual is executed, the user manipulates the manual written in the electronic document and the detailed action instructions and tack entered in each process are delivered to the person in charge of the site according to the delivery method.

When the action tact instructions written in the executed electronic manual are delivered to the person in charge of the site, the manager checks the details and completes the actions that the manager should perform to respond to the disaster situation. The following table is an electronic manual operation to respond to at the scene of the process and justice about the key features.

Table no 4: Shows disaster response processing using electronic manuals

Process	Main function
Launch e-manual	• E-manual execution according to disaster situations • The execution method is divided into 'Automatic' and 'manual'
situation propagation	Send to designated personnel via SMS, SNS or link internal broadcasting systems to spread the situation.
mission delivery	Send the details of the tasks written in the e-manual to designated personnel via SMS or SNS
mission confirmation	Field official check the details of the mission through SMS or SNS
performance of duties	Field official respond on-site according to identified mission details

The e-manual can be implemented by automatically executing the e-manual corresponding to the type of sensor, if sensor information is detected by utilizing the sensor information detecting the disaster situation, such as an earthquake or fire. In addition, if the sensor fails to detect and reports the disaster situation, the manual can be manually executed by the e-manual manager.

Multi-media situation propagation function using electronic manual

The media and electronic manuals to deliver the situation must be linked in order to disseminate disaster situations and deliver action tact. In order to inform the occurrence of a situation, a middle ware is required to connect these media in electronic manuals because there are various situation propagation media such as alarms through PCs, SMS on mobile devices owned by individuals, message transmission through SNS, and internal broadcasting in case of alarm broadcasting system. All situation transmission history can be saved and reported so that it can be used for evaluation of post-disaster response.

Response to seismic disasters

Seismic disasters are representative natural disasters that occur suddenly without notice, and it is important to spread the situation quickly and evacuate. Recently, a large-scale, non-bridge earthquake has raised

awareness of earthquake in South Korea, and the study suggest measures to respond using electronic manuals in the event of a seismic disaster. The magnitude of an earthquake is critical, but the damage depends on the progress of the site in response to the situation. Therefore, the government should be able to cope with the situation based on the magnitude of the earthquake at the site, in case of South Korea, it is divided into 12 stages according to the level of the Modified Mercalli Intensity Scale, MM.

The response steps are divided according to the magnitude of the earthquake, and the corresponding electronic manual is automatically operated according to the magnitude of the earthquake measuring instrument and the situation is propagated in stages according to the magnitude of the earthquake, and the tasks is performed immediately by the person in charge. If the frequency of earthquake is low, the person in charge can manage and prepare for the situation, and if the frequency of earthquake is high, the situation shall be disseminated to everyone in the building, and the disaster personnel shall immediately deliver the details of their duties to induce evacuation or inspect the facilities in charge by responding to the situation. The following figure suggested a plan to use electronic manuals to automatically disseminate and respond to situations according to progress.

Utilization of Seismic disaster response training

In order to increase the efficiency of the disaster response manual, it is necessary to be fully aware of the contents of the manual through regular training so that a rapid response can be made in the event of an actual disaster. The operation of the electronic manual is activated by distinguishing between the "actual mode" for real situations and the "training mode" for training situations. The training scenario can be prepared using the system for generating electronic manuals on a daily basis, and the electronic manual can be operated in training mode in the event of a seismic disaster to understand the content of the manual and to evaluate whether the contents of the manual are properly applied in the event of a seismic disaster.

IV. Conclusion

In order to respond rapidly and accurately to disasters, initial response according to the disaster response manual is essential. The existing disaster response manual is in the form of a booklet of paper documents, and there is a limit to utility in sudden disaster situations if it is not familiar enough. Accordingly, this study suggests response to establish existing disaster response manuals as electronic documents and respond to them according to the contents of the manual in the event of a disaster. In addition, specific use cases were presented through the application plan in the disaster situation of an earthquake. In order to electronically document and utilize disaster response manuals, it is important to classify a system for building as an advisory letter and a system capable of operating it. Thus, this study suggests detailed functions which are required to create and manage electronic manuals and detailed functions needed to drive and utilize them.

First of all, the e-manual generation system was designed to create e-manual according to the type of disaster and to include document management functions that included the revised information of the documents, and to manage and link organizational information to communicate the situation and mission of each operator. The system that operates the electronic manual was able to execute the electronic manual according to the disaster situation, and to disseminate the situation to the site or deliver the mission to the person in charge according to the content s of the manual. The study suggested the example of earthquake disaster for practical use of systems that establish and operate electronic manuals.In this study, the electronic manual presents sensor information that detects the situation and links the media to spread the situation and to deliver the mission, so the response is made by the person who receives the situation and mission, and there is a limitation of this study that the part where the situation does not develop according to the manual. However, it is believed that the use of electronic manual is meaningful by raising the possibility of preventing the expansion of disasters without missing the Golden time by immediately spreading the situation and responding to the initial response in accordance with the manual when a disaster situation occurs.

It is expected that faster and more automated disaster response will be made if the further studies investigate on that automatically control and manage various facilities used in responding to disaster situations are carried out by linking them to electronic manuals.

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