

How to improve Emergency Management Information: A Case Study

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Abstract

The importance of emergency management information has been rapidly raised regardless of national boundary. The study aims at improving the issue of emergency management information in Korea by studying both the hexagon gemstone frame and the hexagon gem frame. These two terms have been initially applied to the topic of emergency management information. Whereas the former includes emergency management information's potential limit as well as significant value, the latter simply addresses its significant value.

By utilizing qualitative content analysis as a major methodology, the study cross-checks six information sources namely governments, colleges, industry, non-governmental organizations (NGOs), family and foreign sources and four information features namely creativity, accuracy, access and timing. The main tenet is that Korea has to change from its hexagon gemstone frame into the hexagon gem frame to get to the goal of emergency management. This study maintains that the conceptual architecture between those two frames has been scrupulously examined through a national perspective.

Keywords: Governments, industry, NGOs, foreign sources, information development.

Introduction

Modern emergency management in South Korea (hereinafter, Korea) was started about 16 years ago with the establishment of the National Emergency Management Agency (NEMA) in June 2004. Since that time, the issue of emergency management information has always been a hot topic, particularly during the occurrence of an emergency. For example, the ferry MV *Sewol* sank around Jindo on April 16, 2014 and only 172 out of 476 people were rescued. Of the 304 people who drowned to death, majority were high school students. Though some stakeholders were very irresponsible on information flow during the catastrophe, emergency management information itself was evaluated as worked out in general.¹⁴

Many researchers have discussed the importance of information and communication technology during an

emergency like the outbreak of coronavirus disease 2019 (COVID-19). However, almost no distinctive study has systematically delved into the topic of related emergency management information in Korea.

Additionally, the Korean case is excellent for examining the entity of emergency management information in the international community, especially since many nations or regions have shown their interest in knowing how Korea has achieved the status of a leading nation regarding information and communication technology. Simultaneously, these foreign nations are keenly interested to know how Korea will react to the issue of emergency management information in the future as a test bed. They may compare their cases and that of Korea, when necessary. To this point, a major research question is how the current emergency management information has to become future-oriented or what types of emergency management information should be addressed in Korea.

Accordingly, the purpose of this study is to analyze how to improve the issue of emergency management information in Korea by comparing both the current situation of hexagon gemstone frame and the future alternative being the hexagon gem frame. We have identified these two frames for application to the field of emergency management information as a pioneer study. The former suggests that emergency management information does not only have a positive function but also a negative function in its operation. On the other hand, the latter means that emergency management only has a positive function in its details. This study maintains that the hexagon gemstone frame must be transformed into the hexagon gem frame for the ultimate goal of reducing human loss, economic damages and psychological impact.

The significance of emergency management information:

The high demand on information has increased dramatically in all parts of the society. As a result, three basic concepts have been frequently supported namely, information integration, information processing and information transformation.^{19,21} Information integration predominantly means the degree of interconnectivity and interoperability among many technical elements. The majority of literature has maintained that information integration is a desirable and optimistic phenomenon regardless of nationality; however, it is also influenced by costs, organizational change, the complicated aspects of politics and other side effects.

Information processing is about being to change, transform, or manipulate related information, if applicable. The emergence of internet technology has contributed much to the abundant development of information processing. Even though information processing has been often influenced by machine-oriented technology, it has also been influenced largely human behavior or human factors. In short, human component as well as internet technology has equally shaped the whole picture of information processing.²⁶

Information transformation contributes to the choice quality information, while the serious competition between information quality and information quantity is debatable.¹⁶ With the increase in the quality of information, it is necessary to discern information quality via information transformation. As such, information transformation becomes about how to interpret, analyze and act upon related information by improving related operating routines.

Based upon the above-mentioned three important concepts, emergency management information has been diverse in many regions in the international community. In other words, the flow of emergency management information has been surrounded by unique regional culture including ways of people's thinking, the mainstream of human values, the extent of openness, technological improvement, organizational learning, organizational atmosphere and others.

Emergency management information is somewhat different from that of other areas. Emergency management information has its own characteristics when compared with other kinds of information.⁵ For example, plenty of information comes out at the occurrence of emergency within a short period of time and necessary information abruptly changes depending on a specific kind of emergency and emergency management phase. In a similar token, while specific information is examined, the surrounding environment changes constantly and dynamically.

A series of studies have attempted to investigate the topic of emergency management information, but majority of them have only reported how to use information and communication technology to facilitate information development in the field of emergency (or disaster) management.²⁰ In short, the technological aspect has been widely examined on emergency management information like the case of COVID-19 outbreak and only a few researches have focused on studying the holistic aspect of facilitating information development.

One of the most typical failures during emergency management is the collapse of emergency management information such as unmet information needs, information overload, information deluge, inadequate information, the spread of critical rumors and others. Owing to the unavailability of information or its infrastructure to the stakeholders, there may be increased human loss, economic

damages and psychological impact. Therefore, the entity of emergency management information is crucial to the entire field of emergency management.

Vital sources of emergency management information consist of all the participants in emergency management such as governments, colleges, industry, NGOs, family and foreign sources among others.¹⁸ They make every effort to produce, obtain and distribute related information to coordinate the rising issues before, during and after the occurrence of an emergency. This signifies that emergency management information flows among those sources through various directions.

Similarly, the effect of coordination has been actively considered between/among many sources of emergency management information. Without integrated or comprehensive coordination or related efforts among them, it would be quite difficult for each source to produce and exchange appropriate information to effectively fight against emergency. During the process of coordination, emergency management information should be creative, accurate, accessible and delivered in a timely manner among others.

The entity of emergency management information has historically produced many advantages in managing emergencies, not only natural disasters but also man-made ones. One of the greatest advantages is that it helps stakeholders make effective decision before, during and after the occurrence of emergency. In particular, appropriate information may facilitate the whole process of effective decision making within a short period of time; as a result, human fatality as well as economic damages and psychological impacts could be clearly mitigated or reduced.^{2,22} Of course, the other potential advantages may be variable under a unique environment.

Methods

Regarding the direction of emergency management information, several promising researchers have tried to provide innovative theories via their own viewpoints. Each theory has been drawn within a dynamic context.³ However, in general, there have been two chronological research directions. One has been to study how the current field of emergency management information has dealt with the occurrence of previous emergencies. Many negative problems have been critically examined and related theories based on lessons learnt have been subsequently produced for related individuals and institutions.

The other direction has been related to delving into how the field of emergency management information must effectively confront related information problems in the near future. Researches in this category have partially touched on previous emergencies or related emergency management information; however, they have still focused on providing how to wisely deal with potential future information problems and rather than examining previous negative

problems, the research direction has supported the future's positive solutions.

With the above-mentioned two chronological directions, the needs for structuring emergency management information have also increased. Many related aspects should be clearly considered when suggesting an appropriate architecture. However, it is true that the architecture should include a simple, flexible and dynamic mechanism on emergency management information, so that its whole operability, performance and continuity are improved without compromising its temporary situation.

Accordingly, this study proposes both the hexagon gemstone frame and the hexagon gem frame as an analytical framework as shown in fig. 1. We thoroughly evaluated emergency management information and in the process, have identified two major types: (1) raw and unpolished and (2) cut and polished. The first one, as the name implies, has a wealth of information with significant value, but cannot be used as such because of its rawness; the contents need to be validated. The second one, as its name also signifies, contains information that has been processed, integrated and even transformed in some cases. In brief, they have been cut, polished and refined; therefore, ready to be accessed for beneficial use.

The hexagon gemstone frame plays a role in studying the current situation of emergency management information whereas the hexagon gem frame has a role in future-oriented emergency management information. The former is placed under a static rectangular skeleton whereas the latter is placed under the elastic circular skeleton.

Two strategic techniques, cutting and polishing, will be predominantly utilized in this architecture for the

improvement of emergency management information. By roughly cutting tough sides of the gemstone, it can be shaped into a gem. The technique of cutting includes big changes in the field, similar to a forest. In addition, it is inevitable to diligently and continually polish each side of the gem to make it shine. Thus, the technique of polishing consists of minute efforts toward information, similar to trees in the forest. In other words, without cutting and polishing, a gemstone cannot be turned into a twinkling gem.

In this study, the role of emergency management information includes two major criteria, namely, the sources and the features of emergency management information. The two criteria play a role in reflecting every aspect of emergency management information. In fact, these two criteria were chosen via a Korean online survey from December 11, 2018 to January 11, 2019. This online survey as an assistive device played a role in supporting the analytical framework in this study. Eighty-one percent of online respondents (164/203 respondents) chose those two criteria as the major elements on the role of emergency management information in Korea.

To elaborate, the sources embrace six key players: (1) governments, (2) colleges, (3) industry, (4) NGOs, (5) family and (6) foreign sources whereas the features include four characteristics: (a) creativity, (b) accuracy, (c) access and (d) timing. Note that the survey respondents were professionals in the field of emergency management, making their choices of the factors even more valuable. The factors were then cross-checked to ensure validity and applicability. Further, the use of online survey was advantageous and meant completion of the framework smoothly and without delay

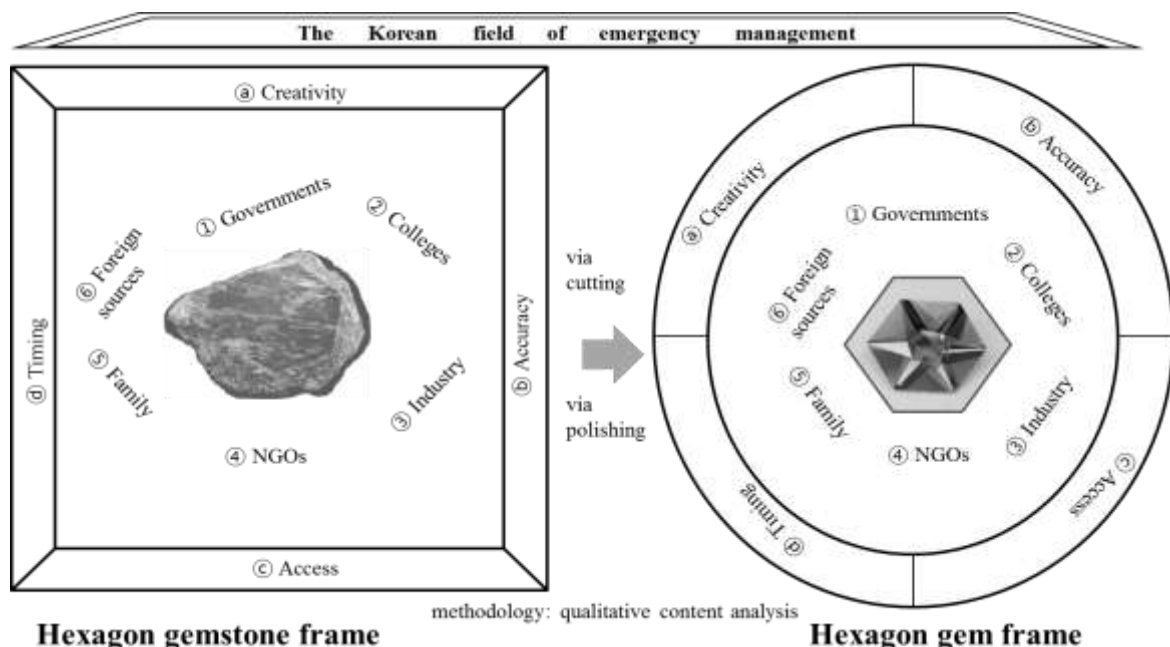


Fig. 1: Analytical framework

The major methodology is a qualitative content analysis, especially since many qualitative information and data have been analyzed and then cited. Although some numerical data have also been used, qualitative information and data have been much more extensively utilized. All information and data have been collected mainly via online information

sources such as ScienceDirect, EBSCO, Google Scholar, RISS, Koreanstudies Information Service System (KISS), DBpia, Government websites among others. After that, those texts were appropriately interpreted and then incorporated in this manuscript.

Table 1
Major statistics on the reality of hexagon gemstone frame in Korea.

The 6 information sources/4 information features	(a) Creativity	(b) Accuracy	(c) Access	(d) Timing
(1) Governments	- Yearly ratio of MOIS's research budget against fires, flood due to typhoon and maritime accidents was 93.2% from 2014 to 2019.	- Yearly number of complaints against MOIS's wrong info was 43.3 from 2014 to 2019.	- Total number of articles on the difficulty of access to governments' info was 22 from 2014 to 2010.	- Yearly number of complaints against MOIS's info timing was 9.9 from 2014 to 2019.
(2) Colleges	- Number of colleges that have departments of firefighting, civil engineering and maritime science was 59 in 2019.	- Efficiency of foreign language in these college departments was almost at middle level from 2014 to 2019.	- Ratio of access to KISS database between non-college and college stakeholders was 11:89 in 2019.	- Ratio of college researchers' articles on between future and past emergencies was 14:86 from 2014 to 2019.
(3) Industry	- Ratio of info investment between small- and medium-sized and conglomerate industry was 85:15 from 2014 to 2019.	- Ratio of consumers' satisfaction with industry' info product was 77% in 2019.	- Response of industry on the level of own info access was "average" from 2014 to 2019.	- Not available
(4) NGOs	- Yearly ratio of copying and pasting others' info in seven NGOs' website was 89% from 2014 to 2019.	- Yearly number of complaints against each seven NGOs' info was 12.4 from 2014 to 2019.	- Yearly number of complaints against each seven NGOs' membership was 5.2 from 2014 to 2019.	- Response of netizens to seven NGOs' info timing was "average" from 2014 to 2019.
(5) Family	- Ratio of family's "satisfactory" response to its info creativity was 68% from 2014 to 2019.	- Ratio of family's "generally accurate" response to its info was 76% from 2014 to 2019.	- Ratio of family's "excellent" response to its info access was more than 89% from 2014 to 2019.	- Ratio of family's "excellent" response to its info access was more than 91% from 2014 to 2019.
(6) Foreign sources	- Ratio of info experts' response to foreign sources as the most creative one was 78% from 2014 to 2019.	- Ratio of info experts' response to the matter of interpreting foreign resources as the biggest challenge was 91% from 2014 to 2019.	- Response of ordinary citizens on the level of access to foreign sources was "average" from 2014 to 2019.	- Response of ordinary citizens on the level of timing around foreign sources was "average" from 2014 to 2019.

Sources: (KISS;¹⁰ NDMRI¹⁵).

Table 2
The reality of hexagon gemstone frame in Korea

The 6 information sources/4 information features	(a) Creativity	(b) Accuracy	(c) Access	(d) Timing
(1) Governments	●	●	▽	●
(2) Colleges	●	●	●	●
(3) Industry	●	▲	●	▽
(4) NGOs	▽	●	●	●
(5) Family	●	●	▲	▲
(6) Foreign sources	▲	▽	●	●

Notes: ▲ = top level; ● = middle level; ▽ = low level.

Results

Hexagon gemstone frame in Korea: Many empirical data are provided. However, recognizing the difficulty of collecting every matching statistical data for 24 items (6 information sources × 4 information features) in the field of emergency management information, table 1 has been made to include many appropriate or at least similar data. Additionally, table 2 has tried to evaluate the same 24 items by utilizing three appraisal standards (e.g. top, middle and low levels).

Governments: Until the end of 2014, the NEMA officially took charge of dealing with emergency management information on all kinds of risks such as natural disasters and man-made emergencies, via the National Emergency Management Information System (NEMIS or locally known as either the National Disaster Management System or NDMS). The NEMA changed its official name into the Ministry of Public Safety and Security (MPSS) (from 2014 to 2017) and then the Ministry of the Interior and Safety (MOIS) (in 2018). Also, other public institutions have played their own roles in creating and managing related emergency management information.

In general, government research institutes have repeated similar researches every year to include how to deal with fires, typhoon accompanied by flood and maritime accidents and hence, creativity has not been noteworthy. The accuracy has been just average, if considering that Government information has not always been right such as the cause of current wave, the scope of emergency management and others.

Moreover, the public should be freely allowed to access Governments' emergency management information via multiple channels, as a principle of emergency management.¹⁷ Yet, based on their experience, it is quite difficult to have access to sensitive information in Korea, such as those on the topics of the possibility of nuclear power leakage, the outbreak of new emergency and matters of national security. The extent of access has been much lower than expected. However, as Governments have provided

related timely information to the public on a regular basis, timing has not been poor.

Colleges: All the four features of colleges in emergency management information have been evaluated as middle level in Korea. Colleges have their own laboratories to delve into emergency management information including engineering disaster knowledge, psychological treatment, meteorological prediction, evacuation routes among others. Particularly, departments of firefighting science, departments of civil engineering and departments of maritime science have tried to create information as front runners, but not as innovative as other departments. Even though colleges are academic pioneers, their information on emergency management has not always been correct, especially when introducing foreign information to Korea such as basic emergency terms including hazard, emergency, disaster and risk, their information is sometimes arbitrary.⁸

A group of colleges has set up their own database to share their emergency management information with others. However, besides college stakeholders, access has not been easy because of the high degree of information difficulty. Furthermore, it has been observed that colleges' researches have generally focused on past emergencies and not on potential emergencies and that they have not been very successful in informing others in advance regarding future emergencies.

Industry: Though industries have made efforts to develop growth-oriented technology for economic progress, their creativity on emergency management information including early warning system, hazard map, the composition of active faults under the ground and others which reflect equity-oriented aspect, has not been very rich.⁹ Comparatively, their creativity has not been extraordinary because industries have disregarded their investment for emergency management information.

Nevertheless, their information accuracy has been excellent so far, presuming that they may not provide or sell information to the customers without confirming

information accuracy. Although their information is not perfect, related accuracy is still very robust.

Despite the fact that the public can freely access industries' emergency management information by paying charges, it is also true that industries have not allowed any access to sensitive information notwithstanding the political demand and permission to access has been mixed. Additionally, as many industries have attempted to provide related information to the customers after clearly deciding on its possibility of commercialization, information timing has been largely. Without exploiting the opportunity of making benefits, industries would not work on any crucial information.

NGOs: NGOs have recently started their activity on emergency management in Korea, but not in a professional way. Many NGOs have come to collect and provide textbook information such as the number of human losses, the amount of economic damages and others which are known to the public already without realistically focusing on how to address emergency response.²⁷ Hence, their information badly lacks creativity. However, as NGOs have provided textbook information via their own information network, its accuracy has not been very bad except regarding new emergencies, a disease outbreak, infectious animal diseases and also seismological information and data and others.

Ordinary citizens can usually have access to NGOs' emergency management information via computer network or other tools, as long as they become members. Nonetheless, it is true that NGOs' response to citizens' inquiries has not been very fast and satisfactory. Particularly, as NGOs have provided textbook information, the information timing has been faultless. Yet, it does not mean that timing has not been a problem at all, considering the fact that they have failed to provide appropriate information on new emergency including pandemic disease and new critical bacteria on time.

Family: As families have to directly fight against emergency in a community in Korea by implementing simple activities, their members have always exchanged emergency management information including emergency victims' names, reunion places and others, in particular when they are far away.²³ It has been recognized that each member of a family is willing to monitor new emergency such as H1N1 virus around the house, Middle-East Respiratory Syndrome (MERS), animal infectious diseases around farms such as avian influenza and foot-and-mouth disease and COVID-19, thus, information creativity is satisfactory, although not complete. Additionally, as families have prepared and circulated their own information, its accuracy has been moderate.

Predominantly, as all members of a family live in the same household, they have free and easy access to their information. In particular, when a certain family member

asks any question on home emergency such as emergency phone numbers, the location of emergency kit and others, he/she will immediately get related response from other members. Also, the majority of family members may easily access the internet for relevant emergency management information. Likewise, information timing has been extraordinary among family members because of their location and blood relationship.

Foreign sources: Many foreign sources of emergency management information are available for free and by a number of means including via the internet.¹³ Though their contents may be creative, accurate, accessible and timely, their potential benefit and use have not been maximized because of the language barrier. The use of English, French, German, among others is not prevalent in Korea. As such, foreign sources are still concerned barriers because of the limitation on their interpretation.

Discussion

Hexagon gem frame in Korea: The outline of hexagon gemstone frame in Korea has been just provided. Even though some data have been indirectly related to the situation of hexagon gemstone frame in Korea, they have been satisfactory enough to qualitatively analyze the issue. In addition, they form a basic material to figure out the proportional alternatives.

Governments: Majority of Government researchers were firefighters and civil engineers in the NEMA. Researchers in the MPSS consisted of maritime policemen as well as firefighters and civil engineers. Now, MOIS consists of firefighters and civil engineers again. To improve the extent of creativity, government research institutes must expand the range of researchers to other academic areas or various emergencies. Alternatively, the MOIS (or even MPSS) should attempt to coordinate its research with other public institutions. Similarly, the MOIS must correct wrong information to improve accuracy, in particular, by allowing joint researches with diverse researchers in other institutions.

As residents in each community have their own priorities and needs about information, Governments should allow them to flexibly access related information. Also, access to Governments' information has not been fully based on security reason, but on bureaucratic issue.^{1,24} Therefore, Governments should improve the issue of access by dramatically reforming the bureaucratic process. By encouraging researchers to examine new or potential alternatives to addressing an emergency, Governments must provide updated results or related information for the public in advance, to improve timeliness. The Government must initiate and lead the flow of emergency management information on time.

Colleges: Colleges have to integrate all academic information by and for all concerned and relevant fields when developing emergency management information. The

fusion of all information will contribute to improving both creativity and timing, in particular by facilitating comprehensive research.

Similarly, when departments of firefighting science, those of civil engineering and those of maritime science attempt to apply foreign information to their information, they have to allow other departments to participate and assist. One way to do this is to commission (language) interpreters, for example, if they exist in other departments or colleges. By doing so, their information will no longer be arbitrary owing to improved accuracy. In addition, college researchers should try to publish their research information via diverse channels (e.g. joint researches) in a more comprehensible manner, if possible. Without ordinary citizens' understanding of information, the issue of access cannot be effectively solved.

Industry: Korea has largely increased its demand on social equity throughout the nation in the 21st century and the demand on emergency management information has been dramatically increased via most current emergencies such as the outbreak of COVID-19 in the whole year of 2020 and beyond, the occurrence of flood in August in 2020 among others. In short, related commercialization is increasingly possible in the society. Thus, it is the right time for the industries to increase their investment on information creativity and simultaneously provide information to any customer in a timely manner.¹¹

Industries should not stop their efforts toward information accuracy, because the extent of accuracy has been good so far. However, they try to sustain their efforts by developing efficient tools for the survival of the fittest.⁴ In addition, industries have to expand their information access to the public. As a result, the opportunity of industrial commercialization will definitely be improved unlike the conventional thought. By wisely releasing related information rather than keeping it forever, the public may be willing to purchase related product and thus, industries will make profits.

NGOs: NGOs need to be more creative in collaborating with co-NGOs and other stakeholders within the Korean environment. External support, though not discouraged, is not seen as a requirement, especially since the general observation is that there is no much outside support for the Korean NGOs. Solid improvements must be carried out within the first year before NGOs can tap external resources.¹² Doing so may lend credibility to the institution.

It is a requisite for the NGOs to facilitate their response to the public's inquiries by improving emergency awareness because NGOs' late response is primarily owing to their lack of emergency awareness. In particular, NGOs must improve emergency awareness among their staff members via appropriate education, training and exercise. In doing so, the public including every stakeholder will receive early

response on even new emergency, especially with the cooperation of internal members.

Family: Families or residents are the first to be affected when an emergency strikes. As such, family members need to be united and well-informed about their emergency preparations. Examples include ensuring that emergency kits, evacuation plans and communication plans are available and understood well by every member.⁶

Foreign sources: To promote creativity, stakeholders have to extensively introduce appropriate foreign sources to the public such as the U.S. Emergency Management Institute's Independent Study program, emergency news from the International Association of Emergency Managers and others. As some foreign sources are neither creative nor accurate, it is essential for them to select and introduce accredited sources. To dramatically improve accuracy, interpreters need to further study the subject of emergency management²⁵ as well as avoid manipulating their interpretation for political purposes such as civil engineers interpreting emergency management into Bangjae (or civil engineering management).

It has not been easy for Koreans to improve their knowledge on foreign language such as English within a short time⁷. Thus, it is difficult to ask the public to study foreign languages. Yet, by setting up appropriate websites as well as providing correct interpretation, governments or leading researchers may be able to improve the public's information access. Similarly, stakeholders have to play a role in providing correct and timely interpretation in the websites.

Conclusion

The purpose of this study was to investigate how Korea has to improve the issue of emergency management information. In doing so, this study has equally examined the hexagon gemstone frame and the hexagon gem frame to suggest not only big changes by cutting, but also minute alternatives by polishing information in the Korean field. With all these in mind, this study successfully achieved its original purpose, in particular considering suggested big frames, unique barriers and various alternatives in the field. The key tenet is that Korea needs to transform the hexagon gemstone frame into the hexagon gem frame for the goal of emergency management.

After evaluating the current situation of Korean emergency management information, three key players were considered to be the best, namely (1) foreign sources were best in creativity, (2) the industry was best in accuracy and (3) the family was best in both access and timing. In providing appropriate alternatives for Korea, it is inevitable to improve the following: access for governments, timing for industries, creativity for NGOs and accuracy for foreign sources.

It is not easy for one or two players to reform the hexagon gemstone into the hexagon gem frame. Rather, all the six

sources must work together to solve the identified situation or challenge and implement alternatives in terms of the four features and ultimately reform the system. In short, Korea needs to work on the holistic approach to successfully change the hexagon gemstone into an improved architecture.

As one of the greatest values, this study has systematically suggested the conceptual architecture for the field of emergency management information in Korea particularly by modifying existing theories. In fact, it is true that this field lacks appropriate architecture to theoretically explain the complicated dynamics of information process in the international community as well as in Korea. By relying on both the hexagon gemstone and the hexagon gem frames, many will further understand the role of information, especially through a national perspective.

Similarly, this study has contributed to the development of emergency management information not only in Korea, but also in the international community. The issue of information has always been a key aspect at the outbreak of emergency regardless of national boundary.

Thus, this study can assist the field of emergency management information in diagnosing the incoming and outgoing process of information in each region like the current case of coronavirus infection. In other words, by relying on the suggested results and implications, this study may contribute to the goal of transnational emergency management.

In the future, it is necessary for Korean researchers to expand the conceptual architecture to their own studies with different scopes. By doing so, those researches could be systematically examined using 24 different items. Also, international scholars may apply the conceptual architecture to their own national systems and provide different alternatives for their countries. Simultaneously, it will lead to a short cut for transnational emergency management.

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