Improve Understanding and Dissemination of Disaster Management and Climate Change by Using Knowledge Management Systems

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Abstract. In Law Number 24 Year 2007 concerning Disaster Management, it is stated that the central government and regional governments are responsible for implementing disaster management, with an emphasis on preparedness and mitigation in dealing with natural disasters, as well as based on the provisions of article 1 of Presidential Regulation No. 46 of 2008 concerning the National Council on Climate Change that climate change is a change in average conditions of climate and/or climate diversity from one period of time to another as a result of human activity. However, the socialization of these two matters is not regulated in existing laws and regulations, so that the information dissemination plan and dissemination of the information must be carried out to the community itself. In line with developments in technology and information systems that have entered the era of media convergence, the acceleration of the process of spreading government programs can also be done by using this technology. The SECI method model (Socialization, Externalization, Combination, Internalization) was developed through implementation based on the 'Knowledge Management System Cycle' theory, so that a knowledge management system was formed. The results of research on community preparedness in the application of Knowledge Management Systems (KMS) for natural disaster preparedness and mitigation can be used to support the dissemination and dissemination of disaster management mitigation, global warming, and community-based climate change, including performance measurement of success.

Keywords: disaster management, climate change, SECI model, knowledge management systems, dissemination

1. Introduction

Natural disasters are a condition of the natural processes of the earth, such as floods, tornadoes, volcanic eruptions, earthquakes, tsunamis and other geological natural processes. These natural disasters can result in the loss of people's lives or property damage in the environment of...
natural disasters [1], and will usually leave some economic, social, and environmental damage after
the natural disaster, how much the severity of natural disasters depends on the resilience of the
population who are affected, or the ability to recover is highly dependent on the infrastructure
available or prepared [2].

In Indonesia, the Disaster Definition Law No. 24 of 2007 concerning Disaster Management states
the definition of disaster as follows: Natural disasters are events or a series of events that occur and
disrupt people's lives caused by natural factors and / or conditions of non-natural factors and human
factor conditions, which result in community casualties and environmental damage, as well as
property losses and psychological impacts on the community. From this definition it is stated that
natural disasters are caused by conditions of natural factors, conditions of non-natural factors, and
human condition. Therefore, Law No. 24 of 2007 also defines natural disasters, non-natural disasters,
and social disasters. Natural disasters are disasters caused by events or a series of events caused by
nature such as earthquakes, tsunamis, volcanic eruptions, floods, droughts, hurricanes, and landslides.
For Disaster Management in Indonesia, the National Disaster Management Agency (BNPB) becomes
person in charge of organizing disaster management at the national level supported by ministries or
agencies related, such as the Ministry of Public Works and Housing People, Ministry of Health,
Ministry of Social Affairs, Ministry Domestic, TNI, Police, Search and Relief Bodies (Basarnas),
Meteorology, Climatology and Geophysics Agency (BMKG), Center for Volcanology and Geological
Disaster Mitigation (PVMBG), and related ministries/institutions. In the face of disaster threats,
preparedness becomes the key to your safety [4].

Based on the provisions of article 1 of the Presidential Regulation of the Republic of Indonesia
No. 46 of 2008 concerning the National Council on Climate Change that climate change is changing
the average climate conditions and/or climate diversity from one period to another as a result of human
activities, adaptation Climate Change is a process to strengthen and develop strategies to anticipate the
effects of climate change and implement them so that they can reduce negative impacts and take
positive benefits and Mitigate Climate Change is a control effort to prevent climate change through
activities that can reduce emissions or increase the absorption of greenhouse gases from various
emission sources. Climate change which causes this uncertain season shift is theoretically the most
influential is the area around the coast and watersheds. The increase in the earth's temperature is
getting hotter, rainfall is changing drastically, the escalation of forest fires, storms and floods, all of
these make the climate and weather extreme. The temperature of the earth that reaches a certain hot
point will make the ice at the poles melt and cause symptoms of sea water blooming, rising sea levels
and will drown lowlands, coastal areas, and small islands like those in Indonesia. Discussion and
seriousness of the government in the issue of Climate Change in Sustainable Development can be seen
in Figure 1.

Figure 1. The Urgency of Climate Change in Sustainable Development. (Source: PIK Indonesia
Network International Conference 2019: “Transitioning Towards Sustainable Low-Carbon
Development in Asia Pacific” Challenges and Opportunities in Developing Countries, Jakarta, 22
August 2019)
So, and Indonesia's active participation and contribution to the global community in relation to climate change globally are presented in points as can be seen in Figure 2.

![THE FIRST NATIONALLY DETERMINED CONTRIBUTION INDONESIA](image)

**Figure 2. The First Nationally Determined Contribution Indonesia** (Source: APIK Indonesia Network International Conference 2019: “Transitioning Towards Sustainable Low-Carbon Development in Asia Pacific” Challenges and Opportunities in Developing Countries, Jakarta, 22 August 2019)

2. **Materials and Methods**

2.1. **Comprehensive literature review**

Based on the provisions of article 1 of the Presidential Regulation of the Republic of Indonesia No.46 of 2008 concerning the National Council on Climate Change that climate change is changing the average climate conditions and/or climate diversity from one period to another as a result of human activities, adaptation Climate Change is a process to strengthen and develop strategies to anticipate the effects of climate change and implement them so that they can reduce negative impacts and take positive benefits and Mitigate Climate Change is a control effort to prevent climate change through activities that can reduce emissions or increase the absorption of greenhouse gases from various emission sources.

2.2. **Selection criteria**

Global warming is a condition of increasing temperature on the surface of the earth. The above conditions will then trigger various events, such as melting of polar ice caps to rising sea levels, climate change, drought in various places while snowstorms elsewhere, natural disasters, forest fires, the extinction of certain species, sinking of small islands, and others [4]. These effects significantly threaten the existence of human life and the future of the world. Because of that Hunter Lovins called it global warming or by John Holdren termed global climatic disruption (global climate disruption). Friedman writes that the green revolution requires more ambitious intentions and efforts than any other American project. This will be the biggest innovation project in American history, and it will change everything in people's lives such as transportation, industry and other utilities. The green revolution will replace the cold war ‘era that has long been between the western and eastern blocs to the energy-climate war’ which is marked by five main problems:

1. Imbalance between supply and demand in the energy sector;
2. Petrodictatorship, i.e. new dictators who gain power through oil energy wealth;
3. Climate change;
4. Energy poverty, more and more people in the world are unable to buy the energy they need.
5. Loss of biodiversity is the extinction of various types of plants and animals in America.
Meanwhile, because climate change will affect all aspects of sustainable development and because vulnerability is very dependent on development, policy makers must seek to prioritize adaptation to climate change into national and sectoral development while continuing to strive to improve performance in mitigation and sustainable socialization of climate change based on the local wisdom of the local community [16].

Climate change adaptation is a variety of adjustments to the conditions of climate change that occur; adjust economic activities in vulnerable sectors so that it supports sustainable development. Until now, adaptation activities have focused on areas that are considered vulnerable to climate change, namely coastal areas, water resources, agriculture, human health and infrastructure [2], where the effects of climate change is shown in Figure 3.

Adaptation to climate change is very important and must be done immediately, given Indonesia's vulnerability to the effects of climate change and low capacity to adapt. Adaptation strategies to climate change must be immediately compiled and adopted in national development strategies. The design requires mainstreaming within the framework of cross-sectoral (interdepartmental) sustainable development goals. The direction and adaptation activities require consistency from all levels of relevant government agencies, as shown in Figure 4.

2.3. Knowledge Management
Information is a set of facts and images, while knowledge consists of views and interpretations, which are personalized and refer to specific situations. In addition, what is called information is determined
by the recipient, not the sender. Information flows both formally (e.g., memos, etc.) and informally in organizations. Knowledge is derived from the mind at work, where knowledge can be a process or a stock. Knowledge includes: comparisons between situations, consequences and connections that allow individuals to connect parts of knowledge (information) to other parts [5].

The knowledge and information equation according to [17] and Figure 5 is an overview of information; a subset of information; related or specific adjusted to a domain, or work, or to achieve a business goal. While the difference is that information is very general, covers a wide scope; information can be collected, analyzed, but cannot be internalized, while knowledge can be internalized (tacit), built within the individual. In this sense, knowledge can be linked to information that is internalized and capable of actionable.

![Figure 5. Modes of Knowledge Creation Process [18]](image)

### 2.4. Knowledge Management Systems (KMS)

The concept of KMS is technologies that support organizations that include: knowledge generation, codification and knowledge transfer [6]. This concept helps identify several KMS functions and is subsequently used to define similar systems such as Collaborative Systems, Information Systems and KMS. [7] explained that KMS refers to the contribution of information systems implemented to manage organizational knowledge, then developed to support and improve the process of creating, storing and retrieving knowledge, transfers and applications in an organization and its dissemination [8].

Therefore, KMS is an information technology-based system developed to support and improve the knowledge management process that is owned by the organization for the innovation of the creation, storage, transfer, and application of existing knowledge to the organization. Maier [9] extends the concept of information technology and incorporates it into KMS by defining that KMS is a comprehensive information technology platform for collaboration and knowledge sharing with advanced level of knowledge services built on contextualization and integrated ontologically, and personally disseminated for connected participants into the community.

### 2.5. Knowledge Management Systems (KMS) Cycle

The Knowledge Management System Life Cycle is a process framework that consists of storage of knowledge, relationships, IT, communication infrastructure, functional expertise, environment, organizational intelligence and external resources [15]. The Knowledge Management System Life Cycle is a cycle that is run when an organization begins to implement a Knowledge Management System as a medium to accommodate the knowledge held by employees. The cycle covered by the Knowledge Management System Life Cycle itself begins with making or acquiring knowledge to spread the knowledge itself, as shown in Figure 6.
The steps can be described as follows:

1. **Create Knowledge**
   Create Knowledge is a process where someone gets Knowledge that comes from outside the person. Starting from experience experienced, reading a source of knowledge, to sharing that is done either intentionally or unintentionally.

2. **Capture Knowledge**
   Capture Knowledge or commonly known as the absorption of knowledge is a process where the knowledge that has been obtained is processed in various ways, ranging from making more in-depth observations, exchanging ideas, to conducting research to get more valid results.

3. **Refine Knowledge**
   Refine Knowledge is one of the Knowledge Management System Life Cycle processes that has a role to improve or even perfect existing knowledge so that later it will be easier for others to understand and understand.

4. **Store Knowledge**
   Store Knowledge has the role to store knowledge held by employees into the Knowledge Management System in a systematic format, so that members in the organization can access it.

5. **Manage Knowledge**
   Manage Knowledge is a process where organizations must ensure that existing or available Knowledge is still relevant or accurate, so that it can still be utilized by the organization.

6. **Disseminate Knowledge**
   Disseminate Knowledge is the final process of the Knowledge Management System Life Cycle that functions to disseminate the knowledge that is owned by the organization whenever and wherever the Knowledge is needed so that the authorization is needed in obtaining that access.

3. **Results and Discussion**

   By looking at the development of information systems and technologies that have entered the era of media convergence, namely the merging of various technology platforms on one media or equipment owned by all levels of society, then to accelerate the process of disaster preparedness and mitigation dissemination can also be done by utilizing these equipment and knowledge transfer carried out in various ways, including through skills training, courses, seminars, workshops that will take place effectively and efficiently using modalities based on community participation and local wisdom by utilizing media convergence [10]. The method of carrying out activities in general is in the form of transfer of knowledge and capacity building of those who play a role in efforts to build preparedness and mitigation, so that they are more monitored and measurable in their performance [11].

   Optimization of dissemination and development of data and information on sustainable development and mitigation activities related to natural disasters are more effective and efficient. The
results of community service activities in the form of Knowledge Management Systems (KMS) for natural disaster preparedness and mitigation can be used to support the socialization and internalization of community-based disaster preparedness and mitigation activities, including the development of dissemination and performance measurement of preparedness readiness and community mitigation in the face of natural disasters [12]. The implementation of the concept of knowledge management has objectives to create, disseminate knowledge, and produce explicit knowledge that can be followed up for all fields and jobs [13]. Through the process of internalizing knowledge, users can practice a range of management knowledge and put experience in practice, which enables them to gain higher levels of expertise [14]. However, it needs to be done in basic conditions, taking into account that users will be responsible for actively delivering explicit knowledge that is packaged in the system, processes and transforms it into a key factor to improve their skills and productivity. Knowledge management actions related to skill levels are shown in Table 1.

| Stage | Knowledge Action | Level of Expertise | Responsible | Activities |
|-------|------------------|--------------------|-------------|------------|
| Socialization | Share (Between peers) | All levels | IT Unit | Newsletter |
| | Classify (Individually) | All levels | Internal | Newsletter |
| Externalization | Analyze | Expert | IT Unit | Experience report |
| | Express | Proficient | Directorate | Formulation of action protocols |
| Combination | Systematize | IT Unit | Information storage and content update |
| | Prioritize | Directorate | Focus Group |
| Internalization | Acquire (Individual-group) | All levels | Each collaborator | Daily interaction in ERP, EAS GC module |
| | Practice | Directorate | Performance evaluation |

Knowledge exploitation in organizations is projected in modules taking into account the following factors: the generation of an environment of trust, the development of work and shared learning in the community, exchange of knowledge and experience, participatory leadership, collaborative learning for constructive and competitive feedback on people's interactions regardless of their level of expertise. Thus, a strong virtual interaction space needs to be created to improve individual and organizational learning, based on existing standards in the organization and internal regulations, this is often referred to as "Identity of Knowledge", as reflected in Table 2.

| Factor | Contribution |
|--------|--------------|
| Point of Entry | The system is prepared for users who have unique access to the preparedness and mitigation module, through their ID and password. |
| Community support | Users are expected to participate and collaborate with experience during disasters and also with preparedness and mitigation activities. |
| Content managing | Users are expected to be active in searching, sharing and recommend to develop content regulated in disaster mitigation documents and knowledge. |
| Learning | Users increase abilities higher in the level of knowledge, because of them understand the importance of sustainable disaster preparedness and mitigation for better management of disaster areas. |
| Information source | Users can submit interest in the field of sustainable preparedness and mitigation knowledge in full by explaining their activities, and having skills in recommending to experts. |

The implementation of this community service program will be carried out experimentally to obtain an ideal model of knowledge management systems for sustainable preparedness and mitigation in the management of natural disasters, activities will be carried out in stages through direct observation of coordination activities on natural disaster management. Knowledge Management conceptually is how to gather knowledge, manage knowledge, and redistribute that knowledge to the
community. Knowledge referred to in this case is preparedness and mitigation of natural disasters and their implications for the community. Based on the concept of the Knowledge Management Systems (KMS) described earlier, the components within it can be grouped according to the stages of function of the KMS component, namely:

1. Management of documents related to natural disasters
2. Document ontology / taxonomy or categorization
3. Artificial intelligence based
4. Management of documents in the organization
5. Communication in the organization
6. Communication with relevant stakeholders or organizations
7. Organizational knowledge actualization in the form of a company website
8. Actualize individual knowledge and experience through blogs, personal events, and
9. Actualization of knowledge collected with the organization in the form of a wiki.

The successful implementation of knowledge management systems is designed as something that has a function for knowledge management innovations, ranging from knowledge collection, knowledge search and storage, to the dissemination of knowledge back to the community and the successful implementation of knowledge management systems highly dependent on factors outside the system formed, including several strategic issues that affect the design of the systems. These factors include: the focus of the knowledge management systems, the amount of knowledge that will be managed and in its format, who will manage, and what limits in the use of individual knowledge. From the various theories presented above related to the development of a knowledge management system for socialization of mitigation about natural disasters, the system can be seen in Figure 6, which is one of the displays that can be followed up by the community to develop further understanding of natural disasters and mitigation at the same time the system also prepared a control device to monitor the level of community readiness in understanding natural disasters.

Conclusions
Knowledge management systems can be developed by utilizing information systems and technologies to support sustainable disaster preparedness and mitigation socialization processes taking into account the following:

1. Availability of good technical infrastructure by utilizing open source and cloud computing as well as easy changes to support disaster preparedness and mitigation systems.
2. Involve stakeholders in disaster preparedness and mitigation in operational implementation.
3. Having a clear organizational structure in management and governance of knowledge about sustainable readiness and disaster mitigation.
4. Support from disaster management stakeholders.
5. Training in using the system for all communities in communities potentially affected by the disaster.
6. Build motivation and commitment by including the performance of KMS utilization in the evaluation process, and implementation of the steps.

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References
[1] U.S. Billion-Dollar Weather and Climate Disasters
[2] G. Bankoff, G. Frerks, D. Hilhorst (eds.) (2003). Mapping Vulnerability: Disasters, Development and People. ISBN 1-85383-964-7.
[3] Jason Enia. (2016). *Rules versus discretion: Comparing disaster declaration institutions in the Philippines and Indonesia.* International Journal of Disaster Risk Reduction, Volume 16, June 2016, Pages 158-166

[4] Thomas L Friedman. (2009). *‘Hot, Flat, and Crowded Mengapa Kita Butuh Revolusi Hijau dan Bagaimana Masa depan global Kita.’* Jakarta: Gramedia.

[5] Terence Ahern, Brian Leavy, P. J. Byrne. (2014). *Knowledge formation and learning in the management of projects: A problem solving perspective.* International Journal of Project Management, Volume 32, Issue 8, November 2014, Pages 1423-1431.

[6] Esther, Carmen. Allan, Watt. Laurence, Carvalho. Jan, Dick. Ioan, Fazey. Gemma, Garcia Blanco. Jennifer, Hauck. Zita Izakovicova. Leena, Kopperoinen. Camino, Zitalzakovicova. Leena, Kopperoinen. Camino, Liquete.David, Odee. Eveliene, Steingröver. Juliette, Young. (2018). *Knowledge needs for the operationalisation of the concept of ecosystem services.* Ecosystem Services, Volume 29, Part C, February 2018, Pages 441-451.

[7] Alavi, M., & D.Leidner. (2002). *Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues.* MISQ, 25(1)

[8] Wu, J.H., & Wang, Y.M. (2006). *Measuring KMS success: a respecification of the DeLone and McLean’s model,* Information & Management

[9] Maior, Ronald. (2006). *Knowledge Management Systems,* Springer-Verlag

[10] Bikram Manandhar. (2016). *Remittance and earthquake preparedness.* International Journal of Disaster Risk Reduction, Volume 15, March 2016, Pages 52-60

[11] Ford A. (2009). *Modeling the Environment,* Second Edition. 2nd Editio. Washington DC: Island Press; 2009. 380 p.

[12] Bercerra-Fernandez, I, Sabherwal, R. (2004). *Knowledge Management System and Process.* Prentice Hall, editor. Upper Saddle River, New Jersey: M.E. Sharp, Inc.; 2004

[13] Badan Nasional Penanggulangan Bencana Data dan Informasi Bencana Indonesia, accessed from (http://dibi.bnpb.go.id/data-bencana) August 18th, 2016.

[14] Felisa M. Córdova, Felipe A. Gutiérrez. (2018). *Knowledge Management System in Service Companies*

[15] Dalkir, K. (2005). *Knowledge Management in Theory and Practice.* Oxford

[16] BNPB. (2017). *Tanggap Tangkas Tangguh menghadapai Bencana.* Badan Nasional Penanggulangan Bencana. Edisi 2017.

[17] Mustafa I. M. Eid, Ibrahim M. Al-Jabri. (2016). *Social networking, knowledge sharing, and student learning: The case of university students.* Computers & Education, Volume 99, August 2016, Pages 14-27

[18] Shu-Chen Kao, ChienHsing Wu. (2016). *The role of creation mode and social networking mode in knowledge creation performance: Mediation effect of creation process.* Information & Management, Volume 53, Issue 6, September 2016, Pages 803-816

[19] Anna Mazzi, Sara Toniolo, Stella Catto, Valentina De Lorenzi, Antonio Scipioni. (2017). *The combination of an Environmental Management System and Life Cycle Assessment at the territorial level.* Environmental Impact Assessment Review, Volume 63, March 2017, Pages 59-71