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Towards industry 5.0 in disaster mitigation in Lombok island, Indonesia

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Abstract A recent natural disasters that gained extensive news coverage and public concern in Indonesia is the earthquake that occurred in Lombok Island, West Nusa Tenggara Province, in early August. Initially, local authorities stated that the earthquake on Lombok Island on 5 August 2018 was at an M 6.8 scale. However, the scale was later revised to M 7.0. This research used descriptive-qualitative case study method. Research result proved that the technological advances that have brought human civilisation to Industry 4.0 have a significant contribution to disaster mitigation. In the disaster that occurred in West Nusa Tenggara, researchers found that the government, disaster mitigation and recovery agencies, journalists, and the public used internet chat-based digital technology to conduct effective coordination. However, Industry 4.0 technology still has limitations in terms of disaster mitigation. Researchers suggest that the issues be addressed using industry 5.0, a technology based on the internet of things.

Keywords: industrial revolution 5.0; technology; disaster mitigation

INTRODUCTION

Indonesia is a country that is prone to natural disasters. The main factor contributing to this situation is the fact that Indonesia is surrounded by three active tectonic plates, namely the Eurasian Plate, the Sunda Plate and the Australian Plate. According to the Indonesian National Disaster Management Agency, from 2014 to 2017, Indonesia has experienced 7985 natural disasters which claimed 1,725 lives and

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caused 10 million refugees (Fahrimal et al., 2019). Indeed, in 2018 alone, Indonesia has witnessed 2,572 natural disasters, which killed 4,814 people and affected more than 10 million people. Earthquakes and their effects, such as mudflows and tsunamis, were often noted as the leading causes. Of the 11,577 earthquakes that occurred in Indonesia in 2018, 21 of them were classified as strong and large (Kholil et al., 2019). The two major disasters in terms of damage and casualties were the tsunami in Java which killed around 400 people and the mud flood in Sulawesi which killed around 2000 people. Although in the context of Southeast Asia the Philippines may be more vulnerable to natural disasters (Lagmay et al., 2015), Centre for Research on the Epidemiology of Disaster (CRED) (Guha-Sapir, 2019) argues that intense earthquake activity in Indonesia should not be ignored.

This research focused on other disasters that have received widespread attention from the national mass media and the public, namely the earthquake that hit Lombok Island in West Nusa Tenggara in early August 2018. Initially, the authorities confirmed that the earthquake on 5 August 2018 was on the scale of M 6.8 but later revised to M 7.0. The earthquake centred on the land triggered a tsunami, although it was not too massive. Earthquakes, not tsunamis caused most of the fatalities. Since the tsunami in Aceh in 2004, Indonesians often panic whenever land distortions occur, especially those who live in coastal areas. They are afraid that a tsunami will occur if there is an earthquake on the coast.

Before hitting North Lombok, earthquakes had also occurred in other areas on the island of Lombok. For example, the earthquake that occurred in East Lombok on 29 July 2018 with a scale of 6.4 M. The mass media reported that before the earthquake occurred in North Lombok, 564 aftershocks occurred in East Lombok. However, unlike the earthquakes in Aceh (2004) and Yogyakarta (2006), the earthquakes in Lombok occurred several times. Around hundreds of aftershocks, one of which was larger in scale than the main earthquake had caused tremendous panic in the community. The damage caused by the earthquake was significant. The National Disaster Management Agency stated that the death toll reached 564, mainly in North Lombok, where 467 people died (Zulfakriza, 2018)

Therefore, advances in communication and information technology in disaster mitigation must be maximised. Thus, this study aims to understand the effectiveness of communication and information technology in Lombok disaster mitigation, including through the media, and reflect on how communication and information technology in Industry 5.0, namely evolutionary progress that eliminates gaps and asymmetry in industry 4.0 (Özdemir & Hekim, 2018), should be used to maximise disaster mitigation.

Regarding the use of technology, it is not a new method. However, recent studies still focused on the integration of technology in Industry 4.0 for disaster mitigation and management. For example, a study conducted by Wardyaningrum (2016) on changes in communication in disaster mitigation innovations around Mount Merapi in Yogyakarta after the eruption in 2010 shows that the technology used for disaster mitigation has changed. Before 2010, communication methods only relied on word of mouth, traditional tools such as *kentongan* (a traditional communication tools from bamboo), and sirens. However, after the 2010 eruption, local residents preferred to use additional means of communication, such as the Handy Talkie, which is now owned by most of the RT and used to receive information from control towers on the mountain. Regarding emergency information, after the 2010 eruption, the community take more initiative to seek information and are more careful, such as understanding when to evacuate from dangerous areas.

Chatfield & Uuf (2013) and Qiantori et al. (2012) followed the same research trend. The two studies discussed how the adoption of technology, especially the internet, both hardware and features, such as social media, can be used, not only to lessen damage but also to improve communication of victims and stakeholders and make mitigation activities more productive in Indonesia. Chatfield & Uuf described the viability of Twitter-based warnings in the information dissemination process on earthquakes that occurred on the west coast of Sumatra from 2010 to 2012. They concluded that Twitter was a valuable means of reaching the public because of its speed and could be used as a complement to in a TEWS applications. With a different approach, Qiantori et al. proposed a Low Altitude Platform that could stabilise WIFI signal with a tethered balloon and assist emergency medical services in communicating information regarding disaster casualties. This is because, reflecting on the post-disaster Aceh and Yogyakarta earthquakes, communication is often unstable. Technology adoption meets the requirements, although further development is required.

Previous studies mostly discussed the productivity of technology in conveying messages. However, the media which play an essential role in communication are not discussed. The media plays a vital role in disseminating information both before, during and after a disaster. In this regard, Istiqomah studied whether the reporting of natural disaster affect public awareness in Banda Aceh. By adopting agenda-setting theory and a quantitative approach, as well as a survey and a purposive sampling as the collection data technique, her study shows that news of natural disasters in Serambi Indonesia’s newspaper significantly affects the awareness of the people of Banda Aceh (Istiqomah, 2019).

However, the policies of stakeholders, especially the government, in preparing, handling, and mitigating communication problems in natural disasters, must also be considered. It is almost impossible to imagine modern productive communication without the presence of a capable government. Whether they are political, as stated by Harwell (2000) in the case of peatland fires in Indonesia, or those influenced by local traditions and wisdom, such as the case in Samar, Philippines

(Cuaton & Su, 2020), the government's response and ability to integrate resources and to combine many different skills are essential. A study by Kusumasari (2012) describes the actions of the Bantul government as an example. She argues that the integration of skills, mutual support between institutions and the technical, financial, policy and leadership resources developing in Bantul has been slow to raise awareness about disasters. However, this does not mean that structure is always a significant factor. Pan (2020) states that individual decision-making behaviour, such as consideration of evacuation locations and description of cognitive disaster factors in determining the success of disaster mitigation.

It is clear that these three elements are interrelated in the discussion of disaster mitigation. The current article considers the factors previously described. What makes this article different from the research mentioned is the contribution that focuses on the rise of technological developments, especially industry 5.0 and disaster-related issues. Technological developments in the era of the fifth industrial revolution should not only be considered but can also be used for disaster mitigation. If in the era of the fourth industrial revolution humans are required to repair damaged hardware, then in the fifth industrial revolution, the device can repair itself. For example, if used for tsunami disaster mitigation, a tsunami detection tool called the Deep Ocean Assessment and Reporting Tsunamis (DART) which is located in the ocean and is in the shape of a buoy, can carry out its own repair without human intervention. In situations where DART is used the most, the number of victims from the tsunami, both victims of tidal waves from the tsunami and victims of panic due to lack of adequate instructions and warnings, can be reduced.

The current article described how the media, together with disaster mitigation and recovery agencies, use communication and information technology in dealing with earthquakes on the island of Lombok. Based on the experience of using communication and information technology in earthquake mitigation on the island of Lombok, this study provides recommendations for the government, community and other relevant stakeholders to use technological advances in Industry 5.0 as a road map in future disaster management, especially in the aspect of mitigation.

METHODOLOGY

The research used a descriptive qualitative case study. This method is considered able to present holistic data. The data was collected by several methods, namely: in-depth interviews, observation, documentative study, and literature review. The most substantial session in the in-depth interview was when the researcher asked the stakeholders who have been involved the management of the Lombok Island earthquake, including the government representations, mitigation and recovery institutions, and journalists using questions listed in the interview guide. The informants were selected using purposive sampling or criteria-based selection, and the criteria were former members of disaster information team. All informants in the research came from disaster mitigation institutions in the West Nusa Tenggara Province, namely Muhammadiyah Disaster Management Centre and local journalists of Lombok Post, a part of Jawa Pos Group in West Nusa Tenggara Province, who covered the earthquakes. The observation was conducted by through observation of disaster information management, editorial room, and journalism practices in the disaster location; the results of which were noted in the fieldnote. Documentation study was performed by analysing the archive regarding disaster communication.

Table 1. Informant Background

Code	Name of Informant	Background
1.	Diah Rahmawati	Committee of Muhammadiyah Disaster Management Centre, West Nusa Tenggara Province
2.	Hidayatul Wathoni	Local journalists of Lombok Post (a part Jawa Pos Group) in West Nusa Tenggara Province

Source: Data Processed by Author (2020)

All collected data were analysed by cross-site analysis (Neuman, 2000, p. 33) which enabled the researchers to explore micro-level individual action as well as the macro-level of broad social process and structure (Neuman, 2000, p. 33). In each case, the interactive model analysis was carried out with three reduction components, namely data reduction, data display, and conclusion drawing or verification cycle process (Sutopo, 2000, p. 186). Data reduction in this research was a part of a selection, focusing, simplification, and abstraction data process from the fieldnote. Data display was assembled information, a description in the form of narration that enables the research conclusion. Finally, conclusion drawing should be satisfactory and accountable for the sake of the public (Sutopo, 2000).

RESULTS AND DISCUSSION

Disaster Management

Modern disaster mitigation comprehensively covers four functional components, namely, mitigation, preparedness, response, and recovery. All the components can be described as follows. Firstly, mitigation reduces or eliminates the harmful risk of disaster. Secondly, preparedness equips disaster-prone communities to deal with a disaster and prepare them to assist stakeholders or other locals with various equipment and tools to minimise harmful risks, such as financial, and maximise survival skills in the situation. Furthermore, response aims to reduce or eliminate the effect of a disaster. Finally, recovery fixes, reconstruct, and regain or recollect what has been destroyed or lost and ideally also decrease potentials of harm in the future (Budi HH, 2012, p. 366).

Disaster mitigation should be supported by various approaches, including soft and hard power, to reduce the risk. Soft power approaches condition the people to be alert through the dissemination of truthful and accurate information regarding disasters. Hard power approaches, on the other hand, prevent disaster by constructing communication facilities, levee, and dam; activating buoy for detecting tsunami; and dredging rivers. These two approaches are essential for disaster mitigation and, at the same time, disaster communication is vital for these two approaches. Technological advancements in information and communication are supposed to facilitate the process of disaster communication.

Hidayatul Wathoni, a senior journalist and news coordinator at the Lombok Post, a leading newspaper on the island of Lombok, argues during the research interview that the development of technology and information is in line with the development of literacy in society. This is shown by the re-emergence of hoaxes that were rife in the community when the earthquake hit Lombok Island.

Furthermore, Wathoni added that his newspaper could not be published on 5 August 2018. Even though he thought it could be published because all active journalists were still working and in the process of producing news. The problem is the journalist family. Given this, continued Wathoni, information technology and technology are very important in the event of an earthquake. After the earthquake, all journalists opened their cell phones to view messages sent by other journalists or forward other reliable sources to their WhatsApp groups. They received messages from many journalists from all over Lombok because these journalists also experienced tragedies in Lombok. In the office, the editorial staff can verify this information. Post-earthquake information verification is crucial to ensure that the information published in the mass media is accurate.

Based on these situations, communication is needed in an emergency. Communication is required not only in post-emergency situations but also before and during a disaster. Preparing people in disaster-prone areas, therefore, must always be done before an accident occurs. In addition to adequate information regarding potential disasters in an area, training and internalisation of habits in dealing with disasters also need to be carried out. However, information alone is not sufficient to make people aware of the dangers they may face (Haddow, George D. & Haddow, 2009, p. 4).

In disaster management information, two elements must be considered carefully. First, information must be fast, accurate, consistent, and straightforward. Second, providing recommendations to the community about what they should do (Haddow & Haddow, 2009, p. 4). Information delivery should also be carried out correctly. Error or misinformation in communicating information could affect uncertainty that could exacerbate the situation (Rudianto, 2015, p. 52).

In Indonesia, disaster management is a relatively new field of study. There was limited attention to disaster management before the Aceh and Northern Sumatra Tsunami in 2004. Earthquakes in Yogyakarta and Central Java Province in 2006 also urges concerns in disaster management. Much research in disaster management after the tsunami and earthquake yielded essential findings. For example, Budi initiated a new study in disaster management, especially in the communication domain. He argued that a disaster and aspects of disaster management are humanitarian works. Therefore, essential determinant factors need to be developed, trained, and applied. Those factors are communication, information, coordination, and partnership (Budi HH, 2012).

Diah Rahmawati, a manager in Muhammadiyah Disaster Management Centre (MDMC), who was heavily involved in mitigating the Lombok's earthquake, stated during the research interview that communication, coordination, and partnership among institutions was vital in dealing with an earthquake. Mobile phones technology, especially applications like WhatsApp, provided immense assistance to inter-institution communication. Others who were active in the Muhammadiyah organisation during the disaster agreed with her statement. They benefited from mobile phones in looking for fast and accurate information concerning the effect and victim of the disaster. It enabled aid distribution to be more accessible. In terms of institution and society involvement, in this case, an integrated approach with a humanitarian approach should be known, mastered, and implemented is the systematic approach. It is a synergic and integrated effort from institutions whose primary duties include handling disaster and establish reliable teamwork with other institutions to reduce the risk of disaster (Budi HH, 2012).

If mobile phone technology, such as chatting application, could support disaster communication, the technology industry 5.0 would bring more advantages, especially in disaster mitigation. Consider wireless technology as an example (Kreps, 2006, p. 271). The problem that typically occurs in a disaster is the infrastructure problem related to communication that relies mostly on concrete and inflexible buildings, like communication tower. By changing to a new city blueprint that takes advantage of wireless technology, the risk of loss of communication signal during and after a disaster in an area can be limited. It can significantly aid health workers, leaders of various aid organisations to coordinate their members, families, as well as journalists. The effect may be manifold because the circulation of information can be transmitted more quickly to other areas, so that aid flows more efficiently. Admittedly, a high level of effort is required to achieve this level of infrastructure as it is only possible by spreading wireless points over multiple areas.

Disaster mitigation 5.0: risk and challenge

Before moving on to this section, it is vital to understand how hazard managers play an essential point based on the Lombok study. A hazard manager is someone responsible for influencing a community. It could be someone in a family or neighbourhood, but ideally, someone who comes from a more significant institution, such as businesses, organisations, and government. Their work ranges from preparation to post-disaster mitigation and ensuring that the agreed and adopted methods are implemented to minimise the number of victims. In the hazard manager job list, managing communication risk is very important and cannot be ignored. This work requires hazard managers in the community to prepare various possible communication methods during a disaster and take collective communication actions in the pre- and post-disaster period, such as coordinating with relevant agencies to obtain information on prevention measures, recruiting more volunteers, and partnering with certain risk groups. This action is usually called hazard adjustment, and the role of the hazard actor or manager is so organic that anyone, from friends, relatives, neighbours and co-workers, can contribute to information flexibility or vice versa if not adequately prepared.

Communication devices for transmitting a message to a specific individual or group, therefore, is the focus that must be noticed by related institutions and each hazard managers—for example, understanding how each communication channel differs in terms of precision, scope, penetration, distortion rate, facility availability and what should be prepared before a disaster. It is essential to decide whether a community need broadcast, telephone, chatting application, or radio transmitter. Unfortunately, this issue has not been the focus of much of the latest disaster research, and thus no simulation and feedback can be considered as a solution. Besides, various forms of messages must also be considered because they can determine the effectiveness of messages that need to be conveyed, ranging from the consistency of threats, repetition, certainty, clarity, and accuracy, specificity, to adequacy (Kreps, 2006). In the context of these challenges, the formation of a paradigm for solving disaster communication problems through Industry 4.0 can be studied.

Regarding Industry 4.0, this term is used to describe the tool-making paradigm that began when humans made it possible to produce and develop automatic production processes with the help of digital technology and the internet. Four products can be seen as the main elements of Industry 4.0, namely the Internet of Things, cognitive computing, cloud storage and cyber-physical systems, such as 3D printing, sensors and mobile devices. Industrial 4.0 products have specific characteristics and are relatively difficult to imitate by the previous industrial framework, namely that they cannot be faked in other fields outside the real sector of the economy. This fourth industrial revolution made a substantial and significant contribution in developing the transformation of the economic system, in which there is social space. These conditions change the relationship between humans and technology and encourage human civilisation to adopt new economic conditions in which automation plays an important role. For example, a revolution in product manufacturing automation with the help of wireless, internet and sensor technologies helps entrepreneurs optimize business processes effectively. However, at the same time, in the social sphere, the technology is pushing employees to acquire new competencies related to the industry and is changing the way marketers contact prospective customers because of changing communication patterns. Although Industry 4.0 only occurs in a small part of the world, especially developed countries, in the end, these changes can bring about a new wave of productivity and modernisation in various types of industries around the world. Consequently, as emphasised by Popkova (2019, p. 8), this transformation can change the "existing technological modes" (2019, p. 8).

However, even though Industry 4.0 looks like it has just reached its early stages and will probably bring another flagship product, Industry 5.0 features have been foreseen to replace it by many experts. The essence of this new wave is the development or penetration of Artificial Intelligence.

Consider the emergence of Industry 4.0 in manufacturing (Nahavandi, 2019) as an example. The need for an active and productive production line allows human robots to work together to assemble electro-mechanical devices. In this process, human workers initiate tasks and let the robots observe all the elements needed, take pictures and monitor the environment, and deduce human intentions, goals, and patterns to complete the task with a camera. After the robots record all the steps, they will help all human work. Since robots have calculated almost everything from average human speed to downtime, and added to their ability to spot abnormalities, if assisted by skilled human workers, work processes will be smoother and increase overall work efficiency. This process implies that industry 5.0 is not only from the robot side but also the collaboration between human intelligence and artificial intelligence that has become a reliable partner. Therefore, the human ability itself is very important for the development of Industry 4.0.

Industry 5.0 must be prepared in Indonesia for natural disaster mitigation. By using Artificial Intelligence, messages about disasters can be managed more effectively. As stated in the first part of this paper, disaster mitigation aspects must be supported by various approaches, including soft power and hard power. For hard power, the government must prepare several infrastructures based on cognitive systems. For example, if in Industry 4.0 humans have to repair damaged hardware, then in Industry 5.0 the device can repair itself by imitating human intelligence as in the use of the tsunami early detection buoys previously described. In addition, the transformation to Industry 5.0 allows for the reinstatement of communication systems that generally get in the way of disaster relief processes. Innovation is the key to achieving this technology.

Cognitive system-based technology in disaster information management can answer challenges in need for delivering disaster information, namely fast, accurate, consistent, and straightforward information, as well as conveying information to the public about what they should do. Although technology has a significant role in Industry 5.0, the human aspect should not be left out. Industry 5.0 is an era where human intelligence and cognitive computing are integrated. This means that in this era, humans and machines will work together to solve a problem. As a result, preparing human resources is very important to welcome industry 5.0, as argued by Nahavandi (2019):

> The Fifth Industrial Revolution will emerge when its three main elements - smart devices, intelligent systems and intelligent automation - fully merge with the physical world and cooperate with human intelligence. The term ‘automation’ describes autonomous robots as intelligent agents who work together with humans at the same time, in the same workspace. This trust and reliability between the two parties will achieve promising efficiencies, flawless production, minimum waste and customisable manufacturing. In doing so, it will bring more people back to the workplace and increase the efficiency of the process Nahavandi (2019, p 11):

CONCLUSION

The advancement of smart computer-based information and communication technology has brought humanity to the 5.0 industry. Regarding the earthquake in Lombok that occurred in August 2018, mobile phone technology had brought many advantages in disaster communication and coordination. Aid distribution was carried out through the coordination of WhatsApp messenger. Disaster mitigation must be supported by various approaches, from soft power to hard power, to reduce disaster risk. In the context of industry 5.0, the soft power approach includes preparing community awareness and enabling them to use disaster mitigation technology. Meanwhile, hard power covers an effort to deal with disasters through physical construction and integrated cognitive computing.

Technology which is based on the internet of things as a component of industry 5.0, can be utilized in disaster mitigation. Cognitive system-based infrastructure is an ideal method to prepare industry 5.0 that is ready and resilient in the face of disasters. The key is to integrate human intelligence and cognitive computing. If this integration is achieved, the number of casualties due to disasters can be minimised.

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