



Disaster Communication in 4.0 Era: Review of Earthquake Disaster Mitigation in Lombok West Nusa Tenggara

Kholil^{1*}, Aris Setyawan², Nafiah Ariani³ and Dan Soehatman Ramli⁴

¹Sahid University, Jakarta, Indonesia.

²Faculty of Economic and Business Gunadarma University, Jakarta, Indonesia.

³Faculty of Economic, Sahid University, Jakarta, Indonesia.

⁴School of Health and Public Safety, Jakarta, Indonesia.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Effect of Lombok earthquake on July 29, 2018 was very extensive, 50-60% of infrastructures (dam, road, market) destroyed, 132.000 houses damaged and 564 people died. Total of economic losses reach IDR 10.1 trillion. The most serious problem is communication, between government, local community and other institutions. Actually the earthquake news makes people panic and confused what to do.

The purpose of this study is to design an appropriate disaster communication model in digital era and to identify the most important aspects during disaster. Method used was SAST (Strategic Assumption and Surfacing Testing) and ECM (Exponential Comparison Method). SAST method selected to identify the most strategic assumption (important and certainty) which must be considered in economic recovery; while ECM is used to select the most appropriate strategy of community economic recovery post earthquake.

Study results showed that the most effective communication during a disaster is establishing a disaster information center involving the BMKG (Meteorology, Climatology and Geophysical Agency) and BPBD (Local Disaster Agency) and local government.

*Corresponding author: E-mail: kholillppm@gmail.com;

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1. BACKGROUND

Geographically Indonesia lies on three active ring plates, namely Indo-Australian plate in the south, Pacific plate in the east, and Eurasian plate in the north. Due to this position, Indonesia is one of the biggest disaster risk countries in the world, such as earthquakes, landslides, floods, and volcanoes. In 2018, there were 2,572 catastrophes, 4,814 people died and 10.239 million were affected; and more than 2 million of houses were destroyed or damaged, National Disaster Agency (BNPB) [1]. Among those natural disasters, earthquake is the highest in frequency in Indonesia, there were 11,577 earthquakes in Indonesia in 2018, [2]. It means that there is 32 earthquakes per day in Indonesia. Seen from their magnitudes, there were nine times of Minor Earthquake (less than 4,0 in magnitude), 2,273 times of Light Earthquake (between 4,1-5,0 in magnitude), 210 times of Moderate Earthquake (between 5,1-6,0 in magnitude), 12 times of Strong Earthquake (between 6,1-7,0 in magnitude), one Major Earthquake (between 7,1-8,0) in Palu on 28 September 2018 (7,5 SR), Meteorology, Climatology, and Geophysical Agency (BMKG), [3]. BNPB has predicted that natural disaster will increase in 2019 that will reach more than 2,500 incidents [4].

Lombok earthquake 7.0 SR on July 28 and August 5 in 2018 caused huge losses and damages. Economic loss predicted reached over IDR 10.1 trillion including economic infrastructures (schools, residential, business centre, roads, markets), but also ecological damages (ecosystem, flora, and fauna). The death toll was 564, and 390,529 evacuated and 130 thousand of houses were destroyed, 51% irrigation was out of order, 28% roads, as well as 46 markets and 138 hotels were damaged [4]. The most apparent after-impact of an earthquake is the cessation of productive activities by the community and the difficulty for them to fulfill their basic needs (food and drink, houses, and health care), [1,5]. Natural disasters also can cause the loss of livelihood, therefore threatening the public life sustainability [6].

One of the most serious social impacts after the earthquake in Aceh is mental stress (traumatic effect) that has disrupted the health of the community [7], thereby it requires necessary community social support in the recovery of

mental health [8]. Study results by Asley and Swick [9] of 23 patients with post-traumatic disorder and 23 controlled military members showed that trauma has led to slow response time, difficult concentration, decline in endurance, easy irritability or offense, and also difficult to communicate. That mental depression has caused the cessation of productive activities and disturbed social life in the society. Similarly, Lombok earthquake has caused serious mental disorder among the society that has influenced the social life patterns [10].

Up to September 2018 (2 months since 29 July 2018), there were 825 times of aftershocks (13-15 times per day) [4]. Society was haunted by fear and insecurity every time there was a sound, thence they could not live peacefully, [10]. Lombok earthquake was categorized as shallow seismic due to Flores Arch Thrust as a response to the pressure from the Australian continent located under the sea [4].

Generally disaster can be categorized in two aspects: (1) the presence of destructive disturbance (*hazard*) and (2) *vulnerability*. If there is a *hazard* but no *vulnerability* in the society then the society is able to overcome the disturbance. On the contrary, if there is a *vulnerability* but no *hazard*, there won't be any calamity. If both of them are present then there will be a human life and livelihood threatening catastrophe [11,12]. Natural disaster of earthquake occurs for several reasons: (1) energy release due to tectonic plates drift; (2) divergent tectonic plate movements which move away from one another since this farther movement will form a new plate between those plates. The new plate will be pressed by both older plates and will make the new plate move downward. This process produces energy with remarkable force. This energy will be the main cause of seismic noises (tremors) or shocks on the surface that will lead to an earthquake; (3) convergent tectonic plate movements which come close to each other. When these plates are approaching each other, it will form a new mountain, which will trigger the earthquake; and (4) due to magma movement that will result in huge gas pressure at the volcanic crater plug and causing an earthquake, [13]. There are 3 types of earthquake: (a) tectonic, i.e. an earthquake caused by ground plate drift due to Earth's convection currents. (b) volcanic, it is due

to the movement of the magma usually found in the volcanoes which followed by mountain eruption, and (c) artificial, namely man-made earthquakes resulted from nuclear or dynamite explosions [11]. Meanwhile, according to Budimir et al. [14], there are two earthquakes due to the movement along the tectonic plates called as interplate earthquake, the scale depends on the plate movement.

July 2018 earthquake in Lombok was classified as shallow earthquake due to Flores Arch Thrust, as a response to the pressure of Australian under the sea continent [4].

Earthquake disaster management consists of two activities (1) Pre event and (2) Post event. *Post event* activities, encompass, among others, disaster response/emergency response, or recovery. Pre event activities include: preparedness, risk-awareness education, training, spatial planning, and disaster-resistant structure design. Meanwhile, post event activities can include disaster mitigation (reducing the impact). In general, post event activities are divided into 2: Risk management and Crisis Management. Risk management encompasses activities of mitigation, protection and early warning, whereas Crisis management involves reconstruction, recovery, rehabilitation, and emergency response. Reconstruction and recovery are some efforts to restore economic and social activities of the people affected by the earthquake.

Earthquake is an incident in which we can not predict the precise time thus when it happens many people are not prepared. Therefore, people seek for information to know what to do and what objective conditions they are going through. In today's digital era, the most accessible information source is via social media. IT (information technology) utilization in the natural disaster countermeasure activities have been performed in many places, such as in Japan and other developed countries. The support from Information technology has given significant contribution in reducing the damages and death tolls. By the help of information technology and social media thus the information and action should be taken by the community can be immediately passed on to them [15,16] asserted that social media can be used to help the community in obtaining information faster and accurately regarding disaster countermeasures. Meanwhile, according to Velev [17] that social media can be the most effective information

channel at the time of the natural disaster occurs. There are several social media that can be the options for the community to communicate and to share information to each other. There are three main options, namely: WhatsApp (45.5%), Youtube (32.5%), Line (13.5%), the remaining are email and others [12,16]. There are some principles in digital communication: (1) virtual world; which is a sort of communication conducted in non physically face-to-face; (2) virtual reality, i.e. a communication system that uses certain media connected to computer/cellphone, such as google, etc. (3) virtual communication, which is a communication in a virtual world without knowing whom engaged or connected; (4) multimedia; i.e. communication that combines text, picture and voice and (5) hypertext, namely communication through writing texts connected to other documents. The advantage of digital communication is *mutliplexing*, i.e. the ability to distribute information in as many quantities as possible simultaneously. Digital communication can be carried out via digital technology of Integrated Service Digital Network (ISDN). Other advantages of this kind of communication system are, among others: (1) digital transmission, without location and time limitation; (2) cheap; (3) high accuracy; (4) capability to store bulk information. As for its weaknesses are, among others: (1) easy to virus attack; (2) if there is network failure, the communication can't be carried out; (3) depends on the bandwidth; (4) requires necessary synchronization in each and every process. Digital communication system is similar with the Lasswell communication model (1948), which consists of Who (Sender), Says (What) message content, Channels (media), and to Whom (receiver/communicant), and feedback. [18,19] stated that lack of information during a disaster may lead to the society are affected by sense of frustration and anger.

The problem is, since there is no institution that is directly responsible for the necessary information deliver to the public. In fact, the circulation of information and pictures via social media makes the society becoming more confused and suffering from mental depression. There are also a lot of people actually makes situation more chaos. BMKG (Meteorology, Climatology, and Geophysical Agency) actually has provided news, and always updates any event or incident, however in social media it is more massive and their circulation frequency is very high, which is beyond BMKG's control.

Identifying the most strategically aspect and selecting effective communication strategy in the 4.0; during an earthquake catastrophe.

2. METHODOLOGY

Expert Based was chosen as the research methodology, in which data collection was gathered from expert discussion, policy makers, disaster experts in BPBD (Regional Disaster Management Authority), regional decision makers (Bapeda - regional development planning agency, Dinas PUPR - public works and office, Dinas Tataruang - spatial planning office, Dinas Pertanian - agriculture office), NGO and academics of experts as resource person of 7 people. MPE method (exponential comparison method) was used as data analysis with the following equation:

$$Total\ Nilai\ (TN\ i) = \sum_{j=1}^m (RK\ ij) \quad TKK\ j$$

Where:

- TN I : Total Value of the *i*th alternative.
- Rkij : The importance degree of *j*th relative for the *i* decision.
- TKKj : The importance degree of *j*th decision criteria; $TKKj > 0$; round number
- n : The number of decision options.
- m : The number of decision criteria.

In addition to discussion with the experts, a field survey was also conducted to uncover the exact post-earthquake community condition.

3. RESULTS AND DISCUSSION

Based on the field survey result, it shows that aftershocks are still going on under mangitude-4.0 4 SR. Most of the community are accustomed to those shake-ups, thereby they do not try to run to save themselves. However, there is a number of them who are suffering from trauma. This group is highly sensitive to noises and very reactive. The local government, in cooperation with some institutions like Polri - national police, NGO and some universities, have conducted traumatic healing by establishing the traumatic center.

Interview results with 25 respondents selected reveal that most of the respondents (66,67%) stated that the availability of information is very important factor at the time of earthquake. But

official information via TV cable from the government can not be accessed, because all of the infrastucrure network was destroyed. Meanwhile, when earthquake happened, some communication via social media that still can function are only WA, Youtube, and Line this results supported [20]. The majority of respondents (79.67%) also asserted that information available through social media actually make people confused to find a safe place. The reason can be attributed by the circulated news are non standard in their contents, containing hoax which delivered by irresponsible man. Problem faced by the community through this social media communication is that they cannot filter or select whether the news is the true one or hoax. Meanwhile, according to their characteristics, digital communication of text/information persistently and constantly flows without interruption. Based on the objective condition found on site, in communication system there are at least 4 important aspects: communicant, message, channel and communicator, which can be described as follow.

Disaster communication in Lombok in this digital era requires a channel in form of social media (C) (Whatsapp, Youtube and Line). Most of message (B) at the time of disaster are found more in pictures rather than in voice and texts. However, no one is making any verification about the picture sent by communicator (A), whether those pictures are real incidents in Lombok or not. Therefore those pictures often make the message receivers (Communicant: D) panic. Moreover, very high information transmission (picture/text) at the time of earthquake taken place also has made the communication networks disturbed. As a result, the community cannot access the information about the earthquake.

The expert discussion result about the important and certain aspect in the disaster communication through digital communication media are presented as follows.

Where

- A. Credibility of information/news source/ institution
- B. News/information channel
- C. Information velocity
- D. Information quality/accuracy
- E. Time of releasing information
- F. Frequency of information delivery
- G. Types of information (text/picture)

H. Feedback

I. Target of information/Communicant

Fig. 2 shows that information velocity and information accuracy (C,D) are two of the most strategical assumptions. The speed of the information related to objective condition is highly needed by the panic community, thereby they can do quick rescue action to prevent victims or property damage. However, having such faster information is not enough, it also needs a guarantee for the information quality and uprightness. This is in accordance with some statements given by the respondents (79,67%), i.e. that at the time of panic situation, the community is in desperate need of information that is able to guide and direct them to get to the safe place as shelter.

The credibility of information source/communicator (A) and type of the information (text/picture), (G), are also crucial; yet less certain (Fig. 2). It means that who is the information sender/communicator and types of message are very important. However, at the time of an earthquake, the communicant (the community) cannot identify who is the source of the information (communicator). Following the basic principle of digital communication which is still and not limited by time and place; so that if the source (communicator) and the message (information) regarding the disaster are not valid thus it will have such a huge impact. Official source for information at the time of disaster is

BMKG (Meteorology, Climatology and Geophysical Agency), still BMKG will deliver or convey official information at particular time or moment, usually every hour through TV broadcast, yet most of the community cannot access those TV broadcasting.

The most appropriate strategy in uncertain earthquake situation, based on the expert discussion, is presented in Table 1.

Based on Table 1, therefore the most effective disaster communication strategy in the 4.0 digital era is by establishing disaster information centre (991.2), followed by using public Figure as communicator (568.4). It means that through this centre thus message content can be spread to the public digitally by means of social media (WA, Youtube or Line). For avoiding any overlap in the spreading information between BMKG and BNPB, this information centre should involve both of these institutions, so that the source of the information can be accountable. The problem lies in the time for delivering the information, if it is late, the news/information is no longer needed by or even useful for the community.

Table 1 also showed that culture aspect is the highest level interconnectedness to all of strategy alternatives (28.4) then economical aspect (27.4). This mean disaster communication will be effective if it is in accordance with the culture of the people in term of messages (language style and terminology).

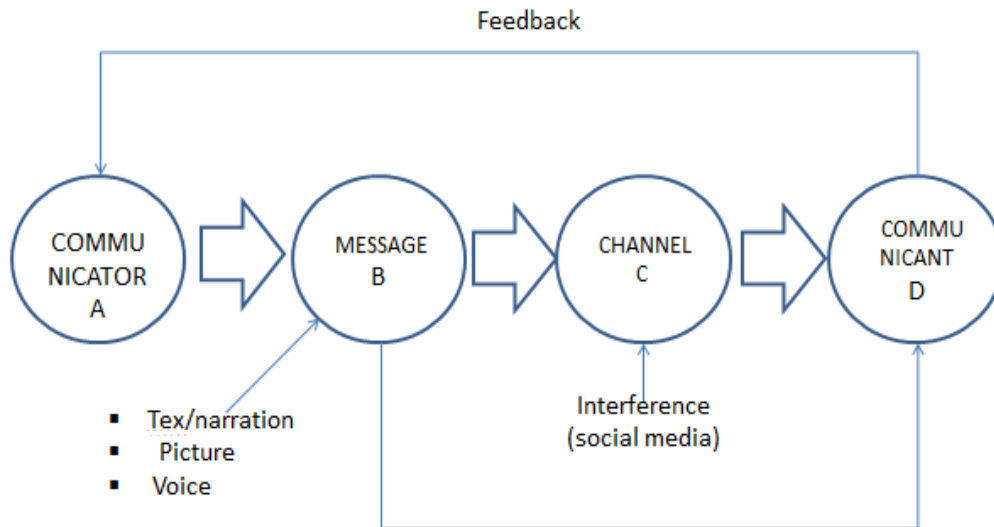


Fig. 1. Basic principle of communication

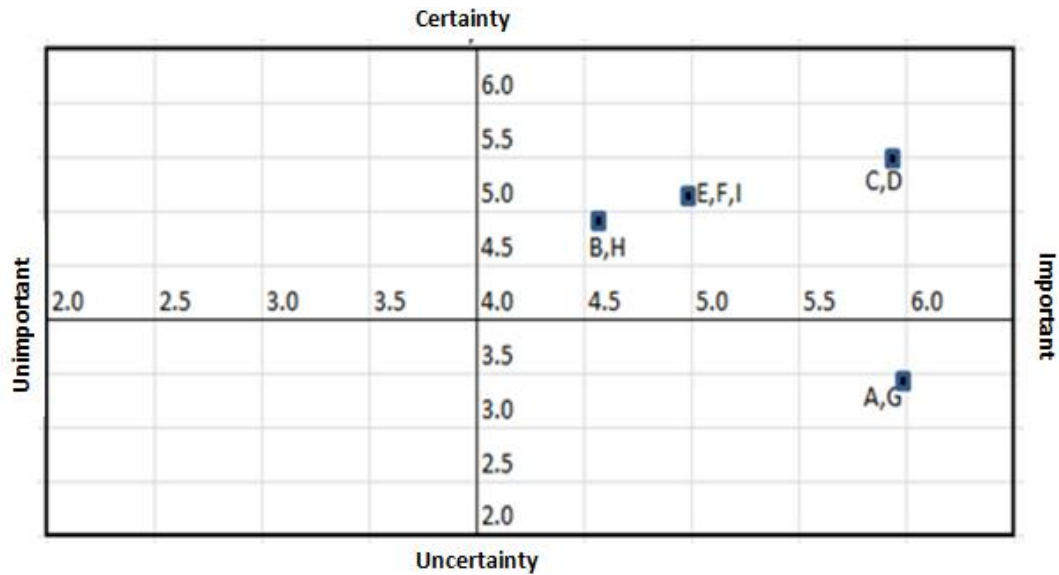


Fig. 2. Important and certain aspects in disaster communication in the digital era

Table 1 also demonstrates that factors which have the highest interconnectedness are cultural (28.4) and followed by economical (27.4). It shows that communication is closely related with local culture. The effectiveness of the message delivered and the language style used must be in accordance with the cultures of the local community.

Based on SAS and MPE analysis results above, the right disaster communication model in the digital era is developing disaster information centre that involves the public figures, local government, supported by adequate network infrastructures; as depicted by the following figure:

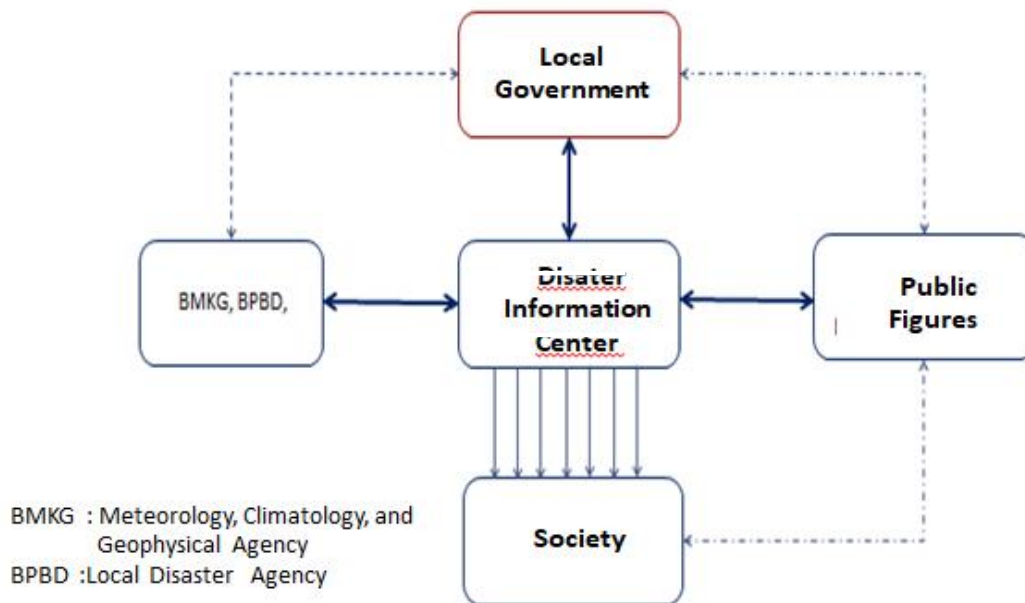


Fig. 3. Disaster communication model in the 4.0 era

Table 1. Strategy for disaster communication in the 4.0 Era

No.	Strategy alternatives	Criticality level (1-5)	Level of interconnectedness				Value	Ranking
			Social aspect	Economical aspect	Cultural aspect	Political aspect		
1	Using public figure as communicator	4.1	3.2	2.9	3.8	3.3	568.4	2
2	Establishing Disaster-Responsive Group	3.6	3.3	3.4	3.5	3.1	305.1	5
3	Constructing communication networks related to disaster	3.6	3.4	3.4	3.4	3.4	327.6	3
4	Community socialization and education	3.5	3.3	3.5	3.5	3.5	305.9	4
5	Establishing disaster information centre	4.0	3.6	4.2	4.0	4.0	991.2	1
6	Standardization of message content	3.5	3.1	3.4	3.4	3.4	269.9	6
7	Scheduling official message/ information announcement	3.5	3.0	3.3	3.3	3.0	212.5	8
8	Utilizing the network of village administration	3.4	3.2	3.3	3.5	3.2	219.7	7
Total			26.1	27.4	28.4	26.4		
Ranking			4	2	1	3		

Disaster information centre is established and supported by complete network infrastructure in receiving and spreading digital information via social media (What's Up, Instagram and Youtube), by engaging the government institutions (BMKG, BPBD and PEMDA - local government), as well as public figures and young generation. BMKG (Meteorology and Geophysical Agency) is an official government institution that supplies information in every hour regarding the condition and or any development related to earthquake disaster and anticipation should be done by the society. BPBD (the regional agency for disaster management/countermeasure) is an institution at the local level that provides responsive-emergency information in accordance with the earthquake condition (rescuing and searching for victims). Pemda (local government) is responsible for providing necessary logistics and shelters; and public figures/young generation delivers information based on the local culture and language understood by the local society. Through this kind of digital communication, the society is able to update any information related to the disaster in real time ways, and therefore take any rescuing action based on the instructions provided.

4. CONCLUSION AND SUGGESTION

1. The utilization of social media in spreading information at the time of earthquake is very helpful for the community in obtaining information related to take any rescuing action. Communication via WA and Youtube is a form of communication mostly used when a disaster happened.
2. Effective communication at the time of a disaster/earthquake is by establishing disaster information centre as well as becoming the official communication by means of social media in guaranteeing information delivery correctly, faster and accurately to the society through social media.
3. Information about disaster has to be delivered in accordance with the culture and linguistic style of the local society thus the message given can be understood by them.
4. To avoid any message overlapping, the disaster information centre has to involve BMKG and BPBD, as well as the local government.
5. The involvement of public figures in delivering information related to disaster

condition, digitally via social media, is highly helpful for the society to take appropriate action during the catastrophe.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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