Utilization of Technology for Early Warning of Natural Disasters in Indonesia

W H Pratama\textsuperscript{1*}, I D Sumitra\textsuperscript{2}
\textsuperscript{1,2}Departemen Sistem Informasi, Universitas Komputer Indonesia, Indonesia

Email: *wahyu.hp77@mahasiswa.unikom.ac.id

Abstract. This research aims to determine the signs of a natural disaster that may occur in Indonesia. Indonesia is a country that is very prone to natural disasters, for example, volcanoes and tsunamis, which caused by earthquakes under the sea. This research used a qualitative research method. The respondent involved in this research is several government agencies that are authorized for natural disasters in Indonesia. The results of this study show a high level of knowledge of early warning of natural disasters, especially in prone areas to natural disasters to reduce casualties when natural disasters occur. The comparison when an area does not have an early warning system to know the good and bad impacts. This study concludes that many people do not understand the code given when the natural disaster early warning device sounds. Besides, a lot of them do not understand the signs intended in natural disaster detection devices. Therefore, there is a need for socialization from the government so that people understand the warning technology early.

1. Introduction

The use of information technology has now become a new phenomenon in society. People began to be served with technology in all aspects of their lives, one of which was the use of technology for an early warning of natural disasters in Indonesia. Even though natural disasters are difficult to predict, information technology as an early warning tool for natural disasters can help humans in reducing losses or casualties, so that people can be evacuated long before natural disasters occur. Nowadays, information technology has changed the face of the world from the real world to the virtual world. The world that we see nowadays is a world that has undergone an IT revolution that is the transformation from the existence of boundaries into infinity [1]. Therefore, the cost of implementation should not be a barrier to the development of an early warning system for natural disasters because of the benefits we can feel. The development of information systems and information technology in an organization and its use are needed to continue to improve competitiveness in various fields [2]. This causes system changes in the company that can change their performance. This means that early warning systems for natural disasters will affect human life because they utilize technology. Earthquake Early-Warning (EEW) is the delivery of ground shaking alerts or warnings. It is distinguished from earthquake prediction in that the earthquake has nucleated to provide detectable ground motion when an EEW is issued [3]. Explosive volcanic eruptions can eject large amounts of ash into the atmosphere, posing a serious threat to populations living near the volcano. The abrupt occurrence of such events requires a rapid response and proper volcanic hazard evaluation [4]. In Indonesia, the conveyance of data identified with early notice of catastrophic events has utilized internet-based life, for instance, Twitter. In any event, as indicated by one examination referenced that this exploration reasons that the Twitter-based admonition framework showed its incentive as a feasible supplement to Indonesia’s InaTEWS - an extensive debacle data the board framework for governments - by advising people in general and making open an incentive through...
its correspondence speed, reach, and data quality [5]. Currently, the beginning implementation of regional tsunami warning infrastructures indicates a new phase in the development of TWS. A new generation of TWS should not only be able to realize multi-sensor monitoring for tsunami detection [6]. Historically, empirical research has focused on the individual components or sub-systems of EWs, such as hazard monitoring, risk assessment, forecasting tools, and warning dissemination [7]. Seismic tremor early cautioning frameworks can be a helpful apparatus for lessening quake perils if urban communities are well situated as for quake sources and their residents are appropriately prepared to the reaction to seismic tremor notice messages [8]. The basic fundamental is that every EWs should be seen as a social procedure that frequently includes specialized segments inserted in their social setting [9]. The December 2004 tsunami showed the requirement for a successful wave early cautioning framework for the Indian Ocean [10].

The purpose of this research is to know about the benefits of early warning of natural disasters in Indonesia from various aspects. Therefore, people can understand more in all aspects of the natural disaster early warning system. Moreover, we discussed the benefits of an early warning system for natural disasters so that this system can be felt by the wider community. This research used a qualitative approach method.

2. Method
This research used a qualitative approach combined with content analysis of several examples of journalism works related to the development of technology about disaster early warning in Indonesia. Besides, this research also used interview methods with several informants from government agencies that are authorized with all matters relating to natural disasters. Several data sources also include a variety of literature reviews from various sources about the benefits of using technology in early warning of natural disasters in Indonesia.

3. Results and Discussion
The use of technology for early warning systems in Indonesia has begun to be widely used since the natural disaster of the Tsunami that struck Aceh in 2004. Learning from this experience the importance of an early warning system is made to reduce the number of victims when a natural disaster occurs. Besides, the natural disaster early warning system technology is also used for volcanic eruptions by using a hot cloud temperature sensor. When the temperature of the hot clouds rises, the status of an active mountain can be said to erupt. The use of the natural disaster early warning system in its development currently uses several advanced features, for example, at this time the natural disaster early warning system has been designed which reports its reports directly to this smartphone can be more effective and accelerate the dissemination of information. The following is an early warning system that has begun to be used in Indonesia.

3.1 Tsunami Early Warning System
The Tsunami Early Warning System in Indonesia was built after the tsunami in Aceh in 2004. Therefore, the tsunami early warning system is a mature system in its development in Indonesia. The Indonesia Tsunami Early Warning System, or what we might call InaTEWS, predicts tsunamis when there are earthquakes under the sea or landslides under the sea that cause shifts in the earth's layers that triggering sea waves to the coast. The system that works in InaTEWS includes various aspects of the indicators that cause tsunamis so that when a tsunami is predicted to come, sensors installed at sea will provide information to InaTEWS management centers about the phenomena recorded by sensors (see Figure 1).
Figure 1 shows that we can find various information that occurs in the middle of the ocean when there is movement in the earth slab or changes in sea water waves. The information conveyed in this system can already be accessed openly. Therefore, we can find out for ourselves if a natural disaster phenomenon occurs. In this system, we can also see an estimated map of the impact when the tsunami comes, so that we can prepare for the evacuation process on the coast. This system is also equipped with information when an earthquake occurs at the bottom of the sea, the information consists of the epicenter, the distance from the coast to what level of potential tsunami will occur (see Figure 2).
3.2 Mount Eruption Early Warning System

In the past, residents who lived around the slopes of the volcano only relied on a caretaker to monitor volcanic activity and also analyze animal characteristics to find out whether the mountain's activity was increasing or not. However, this method is considered ineffective because if the caretaker miscalculates it will be fatal. The Early Warning System for volcanic eruptions uses sensor technology on seismometers and tiltmeters around the foot of the active mountain. This sensor will give a signal to if there is recorded volcanic activity, then translate the warning in the form of a warning with the help of speakers mounted in the center of residential areas. Its function is so that the public knows about the status of the volcano activity. Signals sent by these sensors are also received by the volcanic watchdog. Later the signal is translated back adjusted to the status of volcanic movements that occur within the volcano (see Figure 3).

![Figure 3. The sensor used as an Early Warning System](image)

From the Figure 3 above, it can be seen sensors that are used to detect volcanic activity of volcanoes installed in a place that is used as a benchmark for calculating activity. The device, which consists of a chipset, radio unit, and tiltmeter, is used not only in one place. However, in several places from the foot of the mountain to the highlands where there is an estimated lava path if a volcano erupts. In addition to censoring the movement of volcanic activity, there are also speakers installed around the settlements that function as providing information to the public to be prepared to be evacuated in case of danger in volcanic activity on the volcano (see Figure 4).
Figure 4. Speaker that serves to provide information

Waves received by sensors of volcanic activity, translated and conveyed to the public through sound waves that are understood by the community as a sign or status of a volcano. The technology used in the Mount Explosion Early Warning System has been very good and helps us in detecting volcanic activity that is happening. One of the benefits of this system is that it reduces the victims of a volcanic eruption, so that the evacuation process can be faster even before the volcano erupts. It is just that in the process, the government has not fully provided this technology in every active volcano in Indonesia. Therefore, there is a need for new innovations so that the development of an early warning system for natural disasters can be widely felt.

3.3 Earthquake Early Warning System

For the early warning system in Indonesia, it is still new. In this case, the BMKG, which has the authority over natural disasters in Indonesia only tested this system in 2019. This system is used to detect tectonic activity that occurs in Indonesia. This system is called InaEEWS (Indonesia Earthquake Early Warning System) the results of the BMKG research are the achievements of a long-standing research together with the Institute of Care Life from the People's Republic of China. The results of the collaboration between the two countries resulted in an earthquake disaster early warning system technology. This system works by calculating the arrival time of the S wave (shear) which has the potential to produce waves (pressure) to provide a warning signal. The sensor in this system is installed in several places that are believed to be the epicenter or moving plate (see Figure 5).
From the picture above we can see the process that occurred when the early warning system was running. This system can later reduce the adverse effects when an earthquake occurs. It is because we can predict the event. Besides, we also need to know that this system is only a tool to predict, not to reject the coming of a disaster. Therefore, we still need to know what we have to do when an earthquake occurs.

3.4 Early Warning System in Indonesia
The government, with the ability of the experts in it, can certainly determine its own technology and disaster early warning system that is most appropriate. A good system definitely requires reliable infrastructure. However, clearly, infrastructure is only one part of the system. That is why, reflecting on the experience of the tsunami that we have experienced, the early warning system should also include strict and fast decisions and coordination between relevant agencies at all levels of the process; sectoral egos can no longer be tolerated. Even more important, the early warning system must really be felt by community groups that are potentially affected by disasters. Early warning is not enough to only be accessed by the public; there must be a mechanism that ensures that early warning information really reaches potential community groups affected by disasters. The development of an early disaster information system that we need may require a very large budget. The issue of the budget should not dampen our sincerity to build it as an investment in the security and safety of all citizens. However, we cannot bargain for the position of this country which is mostly located in the Pacific Ring of Fire, has various volcanoes, even active volcanoes in the middle of the sea. Likewise, we cannot negotiate the need for an adequate disaster early warning system as part of disaster adaptation and mitigation efforts.

4. Conclusion
The use of technology in the natural disaster early warning system in Indonesia has begun to function in several locations that are considered prone to natural disasters. From the description above, we can draw the conclusion that each use of the Early Warning System has many benefits so that its development must continue to be updated. In Indonesia, the use of the Early Warning System still needs a lot of improvement, especially in terms of tool maintenance. It is because there are a lot of theft of sensors or other devices that support this system where people are not responsible for installing it. The government must have standard rules regarding all uses of this system so that the technical can be more effective and the benefits can be greater.
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