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Developing a Crowdsourcing-Based Disaster Relief Model Based on Public Participation

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ABSTRACT

These studies aim to accomplish the following: (1). Examining and developing a crowdsourcing-based model for community disaster preparedness, (2). Outline the model for disaster management in the region and the structure and procedure that will be used to put it into effect in local communities. The R&D method behind this study aimed to undertake a thorough analysis before constructing a brand-new framework for the concept. The province of Lampung was chosen because it has both an established regulatory framework for disaster management and innovative technical programs. New processes and workflows for volunteer coordination were defined and tested in collaboration with the Indonesia Community disaster and other volunteer group as the end user, and a platform was developed to support them. Increased situational awareness in real-time via unprompted input from many users is a key benefit of such a system. Not only that, but unannounced participants can join the conversation simply by signing up for a website or portal. The crowdtasking system will not fully trust spontaneous volunteers until the community disaster staff has verified their profiles. As a result, they are given less important and less taxing activities than pre-registered volunteers, and their observations are given less weight.

1. INTRODUCTION

According to Indonesia's national disaster management agency (BNPB), Indonesia is one of the 35 countries in the world that face the greatest risk of natural disasters [1]. Meanwhile, referring to the BNPB's Indonesian Disaster Hazard Index, Lampung Province is the sixteenth most disaster-prone province out of Indonesia's total of thirty-three. A total of 136 locations across 14 municipalities have been affected by the flood. Large areas, those with a moderate to high risk of landslides up to 47.4 percent, require special precautions [2]. Even more so than the City of Bandar Lampung, the coastal areas of Lampung were at risk from an earthquake and tsunami [3, 4]. The widespread nature of damage caused by natural disasters is a major source of anxiety. The Sunda Strait tsunami, for instance, resulted in 426 deaths, 7,202 injuries, and 23 reported missing [5]. Urban and rural areas confront the risk of flood disasters with the impact of damage to public and domestic infrastructure where flooding is accompanied by landslides that result in unanticipated casualties [6, 7]. Since the community was not ready for the calamity, lives were lost even though the harm may have been lessened.

Earlier studies have established disaster management governance as (1). Usually don't do much in the way of preventive and preparation (2). Only unplanned interactions that strengthen bonds between people are taken into account in the name of preparation (3). Assembling and organizing neighborhoods for disaster preparedness lacks coherence [8]. Community-based mitigation strategies, such as the disaster-resilient village program, have recently been recognised as an important part of this type of emergency planning [9]. However, there are issues with this program that need to be addressed. These include the dispersion of resources, the ineffectiveness of the work plan, and the absence of community input [10]. Another manifestation takes the shape of disaster preparedness cadets; nevertheless, there have been issues with their placement, making it difficult to evaluate their long-term performance consistency [11].

Challenges remain in the form of community involvement in disaster preparedness, particularly in the formation and management of disaster preparedness networks, such as the following: (a) Uncertain driving factors, (2) Uncertain region, disaster, and communication system, and (3) Diverse community backgrounds (3). Dedication and regularity are the motors of the apparatus [12]. Not all of the community's actors, interests, and social capital variables have been properly synergized [13]. As a result, there is a pressing need for a realistic model that can boost community capacity for disaster preparedness. Although contextual adoption is necessary for its application in the setting of crisis management, crowdsourcing has the potential to be adopted because of its qualities of being open to community involvement and efficient in usage [14].

Crowdsourcing is based on the idea that everyone, regardless of his or her qualifications or affiliations, can participate and offer ideas or solutions to a problem [15]. To maximize the speed with which a group can act,

crowdsourcing refers to the practice of using online funding platforms to accomplish certain tasks or encourage participation in solving specific problems [16]. In the context of disasters, the term "crowdsource" refers to the pooling of human resources to address problems in the aftermath of an emergency. This pooling can take the shape of large crowds or smaller organized teams, depending on the situation [17]. Participating communities typically have a strong interest in the final goods or services crowdsourced [18]. That's why crowdsourcing is always done on a volunteer basis [19].

These studies aim to accomplish the following: (1). Examining and developing a crowdsourcing-based model for community catastrophe preparedness, (2). Outline the model for disaster management in the region and the structure and procedure that will be used to put it into effect in local communities. Meanwhile, the importance of this study lies in the fact that disaster management in these areas desperately needs an intervention to condition the community's capacity to be ready to face all disaster risks, which can be accomplished, for example, by creating a crowdsourced model that is transparent, efficient, and effective in network management.

2. RESEARCH METHODS

R&D research was undertaken in an effort to assess this data systematically and construct a novel concept layout [20]. The province of Lampung was chosen because it has both an established regulatory framework for disaster management and innovative technical programs. The study team collects data using a combination of literature resources (such as research articles, books and encyclopedias) from reputable databases, such as Scopus and Web of science (WOS). This literature is then collected and filtered for relevance using the PRISMA protocol to produce some relevant literature and analyzed its substance through brainstorming. Meanwhile, interviews were conducted using a snowball sampling technique. There were 8 informants involved in in-depth interviews, the informant's background displayed in Table 1:

Table 1. Informants involved in in-depth interviews

No	Institution	Organisation	Age	Gender	Experience
1	Local Government	Government Department, South Lampung Regency	44	Man	20 years
2	Local Government	Social Service Office, Lampung Province	42	Woman	15 years
3	Disaster Management Agency	National Disaster Management Agency	40	Man	10 years
4	Disaster Management Agency	National Disaster Management Agency	38	Man	7 years
5	Disaster Management Agency	National Disaster Management Agency	37	Woman	5 years
6	NGO	Indonesia Community Disaster	44	Man	12 years
7	NGO	Nahdlatul Ulama	42	Man	10 years
8	NGO	Disaster Preparedness Cadets (TAGANA)	38	Man	5 years

Interviews process using interview guides and discussions during the process are digitally recorded and then a transcript of the interview is made and data processing is carried out. There are several aspects that are discussed in the interview process and literature review; (1). The ideal format for managing public participation, (2). Mechanisms that are important to do, and (3). Challenges that may be faced.

Relevant data was gathered through a number of methods, such as the identification of models of community capacity building in disaster preparedness that are in line with current conditions and the analysis of several crowdsource model best practices that have been formulated, developed, or applied to other organizations, agencies, or local governments. The process is carried out through a thematic process of literature review with the sorting of relevant topics and then group brainstorming is carried out so that the correlation is maintained. In this study, the interactive analytical approach of Miles and Huberman (1994) was utilized to reduce data, display data, verify data, and make conclusions [21]. The initial stage is carried out data reduction by observing the relevance and correlation of data obtained from the research location, the second stage is data verification and then data display based on its position in the discussion, the third stage is drawing conclusions where the diverse data is argued and narrated based on certain theories and concepts. The advantage of the data analysis approach is that the three stages of the process can be simultaneously implemented, so that there is a complementary process that occurs in the discussion.

3. RESULT AND DISCUSSION

3.1 Assessment and preventative emergency management using social sensors

Because its adaptability, social media has the potential to serve as a vital resource for first responders and an efficient method of public outreach in the field of crisis management [22]. Yet, despite the pervasiveness of social media in many fields, such as marketing and finance, there is currently no standardized, efficient method of leveraging many social media platforms for crisis management purposes. To overcome this difficulty, a new paradigm is required to create a comprehensive and privacy-friendly strategy to use social media in times of crisis and security issues. The initiative, a collaboration between security and social media professionals, will integrate social media with existing security and management systems for tactical operations and considers all stages of crisis management, including prevention, response, and recovery [22]. Beyond the adaptation, customisation, and successful mixing of existing social media processing algorithms in the emergencies and security sectors is the work necessary to fully harness social media for use in times of emergency [23]. This is due to the delicate nature of security incidents and emergencies, their immediacy, their susceptibility to compromise and manipulation via social networks, the necessity of integrating specialized educational programs, various social media platforms, and processing algorithms, and the fluidity of emergency management software [24].

As shown in Figure 1, the resulting approaches will be incorporated into the model concept, which offers a bird's-eye view of how data derived from social media will be mined for useful insights. Games, debates, role-playing, and other applications that can seek response from residents in virtual spaces can be used to implement social sensors (components of algorithms that scan social media and networking feeds)[15]. In addition to conventional social sensors, this model will enable the merging and reasoning over the outputs

of several processing algorithms, allowing for more accurate results associated with the analysis of citizen behavior and the identification of events in near-real-time. Several security and emergency management applications, such as operations management in real time, policy simulations, and proactive planning for strategies related to security and emergency incidents, will be driven by the results of social media analysis [25]. Various situations, including those involving disaster management and law enforcement, will be used to test the model's accuracy.

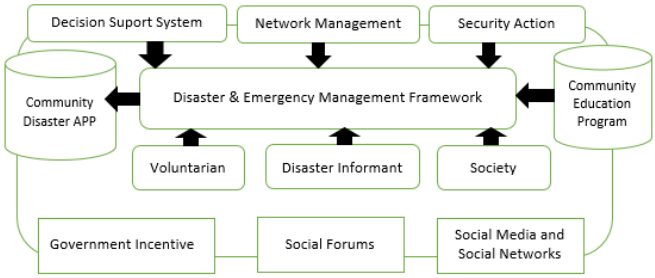

Figure 1. Model framework overview

The advantage of this model lies in the synergistic efforts to combine community-based data, government and volunteers. This data integration can later build a unified perspective on disaster risk in an area. In addition, efforts through incentives and education are also carried out simultaneously and integrated so that it becomes a continuous process. This part of the integration of roles and efforts in one framework later became the innovation of this model.

Meanwhile, in order to maintain the accuracy model, it can be analyzed through four aspects, namely: validity, credibility, utility and feasibility. Validity is related to the degree of information generated from the right process, credibility is related to user qualifications, utility is related to the expediency of the model at a certain scope, and feasibility is related to the ability of the model to be understood and used by the user. To analyze these aspects can be fulfilled through the process of testing the model to the target group and users and then a comparative analysis is carried out between the expected and fulfilled.

3.2 Crowdsourcing and multitasking to improve resilience

Volunteers with high levels of dedication and near-professional competence in crisis management are crucial to the success of emergency response teams [26, 27]. However, in today's more transient culture, the permanence and formality of membership in voluntary crisis management has lost its appeal, and organizations like Community disaster are looking for new ways to keep volunteers committed. We defined and tested new procedures and workflows for volunteer coordination with the Indonesia Community disaster and other volunteer group as the end user, and we built a platform to support these workflows. Volunteers who have already signed up for the prototype can use their phones to accept assignments and submit updates. However, crisis managers can utilize the site as a crowdsourcing tool to seek volunteers with certain talents and in specific geographic areas.

Many researchers intend to take the idea of crowdsourcing one step further. We will put the ideas of crowdsourcing and crowdtasking to the test in a number of scenarios with a wide range of volunteer profiles in order to determine the best methods for strengthening societal resilience through increased involvement of the public in the crisis management process. From a purely technological standpoint, the crowdtasking platform is built on the mobile platform for data-driven apps. In order to make the research prototype into a fully functional product useful for crisis management, this platform's backend was developed. The Platform can store and analyze massive amounts of semi-structured and unstructured data from many domains with geo- and time-references in near real-time.

To ensure the confidentiality of the participants, the observation data is kept in a separate database from the participants' personal information. Ideal for the creation of situation reports and the monitoring of, say, social media, this platform offers a generic interface that can be easily coupled to numerous analytical or visualization tools. Crisis managers and volunteers can stay in constant touch through a web portal that features up-to-date information and allows registration at any time, in addition to facilitating the download of the mobile app. Volunteers can use the app on their own smartphones to respond to the crisis manager's requests for assistance and either accept or decline the assignments made available to them. The approach for crowdtasking management is depicted in Figure 2, with the functional building pieces of the entire platform.

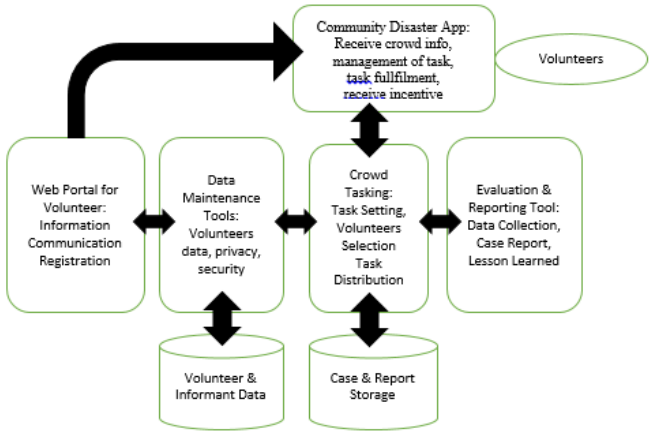

Figure 2. Building blocks of the disaster community platform

Increased situational awareness in real-time via unprompted input from many users is a key benefit of such a system. In addition, unannounced volunteers can join the conversation simply by signing up for a website. The crowdtasking system will not give a higher trust level to spontaneous volunteers until the administration has checked their profiles. As a result, they are given less important and less taxing activities than pre-registered volunteers, and their observations are given less weight.

3.3 Limitations for emergency response: Extracting information and the probability of error

Citizen-collected data is inherently less trustworthy than sensor data collected by physical devices [28]. There is no assurance that citizens will not post incorrect information in the future, notwithstanding the positive outcomes seen thus far [29]. False observations could be from ignorance, pranking, or a simple desire to mess about. The difficulty of teaching a computer to understand human communication presented by social data is a real and present danger. It's a challenging and

error-prone job. Assuming that a minority of contributors are responsible for the inaccurate data, data quality can be enhanced by the application of statistical techniques. The following factors make these concerns far less noticeable in a crowdtasking scenario: (a). Given our familiarity with the typical user, we can more accurately gauge the degree of error in the data we've collected (b). Because of the clarity of the observations, they can be processed more efficiently by an automated system (c). When in doubt, it's simple to get the opinion of another user [30].

In a time of crisis, it's important to quickly allocate resources where they'll do the most good [31]. In practice, the command center cannot distribute global resources optimally because it lacks complete context and cannot instantly compute the best course of action. The "gut sense" of seasoned crisis managers is generally combined with documented readiness plans, situation maps, and other available data to arrive at near-optimal solutions. This is inconsistent with the decentralized nature and lack of structure characteristic of self-organizing mobs and other social-network enabled ad hoc groups. When social data mining is applied to handling a crisis, the premise that people can and should help themselves is accepted without question [32].

The crisis managers' easygoing demeanor suddenly changes when they consider instructing and assigning tasks to the audience. Because of the risks associated with it, crisis managers view self-organization as a liability and work hard to establish a rigorous procedure for assigning tasks [33]. In particular, ad hoc volunteers shouldn't be allowed to have open conversations about the issue, create their own duties, or delegate those duties to other volunteers. Because of this, the system was designed so that each task needed to be accomplished just once. In order to make crowdtasking more resilient to disruptions in mobile networks, we have recently realized that some degree of autonomy must be allowed by design.

Given the unpredictability of network uptime, Ad hoc volunteers in the early warning phase of a crisis should be assigned a minimum number of duties appropriate to the scenario and given the discretion to complete some of these activities as they see fit in the event that connectivity is lost. The local situation view may then be updated by reports from nearby volunteers, which would be the next natural step in development. Some degree of self-organization in the crowdtasking platform crisis managers are responsible for is likely inevitable. While it may seem impossible to strike a happy medium between "total control" and "full self-organization," doing so is likely to yield a plat-form that allows a relatively high level of self-organization while still allowing the crisis managers to request tasks in a top-down manner and to interfere with the counterproductive self-organization efforts [34].

3.4 Rewards for taking part are a key motivator

Perhaps the most crucial design question when thinking about new crowdsourcing systems is how to incentivize participants [19, 26]. Participants are under no obligation to do so because crowdsourcing platforms are open to anybody and do not rely on contractual connections. Instead, individuals must be convinced to take part, and the characteristics that convince people to join a system could be the same ones that determine whether or not that system is successful. Given that crisis management personnel are most likely to be highly motivated in the midst of an actual crisis but relatively uninspired at other times, the primary question is how to incite participation. Microtask markets typically use monetary incentives as the primary motivator for workers [35, 36].

While compensation standards vary by field and specialty, it is generally accepted that offering a higher wage motivates employees to work harder and faster. Sometimes monetary incentives are the only ones that will do the trick. Crowdworkers are less likely to participate in unpleasant tasks if they are not compensated fairly. The expenditure of large sums of money is not always a guarantee of high quality. Factors like "moral obligation" and the desire to make the world a better place are perhaps the biggest drivers of volunteerism, which we have little to no control over [37, 38]. Financial incentives to attract ad hoc volunteers are ineffective and potentially dangerous given that most crisis management work is now performed by unpaid volunteers and the available cash is tight. However, it's crucial to weigh the likelihood of being reimbursed for outlays made specifically because of tasking, such as fuel costs. In the pre-launch phase, when work is typically less interesting and the societal advantages are harder to grasp, monetary compensations may play a more significant role.

4. CONCLUSION

Crisis and disaster management is heavily dependent on a network of dedicated volunteers who have acquired extensive knowledge in the field. However, as individuals become more nomadic, the long-term commitment required by members of voluntary crisis management groups like Indonesia Community disaster has become less appealing. To create and test new procedures and workflows for volunteer coordination, we collaborated closely with the Indonesia Community disaster and other volunteer group as the end user, and we developed a platform to support these operations. Increased situational awareness in real-time via unprompted input from many users is a key benefit of such a system. Not only that, but unannounced participants can join the conversation simply by signing up for a website or portal. Before being examined by Community disaster personnel, the crowdtasking system automatically assigns unverified profiles of spontaneous volunteers a lower level of trust. They are given less important responsibilities, and their observations are given less weight than those of pre-registered volunteers.

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