

### Abstract

The possibilities for the use of social media in the management of natural disasters are discussed in the paper. A brief overview of natural disasters is given. The term social media is defined and their basic functions and components are described. Communication types and the means for their implementation between participants in natural disaster events are analyzed. Basic guidelines for organizing information exchange by social media are proposed.

**Key Words:** social networking, social media, natural disaster.

### Introduction

In recent years, the world has been hit with a series of big natural disasters, from Hurricane Katrina in USA, earthquakes in Haiti and Asia, the tsunami in Indonesia, the earthquake and tsunami in Japan, extremely cold winter in Europe. With the increase of natural disasters that have occurred in the past years it is expected their frequency will continue to increase in the coming years. A natural disaster is the effect of a natural hazard (e.g., flood, tornado, hurricane, volcanic eruption, earthquake, heat wave or landslide)

It leads to financial, environmental or human losses. Natural disasters come without warning and they take lives of tens, hundreds and thousands of people. The resulting loss depends on the vulnerability of the affected population to resist the hazard, also called their resilience. If these disasters continue it would be a great danger for the earth. This understanding is concentrated in the formulation that disasters occur when hazards meet vulnerability. Thus a natural hazard will not result in a natural disaster in areas without vulnerability, e.g. strong earthquakes in uninhabited areas. The term natural has consequently been disputed because the events simply are not hazards or disasters without human involvement.

Due to natural disasters there is an increased communication since people seek to contact family and friends in the disasters zone, and seek information regarding food, shelter and transportation. Social media has played a significant role in disseminating information about these disasters by allowing people to share information and ask for help. Social media are also becoming vital to recovery efforts after crises, when infrastructure must be rebuilt and stress management is critical.

The extensive reach of social networks allows people who are recovering from disasters to rapidly connect with needed resources. There are a lot of groups in the most popular social networking sites, allowing individuals involved in various aspects of emergency awareness and preparedness to connect, discuss, and share knowledge in specific fields. The aim of the paper is to analyze the possibilities for the use of social media in the management of natural disasters and to propose basic guidelines for organizing communications and data exchange between the participants in such events.

### Methodology

In order to find answers to our research questions, as a starting point, we conducted a systematic literature review to gather the bibliography to analyze the articles. Moreover, this approach also sheds light on which different directions the research on the use of social media in disasters is heading to. The combined keywords used for the literature search were social media and disaster, social media and crisis, Twitter and crisis, Twitter and disaster, Facebook and disasters, Facebook and crisis, ICT and disasters, and ICTs and crisis. Furthermore, it should also be noted that we not only selected the articles focusing on social media and disasters or crisis but also the articles that mentioned ICTs, for example web forums or blogs. The literature review has been done in two stages. Initially, by using the combined keywords I searched for the scholarly literature on that topic published in the senior scholar basket of eight journals and also in information systems (IS) conference proceedings such as ICIS, ECIS, AMCIS, HICSS, and PACIS. Because of the nascent nature of the research area, we used the same keywords and conducted a search for relevant articles in Google scholar and also performed backward and forward

search on the collected articles. The final sample of articles comprised 45 articles, including articles from various conference proceedings such as ISCRAM, CHI,

I analysis all the 45 articles and started to cluster them to understand how many research articles are focusing on the real-time social media information analysis of users affected by a disaster. In our research, we consider content from social media users who are not only direct victims of a disaster but also of witnesses present at the time a disaster took place, sharing their observations of a disaster as it happens or shortly afterwards. Overall, the 45 articles are clustered into four different categories based on their research focus. In the first category, the focus is on real-time data coming from end-users through social media, and activities during a disaster. In the second category, even though the research was conducted on disaster data of end-users, the data collection and analysis were performed subsequently after a disaster took place. Especially in this category, the articles focused on user behaviour re-tweets, and uses of social media at the time of disaster and so on. In the third category, the research focus of the articles is about crowd sourced/ open source software applications, tools and systems that either evolved during the times of disasters or developed afterwards to analyse the user generated content of social media witness accounts of the disaster, for example, to generate insights in the catastrophe that might be useful in tackling future disasters.

A few articles belonging to the last category are dealing with the use of social media by the humanitarian organizations themselves, for example for fundraising or other communication purposes. In order to answer our research questions, we focused on the first and third paper categories, resembling together solely 15 articles. For the analysis of the papers, we further subcategorized the papers as being part of one of four disaster management phases, and started coding the articles based disaster social media uses drawn from the functions of disaster social media as further discussed in the analysis section.

## **Analysis**

A disaster is a sudden event that seriously affects the normal routine conditions of a community or society. It has not only an economic and environmental impact but also an important humanitarian component. Disasters could be natural calamities such as earthquakes, tornadoes or hurricanes but also man-made destructive activities such as terrorist attacks or industrial accidents. These kinds of disasters occur suddenly, that demands immediate and fast relief activities in devastated areas. Other kinds of man-made or natural crises such as epidemic diseases or economic crises also have an impact on society but occur not as disruptive over time which is the reason while the role of real-time intelligence is not as important. Clearly, each type of disaster has to be managed differently, while for all disasters being able to reach victims as fast as possible to provide first aid and supplies are of paramount importance for any humanitarian organization. Thus, in order to perform the humanitarian operations efficiently and effectively, commanding over good intelligence for planning and organizing the disaster management activities is of vital importance.

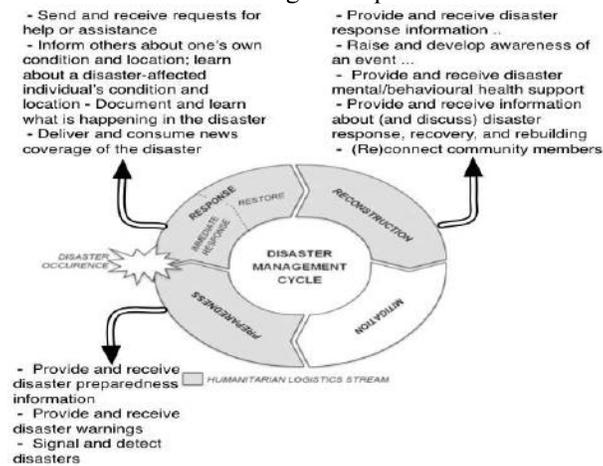
Since disaster management activities are rather complex, comprising several sub-tasks and specialist decision making and skills in the different disaster management phases, humanitarian operations research is studied by many disciplines applying different perspectives. For example, research on the recovery phase is conducted from a process management perspective while natural disaster management has been researched from a design science perspective as well as from a humanitarian logistics and supply chain management point of view. While some literature on the humanitarian logistics and disaster management phases mentions that there are some disagreements about the structure and nomenclature of the disaster management phases, there seems to be a general agreement that the disaster management can be modelled into four phases, namely mitigation, preparedness, response, and reconstruction. Having a good strategy for each of the phases is essential for an efficient disaster management. In order to accomplish this, managers need proper information about the different activities within each of the four disaster management phases with social media information is now accessible in real-time, so those activities can be planned more accurately. Thus, we adopted the disaster management model and its phases in our research to map where and how social media information can be used to improve the decision making.

While social media platforms have not been designed to be used in disaster management, the people affected by a disaster nevertheless turn to those Medias to communicate, thereby also changing the role of the general public from receiving information about a catastrophe to producing and sending

important information. From a disaster communication point of view, Houston et al. developed a comprehensive framework containing 15 disaster social media uses and their applicability from a communication perspective.

They reviewed online information and official websites in addition to scientific literature to explain the disaster social media uses and users. Given the two-way communication nature of social media, the authors considered the users as producers of information and mainly categorized them as: individuals, organizations, governments, communities and news media. Since the research angle they applied primarily considers social media from a communication point of view, the social media uses are more generic. Even though we considered the 15 social media uses in our study, we only considered and integrated those uses which are relevant for the real-time use within the disaster management phases. In order to set a theoretical basis for this research, we adopted two guiding frameworks, dealing with the functions of disaster social media use and disaster management phases.

As mentioned before, we categorized the research of the collected articles into four disaster management phases, as shown in Figure 1. Instead of categorizing the existing research into disaster management phases directly, we added the disaster social media uses because they represent a more fine-grained perspective of social media within a disaster. Moreover, in applying the disaster social media uses to traditional disaster management phases allows us to integrate literature about potential social media activities into the disaster management model. This will act as a theoretical lens to categorize the existing research into disaster management phases.



**Figure Use of social media in different disaster management phases (adapted from**

Even though Houston et al. Proposed their framework from a communication point of view, it is useful to shed some light on the disaster situations where social media is facilitating communication during disasters from different actors or stakeholders.

Moreover, most of the disaster social media uses were apparent in more than one disaster management phase in Houston et al. In order to categorize the discovered literature, firstly we mapped the disaster social media uses to disaster management phases as shown in Figure. We coded the literature along the two dimensions (disaster management phase and disaster social media use) and whenever we believed an article could be categorized in one or more of the categories we did so. The resulting figure allowed us to understand how the social media in disaster classification actually resonates with the more commonly used disaster management phases since the disaster social media uses explain the fine-grained activities performed during disaster, I coded 15 articles to these activities and thereby categorized them into different phases of disaster management. The result of the analysis is discussed below.

### **Categorization of articles into disaster Management phases**

In the following, the findings will be discussed now in more detail. Most of the disaster social media uses we found in literature have an overlap across different disaster management phases. Hence some of the articles are related and mapped to more than one phase.

## **Mitigation**

The mitigation phase focuses on measures that either try to prevent the disaster or try to reduce the impact of the disaster. We were not able to identify any articles that fit into that category, as we have confined ourselves to either research on real-time data during disaster or the applications that will be useful in future disasters. Thus, it could be due to our focus that we have not detected research on social media to support disaster management in the mitigation phase. An alternative explanation could be that there are only limited application areas imaginable how social media can be off use before a sudden, unexpected disaster takes place. In case of flooding or wildfire it is nevertheless thinkable that social media can be used to mitigate the most severe effects of such catastrophes if there is enough time to prepare the general public. However, here we have a clear overlap to the preparedness phase.

## **Preparedness**

In the preparedness phase, the aim is to prepare people to respond to a disaster. The articles that are relevant to this phase falls into two categories in our framework as described below.

### **Twitter-based monitoring applications**

The first category under preparedness mainly focuses on the recently developed applications and tools that monitor, track and analyses the tweets for event detection and location extraction. In other words, it gives situational awareness. One of those applications provides information to first respondents and the other one acts as an earthquake responding system

### **Twitter-based data analysis**

In this category, research focus is mainly on micro blogging or Twitter data either to find out the process of information production and distribution by general public or to identify the information shared by local residents to enhance situational awareness. Twitter users and communities shared local disaster information such as flood levels, wind direction and fire paths, which lead to the preparatory activities. These situational updates are useful in humanitarian relief operations as well as to the affected community members to prepare themselves to respond actively for a disaster.

## **Response**

The response phase is the most important stage where the concern is to preserve the community, environment and saving lives by deploying proper resources. One can notice that Most of the papers are categorized into the response phase. According to our framework, the articles falls into four categories.

### **Role of ICTs for disaster response**

Communities and individuals seeking and providing disaster/crisis information for emergency response. The main key practices observed in the communication are sharing of real-time information, extending moral support to communities, proposing relief activities. Citizenry are also asking for help, suggesting to the officials what kind of actions need to be taken, and giving moral support to the community members through ICTs such as web forums, blogs, Facebook. The ICTs during disaster. Events, despite being back channels acted as main channels to full fill the timely needs of the people Moreover whenever a crisis occurs in networked world online communities are responding positively to disasters.

### **Role of microblogging for disaster response**

Twitter has been widely used for risk and crisis communication in crisis/disaster response events. End users by self-organizing themselves disseminate crisis/disaster related information as a way to reassure other victims and to help in relief activities. Some of the articles are dealing with the social life of microblogged information where authors discussed the information production on Twitter at the time of floods. For example, Twitter helped the end users to self-organize themselves by producing as well as distributing the flood relevant information Moreover, a microblogging site acts as a system to share different types of messages for different purposes such as situational updates, asking for help, expressing opinion and emotional support and also for the crisis communication . Others discuss the role of microblogging in response situations such as in the case of re-tweeted messages after the Fukushima nuclear radiation disaster. One important finding of the Fukushima nuclear radiation disaster is that, even though government organizations tried to create situational awareness and calmed the end-users via microblogging, the user engagement in re-tweeting the information shared by government has been very low due to lack of trust and increased fear among public. However, the information that is

shared by the end users is useful to the humanitarian organizations to act in the response phase of any crisis or disaster.

### **Twitter-base applications for response**

Monitoring applications based on tweets were developed to visualize the disaster-affected area and to provide geo location information. This situational awareness is also helpful in the disaster response phase. This helps humanitarian relief activities to act and reach the victims. The reviewed articles are concerned about location extraction from disaster related microblogs, and emergency situation awareness.

### **Crowd-sourced applications for disaster Response**

The crowd-sourced open software applications collect data from different disparate sources and provide the visual information of affected areas as well as needs and urgencies of the victims. This information is especially helpful in humanitarian relief activities to coordinate and allocate the resources effectively

### **Reconstruction**

In the aftermath of a disaster, the reconstruction phase involves both long-term and short-term activities to stabilize and bring the community to normal conditions in the reconstruction phase, the research is primarily focused on ICTs such as web forums and Twitter.

### **Role of ICTs and microblogging in the reconstruction phase**

Mainly individuals used ICTs to inform others about their safety and also enquiring about others safety. People through web forums and Twitter trying to re-connect to their community However, crowd-sourced applications are also useful in reconstruction phase to find their missing family members. Given to the nature of disaster social media uses that are useful to disaster management phase, some of the articles are also categorized into more than one phase. However, primary motivation for clustering the discovered articles from preparedness phase to reconstruction phase, (for example role of ICTs in response, role of microblogging for response, so on) is to observe a paradigm shift in the gradual use of different ICTs during disasters, away from the idea of bringing technologies by NGOs or governmental organizations to help towards an increasing focus on social media possessed by the general public. Along with the technological developments general public also switching to their own accessible latest social media, for example, web forums to Twitter during disasters.

### **Social Media Essentials**

Social media includes web-based and mobile technologies used to turn communication into interactive dialogue. Social media is defined as a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content. In Web 2.0 terms this would be a website that does not just give information, but interacts with users while giving them information. Social media is media for social interaction as a super-set beyond social communication. Enabled by ubiquitously accessible and scalable communication techniques, social media has substantially changed the way organizations, communities, and individuals communicate. Social Media are the platforms that enable the interactive web by engaging users to participate in, comment on and create content as means of communicating with other users and the public. Social media has the following characteristics Encompasses wide variety of content formats including text, video, photographs, audio, PDF and PowerPoint. Many social media make use of these options by allowing more than one content alternative.

- Allows interactions to cross one or more platforms through social sharing, email and feeds.
- Involves different levels of engagement by participants who can create or comment or on social media networks.
- Facilitates enhanced speed and breadth of information dissemination.
- Provides for one-to-one, one-to-many and many-to-many communications.
- Enables communication to take place in real time or asynchronously over time.
- Is device indifferent? It can take place via a computer, tablets and smart phones.
- Extends engagement by creating real-time online events, extending online interactions offline, or augmenting live events online. Social media operates through social media websites implementing functions such as

- Social Bookmarking (Del.icio.us, Blinklist, Simpy) - Interact by tagging websites and searching through websites bookmarked by other people.
- Social News (Digg, Propeller, Reddit) -Interact by voting for articles and commenting on them.
- Social Networking (Face book, Hi5) -Interact by adding friends, commenting on profiles, joining groups and having discussions.
- Social Photo and Video Sharing (YouTube, Flickr) - Interact by sharing photos or videos and commenting on user submissions.
- Wikis (Wikipedia) -Interact by adding articles and editing existing articles.
- Such websites are not the only social media websites. Any website that invites users to interact with the site and with other visitors falls into the definition of social media.

### **Social Media in Natural Disasters**

Online social networking services and social media like Face book, Twitter, Google+, Etc. can act and try to solve many problems during natural disasters. During disasters all the conventional communications generally stop functioning at this time interval while social media or networking services stay active. Online social networks allow the establishment of global relationships that are domain related or can be based on some need shared by the participants. They have investigated whether or not the social network paradigm can be used to enable individuals and organizations to collaborate in mutually beneficial ways, in all stages of emergency management: mitigation, preparedness, response and recovery. Conducted research has found that though the use of mobile phones and email did predictably increase in the immediate aftermath of the earthquake the use of social networking sites also increased and even surpassed the use of more conventional methods of communication such as networking services, many companies actively used their own secured corporate social fixed phones. Apart from the use of major public social networking services after disasters to confirm the safety of employees. As with any new technology, there remain many hurdles between current use and optimal exploitation of social media. Although these media are used by people of both sexes and an expanding range of ages, it is important to recognize and explore the technology's limitations in reaching at-risk, vulnerable populations. It is not always possible to know whether social media users are who they claim to be or whether the information they share is accurate. Although false messages that are broadcast widely are often rapidly corrected by other users, it is often difficult to separate real signals of a health crisis or a material need from background noise and opportunistic scams. Careful consideration must also be given to issues of privacy and the question of who should monitor data from social media. Most of the commentary about social media during natural disasters has centred on its role as a news source. Certainly this is invaluable with instantaneous information available across multiple devices, critical with power outages shutting down TV stations and landlines. People need advice and information, not only in the wake of a disaster but also for ensuring in advance that they are prepared. Disasters bring risk into the mainstream conversation as people have heightened concerns about their loved ones, and not just the ones in the path of a disaster. During these periods, there are sharp increases in the information shared about claims, preparedness tips and how-to insure for the future. Social media is a critical sharing vehicle because it already connects people and it is very easy. Emergency service agencies are utilizing the power of social media and SMS to instantly broadcast and amplify emergency warnings to the public. The multi-channel communication approach incorporates mainstream media. They monitor and actively crowd source localized information from community agencies and the public, which they relay with geospatial information to emergency personnel on the scene. The public are directly receiving and acting on localized, real-time emergency warning information via SMS alerts and messages to their social networks as well as the traditional channels of radio, TV and online. They are directly accessing links to online information via a number of platforms including websites, mobile friendly sites, smart phone apps and video sharing sites as well as social networking sites. They are actively forwarding emergency agency messages to their social networks and amplifying the warnings.

The role of social media in the wake of natural disasters is still unclear, but sites like Face book, Twitter and YouTube can be of great value when tsunamis, earthquakes, floods and other natural disasters strike. Social media

- Provides valuable information to those in a disaster area pre and post disaster (via Internet, if available, or SMS updates).

- Drives awareness to those outside the affected areas, generating volunteers and/or donors.
- Connects displaced family & friends.
- Provides information about unclaimed property, and in worst case scenarios, bodies.
- Offers information about aid, canters and other resources available to those affected.

A study by the American Red Cross shows more people are turning to sites like Face book and Twitter to learn about emergencies, get information and check on friends and family Face book, you tube, My Space and Twitter were the most popular social network sites when nature strikes. Research and reviews of different case a has identified the four primary ways that citizens use social media technologies during natural disasters

- Family and Friends Communication-To connect with family members between affected and unaffected communities/areas (or within affected communities) for situation updates and planning responses.
- This is the most popular use. Primary tools used are Twitter, Face book and/or a blog.
- Situation Updates-Neighbours' and communities share critical information between each other such as; road closures, power outages, fires, accidents and other related damages.
- Situational/Supplemental Awareness- in a number of cases citizens rely less and less on authority communication, especially through traditional channels (television, radio, phone.)
- Services Access Assistance- Citizens would use social media channels to provide each other with ways and means to contact different services they may need after a crisis.

Before a disaster social media can help people better prepare for a disaster and understand which organizations will help their communities during the disaster social media helps users communicate directly to their families, reporters, volunteer organizations and other residents and immediately share information. It also controls rumours because it's easier for organizations to validate facts. After the disaster, social media helps bring the community together to discuss the event and share information, coordinate recovery efforts and get information about aid. The use of social media for disaster preparedness has two components

- As an effective means for providing updated information about a crisis, proactive steps must be taken prior to disasters in order for effective communications to occur.
- As a part of crisis observation, managers should be monitoring social media platforms and channels that may be relevant to their organization. Observing can be as simple as conducting regular searches and analyses of media platforms for keywords and phrases that may imply an emerging crisis or disaster. Monitoring of social media should extend into the crisis response and post-crisis phases to check how crisis management efforts are being received.
- Many researchers propose three ways to use social media during natural disasters
- Preparing for a natural disaster - though no one can predict an earthquake days in advance, social networks such, email and text messaging could help people prepare for the emergency.
- Responding during and immediately after the natural disaster - this is especially the case for SMS messages and other communications that can be received through cell phones.
- Recovering from the natural - communication is done through social media.
- Nevertheless, the tendency to sensationalize news that is inherent in human nature, basic information may get disproportionately misconstrued as a result of which rumours are created, misleading people with regard to ongoing activities.
- In the process, there is a loss of confidential information and victims may fail to be notified about revised safety measures. Eventually the lack of constant flow of communication can result in chaos and confusion.
- Critical tasks that can be implemented by social media
- Prepare citizens in areas likely to be affected by a disaster;
- Broadcast real-time information both for affected areas and interested people;
- Receive real-time data from affected areas;
- Mobilize and coordinating immediate relief efforts; and
- Optimize recovery activities.

Concerns such as the threat of technology failure, hackers, stalkers, viruses, flaming, and usability issues will have to be addressed in the development of emergency online networks Current

social networks have limitations in terms of the collaborative tools available to users that might be repurposed for emergency use, especially given as they were generally designed with socializing rather than emergency efforts in mind. Nevertheless, within a short time, even

The most enhanced system will seem primitive as user requirements mature and develop in all areas. Systems will ultimately emerge that allow true collaboration and have complete user control. When developing the use of online social networks, it is essential to engage emergency management personnel and their organizations in dialog to determine their concerns, needs and how to serve them in the best feasible manner.

**Conclusions -** Social media has re-defined communication in today's modern world. Text messaging, the internet and social networking sites have made it possible to communicate with a large number of people anywhere on earth. It is an efficient and easy way to keep in touch and impart information, particularly in a time of crisis. The Internet has become an essential communication network during this time. With thousands displaced from their homes and many having fled the disaster zone, people turned to social networking sites to contact friends, post photos and share stories. Social Media has become a valuable means of communication in many places affected by a natural disaster, which allows people to keep in touch with family and friends and access important information. Social media cannot and should not supersede current approaches to disaster-management communication or replace existing infrastructure, but if managed strategically, they can be used to bolster current systems. Now is the time to begin deploying these innovative technologies while developing meaningful metrics of their effectiveness and of the accuracy and usefulness of the information they provide. Social media might well enhance systems of communication, thereby substantially increasing the ability to prepare for, respond to, and recover from events that threaten people and infrastructure.

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