Fire, Wind and Water:
Social Networks in Natural Disasters

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EXECUTIVE SUMMARY

This case examines the issue of increasing adoption of Social Networking Technologies (SNTs), particularly microblogging, for emergency management practices during natural disasters. It discusses the technologies and how they are an integral part of information transfer for citizens in the geographic region affected by the natural disaster. This case presents the progression of how SNTs have been used during and in the aftermath of natural disasters in Australia between 2009 and 2011; these events are used as 'organization' for the paper. Accurate and timely information during natural disasters is essential in providing citizens with details about whether they should stay or leave an area. Traditionally, information was provided through television and radio broadcasts; however, these types of communications were one-way and only allowed for the push of information to citizens. SNTs are being used by the media and emergency organizations to provide information to citizens. These technologies are dynamic in their approach, allowing for knowledge sharing of all parties involved.

Keywords: Community Informatics, Emergency Management, Media, Mobile Computing, Natural Disasters, Social Networking Technologies

ORGANIZATIONAL BACKGROUND

There is a critical need for information when a disaster occurs, and it is important for this information to be targeted at the needs of the affected citizens, organizations and/or governments. Typically, a specific organization is used as the case study for review of the challenges and problems that face the case study, however instead of focusing on one organization this case focuses on using the major natural disasters in Australia between January 2009 and February 2011 as the case study. This allows for greater research into the phenomenon of how society as a whole has (over that short period of time) accepted the use of SNTs, particularly for emergency management and providing information.

It has been stated that natural disasters are one of the major problems facing society (Strömberg, 2007). As they are indiscriminate they affect all citizens, organizations and governments combined in a geographic area and have the potential to lead to loss of life, economic loss and environmental damage. Natural disasters include: floods, fires, earthquakes, low-pressure storm systems (cyclones, typhoons and hurricanes), tornadoes, tsunamis and landslips. To minimize

the effects of natural disasters, citizens in the vicinity of an event are given essential information about their situation for decision making purposes, and the best strategies to avoid harm. Thus the information provided is vital for connecting people and aiding in their decision making processes.

Strömberg (2007) stated that worldwide research of natural disasters between 1980 and 2004 had found that two million people have been killed; five billion people have been affected by the reported 7,000 natural disasters. When it comes to their economic impact in Australia, Crompton and McAneney (2006) state that Australia's historical average annual insured loss due to natural disasters is approximately AUS$1billion in today's monetary terms (historic data 1974-2006), with the worldwide effects of natural disasters constantly increasing.

Natural disasters create a mass emergency for the citizens, organizations and government in the geographic area affected by the disaster and these groups are provided with large amounts of information that they need to evaluate to make decisions on what are the best possible actions that they should follow. The three case studies that will be used for this research are: Victorian bushfires (2009) (bushfires are also known as wildfires in the United States and Canada); Queensland floods (2010/2011); and Tropical Cyclone Yasi (2011).

Victorian Bushfires

During the period of January – February 2009, there were a large number of bushfires that were burning throughout the state of Victoria in Australia. On February 7, 2009, extreme weather conditions were recorded in most of the state, with the media and the Country Fire Authority (CFA) of Victoria reporting up to 400 separate blazes. These fires led to the death of 173 people and 414 people were injured. This was Australia's highest ever death toll from a bushfire. A Royal Commission into the fires was conducted by the Victorian Government (http://www.royalcommission.vic.gov.au/). In their report, they stated that it was reported that AUS$1.2 billion worth of insurance claims were made for damage to property. In this natural disaster there was limited usage of SNTs in providing information to help the decision making processes by authorities. This was the first significant Australian natural disaster where the media and citizens took it upon themselves to provide information via SNTs gathered from traditional means (for example, media releases) to inform citizens about the bushfires.

Queensland Floods

During the period November 2010 – February 2011, parts of the state of Queensland were declared a disaster situation due to large amounts of flooding. On January 10, 2011, a flash flood affected the city of Toowoomba and by January 13 three quarters of the state was affected in some way with flood waters in Brisbane (the capital of Queensland). The death toll from the natural disaster was 35 people since November 30, 2010, with 22 deaths occurring after January 10, 2011. During this natural disaster SNTs were used heavily by the authorities, media and citizens in providing timely information about the natural disaster.

Tropical Cyclone Yasi

The third major natural disaster under review is Tropical Cyclone Yasi. Tropical Cyclone Yasi came in contact with the far north Queensland coastline on February 2, 2011. The cyclone was classified as a category 5 cyclone – the highest category that can be given to this type of storm system. The cyclone led to the death of one person. As this event occurred only two weeks after the floods that encompassed the south of Queensland, authorities had a strong understanding of the use of SNTs

to provide information to citizens. During this natural disaster, SNTs were used heavily by the authorities, media and citizens in providing timely information about the situation.

SETTING THE STAGE

This section of the case is categorised into the following sections: Social Networking Technologies (SNTs); Community Informatics (CI) – the domain that the study of SNTs falls under; and the research framework.

Social Networking Technologies (SNTs)

Social Networking Technologies (SNTs) have gained popularity over the past decade with the number of users of these sites increasing at a rapid rate. In the media about the three case studies, three main sites are referred to: Twitter, Facebook and Flickr. SNTs were used in a variety of ways during and after the case studies, including linking citizens of the geographic communities and disseminating critical information. With regard to the Victorian bushfires SNTs were also used in the discussion of a potential arsonist's court proceedings and ways to be more prepared in the future. SNTs use a bottom-up approach to community engagement of emergency management with no overarching body directing how the technology is to be used, although authorized emergency management organizations can post information which would have procedure on what can and cannot be posted. The messages that are being delivered to the communities through these SNTs typically stem from community members wanting to engage with other members of their community, and media emergency management organizations wanting to make available timely and accurate information for the people affected. All of the SNTs discussed in this case have mobile versions of the software that can run on a number of different brands of Smartphones (for example iPhone, Android, Windows Mobile 7). Citizens therefore have access to these technologies whenever they have cell (mobile) coverage.

Microblogging, one type of SNT, is a recent form of web-based communication that was originally designed for users to share small snippets of information (a post) about their current status. These posts are then distributed through the Internet, instant messages, cell (mobile) phones or emails. One of the most popular microblogging systems is Twitter (http://www.twitter.com/). In this system the posts are referred to as *tweets* and have a limit of 140 characters. Most research considers these systems to be part of Web2.0 technologies and they are constantly evolving. These systems provide an easy way for people to communicate their current activities, thoughts and opinions on issues. One of the great benefits of these technologies is that they are able to share the information publicly. For this reason it has been considered an ideal technology for the dissemination of information about natural disasters. However, one of the drawbacks is that there is no quality of service regarding the transmission of the posts.

Originally, when using Twitter a user could follow other users by their @ symbol (e.g., to follow the Queensland Police Service the user is @QPSMedia, who started to use the service on July 23, 2009). One benefit of Twitter is its method of categorizing tweets using the hashtag feature (# followed by a short description, in the body of the tweet). For the natural disasters these tags were created so that interested users could follow the tweets about the topic. Hashtags for the Queensland floods included #thebigwet, #qldfloods and #bnefloods; for Tropical Cyclone Yasi the hashtag was #tcyasi. By using these hashtags a citizen can follow the messages regarding that topic rather than an individual or organization through the @ symbol. The messages followed are then specific to their needs of the natural disaster.

The second major SNT that has been used during natural disasters is Facebook (http://www.facebook.com/). Facebook is a service that allows users to create a personal profile and then exchange this and messages with a user's friends. By being another user's friend, a user is able to connect with them and receive their posts via the Facebook interface and through email (e.g., to connect with Queensland Police their username is 'QueenslandPolice'). The 'Wall' feature is the main way that a user can interact with other users on Facebook, providing feedback to their posts.

The third major SNT that has been used during natural disasters is Flickr® (http://www.flickr.com/). This SNT is a photo management and sharing technology that has enabled users to post photos of the effects of natural disasters. The images can be tagged with keywords so that other users can search for them, and users also have the ability to leave comments on images. Unlike the first two SNTs, Flickr® is more commonly used after a natural disaster to show its effects.

All three SNTs are available for use on any Internet connected device. The SNTs also have dedicated applications for Smartphones to enable timely information, especially in events such as natural disasters. Previous studies have shown how these technologies have been used in other crisis events successfully, such as the Virginia Tech event on April 16, 2007 (Palen, Vieweg, Liu, & Hughes, 2009), the 2008 Sichuan earthquake (Qu, Wu, & Wang, 2009), and the December 22, 2008, Tennessee Valley Authority's Kingston Fossil Plant in Roane County, Tennessee Coal ash spill a technological disaster (Sutton, 2010).

Community Informatics

The field of Community Informatics (CI) is relatively young within the entire Informatics area, with the first hard copy CI literature published in 2000 (Stoecker, 2005). The analysis of SNTs typically falls within this field, with some specialized research into crisis informatics (Palen et al., 2009). The majority of advances in using technology to support community information sharing, as opposed to supporting business activities, have been made since the year 2000 (Parameswaran & Whinston, 2007). CI literature covers a range of topics, including social capital, the digital divide, virtual communities, community technology centers and social networking. The two main elements in CI are information and communication technologies (ICTs), and 'community' (Day, 2002; Stoecker, 2005; O'Neil, 2002). CI is a strategy or an approach that seeks to use ICTs to serve communities (Stoecker, 2005), links community development efforts (such as social and economic development) with the emerging opportunities presented by ICTs (O'Neil, 2002; Room & Taylor, 2001), and considers how ICTs are used by geographic communities (O'Neil, 2002). It is essential that ICT initiatives are based on the needs of the local community (Day, 2002). Two distinct areas of CI have been identified by authors seeking to define the field: the practical application of ICTs to facilitate community processes and assist in the achievement of community objectives, and the scholarly research and practice of "systematically approaching Information Systems from a 'community' perspective" (Stoecker, 2005). With regard to this study, CI is about the three SNTs that citizens in a geographic community have access to during a natural disaster and the type of information shared by citizens and government organizations to aid in emergency management.

The suggestion has been made that CI can "contribute to empowered communities – communities that are politically, culturally, and economically strong enough to negotiate agreements with corporations and higher level governments that bring them more benefits than costs" (Stoecker, 2005, p. 21). This implies that all information technology projects implemented in a community will provide benefits to the community. This research will consider the benefits provided to communities affected by the three natural disasters used as case studies, with their use of SNTs during and after the natural disasters.

Research Framework

Qualitative methods were "developed in the social sciences to enable researchers to study social and cultural phenomena" (Myers, 1997), and allow researchers to use varied data sources to study social and cultural phenomena, such as how citizens use SNTs during natural disasters. The advantage of using qualitative research methods is that they allow the individuals and situation to be understood within their social and institutional contexts (Myers, 1997), as opposed to quantitative methods which can only record the facts when used in these types of studies.

Primary sources are those gathered from the individual or organization directly, and these are typically unpublished (Creswell, 2003). Secondary sources are previously published materials (Creswell, 2003). This research relies heavily on secondary sources to collect the data that is being reported by the media and the posts on the SNTs about the natural disasters, about the experiences and usage of technologies of the communities affected by the natural disasters. The role of media in contemporary society is significant. McLuhan (2003), Gouldner (1976) and Marshall and Kingsbury (1996) all note that the mass media has the ability to create and influence the perception of citizens through their publications. McLuhan (2003) stated that the individualistic role of the press is dedicated to "shaping and revealing group attitudes". This, coupled with the modern concept that information is power, has lead Marshal and Kingsbury (1996) and McLuhan (2003) to believe that the media is simply a reflection of what society wants and needs to hear. For dealing with emergency management this point becomes especially relevant when citizens are faced with life or death decisions.

Given the power contained within mass media and its relationship with society's needs and wants, an examination of mass media articles can be seen as a fundamental examination of public sentiment (Gouldner, 1976). Gouldner also noted that newsprint was an especially valuable form of media for these examinations stating "the information they [newspapers] provide enables the reader to view issues from a wider cosmopolitan view, adding perspective that is outside of any local shaping factors".

Qualitative context analysis was used to 'read' the articles with an understanding of their context (May, 2001), with the researcher identifying what is relevant and piecing this together to create patterns (Ericson, Baranek, & Chan, 1991). Categories used across all data sources were used as the basis for recording the documentary analysis. Where necessary, categories were extended to accurately record the documentary analysis. When conducting this type of analysis, researchers have emphasized that "Full coverage [of the data] is impossible, equal attention to all data is not a civil right" (Creswell, 2003). The identification of issues and grouping of these issues into categories is in a search for meaning, rather than an attempt to describe every element of the data being summarized. Documentary research "covers a wide variety of sources, including official statistics, photographs, texts and visual data" (May, 2001, p. 175). Each document "represents a reflection of reality" (May, 2001, p. 182) and provides "material upon which to base further investigations" (May, 2001, p. 175). Documents tell the reader "about the way in which events are constructed" (May, 2001), and may be classified as 'public' or 'private' (May, 2001). Documents produced by government departments are usually public documents. The context influences the style and content of the documents, and requires consideration of the requirements under which they were developed (May, 2001). While recognizing that the "ways in which documents are used is clearly a methodological and theoretical question" (May, 2001, p. 177) influenced by historical and social perspectives, when compared to formally established research methods, documentary research is "not a clear cut and well-recognized category, like survey research or participant observation… It can hardly be regarded as constituting a method, since to say that one will use documents is to say nothing about how one will use them." (Platt, 1981)

The documentary analysis conducted in this research was based on 'practical reasoning' where the expectations, experiences and perceptions of those producing the documents was considered as 'fact', while recognizing that the understanding of these documents was open to negotiation (May, 2001). Documents were considered in terms of their authenticity, representativeness, credibility and meaning.

A standard process for data analysis in qualitative research was used as the basis for data analysis in this research (Creswell, 2003). The collected data was organized and prepared for analysis, and all data was read to develop a general sense of the available information. General notes were written and patterns in the data recorded (Creswell, 2003; Stake, 1995; Strauss & Corbin, 1998). Prior to reading the data, a list of general terms was developed based on previous research and experiences, as recommended by Miles and Huberman (1994). These terms were used as the basis for recording notes, and allowed for a more efficient analysis. Overall ideas, depth and credibility were considered.

CASE DESCRIPTION

This research used a triangulation of different sources to draw conclusions on the challenges and problems facing the usage of SNTs during and after natural disasters. Case study research has been used as one of the major methods for conducting qualitative research and is the most common research method within Information Systems (Myers, 1997). This section presents the changing role of SNTs during the three natural disaster case studies.

Technology Approach

One of the issues with usage of SNTs is how citizen involvement was initiated. There are two broad approaches that can be taken; these approaches are from the top-down and from the bottom-up. A top-down approach is where an overarching policy effort (e.g., national) is used to assist and make the decisions of how the technology can be used by citizens. A bottom-up approach is driven by the citizens themselves and needs active participation for the information to be disseminated to citizens affected by the natural disaster.

SNTs During and After the Victorian Bushfires

During the bushfires, SNTs were discussed in the media. A number of articles such as 'How tweet it is in this fight to the Twittering end' (Sinclair, 2009) and 'Twitterers aflutter as the social media comes alive' (Day, 2009) discuss how conventional media embraced SNTs (especially Twitter) in an effort to disseminate as much coverage as possible about the bushfires to the general public. These messages came from an Australian Broadcasting Authority (ABC) radio station '774 Melbourne' which not only provided a large number of fire related updates during the bushfires, but also increased their following from 250 followers to 1200 in the days of the event and was one of the top three re-tweeted accounts in the world (Sinclair, 2009). Another traditional media reporter was Caroline Overton from The Australian newspaper, who tweeted 197 times whilst in the bushfire affected areas. These examples show how traditional media outlets are using SNTs to increase the access of information to people living in or near a geographic area affected by a natural disaster, such as the Victorian bushfires. New Matilda ("Word Spreads", 2009) reported that SNTs had information about the bushfires before the traditional media, with Twitter user "@cfa_updates" providing (unauthorised) RSS feeds from the Country Fire Association of Victoria's website. Hobbs (2009) and Clayfield (2009) discussed how SNT users reported the

events of the bushfires with the use of wireless Internet, keeping friends and families up-to-date with what they were experiencing.

In the months following the Victorian bushfires, SNTs were discussed in the media, mainly in relation to two issues: how these technologies could be better utilized in the future, and the court proceedings of one of the arson suspects. In the articles 'Fire alerts on Twitter' (2009), 'Lives before properties in stay-or-go policy changes' (Cooke & Collins, 2009) and 'Tall order to fix fire policy soon' (Ruffles, 2009) there were discussions on how SNTs such as Twitter and Facebook could be used to give people early warning of bushfires in Victoria for similar situations in the future. The then Premier of Victoria John Brumby stated, "We'll be providing more information to the community, like Twitter and Facebook, alternative means of communication to get the information out to the public" ("Fire alerts", 2009). Lauder (2009) stated another comment by the then Premier of Victoria, "Like Facebook and Twitter; alternative means of communication to get the information out to the public so that they've got better information from a variety of sources, and if they need to make a judgement to go early they will go and they will go early". These comments highlight the government's consideration of using SNTs after the Victorian bushfires of 2008, a technology that was not officially used during that event. On the negative side of SNTs, a number of articles reported ofnthe creating of 'hate groups' when arrests were made of suspected arsonists (Black, 2009; Sands, 2009).

SNTs During the Queensland Floods

Nearly two years after the Victorian bushfires the Queensland floods occurred. This natural disaster provided insight into the adoption of SNTs by authorized emergency organizations. One of the leading users of Twitter and Facebook during the natural disaster was the Queensland Police Service. This was reported in the media by both Bartos (2011) and Griffith (2011). Bartos (2011) discussed in his article 'Our destructive need to find a scapegoat how typically there was a perception by the citizens of Australia that the public service did not know how to engage society through the use of social media. However, during the Queensland floods the Queensland Police Service was able to provide accurate information to those affected and reduce the inaccurate information provided by other citizen Twitter users. Griffith (2011) discussed in his article 'Social media had crucial role in floods' how the Queensland Police Services mirrored its Facebook postings with its Twitter account to provide information to citizens during the Queensland floods.

While authorized emergency management organizations were providing information to citizens during the floods, other groups after the floods were also providing information to dispel mistruths. One such occurrence of this was the postings by Sunshine Coast Tourism. The Sunshine Coast area was not affected by the floods during 2010-11; however, holiday makers were cancelling their holidays to the area as they thought that it was affected by the floods that covered three quarters of the state. The organization posted messages on both Facebook and Twitter stating that the Sunshine Coast was "open for business" (Denton, 2011). The Sunshine Coast is another example of how SNTs can be used to provide information after a natural disaster has occurred to allow citizens to get accurate information.

SNTs During Tropical Cyclone Yasi

A few weeks after the Queensland floods in southern Queensland, the northern part of the state was hit by the natural disaster of Tropical Cyclone Yasi. As a result of the understanding of how the technologies were used during the floods, information was made available through SNTs by the emergency organizations and by citizens both in the geographic area and around the world. The Queensland Police Service and Ergon Energy (the provider of electricity for the area of

Queensland) posted messages on both Twitter and Facebook to keep citizens informed about the event.

Citizens also used the technology to keep others informed. The *Herald-Sun* ("The 300km/h monster", 2011) posted comments by citizens using Twitter in their newspaper article 'The 300km/h monster swept in from the ocean, crushed all before it . . . and it's still not finished Yasi carves a path of terror'. One tweet that was posted stated "@heartbieb Cyclone Yasi is still here in the morning. My whole street is filled with broken trees. We can't even leave our street. Stay safe qld." This post shows the sentiment of a citizen living in the geographic area of the natural disaster. Although most posts provided accurate information from citizens, some media pointed out that there were rumors that an evacuation centre in one of the small towns that had lost its roof; however, this was incorrect (AAP, 2011). This inaccurate rumor was then reported through the mainstream media. This illustrates a major issue with citizens posting information that does not have the accuracy of posts by authorized emergency management organizations.

After the tropical cyclone, The State Library of Queensland stated that both the floods and Tropical Cyclone Yasi were significant events in the state's history and called on citizens of Queensland to post images of the events on the SNT Flickr ("State Library", 2011). This is another example on how SNTs can be used after an event to collect collective experiences from citizens.

CURRENT CHALLENGES/PROBLEMS FACING THE ORGANIZATION

Within the case study of the three major natural disasters in Australia between 2008 and 2011, the major challenge that is faced by citizens, organizations and governments is how relevant information can be exchanged in a timely manner that allows actions to save lives and help reduce further damage. Information has traditionally been provided through official media channels, thus there was an editorial process that considered the information being broadcast. With all citizens able to provide information via SNTs, accuracy of the details potentially becomes an issue (see Tropical Cyclone Yasi example of the roof being lost at an evacuation point as one example).

Quality is one concern with the information being posted by citizens on SNTs, because it is generated outside the control of government bodies (such as police, fire, emergency services and rescue units). This also poses issues of reliability of the information that other citizens use to make decisions during the emergency. In the time between the Victorian bushfires (2009) and the Queensland floods (2010-11), uptake of SNTs by authorized emergency management services occurred (for example Queensland Police Service).

National ICT Australia (NICTA) has a focus on e-government research and developing means to coordinate the dissemination of information through ICT. On his website, Worthington (2009) discusses how official authority for the issue of safety information occurs, discussing the SEWS Guidelines (Victorian State Emergency Service – Standard Emergency Warning Signal). These approaches to providing information to individuals affected by emergency disasters are the official means that community members should use to source their information for advice such as evacuation procedures. However, SNTs can provide information beyond these official statements – for example knowing where friends and relatives in your community are after the official evacuation notices have been issued. The challenge comes in how to get the best information during the disaster so the citizens can make the best possible decisions.

CONCLUSION

This case presented how SNTs, such as Twitter and Facebook, were used during and after the Victoria bushfires, the Queensland floods and Tropical Cyclone Yasi. The findings from the research in response to a national disaster were that technologies such as SNTs can both add benefit to a geographic community (for example providing alerts and support networks) and have a negative impact (for example hate groups formed in response to the suspected arsonist and incorrect information being disseminated). With this initial discovery, further work can be conducted to establish the extent to which these technologies can provide a service to the community beyond the traditional interactions with government bodies and the media, facilitated by uptake of these technologies by authorized emergency management organizations. A combination of top-down (from authorized emergency management organizations) and bottom-up (from citizens) approaches has the potential to increase engagement, allowing users to share information about the natural disaster events.

Between 2009 and 2011 the natural disaster information delivered through SNTs has changed from being provided by unauthorized personnel (@cfa_update – twitter, Victoria Bushfires) to being a leading means for authorized personnel to broadcast information (@QPSMedia – twitter, Queensland floods, Tropical Cyclone Yasi). The challenges come in how these organizations ensure that they are using the technologies that are used by the citizens, while continuing to delivered relevant information to people who do not use these modern technologies. SNTs must be used as a complementary element in disaster management processes.

The main challenges that still need to be overcome are:

- Digital divide and those that do not use the social networking technologies, particularly problematic for the elderly, less educated and people without Internet access;
- The issue of loss of control by authorized emergency management organizations and having multiple sources of information available to citizens;
- Unavailability of Internet connectivity (fixed and mobile) during times of disasters, particularly in remote areas; and
- Ensuring that the information provided is timely, accurate and reliable.

SNTs can provide a way for citizens to access information that is specific to their geographic needs that also allows them to gain the information in a searchable format. This is something that traditional means of communication cannot do. The benefit of using these technologies as a complementary means of providing information far outweighs the negative issues and this is why authorized emergency management organizations are starting to utilize the technologies.

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