



Crisis Mapping Community Social Media Information During and After Large-Scale Disasters in Victoria

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Abstract

Sponsored by the Emergency Services Foundation, this project investigates Victoria’s potential to increase the situational awareness of its emergency service organisations (ESOs) in large-scale disasters by harvesting community social media information. This report acknowledges that, Victorian ESOs view social media as an important communication tool. It identifies the value to ESOs of harvesting and mapping community social media information, and suggests ways in which Victoria may overcome some of the associated challenges. As its ESOs strive to be “community-focused and consequence-driven”, this report recommends that Victoria utilises the rich information that the community can provide, enabling it to further “deliver the highest level of service to the community”.

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The writing of our project was a collaborative effort that took advantage of each of our respective interests and strengths. As noted above one or two group members primarily wrote each subsection. Further, every group member participated in the full revision of every subsection to ensure a fluid tone and balanced level of information throughout the paper. Our findings and conclusion represent our collective team views.

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Executive Summary

Large-scale emergencies test the capacity of emergency response systems and expose their inherent limitations to a fault. Over the past two years, large-scale disasters in Victoria, Australia such as the 2009 Black Saturday bushfires and significant flooding events have proven this. Victoria has learned that its existing 30 year-old emergency response framework requires fundamental changes. To improve, Victoria is currently undergoing significant emergency management policy reform by focusing on:

- “service delivery to Victorians across government and communities;
- building community resilience;
- achieving a genuine ‘all-hazards, all agencies’ approach; and
- enduring and sustainable change” (Victorian Government, 2012)

In large-scale disasters, Victorian ESOs are challenged to continuously monitor the vast size of the State and effectively respond to its sparse population. As Victorians become more connected to the Internet and social media, the community information they create can provide Victorian ESOs with valuable intelligence. When a large-scale disaster occurs, community social media use skyrockets, drastically increasing the amount of information available. Victorian ESOs can take advantage of this information and increase their situational awareness. With 92% of Australians connected to the Internet and 70% of them using a social media profile (Nielsen Company, 2012), there is a tremendous opportunity to capitalise on the community information they create.

This report was developed to aid Victorian ESOs’ understanding of how harvesting and mapping crisis-relevant community social media information can benefit them during and after large-scale disasters. By taking advantage of this community information, Victorian ESOs can

further “deliver the highest level of service to the community” (Lapsley, 2011). Our preliminary research on this subject led us to develop the following objectives:

1. Investigate how emergency service organisations currently interact with the Victorian community through the use of social media;
2. Identify the value of pulling social media information from the community for the benefit of emergency service organisations; and
3. Address apparent challenges and potential solutions for implementing a social media based crowdsourcing system.

To accomplish these goals, we began by interviewing representatives from Ambulance Victoria¹, Country Fire Authority, Department of Justice, Department of Premier and Cabinet, Department of Primary Industries, Department of Sustainability and Environment, Metropolitan Fire Brigade, and Victoria Police². From these interviews, we developed an understanding of Victoria’s current emergency management arrangements and the existing ways that Victorian ESOs use social media. We found that all of the available agencies use at least a Facebook and Twitter account in their emergency management arrangements to broadcast up-to-date information. In doing so, they acknowledge the value of social media to quickly spread and share information with the online community. Even with this level of usage, Victorian ESOs have the potential to further utilise community social media information to increase their situational awareness.

Social media presents an incredible opportunity to improve ESO’s situational awareness because of the large volume of rich, detailed, and visual information it provides. The community already uses the wealth of knowledge and experience available through social media to improve

¹ This interview was held with former Ambulance Victoria representative James Howe, who now works at Telstra.

² We were unfortunately unable to meet with a representative from the Victoria State Emergency Service due to their priority involvement with the 2012 Victorian floods and our project timeline.

their understanding of emergencies. ESOs can realise similar benefits by analysing social media information. A map of the sheer volume of geo-located social media information available during and after a disaster can help ESOs understand where the disaster is impacting the community. Additionally, multimedia posts available through social media can provide clear, detailed information that is impossible to convey verbally. The situational awareness gained from this information can help ESOs respond more effectively..

Granted the benefits of harvesting social media information, there are still important challenges to address before social media can be used in an official capacity. This report focuses on the sharing of emergency information across agencies, the lack of trust in verifying publicly generated posts and the resources needed for verification.

For Victorian ESOs to benefit from a crisis map based on community social media information, they must first work to establish active communication lines across each of the agencies. The sharing of emergency information is critical to the realistic conception of a cross organisation crisis map. At this time, each of the ESOs do work together but have the opportunity to improve how they share information by challenging the core ESO structure by which they operate. Further, full support and endorsement from senior level emergency service officials such as Chief Victorian Fire Commissioner, Craig Lapsley, will promote such shared communication and accelerate the progress made towards a cross organisation crisis map.

Social media enables additional, beneficial information to flow freely, but due to its community-generated nature, it must be validated differently. During and after a large-scale disaster, large volumes of social media information produce patterns of geo-located posts, pictures and videos on a map, depicting the locations with the highest level of disaster impact. These patterns can act as a method for self-verification by overriding any errant information.

Additional geo-located and time stamped multimedia information available through social media can also be validated easily because of the level of visual detail available. However, responders are culturally inclined to use only the most valid information possible. There are methods for verifying individual reports that have been developed by previous crisis mappers worldwide. Some of these methods include directly contacting the original source of information to clarify details or only accepting information from a list of trusted sources. These methods can lose the true strength of social media in a large-scale disaster and prove to be time consuming and labour intensive, which lies within the overall knowledge contained in aggregating information from many sources.

In order to manage any of the verification processes listed above, a volunteer network of moderators must be used. Since credibility of sources has been a central concern of ESO representatives throughout our research, the most logical option for a crisis-mapping network lies within already credible people who are familiar with social media. These personnel can be sourced from all levels of Victorian government as well as greater Australia. However, if a larger set of volunteers is needed, additional aid can be found in local community members within the range of 16-24 years old. This age range produces the most active Internet and social media users attributing to the availability of a social media knowledgeable volunteer force. If further volunteers are necessary, a global set of volunteers, such as the Standby Volunteer Task Force is another viable option as moderators can be trained and work from remote locations to verify social media during and after large-scale disasters.

Victorian ESOs have the potential to “deliver the highest level of service to the community” (Lapsley, 2011) by harvesting and crisis mapping community social media information. As information is the key to effectively managing emergency response and recovery

efforts, it is critical to realise the power of community information to increase the situational awareness of ESOs. Victorian ESOs already realise that social media is an important communication tool and use it on a foundational level. Although Victoria will face a variety of associated challenges in the process, all can be overcome. As a result, full interoperability between the community and Victorian ESOs can be achieved promising a Victoria that can stay “community-focused and consequence-driven.”

From this report, we hope that Victorian ESOs will realise four important ideas:

- Community social media information is both **real and relevant**
- Large-scale disaster emergencies will **always** affect the community
- Community knowledge is **emergency intelligence**
- Victoria can **realise its potential and act**

1 Introduction

In recent years social media has allowed people and organisations to connect and share information like never before. During and after large-scale disasters, such as the 2004 Indian Ocean tsunami and the 2010 Haitian earthquake, such connections gave the affected communities an opportunity to provide mass volumes of detailed information to emergency responders. With the increased volume of information from the community, emergency responders were able to increase their situational awareness of the disaster. After the Haiti earthquake devastated the capital city's core infrastructure, for example, a major stream of information available to responders was sourced from publicly input social media feeds such as Facebook status updates, Twitter tweets, and uploaded pictures and videos. The heightened situational awareness resulting from this information was instrumental in focusing the allocation of humanitarian aid.

With the ongoing development of Australia's National Broadband Network (NBN) and the increasing popularity of social media, Australia is becoming more connected to and reliant on the Internet. In 2011, the Nielsen Australian Online Consumer Report published that 92% of the Australian population has home Internet access. An additional 2% increase was to be expected in the next 12 months and the NBN projected to connect every Australian to the Internet by 2020 (NBN Co, 2012). Of the total number of Australians online, 93% use Internet at least once a day and 70% have a social media profile. With 52% of online Australians preferring the Internet as their primary source of information, Australia, and therefore Victoria, has the opportunity to capitalise on the capability of social media to harness emergency information from the public.

Victoria is currently reviewing its large-scale disaster emergency response because issues have been revealed relating to its prior disaster responses that have affected its communities

(Victorian Government, 2012). In February of 2009 the Black Saturday bushfires destroyed approximately 4,400 square km of Victoria and killed 173 people making it the deadliest natural disaster ever to hit the Australian continent (Cameron, Mitra, Fitzgerald, Scheinkestel, Stripp, Batey, & Niggemeyer, 2009). Victoria did not have the benefit of a crisis map with crowdsourced social media information made available by the community in these fires. However, in the Queensland floods that occurred from December of 2010 to February of 2011, the Queensland Police Service (QPS) did employ social media communication tools to update the public when traditional forms of communication became overwhelmed (McDougall, 2011). To better understand the developing flood situation, the Australian Broadcasting Corporation (ABC) set up a mapping system called Crowdmap that organised public social media information such as tweets, pictures and videos on a centralised geographic map. The ABC map would have provided a useful source of information for prioritisation and allocation of Queensland ESO resources.

In Victoria emergency information is communicated to the public mostly through forums such as Twitter and Facebook accounts, television and radio warning announcements and departmental website updates. Victoria's capability to gather information from the public just as the QPS did, though, is currently limited. Due to the vast size of Victoria, emergency service organisations³ (ESOs) do not have enough resources to monitor and respond to the entire state simultaneously during a large-scale disaster. To fill these monitoring and response gaps, social media information such as that posted to the Crowdmap in the Queensland floods, promises useful information in a timely fashion.

³ For the purposes of this report, we consider the Emergency Service Organisations of Victoria as the CFA, MFB, VicSES, as well as the Department of Primary Industries (DPI), Department of Sustainability and Environment (DSE) and Victoria Police (VicPOL).

In contrast to Queensland's ad hoc approach to Crowdmap, preparing to use social media information in an official capacity prior to an actual large-scale disaster raises important questions that must be addressed: How would this information be shared amongst agencies? How could ESOs trust the validity of this information? Who would collect and monitor this information? To answer these questions, the Emergency Services Foundation (ESF) and the Victorian Department of Premier and Cabinet (DPC) have sponsored our research. With the help of Victorian ESO representatives and senior Victorian government officials, we will consolidate knowledge about social media information in disaster situations, highlight common concerns about implementing a social media based crisis map, and suggest how social media usage can aid the efforts of emergency responders to deliver the highest level of service to Victoria.

This project will advance the ESOs' understanding of how crisis-relevant information can be sourced from public social media information during and after large-scale disasters in Victoria, Australia. To achieve this goal, we investigated the current use of social media by Victorian ESOs, identified the value of social media information in Victoria and addressed the challenges that using this information entails. We then created a cohesive report to advance Victorian ESOs' understanding of the value of harvesting public social media information and the ways that they can overcome the inherent challenges in implementing a social media based crisis map in Victoria.

2 Background

2.1 An Information Revolution

During a disaster response, information is the key to effectively managing a situation. The availability of more information enables emergency responders to have a clearer picture of the situation so they can allocate their aid accordingly. Due to the rising prevalence of mobile phone usage and the development of social media in recent years, the amount of information available during an emergency response has skyrocketed.

Regardless of the social media platform, real-time message posting, photo and video uploads and geo-location pinning capabilities have enabled the public to share information more effectively than ever before. The ease at which people can share information online has created an environment where individuals and communities can learn from each other in a revolutionary way. Emergency responders can take advantage of this environment to increase their situational awareness through publicly shared information.

The high potential for social media use in emergency situations may suggest that ESOs are actively pursuing such communication opportunities. Although many are aware of such potential, most do not yet fully capitalise on these opportunities. At this time, the information revolution is beginning to surpass the operational processes of emergency service organisations. In effect, communities will soon have the capacity to know more than emergency service organisations via social media. If emergency service organisations fail to utilise the power of social media now, its' capabilities will surpass the government's ability to integrate it into current emergency management.

The background information below will convey the scope of social media and relate it to opportunities for advancing emergency management. Further, the section will demonstrate an evolution of available information in large-scale disasters and demonstrate the development of

social media in emergency management. A description of Victoria's current emergency response system and ongoing efforts to improve its effectiveness will follow. Finally, the future of Victorian emergency management will surface as we introduce our project, explain our approach, discuss our findings and share our recommendations.

2.1.1 Framing Social Media

Social media encompasses more than the common list of social networking websites such as Facebook, Twitter and YouTube; it spans a broad spectrum of online information sharing channels and networks. Social networking sites like Facebook allow users to create selectively visible profiles that they share with other users on a personal level. Most other social media channels including online forums, wiki-pages, and blogs, share less personalised information publicly. The unifying factor between these medias is that they are designed to share information that is created by users. Through the use of social media, people can accomplish everything from seeking tech-support to soliciting ideas. As will be demonstrated below, the diverse and innovative communication channels presented by social media enable people to share information, collaborate with others in a revolutionary manner, and learn in the most dynamic environment ever created.

Since the introduction of popular social media platforms such as Facebook in September of 2006, the structure of the Internet as we know it has undergone a fundamental shift. When the Internet was established, relative experts formulated information that was posted on the Internet for the benefit of people seeking such knowledge. Encyclopaedia Britannica Online is an example of this model where people could access a direct learning environment where field experts posted information. This one-way structure of presenting information lacked a feedback element, or ability for the viewer to provide further insight in a two-way manner. Without this feedback element, expert postings required extensive development time for proper research and

information validation. While information in this structure was accurate, it lacked the flexibility to be made better and could easily become out-dated.

As the Internet developed, the concept of “Web 2.0” emerged allowing the greater online community to influence the available information by actively collaborating to improve it. Andreas Kaplan and Michael Haenlein defined “Web 2.0” “as a platform whereby content and applications are no longer created and published by individuals, but instead are continuously modified by all users in a participatory and collaborative fashion” (2009). This shift may be best represented by the development of Wikipedia. Here, people create informational articles that the community edits and improves by adding further details and citations to increase accuracy and validity. Information developed through this model is often seen as less valid than peer-reviewed and fact-checked publications, but research by Nature magazine suggests that articles on Wikipedia are comparably accurate to similar articles on Encyclopaedia Britannica (Giles, 2005). Another study reports that Wikipedia’s main fault as an information source is its inconsistent depth of information between articles. However, the articles are still reasonably accurate and are able to cover “truly current events” (West & Williamson, pg. 11, 2009). This speed of information development is a feature of “Web 2.0” that has transformed the Internet into a still accurate space with more flexibility, improved sharing capabilities and a diverse wealth of knowledge.

The ability of “Web 2.0” to spread information quickly has enabled social media to become an integral form of daily communication for much of the world. Google’s 2011 list of the world’s most visited websites ranked social media networks such as Facebook and Twitter #1 and #16 (Smith, 2011), respectively, even though they have only been open to the public for five years. A fundamental reason for these top usage rankings lay within social media’s fascinating

ability to better connect people and information. Due to its high public usage rate, social media has become a vital arena for organisations and campaigns.

2.1.2 How Organisations Use Social Media

Organisations have taken advantage of social media in a variety of different ways to collect information. From a running enthusiast group posting to an online forum website to news media members requesting their Twitter followers to identify and verify news leads, social media has created opportunities for groups to organise information in new ways through varying levels of community involvement.

2.1.2.1 Using Social Media to Help the Community

Many organisations use social media as a method for promoting their presence in the market and engaging the community. In general, the philosophy behind social media usage is that a greater audience will lead to a higher contribution or participation rate. Websites like runnersworld.com provide forums for the community to discuss training plans, running routes, injury prevention and related news articles (www.runnersworld.com). The website's existence alone provides a focal point for the community to share and learn information. Many groups will create a Facebook page instead that provides a similar opportunity for community members with common interests to share knowledge. In this forum, members can interact without any commitment to the group that originally created the page serving as a springboard for even greater community involvement.

Social networking sites enable greater interaction with the online community through broadcasting up-to-date, consumer relevant information. Many of these websites have a significant user-base following their site giving the site owner the ability to easily send out information to all of its subscribers simultaneously. Online stores such as Amazon.com, for example, broadcast special deals through their Facebook page daily to market and generate more

traffic on their website. By marketing their products or services through social media websites, the community can learn about information from the original site owner.

These methods of interaction allow the community to learn information in an effective manner because the information is shared amongst community members or is pushed out by the site owner. However, these methods do not take full advantage of social media's ability to gather information for the enhancement of the organisations' knowledge. Other methods for gathering information require a deeper involvement and greater understanding of how social media's communication capabilities are used by the community in order to draw valuable knowledge from the community.

2.1.2.2 Crowdsourcing: Using Social Media to Learn from the Community

News media often interact with the community through social media to learn more information about events. By gathering information from the community, journalists take advantage of the community's knowledge of events to improve their own understanding, a process otherwise known as crowdsourcing. The BBC's "User-Generated Content Hub" and National Public Radio's Andy Carvin exhibit how learning in this manner works.

The BBC's User-Generated Content Hub utilises social media to quickly find newsworthy related content developed by the community. BBC journalists search for recent pictures and videos to provide information that can improve existing stories or create new leads. One Hub journalist explained how the best information available is often found in open comment logs at the end of existing articles where community members actively try to share information with the BBC (Stray, 2011). Once this information is collected, a reporter can reach back to the source and gather more complete information about the situation. This approach enables the BBC to find information about a diverse set of events from a variety of sources.

National Public Radio Senior Strategist, Andy Carvin, uses social media in a more focused and involved manner. Taking advantage of his personal social media network, Andy finds specific news information by requesting his Twitter followers to confirm rumours and collect details about events in Arab nations (Silverman, 2011). This direct approach enables him to find important information even if there are few sources available. He is able to direct and guide the information to suit his personal needs by operating in this manner.

Journalists are able to quickly develop superior understandings of newsworthy situations by crowdsourcing community knowledge. The methods they use to pull this intelligence from the community could be applied to large-scale disaster emergency responses. Here, an improved understanding promotes better emergency management and more effective relief efforts.

2.1.3 Defining Large-Scale Disasters

Before continuing further, we find it necessary to define the term “large-scale disaster” as it is used in the Victorian context. Victoria has historically been prone to several annual large-scale disasters that have at times reached catastrophic levels of destruction. A catastrophic disaster describes an impact so critical that even the overseeing emergency management organisation of a population is overwhelmed by the level of resources required. In this scenario, external resources are necessary to effectively manage the disaster.

The phrase “large-scale disaster” can now be better understood by the level of emergency resources it requires. To further this point, it is also important to understand the range of emergencies the term “large-scale disasters” incorporates, at least in this specific study. Due to Victoria’s experience with state emergencies ranging from mountainous bushfires to inland floods, ESOs prepare it to respond to a multitude of large-scale emergencies. In this sense, our study will utilize the phrase “large-scale disaster” to encompass an all-hazard approach to emergencies of such magnitude. This all-hazard umbrella includes but is not limited to bushfires,

floods, biosecurity threats (such as locust swarms), terrorist attacks, drought, and infrastructure failures.

2.1.4 The Value of Social Media in a Large-Scale Disaster

Social media networks harness the power of “Web 2.0” by enabling more people to create and share user-generated content than many other means of communication (Kaplan & Haenlein, 2010). The 2010 Haitian earthquake Wikipedia article, for example, provides a well-rounded synthesis of information relating to the unfortunate event. Developed from several diverse sources, the article offers a plethora of information including, but not limited to the specific date and time of the earthquake, its magnitude, a number of and details relating to people affected, and images of the resulting mass destruction (2010 Haiti Earthquake, 2012).

In the case of the 2010 Haitian earthquake, Wikipedia allowed information to be shared and integrated from various sources into one cohesive representation. In addition, social media and “Web 2.0” information can also enable emergency responders and community members to share related information in real-time for the benefit of all.

2.1.4.1 Resilience in Communities

The power of social media in large-scale disasters empowers communities to regain critical communication with each other and share crucial information. When physical infrastructure elements such as local power and phone lines are disabled or destroyed, communities need a channel of communication through which they can interact. Social media can provide this communication channel and connect communities when it truly matters.

The 2011 Midwestern U.S. tornado that struck the small town of Joplin, Missouri, for example, caused massive damage to the town and displaced the majority of the population. Community interaction through social media proved to aid families and individuals in ways that

the emergency services could not. With so many people either displaced or missing, social media enabled the community to locate each other in the completely transformed post-tornado local landscape. The upload of geo-located posts, photos, and videos, provided immediate hope and reassurance for community members who had everything taken from them. Posts such as “Does anyone know where [insert name] is?”, “Where can I get/give help?”, and “I’m safe!” enabled community members to help each other locate lost ones, identify locations offering aid or in need of it, and ease the minds of thousands of community and family members (Stephens, 2011). Facebook pages also helped to indicate where lost property could be returned such as hospital records that had travelled up to 60 miles. At the request of the government of Missouri, U.S.A. and through public social media interactions, the geo-located pictures and videos were posted and helped convey the sheer level of destruction that the tornado had caused enabling them to act accordingly and document the event in near real-time.

2.1.4.2 Informing the Community through Social Media

In addition to its community interaction benefits during and after large-scale disasters, social media has been used to advise, warn, and update community members of impending large-scale disasters. A Facebook page or Twitter account can notify all its followers of specific alerts quickly and simultaneously. In conjunction with that information, these pages can include useful information for preparatory measures and other readiness information for the to-be affected communities as can be seen in the use of Facebook by the Queensland Police Service during the Queensland Floods (McDougall, 2012).

As shown by its current uses across the globe, the main role of social media in large-scale disaster emergency management has been to push crucial information to the community quickly, as described earlier. As the capabilities of social media progress, though, its application potential in large-scale disaster management worldwide grows.

2.2 Evolution of Crowdsourcing Information in Large-Scale Disasters

As information is the key to effectively managing a large-scale disaster, it is important to discuss the evolution of its usage. From the availability of information itself to the amplification and crowdsourcing of it, the presence of information in large-scale disasters enables increased awareness, better resource allocation, and enhanced community resilience.

2.2.1 Effect of Available Information in Large-Scale Disasters

In large-scale disasters, governmental and humanitarian relief organisations assemble to coordinate aid to the affected people and areas. These organisations need up-to-date specific information from people in affected locations to disperse appropriate relief resources effectively. The availability of pictures and video from people in affected areas showing the emergency situation can enable relief organisations to identify specific relief needs and allocate appropriate resources to them in an effective and timely manner. This claim is evidenced by the humanitarian aid response that resulted from the 2004 Indian Ocean tsunami.

On 26 December 2004, a 9.0/10.0 magnitude earthquake triggered a tsunami in the Indian Ocean that devastated 11 countries, leaving millions of people homeless and 273,636 people either dead or missing (Australian Government, 2005). Due to the size of this catastrophe, many organisations around the world provided aid to the relief efforts. One interesting aspect of this relief effort was the international publicity of the destruction in tourist areas, which was made possible through images and videos posted on the Internet. Western tourists with video cameras were able to post videos of the destruction on the Internet, allowing relief organisations to quickly identify the areas in need. In this case, the type of information provided by Western tourists in resort areas exposed the needs of people in that general area to relief efforts allowing responders to supply appropriate resources faster (Grünwald, Boyer, Maury, & Pascal, 2007).

2.2.2 Effect of Crowdsourced Information in Large-Scale Disasters

The utilisation of social media information in large-scale disasters can share available information such as that uploaded to the Internet in the Indian Ocean tsunami to virtually anyone in real-time. This information can then be recirculated in an interactive manner, enabling it to reach an even greater user-base. As the rate at which such information sharing increases, the awareness level of public and private sources will grow. With an increased level of awareness, the ability for relief organisations to effectively respond to distressed people in areas of need also increases. Further, this level of shared information can act as a catalyst for community resilience itself. The availability of social media information on mobile devices can enable affected people and areas to gain a greater understanding of the catastrophic damage thereby increasing their ability to help themselves while awaiting aid. The advanced crowdsourcing of shared information can further enable ESOs to make more intelligent resource allocation decisions about affected communities in large-scale disasters. Usage of a crowdsourced crisis map can enable ESOs to coordinate their efforts based on a cohesive mapping platform, or “common-operating picture”. These claims can be evidenced by the 2010 Haitian earthquake and by the 2010-2011 Queensland floods.

2.2.2.1 *Case Study: 2010 Haitian Earthquake*

On 12 January 2010, nearly five years after the Indian Ocean tsunami, a similarly catastrophic 7.0/10.0 magnitude earthquake struck Haiti just 25 km (16 miles) West of Port-au-Prince, its capital city. The massive destruction crippled Haiti’s brittle infrastructure and destroyed public documentation essential to effective emergency management. With primary communication channels either overloaded or malfunctioning, social media was used to regain a sense of control in Haiti and share information necessary for recovery efforts. Social media’s power as a communication tool was demonstrated in the Haiti relief effort; the first major

international humanitarian response where social media served as the main communication channel (Harvard Humanitarian Initiative, 2011). One of the key benefits of social media use in Haiti was the speed with which the response was started. Within hours of the catastrophic earthquake, a Tufts University (USA) based group created and launched Ushahidi-Haiti @ Tufts, a crisis mapping tool powered by the Ushahidi platform (Morrow, Mock, Papendieck, & Kocmich, 2011). Capable of mapping geo-located information from online forms, Twitter tweets, and direct text messages, this tool enabled emergency responders to visualize the severity of the situation across the area and focus their attention on areas of particular need (Figure 1).

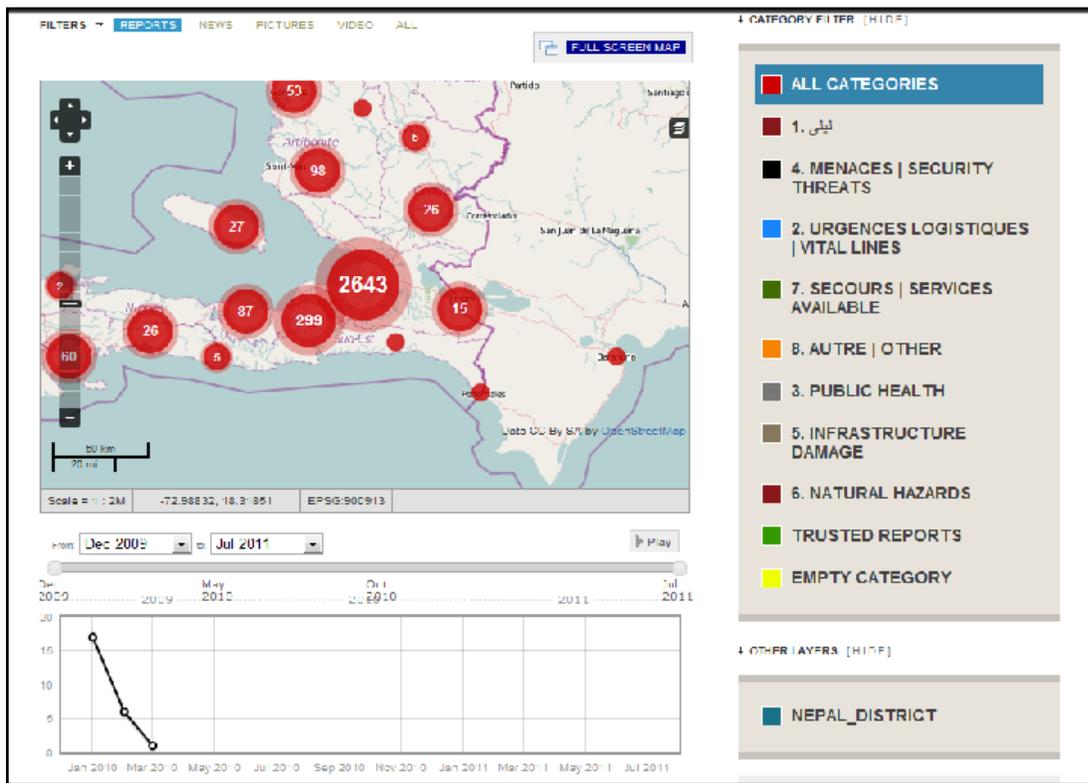


Figure 1 Ushahidi-Haiti @ Tufts Crisis Map

2.2.2.2 Case Study: 2010-2011 Queensland Floods

From December of 2010 to February of 2011, Queensland, Australia faced an ongoing and severe flood threat. Affecting both coastal and inland locations, the natural disaster impacted

hundreds of thousands of people. With the help of the Australian Broadcasting Corporation (ABC), social media was crowdsourced onto a publicly available crisis map. This strategic action enabled ESOs to monitor community-generated information, improve their situational awareness, and make more intelligent resource allocation decisions. Further, community resilience was improved as citizens were able to access up-to-date disaster information and make informed decisions. In a journal article written about the Queensland floods, Kevin McDougall notes that “social media and crowdsourced geographic information played an important role in keeping people informed especially as official channels of communication began to fail or were placed under extreme load” (p. 13, 2011). The ABC was able to collect all of this information on a crowdmap called QLD FLOOD CRISIS MAP, but the service was so popular for sending flood-related data that the server had trouble maintaining peak performance (McDougall, 2011). On the other hand, if a more permanent, potentially government-sponsored service was available, resources could be completely dedicated to this software’s filtering capabilities.

2.2.3 Harvesting Social Media

The concept of “crowdsourcing”, as demonstrated above, has the ability to revolutionise Victorian emergency management. For the purposes of this report, we define crowdsourcing as the collection and analysis of publicly output information to form a cohesive understanding of an event, allowing ESOs to make more informed response and recovery decisions.

As seen in the aftermath of the Haiti earthquake, crowdsourcing social media and SMS information was a key tool to assist in effectively managing the disaster. Through individual geo-located posts and the upload of photos and videos, the Haitian community was able to communicate their needs to a global audience and realise the catastrophe that destroyed their community and displaced their loved ones. This information, when collected by emergency responders, helped them to gain a holistic picture of the disasters impact on the community. With

this understanding, the ESOs had the opportunity to make more informed relief coordination decisions thereby improving the effectiveness of their response and recovery efforts.

2.3 State of Emergency Response and Policy in Victoria

In order to understand the potential for a social media based crowdsourcing initiative in Victoria, it is first necessary to understand the recent disasters that have affected Australia and the current response and warning procedures that it has in place. From the February 2009 Victorian Black Saturday Fires to the 2010-2011 Queensland Floods, Australia has faced large-scale disasters on a more a regular basis. The strategies with which these disasters are managed vary per State ESO structure and by the resources utilised. Evidenced by “000” calls on Black Saturday to the advanced use of social media in the floods, large-scale disaster emergency response methods can quickly develop to take advantage of advanced methods of emergency management

Victoria’s current state of emergency communication generally consists of the triple zero (“000”) process and existing warning procedures such as those found in the ‘Prepare, Stay and Defend or Leave Early’ policy expanded upon below. Although both systems have been successful in the past, their processes have inherited shortcomings. Between 2010 and 2011 alone, the triple zero process has “managed 1,972,539 emergency (“000”) and non-emergency calls. This volume represents a call every 16 seconds, leading to 1,472,393 dispatches” (State Government Victoria, 2011). In addition to this regularly large call volume, large-scale disasters such as the Black Saturday Fires raise the number of incoming calls by a significant level flooding the already stressed system.

Due to the severity of its large-scale natural disasters, Australia has developed emergency management arrangements to help guide public actions in an emergency. In addition, standards

for how ESOs should properly warn citizens have been established. For instance, if emergency service personnel feel strongly that the public should evacuate due to bushfires, residents are highly encouraged to either evacuate long before the fires arrive or to stay in their homes and defend their property (Loh, 2007). Titled the ‘Prepare, Stay and Defend or Leave Early’ policy, this emergency management recommendation is one of Australia’s many evacuation procedures, each dependant on the occurring disaster.

In the event of a life-threatening emergency, further warning procedures are sent out to the public to provide a clear warning and additional safety instructions. One of these warning systems is the telephone based ‘Emergency Alert’ that will send a voice message warning to a landline or a text message warning to a mobile phone with instructions tailored to the receiver’s safety (CFA, 2012). Another warning system for the general public is called the Standard Emergency Warning Signal. It involves a distinct siren noise that is played by way of “radio, television and public address systems in areas such as shopping centres or sports grounds” (CFA, 2012).

2.3.1 Behind the Scenes: The Victoria State Control Centre (SCC)

The Victorian State Control Centre (SCC) serves as a centralised State command centre for enhanced emergency communication and coordination efforts during a large-scale fire or flood. Operational 24 hours a day and seven days a week, the centre continuously monitors preparatory emergency management activities (i.e. planned burning) and manages the response efforts to large-scale emergencies. Bringing representatives together from each of Victoria’s ESOs, the centre facilitates the increased flow of information creating a faster, more effective emergency management response. Organised in a respective and logical manner, the centre’s main operations room includes a command module for each agency facing towards a wall-length emergency management map of Victoria modified in real-time to aid in getting all ESO

representatives on the same page in a visual sense. The layout of the SCC and the ESOs represented at it can be seen the figure below.

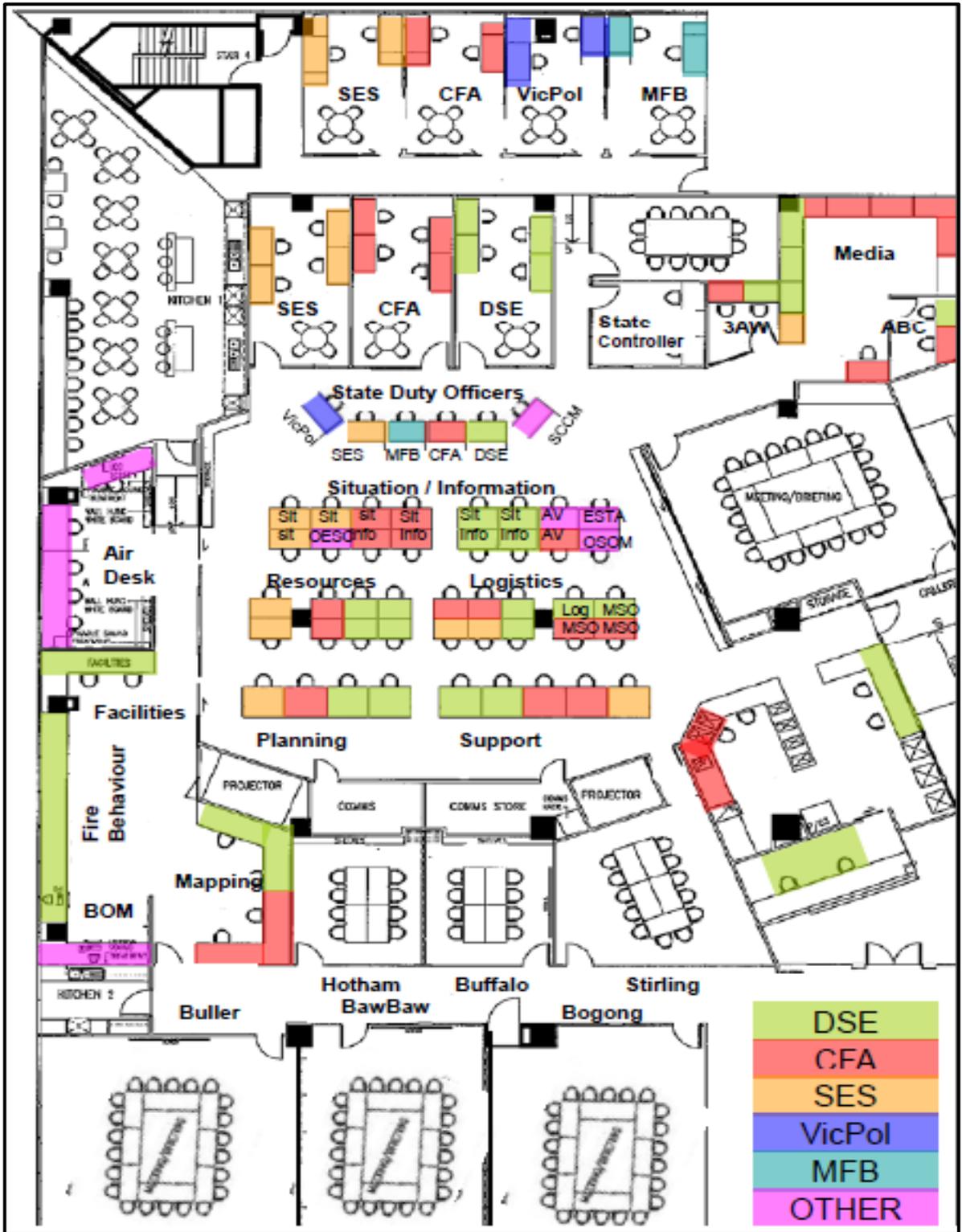


Figure 2: Full layout of the SCC

While this system allows Victoria to manage smaller emergencies relatively well, the Green Paper for disaster resilience recognises that Victoria “needs legislative, administrative and cultural change to break down the organisational ‘silos’ that inhibit an ‘all hazards, all agencies’ approach to managing major emergencies,” such as in the Black Saturday Fires (Victorian Government 2011).

2.3.2 The 2009 Black Saturday Bushfires

By February 7, 2009 Melbourne, Victoria had experienced three continuous days of ideal bushfire conditions including temperatures above 43°C. After fires broke out across the State, strong winds intensified the fires and caught even the most prepared citizens by surprise. According to the Victoria’s state-wide policy ‘Prepare, Stay and Defend or Leave Early,’ citizens are allowed to remain in their homes if they feel that their property is properly outfitted for the onslaught of a bushfire. A well outfitted home requires “having an independent water supply and appropriate fire fighting equipment and clothing and having prepared a ‘defendable space’ – that is, having an area around the house that has been adequately clear of fuel” (Teague et al., 2011, vol. 1, p.336). If the home does not meet these standards, citizens are highly recommended to leave at the first sign or warning of bushfire danger. According to the 2009 Victorian Bushfires Royal Commission, 113 of the individuals who died were in or near a building, and 24 others died while attempting to flee from the fire in vehicles or on foot despite the policy’s installation prior to 7 February 2009 (Teague et al., 2011, vol. 1). The sheer number of fatalities and amount of destruction from the Black Saturday Fires ranked it first among Australia’s worst natural disasters with 173 deaths and a burnt area of over 350,000 hectares (Cameron, Mitra, Fitzgerald, Scheinkestel, Stripp, Batey, & Niggemeyer, 2009). The mass destruction and large number of deaths led officials to propel improvement of policies regarding emergency preparedness, response, relief and recovery.

2.3.3 The Call for Policy Reform

Following the destruction of the Black Saturday fires, policy reforms were proposed to enhance the Victorian emergency management system particularly during large-scale disasters. The 2009 Victorian Bushfires Royal Commission conducted an extensive investigation into the causes of, the preparation for, the response to, and the impact of the Black Saturday fires of 2009. It recommended policy changes mostly in regards to preparedness, response and recovery. The Commission and the Interim Report of the Victorian Floods Review identified issues in Victoria's emergency management arrangements as well as issues with “agencies acting in 'silos' and being stretched beyond their capacity” (Victorian Government, 2011). Due to these issues, a report known as the Green Paper was developed “to challenge current thinking about Victoria's crisis and emergency management arrangements and to pose provocative questions about the practical options for reform” (Victorian Government, 2011). The Green Paper includes:

- “an overview of the current legislative and policy arrangements for crisis and emergency management in Victoria;
- a discussion of the international trends in emergency management;
- an analysis of the issues and challenges for Victoria's arrangements; and
- immediate and long-term options for reform, noting that these are not the only options, nor are they mutually exclusive” (Victorian Government, 2011).

Through the publishing of this paper, it is clear that Victoria is taking a step in the correct direction to challenge their current emergency management system and increase their situational awareness during and after large-scale disasters. Given the policy reform directives above, the Emergency Services Foundation has taken initiative to progress Victoria's emergency management response.

2.4 Delivering the Highest Level of Emergency Service to Victoria

2.4.1 The Emergency Services Foundation

The Emergency Services Foundation (ESF) who is sponsoring our research is an organisation that exists to help the Emergency Services of Victoria. Established in 1987 in response to the 1983 Ash Wednesday Fires, it sponsors scholarship programs for emergency service personnel and their families, and supports research geared towards improving the quality of emergency services (Emergency Services Foundation, 2011). In collaboration with the Victorian Department of Premier and Cabinet (DPC), the ESF organised a working group to help us investigate if and how the benefits of crisis-mapping social media information, as recognised in NGO-based humanitarian responses, can be realised in Victoria's established and structured emergency management system.

2.4.2 In Support of a Solution: Project Introduction

As our host agency, the DPC has generously organised a project-working group for our direct aid and benefit. Composed of public affairs/social media representatives from each of the ESOs in Victoria, the working group's purpose is to help us investigate the potential benefits of crowdsourcing publicly available social media information for the advancement of the Victorian ESOs. As social media leaders within their respective ESOs, these representatives are both naturally invested in the reasoning behind this project and its potential outcome for a social media based crisis map in Victoria. Through their direct contributions, in addition to those of others, our ability to research and identify core project issues, develop mitigation strategies, and recommend a realistic future approach to emergency management for Victoria has been made possible.

3 Methodology

This report will advance the ESOs' understanding of how crisis-relevant information can be sourced from public social media information during and after large-scale disasters in Victoria, Australia. By investigating the current uses of social media by Victorian ESOs, identifying the value of social media information in Victorian large-scale disasters, and addressing the challenges in using this information, we have created a cohesive report to guide Victoria to the implementation of a social media based crisis mapping solution.

Our project was completed at the Victorian Department of Premier and Cabinet in Melbourne, Victoria from 9 March 2012 until 3 May 2012. We hope that this report exposes important benefits and challenges related to including social media based information in the response and coordination efforts of ESOs during and after large-scale disasters. Our project objectives are listed below:

1. Investigate how Victorian ESOs interact with the Victorian community through the use of social media and why such usage is important
2. Identify the value of pulling social media information from the Victorian community to benefit Victorian ESOs
3. Address the challenges and potential solutions of implementing a crowdsourced social media crisis map for Victorian ESOs

Once we developed an understanding of how social media could be more effectively used to collect valuable information during large-scale emergencies, we developed recommendations for continuing the development of social media integration to improve the situational awareness of emergency responders.

3.1 ESO Usage of Social Media

In order to determine the ESOs' foundational usage, knowledge of and experience with social media, we had to explore their current use of social media networks. For our research, we met with representatives of Country Fire Authority (CFA), Department of Primary Industries (DPI), Department of Sustainability and Environment (DSE), Metropolitan Fire Brigade (MFB) and Victoria Police (VicPOL) and explored their websites to get a well-rounded idea of their usage of social media. Unfortunately, we were unable to meet with Victoria State Emergency Service (VicSES) due to their involvement in the 2012 Victorian floods and our project's time frame. However, we were able to collect substantial statistics and information on VicSES's social media presence.

By meeting with each of the representatives, we were able to gather information and insight regarding each organisation's main uses of social media sites and insight on matters not available on their website. After meeting with these representatives, we collected statistics on each organisation's usage of social media and the size of the community following their social media accounts on Twitter, Facebook, and YouTube. By analysing these statistics and the interview data, we were able to understand the reason for differences in usage across these agencies. Keeping in mind each agency's respective responsibilities, we then developed a sense of their social media foundational use and knowledge.

3.2 Identifying the Value of Harvesting Social Media Information

Once we understood where the ESOs stood in regards to social media usage, we wanted to express the value of harvesting social media information for increased situational awareness. We developed our initial sense of social media's value by analysing the Queensland Police Service's (QPS) use of social media, particularly during the December of 2010-February of 2011

Queensland floods, and through our preliminary meetings with ESO representatives. The Queensland floods were a strong example to draw on because QPS used social media as a major channel for communicating with the public and their usage has been widely publicised as well as analytically and statistically analysed. During an interview with the Victorian Department of Primary Industries, we received a recent report completed by DPI where they used social media and crowdsourcing to monitor a major Victorian locust threat in the summer of 2010-2011 with great success. Since DPI is a government organisation, the initiative they took to use crowdsourcing was a good example of the successful use and verification of social media within the Victorian government.

Once our initial understanding of the value of harvesting social media was developed and thoroughly researched, we held a follow up meeting with representatives from the Department of Premier and Cabinet (DPC), DPI, CFA, VicPOL, and DOJ to gather their feedback regarding our current understanding of the value of harvesting social media for emergency management. One of the CFA representatives, Chris Blackstock, was especially helpful due to his experience developing another social media scholarship project and his position at CFA, the fire brigade that handles most of the large-scale bushfires such as the Black Saturday fires.

Between the suggestions of knowledgeable people and cited sources we were able to identify the benefits that ESOs can realise from harvesting social media information from the community.

3.3 Challenges of Implementation

Before a new information system can be implemented, we need to identify and address important challenges. From the consistent concerns brought up in the discussions with various ESO representatives, we decided to focus and develop possible solutions to issues related to

sharing and communication across agencies, verification of data, and recruiting volunteer networks. To understand the sharing and communication issues between agencies, we discussed the cultural barriers regarding the sharing of information between departments with the ESOs' social media representatives as well as senior level authorities such as the Fire Services Commissioner, Craig Lapsley, and the DPC Executive Director, Mark Duckworth. Additionally, we had the opportunity to gain first-hand knowledge of the State Control Centre and its operational accomplishments during large-scale disasters. All of these experiences were essential for understanding the opportunity for greater integration between agencies by sharing information across agencies through the implementation of a social media crisis mapping initiative.

The next and most common concern among ESO representatives was as a result of their responsibility to deliver credible information to the public. In order to fulfil this responsibility, ESOs must feel comfortable that the data they use is accurate enough to more effectively manage the disaster. Due to the scale of disaster our scope entails, we investigated several different methods of verification used by the Standby Volunteer Task Force of crisis mappers and journalists. Additionally, we spoke with Dr. Martin Tomko, a local representative for a disaster information crowdsourcing initiative called Bushfire Connect (<http://bushfireconnect.org/>), about their verification procedures used in Australia for the past two years. After all of our research related to verification was gathered we were able to provide possible solutions for managing information based on time, resource availability, and volume of incoming information.

After we recognised how resource intensive the verification and monitoring process in a social media based crisis-mapping initiative can be, we investigated and developed possible solutions for enlisting a network of personnel to moderate it. In our multiple discussions with

representatives from the Department of Premier and Cabinet (DPC) and our analysis of previous initiatives, we brainstormed several possible solutions for recruiting a volunteer network of moderators in Victoria based on international social media initiatives. The representatives from DPC were especially helpful in developing our understanding of the government's resource limitations and the difficulties that agencies have servicing the entire state of Victoria without the help of a large contingency of volunteers. With this understanding, we were able to develop several creative options to recruit a volunteer network that would be capable of handling the majority of verification and moderation duties for social media information processing during a large-scale disaster.

4 Findings

4.1 Social Media Readiness of Emergency Service Organisations

In exploring the usage of social media within Victorian ESOs, we have developed a greater understanding for the importance of the foundational usage of social media, the true value of harvesting social media for the benefit of Victorian ESOs and the identification of challenges and potential solutions for implementation in the State of Victoria.

4.1.1 Foundational Uses of Social Media & Its Importance

Victorian ESOs are currently using social media within small- and large-scale emergency situations to effectively “push” emergency information to the public. The table below demonstrates the social media sites that each agency mainly uses. In examining this chart, we found that each of the response agencies use at least a Facebook and Twitter account signifying that the listed agencies consider social media to be an important tool for communication.

Table 1: Victorian Emergency Service Organisations’ Use of Social Media

Victorian Emergency Service Organisations	Facebook	Twitter	Other Social Media Sites
<i>Country Fire Authority (CFA)</i>	<u>YES</u>	<u>YES</u>	<u>YouTube</u>
<i>Metropolitan Fire Brigade (MFB)</i>	<u>YES</u>	<u>YES</u>	<u>YouTube</u>
<i>Department of Sustainability & Environment (DSE)</i>	<u>YES</u>	<u>YES</u>	<u>YouTube</u> <u>Flickr</u>
<i>Department of Primary Industries (DPI)</i>	<u>YES</u>	<u>YES</u>	N/A
<i>Victoria Police (VicPOL)</i>	<u>YES</u>	<u>YES</u>	<u>YouTube</u>
<i>Victoria State Emergency Service (VicSES)</i>	<u>YES</u>	<u>NO*</u>	<u>YouTube</u>

*VicSES has a Twitter account but they do not currently use it

Each agency utilizes the sites' capabilities in different ways and a variety of degrees. Through this modern media, most of the agencies "push" information to, or have a one-way communication with, the community by sending out warnings for potential threats, updates on current activities and promotions for campaigns.



Figure 3: CFA responding to a question on Twitter

Some of the agencies will respond to queries sent in from the public about an event and respond with an external link or a direct response. Figure 1, for example, shows someone inquiring about an event for the purpose of clarification rather than to share supplementary information. Although some ESOs are conversing with the public, ESOs are generally not systematically collecting information from the online community to improve their situational awareness.

Shown below is a representation of the percentage of the total community "following" per main social media site each agency holds. This chart exemplifies the amount of followers, or people who have subscribed to receiving updates from a website, each agency has acquired via Facebook and Twitter in particular. In terms of the community's interaction with each site, a Facebook "like" and a Twitter "follower" are ways to follow the updates of a social media site and are analogous with one another.

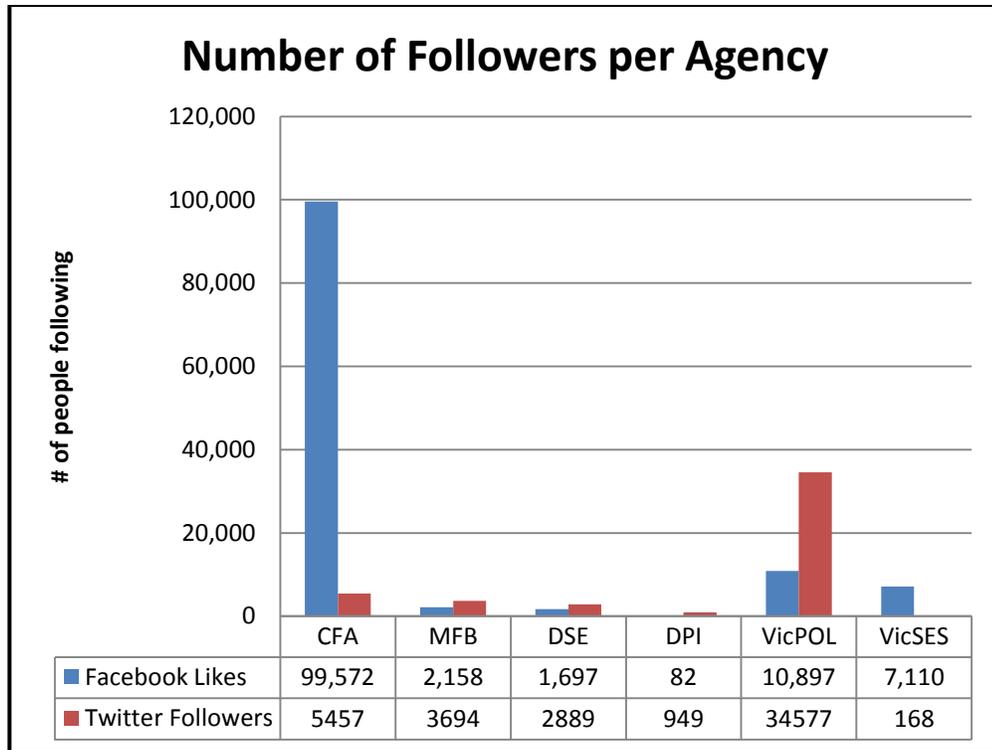


Figure 4: Social Media Usage per Agency as of 4 April 2012

The CFA and VicPOL clearly have made concerted efforts to engage the community through social media as indicated by their significant Facebook and Twitter followings. Their strong background in community engagement is due to the services and information they provide across Victoria whereas an organisation such as the MFB generally only services and provides information to the Melbourne area. DSE and DPI maintain a more focused following due to the nature of their work. Since DSE responds to emergencies on public lands and DPI responds to biohazards related to agriculture, these types of emergencies impact fewer Victorians on a day-to-day basis. VicSES, an agency mostly involved with flooding and other storm related issues, does not use a Twitter account but is quite active on Facebook. Without the opportunity to meet with a VicSES representative, it is difficult to make supported claims about their social media usage.

Overall, we have found that the level of community engagement by the ESOs through social media provides a sound base for further social media development and involvement in emergency management. By continuously developing and increasing the network of people that directly communicate with ESOs, they will continue to build upon the foundation of their social media platforms and spread their information more effectively.

The connections developed with the community will allow the ESOs to influence and increase the awareness of the community members and encourage the usage of additional practices, such as engagement with the community via social media. With 92% of all households in Australia connected to the internet, 70% of all online Australians using a social media profile and all of the Victorian ESOs connected to social media in some form (Nielsen Company, 2012), the potential for further connections and involvement with the community is becoming an increasingly possible prospect. The more engaged ESOs are with the community, the more likely the community is to help and provide information to the ESOs as well as other community members.

4.2 Value of Harvesting Social Media Information

Social media's development fundamentally shifts how information is shared and opens an opportunity for ESOs to communicate and collect rich location specific information from the community for a more complete understanding of the situation. Presently, ESOs use social media as another broadcasting tool to push information, as explained above, but have not taken full advantage of the large-volume of rich information available that they can pull through social media's open communication capability.

4.2.1 Another Communication Avenue

Due to Victoria's large area and sparse population, emergency responders need to take advantage of every available communication avenue. Two-way communication with the

community through social media can provide important information to emergency responders that can improve their preparedness and their overall ability to serve the community effectively. When we spoke with a former representative from Ambulance Victoria, he recalled an incident during the 2009 Black Saturday fires when emergency personnel responded to an isolated area and had little information about the severity of the situation within the town until the fire subsided. In this case few injuries were reported, but had more people needed critical assistance, ambulance workers would have been overwhelmed and incapable of giving appropriate aid. By using social media as an additional tool of communication, ESOs could have improved their knowledge of the situation in the town, giving ESOs the information needed to allocate their resources and prepare accordingly. The lack of information available to responders during this specific ambulance incident exposes the ESOs' need for increased situational awareness. The possibility of social media to acquire the intelligence necessary for a more informed response such as this is evident.

4.2.2 Speed and Volume

Another benefit of social media that is useful to ESOs is the speed with which information is spread. This speed is a significant reason why ESOs currently use social media to broadcast warnings and situational updates to the community (Queensland Police Service 2011), but most Victorian ESOs have not taken advantage of the public's ability to quickly provide information about large-scale disasters through social media. This information is often available through social media well before it reaches more traditional communication channels. In some of our conversations with ESO representatives, they felt that members of the news media knew more about the disaster situations than ESO officials because they take advantage of social media based sources. When ESOs do not look to learn about situations through social media, they miss

out on an opportunity to find valuable information quickly and effectively which limits their ability to respond properly.

Not only is the dissemination of social media information fast, but there is also a large volume of it available to ESOs. According to some of our conversations with ESO representatives, in the immediate aftermath of a large-scale disaster, the community immediately reaches out to the ESOs anyway they can. This happened during the Queensland floods, where in the 24 hours after flash flooding hit Toowoomba and Lockyer Valley, the number of “likes” on the Queensland Police Service (QPS) Facebook page rapidly rose from 17,000 to 100,000 (QPS 2012) and 15,500 Twitter users participated in the #qldfloods conversation (Bruns et al 2012). A statistical evaluation of the 35,000 tweets using the #qldfloods tag showed that the conversation was “focused predominantly on sharing directly relevant situational information, advice, news media and multimedia reports,” (Bruns et al 2012 pg. 7) between the community and ESOs, providing valuable situational updates and the 3,500 images referenced above. While part of information was from @QPSMedia, which is the twitter account for QPS, the majority of information was first-hand knowledge from the community.

Victoria’s DPI was also able to take advantage of the massive amount of information from the public during the 2010-2011 Victorian locust swarms. The 20,000 reports of locust activity crowdsourced from the community helped DPI recognise the extent, location, and life-cycle development of locust swarms across Victoria. Their social media campaign helped the community and DPI to understand the scope, severity and potential direction of the swarms giving farmers a chance to defend and prepare their land. This sharing and availability of information provides a great model for ESOs to learn about disasters from the community, but

requires some planning and preparation to make social media information usable in a disaster context.

4.2.2.1 Trend Identification for Large Volumes of Information

Due to the large volume of social media information in a large-scale disaster, it can be easily organised into trends that help emergency responders identify important general information about the situation. For instance, organising information by location can help responders visually comprehend the locations most affected by a disaster. One major benefit in using trend analysis is that the pattern from the volume becomes the verifying agent overriding inaccurate posts. Software tools such as Ushahidi are quickly able to map geo-located information and highlight trends. Mapping in this way provides an almost real-time depiction of the large-scale disaster's impact on the community. Within 24 hours of the 2011 earthquake in Christchurch, New Zealand, the Ushahidi Christchurch Recovery Map was established by a group of web professionals and run by volunteers (McNamara, 2011). This initiative mapped community requests for information regarding food, water, toilets, fuel, ATMs, and medical care using the #eqnz Twitter hashtag, SMS and email (McDougall, 2011). This map became an important source of information and was viewed by the community over 100,000 times (McDougall, 2012). Below is a screen capture of the Ushahidi Christchurch Recovery Map that shows the distribution of crowdsourced reports in the Christchurch area. This map enables responders to identify areas of high social media activity related to the earthquake and directly correlates to areas in need of more emergency response and recovery resources.



Figure 5: Ushahidi Christchurch Recovery map

A major benefit to this quick mapping of crowdsourced social media activity is its self-verification. The sheer volume of information creates a pattern of activity that overwhelms any inaccurate posts. When this map is used as a supplement to information available through other communication avenues, important locations can be identified quickly. A similar idea implemented after the Black Saturday Fires uses location data recorded from “000” calls. After analysing the call data from these fires, the CFA realised that plotting the “000” calls in real time would have enabled them to see the leading edge of the fires as it progressed (Martin Anderson, CFA). This information would have enabled response coordinators to clearly understand the sheer magnitude of the fires with information that was already in their system.

4.2.3 Pictures and Video

Another valuable source of information available through social media is the rich visual content available. Posted pictures and videos can drastically improve the situational awareness of emergency service responders and coordinators before they arrive onsite, which again leads to better-informed decisions and preparations. Using this information would allow anyone in the community with an Internet connection to aid emergency responders beyond the verbal capabilities of a triple zero (“000”) call. These visuals have shown their value by helping the community during the Queensland floods in 2011, and in the Department of Primary Industries’ (DPI) recent monitoring of locust swarms.

During the Queensland floods, social media exploded with visual information unheard of through the Standard Emergency Management System. From 10 January to 16 January of 2011, there were over 3,500 tweets using the #qldfloods hashtag⁴ that linked to pictures or videos, or one visual every two and a half minutes (Bruns, Burgess, Crawford, and Shaw 2012). Figure 5 shows a popular image circulated on



Figure 6: Actual Twitter message: “People are starting to freak out...”

Twitter depicting supermarket chaos in Brisbane where people were ‘panic buying’ supplies in

preparation for the floods. Although a crowded supermarket may not be worthy of a triple zero call, police officers or volunteer fire fighters may have been available to help manage the panic and prepare the community more effectively. Other common images were “before and after”

⁴ Twitter hashtags, signified by “#” in front of a word, are a user-generated tool for marking specific messages as relating to a particular topic or theme. #qldfloods was a tag that was used to link information about the Queensland floods

pictures of flooded backyards, which provided offsite observers a sense of the flood's magnitude. Similar images in a fire disaster may include information about the size of the fire front or blocked roads, which can provide response agencies critical information about the resources they need to effectively respond to the incident.

During the 2012 Australian Tennis Open, Victoria's DPI used images shared through social media to effectively identify issues regarding the recent swarming of locusts. When insects were swarming around the stadium, DPI received images of the insects from the radio station 3AW through Twitter and was able to identify that the insects were harmless katydids rather than locusts that could have caused severe damage to agriculture across Victoria. This information was then pushed back to the community through Twitter and broadcasted on 3AW to alleviate any concern (3AW Radio 2012). This use of images allowed DPI to recognise the harmless incident quickly so as to not induce panic among the public attending the Australian Open. The ability to clearly identify the severity of an issue and respond accordingly is the key to effectively and efficiently managing a large-scale disaster.

In this way, the entire community has an opportunity to learn how to identify issues, report them to the proper authorities without putting an additional burden on the ESOs.

4.2.4 Fostering a Resilient Community

Like many other governments, Victoria faces the inherent challenge of providing the same service to isolated communities as they do to more populated areas. The strategic effort of the Victorian government to encourage and support self-independence and resilience amongst its community members will enable them to better support themselves and each other.

To challenge the current Victorian emergency management system, a report known as the Green Paper was developed as a way to "stimulate discussion and invite public comments on the

proposed policy response” to the Black Saturday Fires and Victorian Floods Review (Victorian Government, p.1, 2011). One of the main underlying themes in this paper is the development and construction of community resilience in Victoria. The challenges in fostering disaster resilience are as follows:

- 1) Community Expectations Increasing
- 2) Population increase and demographic change
- 3) New technology
- 4) Diverse communities and languages
- 5) Infrequency of disaster events
- 6) Adequate resources

It is far more difficult to promote measures for community resilience prior to an actual disaster. During a large-scale disaster, though, people are far more likely to help and aid one another in a variety of forms. Social media is particularly useful in this manner by easing the minds of family and friends as well as sharing and status reporting through community-led Facebook pages (Taylor, Wells, Howell, & Beverley). More recently, social media has been used to promote the use of crisis maps similar to the ones developed by Ushahidi. This particular use of social media would aid the ESOs in prioritizing and allocating resources to the locations most in need. Currently, a system such as this exists full-time and has serviced all bushfire incidents throughout Australia in the past two years. This system, called Bushfire Connect, is run by a group of volunteers that monitor and verify incoming reports. Due to the lack of large-scale bushfire disasters in the past two years, Bushfire Connect has yet to use their system in a large-scale event. In the event of a large-scale disaster, the community could use Bushfire Connect. However, if other groups developed additional systems, these groups would most likely

collaborate amongst one another and merge the systems into one map, as was done in the Christchurch Earthquake (McDougall, 2012). In collaborating amongst one another an even greater community resilience and support network can develop.

Within the Victorian government, DPI set up a social media system to help the community be more aware of locust swarms and how to handle them. During a major locust swarm in the summer of 2010-2011, DPI set up a locust photo library where the public posted over 200 pictures of locusts. As a result, the public was able to educate each other on how to identify and report the destructive pests. In short, DPI was able to increase the community's resilience by teaching them to identify locust threats therefore enabling them to manage their own locust infestations.

When a disaster strikes, the community will collaborate with one another thereby fostering community resilience and relieving some of the burden experienced by the ESOs. By the community using crisis maps as a means to visually understand the severity of the disaster situation, they will be able to manage their own responses to a disaster. In effect, ESOs will have the added benefit of referring to the crisis map to aid them in more efficiently prioritising and allocating their response and recovery resources.

4.3 Challenges for Immediate Implementation

Although there is great potential for a social media crisis mapping initiative in Victoria, there are specific challenges that need to be overcome before it can be implemented. Such challenges include the sharing of emergency information across agencies, the lack of trust in verifying publicly generated posts and the resources needed for verification.

4.3.1 Cross Agency Communication

The shared communication of emergency information across ESOs is a critical and historically sensitive challenge when considering the implementation of a cross agency large-scale disaster crisis map. Without fluid cross communication in place regarding emergency information, it is unrealistic to imagine the agencies overcoming other implementation challenges they face. Although shared communication is evident across the ESOs, they have the potential to increase it greatly. One specific area of shared communication that they can improve is knowledge of each another's social media initiatives and progress so they can learn from one another's experiences. Without actively sharing even this type of information, achieving a cross ESO crisis map is unrealistic.

This claim can be evidenced by the different mapping platforms used by some of the ESOs in their efforts to interact with the community in a two-way manner. The Department of Primary Industries (DPI), for example, utilised a Google Map platform to collect and share locust swarm information with the community. At this time, most ESOs are of the impression that VicMaps, a mapping platform designed specifically for Victoria, is the only platform allowed for government use. However, our interviews with Department of Premier and Cabinet Victorian Deputy Secretary, Donald Speagle, and Victorian Chief Fire Commissioner, Craig Lapsley, showed us otherwise. Both state representatives seemed unconcerned by the issue of the type of map to be used because the plain and simple usage of a mapping platform to better serve the community was of most importance. Rather than constrain the capabilities of ESOs, Craig Lapsley stated that we must do everything in our power to support their capacity to act for the betterment of society.

4.3.2 Taking Advantage of Crowdsourced Information

Before ESOs crowdsource social media information they should understand how to handle the explosion of social media information during a large-scale disaster. Without the consideration of social media, emergency response coordinators already utilise information from “000” calls, on-site response resources and weather forecasts to make holistically informed emergency response decisions. Adding a large amount of social media posts into this process that contain unstructured, fragmented, and sometimes even inaccurate information requires new analysis methods to extract the valuable intelligence identified previously. We have found several different methods that potentially enable ESOs to realise the information benefits provided by social media.

4.3.2.1 Identifying Trends in Large Volumes of Social Media Information

One simple method to use social media information comes directly from its ability to develop trends. As described earlier, ESOs responding to the Christchurch earthquake were able to map a large volume of geo-located social media information. This quick mapping allows ESOs to identify areas of importance very easily because of the large number of data points used. This method turns the massive volume of information that could be a problem into an advantage because the overwhelming pattern of accurate information will trump any inaccurate or misleading posts while identifying locations in need of resources almost instantly. In meetings with some ESO representatives, they expressed interest in this trending and self-correcting approach because it would reduce the amount of resources required to monitor the social media crisis map process. Despite the advantages of this method, it’s limited in that it does not allow responders to learn detailed information because the focus is not on individual social media posts.

4.3.2.2 Take Advantage of the Clear Value of Pictures and Video

When ESOs are in need of quick information to surplus their situational awareness, they can use visual aids provided by pictures and video. As shown above, the pictures and videos posted through social media can provide rich and valuable information that is unavailable through existing channels. By focusing on geo-located posts that link to pictures and video, ESOs can quickly find detailed information that is also easily verified. Chief Victorian Fire Services Commissioner, Craig Lapsley, believes that a geo-located image or video⁵ of an emergency situation requires little further verification because visuals provide very complete information and are difficult to fabricate.

4.3.2.3 Individual Verification Methods

To find additional information from social media, each post must be individually verified in order to instil confidences in the emergency service providers. ESOs are culturally disinclined to trust the accuracy of individual posts, and want an established method to verify the information. Existing verification models have been used by volunteer organisations that take advantage of very detailed verification procedures or use a snowballing approach to identify a network of trusted sources of information.

Individualised verification is a commonly used model where crowdsourcing moderators of social media information will check credible sources of information or contact the original source to confirm the event, or discover important information. This approach to verification requires a large community of moderators to harvest detailed information from social media leading to a labour intensive and time-consuming process. Some volunteer groups such as Bushfire Connect use this method in their efforts to collect bushfire related information, and

⁵ Twitter provides an option where users can attach their location information to any tweet which is time stamped when it is posted, and

have a team of moderators that monitor and verify crowdsourced emergency reports. When we met with Dr. Martin Tomko of Bushfire Connect, he explained that they usually verify information by directly contacting the original source to clarify details or by crosschecking the information against official reports from ESOs and news outlets to ensure the source's validity.

An easier method that can be used to verify information is known as the 'snowballing' approach (Meier, 2011). This method uses an initial list of credible sources that can be trusted and expands the list to include additional trusted sources per the recommendation of the original sources. This initial list could consist of social media accounts registered to trusted government, ESO, or reputable news media personnel. Initially, the only trusted social media input would be from this list. Then, over time, new sources can be included on this list if they consistently provide accurate information. A similar model was used to counter dangerous rumours spread during political unrest in Kyrgyzstan during May and June of 2010. In this case civil society groups met on Skype to verify rumours using their trusted personal contacts. New individuals were only added to this conversation if an existing member trusted them personally and believed they had important information to contribute (Meier, 2011). This allowed a quick verification of the information because everyone involved in the conversation was considered a trusted source. The same concept can be used in the midst of a disaster when the same source is consistently providing useful, accurate information. In this case, emergency responders can develop a level of trust with that source reducing their need to consistently verify that source's information.

4.3.3 Developing a Sustainable Volunteer Network

Due to the human resource demands of moderating, monitoring and verifying social media information, the sustainable recruitment and retention of a volunteer crisis mapping network will be a key and largely variable factor in the long-term success of this system. Using volunteers and

more effectively managing the current governmental resources is another integral aspect for a successful system. Through the strategic development of such a network, Victoria has the potential to provide an advanced emergency response and recovery communication system for their constituents without burdening their current resources.

4.3.3.1 Government Resources

Since one of the main issues discussed previously involved maintaining credible information from outside sources, the most logical option for a crisis-mapping network lies within already credible people. Government personnel within Victoria and greater Australia provide credible individuals that also understand the government policy and procedures during large-scale disasters. Additionally, because moderating, monitoring and verifying can be done remotely, those participating in the crisis-mapping network need only an Internet connection to contribute their services. This list of government moderators would simply be used only during large-scale disasters versus a constant occupation.

An example of how system similar to this can be found within Victoria Police. When we spoke with a representative of Victoria Police, we found that they maintained a list of capable social media personnel across all government departments from which they can recruit to increase their social media presence during a large-scale event. Capable (media) personnel might include public relations/social media representatives in addition to those who may have expressed interest in or have knowledge of such platform usage. Establishing these relationships between government agencies, departments, and Australian states will aid in compiling a volunteer network in a credible and practical fashion.

4.3.3.2 Local Resources

If a more robust set of volunteers were required for moderating, monitoring and verifying the social media information, people with knowledge of social media and Australian locations and culture would be a viable alternative to government personnel. With 81% of Australians over sixteen active online and an average of 26.2 hours a week for ages 16-24 (Nielsen Company, 2012), it is clear that the younger generation is highly in tune with the Internet and its capabilities. Further, using social media through mobile devices is on an upward climb since the 2011 statistic of 84% of the population between the ages of 16-24 (Nielsen Company, 2012). Considering this age group's clear understanding and use of the Internet and social media, the potential for a knowledgeable volunteer network is immense.

Additionally, community members within this age group are generally students in the area looking for community service to fulfil academic, club or resume requirements. In greater Victoria, there are nine major academic institutions including the University of Melbourne, the Royal Melbourne Institute of Technology, Deakin University, Monash University, Swinburne University of Technology, University of Ballarat, La Trobe University, Victoria University, and Australian Catholic University. With the multitude of Universities within the Victoria, the student population represents a large potential of capable volunteers stationed in the local area.

4.3.3.3 Global Resources

If additional services are required, global volunteer networks and non-government organisations have aided in many humanitarian relief programs in past and would work in Victoria as well. Most large-scale disasters, including the Black Saturday Fires, have employed the help of volunteer networks across the globe to aid mostly in relief and recovery campaigns. One example of such a volunteer network is the global model Standby Volunteer Task Force.

4.3.3.3.1 The Standby Volunteer Task Force

Although the need for an advanced emergency communications system is met with volunteer resourcing challenges, the Standby Volunteer Task Force (SBTF) represents a global volunteer network model that has been both effective and sustainable in emergency volunteer resourcing since September 2010. In the article “The Standby Volunteer Task Force: One Year On” dated 25 September 2011, author Patrick Meier writes that “three hundred and sixty plus days later, no fewer than 621 volunteers have joined the SBTF...(representing) sixty plus countries...(and) several hundred organizations!” A visual representation of the geographic distribution of the volunteer crisis-mapping network is below. Each red target denotes the permanent residence of network member(s).



Figure 7: SBTF Member Distribution

SBTF’s membership distribution across the globe evidences that this volunteer network is not constrained by geographic location. This factor is important as the pool of potential volunteers for a Victorian network grows tremendously. The SBTF has been involved in the Colombia Disaster Simulation with UN Office for the Coordination of Humanitarian Affairs as

well as relief efforts in the aftermath of Cyclone Yasi, Christchurch Earthquake, Libya Crisis Map and the Alabama Tornado. Due to the nature of volunteerism needed for a crisis mapping volunteer network, much of the aid can be contributed remotely if need be, enabling volunteers from around the world to help without moving. Such remotely contributed aid includes the monitoring, moderation, and management of crowdsourced information which is necessary for ESOs to properly use this information in increasing their situational awareness. With this understanding, the pool of potential volunteers spreads beyond the human resources available within Victoria and even greater Australia.

Similar to the members themselves, this training would not be bound by geographic constraints. In our two separate interviews with, Bushfire Connect Legal/Technical Advisor Dr. Martin Tomko, he described an online program that Bushfire Connect developed to train and settle new moderators in less than 30 minutes. In the case of a large-scale disaster, this application achieves effective training in an instrumental time frame making the rapid expansion of a volunteer network highly possible.

5 Conclusion

To implement a large-scale disaster crisis map based on crowdsourced social media for Victorian ESOs, the sharing of emergency information across them must improve.

Overwhelming evidence for this claim lies within our individual working group member interviews and our strategic discussion with Chief Victorian Fire Commissioner, Craig Lapsley.

In accordance with this finding, we have developed the recommendations below to help Victorian ESOs enhance their large-scale disaster response efforts by utilising community social media.

5.1 Achieving the “Highest Level of Service” through Shared Information

The continuation of the social media focused ESO working group gathered to support the research of this report would aid the collaborative effort to achieve shared communication amongst the ESOs. By working together over time to identify and strategically achieve shared communication goals, the ESOs could better integrate and coordinate their response to large-scale disasters. Further, a well-developed communication foundation would enable the ESOs to utilise an effective crisis map that syncs traditional communication across ESOs in an innovative and visual manner. Due to the normally constricted views ESOs have pertaining to changes in their highly procedural operating processes, the endorsement of senior emergency service staff such as Chief Victorian Fire Services Commissioner, Craig Lapsley, would raise the ESOs authoritative ceiling and allow them to use new forms of intelligence gathering through the use of an ESO crisis-map. The combination of collaborative ESO information sharing structure and senior level endorsement of a crowdsourced crisis map could lead to full interoperability between the community and ESOs.

5.2 Overcoming Recognised Challenges

Developing shared communication channels across Victorian ESOs would enable the challenges recognised in the findings to be overcome. Global evidence supports both manual and technological methods of effective data verification. The combination of advanced data trending software and a volunteer network of crisis mappers can enable monitoring, moderating and analysis of incoming social media information. Although data verification is not a defined science at this time, the methods available warrant usage amongst ESOs.

Through the sustainable development and maintenance of a crisis mapping volunteer network, the expected mass influx of information can be effectively monitored, moderated, and verified. The sustainable development of this network can be achieved on a global scale granted that an online connection is the only limiting constraint. The Standby Volunteer Task Force (SBTF) represents a credible global network model that has proven itself to be both stable and effective. The opportunity to contract an established volunteer network such as the SBTF could be considered. In a local context, the diverse recruitment of University students and pull from inter-governmental officials in Victoria and/or greater Australia is a potential opportunity.

5.3 An Established Potential in Victoria

Noting Victoria's ability to overcome the recognised challenges above, it is even more important to realise the elevated level of potential already held by Victorian ESOs. As described in our findings, foundational social media use across the ESOs represents a positive starting point to achieve such an initiative. With most ESOs actively utilising Facebook and Twitter (two popular social media platforms in Australia) to spread emergency information, they have already developed an awareness and comfort level with the capabilities of social media. By interacting with the community through social media, they are slowly building a dedicated and trusted user-base.

To further convey the elevated level of potential, it is important to recognise the increasing rate of Internet usage in Australia. As previously mentioned, 92% of Australian households are connected to the Internet and a significant 70% of them utilise social media including 10 million on Facebook. In addition, Internet connected smartphone usage in Australia increased from 35% to 51% in 2010 to 2011 alone, with a projected increase of 10% in 2012 (Nielsen Company, 2012), a trend that is sure to increase in coming years. Evidently, Australia is and will continue to be supremely connected to the Internet. By tapping into this usage, Victoria can better interact with the community and gain their valuable insight during large-scale disasters.

5.4 The Value of Social Media Emergency Management in Victoria

The opportunity to utilise social media for the advancement of Victorian ESOs large-scale disaster response and recovery efforts is tremendous. Social media's capacity to visually convey a large-scale disaster via geo-located photo and video uploads far surpasses the usefulness of verbal descriptive data. Further, utilising the real-time insight of the community, the level of situational awareness on behalf of the ESOs can be drastically increased. In addition, embracing community insight fosters powerful resilience within the community. People realise the importance of their contribution and are motivated to help further, thereby inherently beginning to aid each other and take advanced action on behalf of their community. This relationship lessens the burden on ESOs to provide simultaneous relief to all in a sparsely populated and large state.

5.5 Closing Remarks

During a large-scale disaster, information is the key to effectively managing emergency response and recovery efforts. It is critical to realise the power held within everyday community members to use social media as it continues to launch the availability and speed of information

beyond the wildest expectations of society. In large-scale disasters where ESOs become overwhelmed attempting to form a cohesive understanding of the response and recovery needs of the community, communication between ESOs and the community is critical. Victoria has the potential to “deliver the highest level of service to the community” in a large-scale disaster (Lapsley, 2011). Keeping its former large-scale disasters in mind, crowdsourcing social media based information now and in the future promises to help Victoria stay “community-focused and consequence-driven.”

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Appendix A: List of Acronyms

ABC-Australian Broadcasting Corporation

BBC-British Broadcasting Corporation

CFA-Country Fire Authority

DPC-Victorian Department of Premier and Cabinet

DPI-Victorian Department of Primary Industries

DSE-Victorian Department of Sustainability and the Environment

ESF-Emergency Services Foundation, this report's sponsor

ESO-Emergency Service Organisation, for the purposes of our report, Victorian ESOs include CFA, MFB, DSE, VicSES, DPI, and VicPOL.

MFB-Metropolitan Fire Brigade

NBN-National Broadband Network, which will allow all Australian citizens to access broadband Internet, and is projected to finish by 2020

NPR-National Public Radio (USA)

QPS-Queensland Police Service

SBTF-Standby Volunteer Task Force

SCC-State Control Centre

SMS-Short Message Service, which is commonly referred to as text messaging

VicPOL-Victoria Police

VicSES-Victoria State Emergency Services