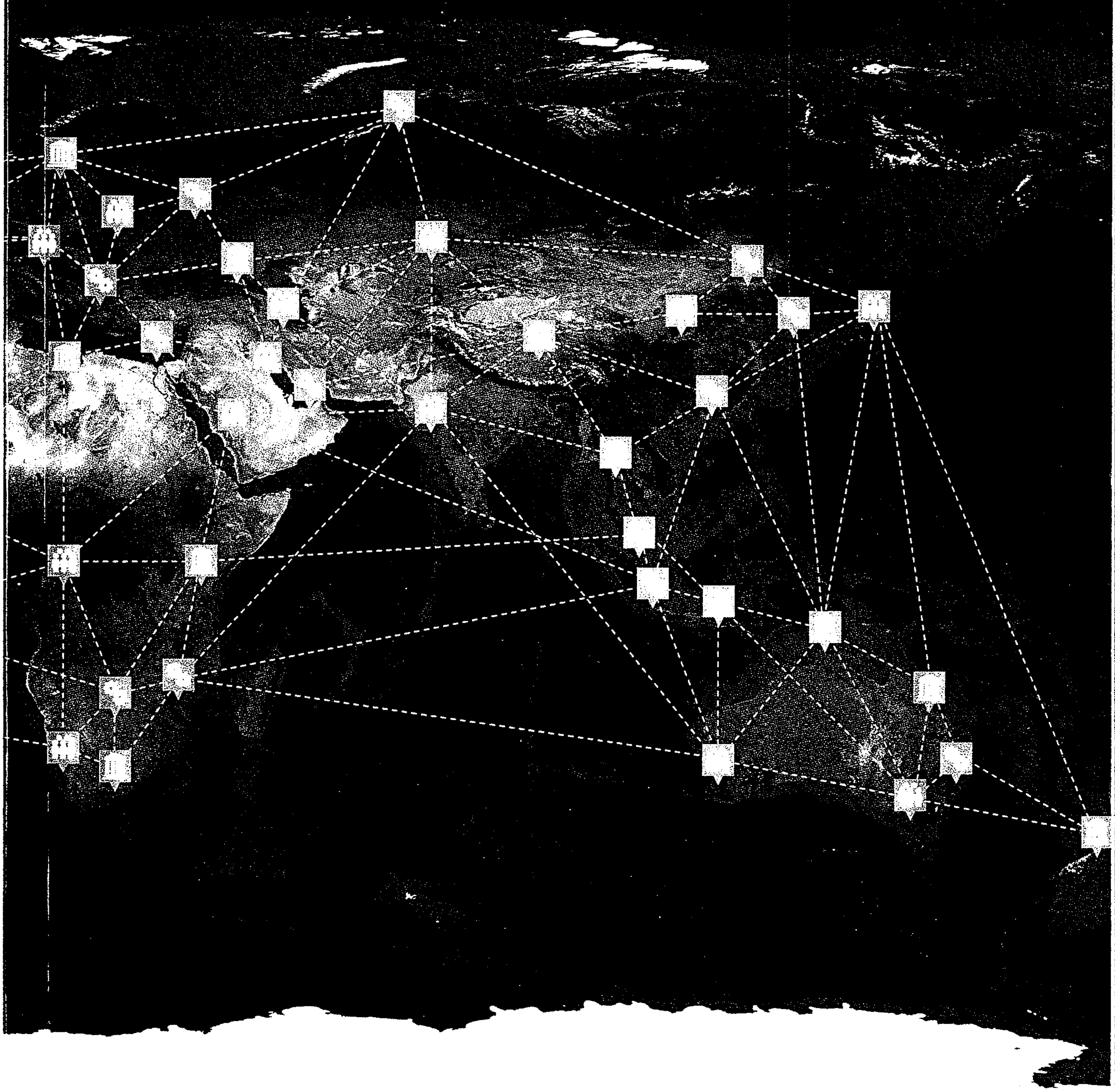
SPATIALLY ENABLING

GOVERNMENT, INDUSTRY AND CITIZENS

RESEARCH AND DEVELOPMENT PERSPECTIVES



EDITORS ABBAS RAJABIFARD & DAVID COLEMAN

GSDI ASSOCIATION PRESS

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EDITED BY
ABBAS RAJABIFARD and DAVID COLEMAN

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Spatially Enabling Government, Industry and Citizens

Abbas Rajabifard and David Coleman (Editors)

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Peer Review Board

Foreword

This book is the result of a collaborative initiative of the Global Spatial Data Infrastructure Association (GSDI), the Centre for SDIs and Land Administration (CSDILA) in the Department of Infrastructure Engineering at the University of Melbourne, and the Geographical Engineering Group in the Department of Geodesy and Geomatics Engineering at the University of New Brunswick. In addition to the traditional Call for Papers for the GSDI 13 Global Geospatial Conference: "Spatially Enabling Government, Industry and Citizens", contributions of full articles were solicited for publication in this peer reviewed book.

The authors and reviewers were advised of the conference theme in advance and, in most cases, the addressed this theme in their papers. Even in cases where the theme was not directly referenced, the article reflected the impact and application of the spatial data infrastructures that are now being developed world-wide. The peer-review process resulted in 14 chapters that together reflect how SDIs are enabling us all today. We thank the authors of the chapters and the members of the Peer Review Board.

We are grateful to the GSDI Association Press for its willingness to publish this work under a Creative Common Attribution 3.0 License. It allows all to use the experiences and research presented in this book to their own best advantage.

We especially thank the sponsors of this book. We would also like to thank Dr Sheelan Vaez and Dr Malcolm Park for their editorial assistance in preparation of this publication.

Abbas Rajabifard, *President*
David Coleman, *President-elect*
GSDI Association

An Assessment of the Contribution of Volunteered Geographic Information During Recent Natural Disasters

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Abstract

In recent years, improved information communication infrastructure (primarily the internet), the growth publicly available spatially enabled applications (such as Google Earth) and accessible positioning technology (GPS) have combined to enable users from many differing and diverse backgrounds to share geographically referenced information. In an increasingly spatial enabled society, user generated or volunteered geographic information is now becoming the first point of response in the immediate aftermath of a natural disaster. With the prediction of more severe weather events in the coming decades, emergency response personnel must be prepared to react quickly and utilize the latest information and communication technologies where appropriate. Crowd source mapping platforms can be operation in a matter of hours of a natural disaster occurring and can utilize the information provided by citizens on the ground to collect timely and relevant information with respect to the disaster. Information can be contributed through multiple channels to inform others of the impact of the event. This paper examines the growth and development of volunteered geographic information over the recent years. The use of volunteered information and social networking in three natural disasters during 2011 are explored. The timeliness of the responses, the types of information volunteered and the impact of the information during and after the natural disasters are assessed. The relevance of these initiatives to the ongoing development of spatial data infrastructures and their contribution to formal response efforts and authoritative mapping is discussed.

KEYWORDS: Volunteered geographic information, social networking, natural disasters

1. Introduction

The Intergovernmental Committee on Climate Change (IPCC) has outlined the scientific case for climate change and global warming. Along with the risk of drought, the IPCC has indicated that there is an increased chance of intense precipitation and flooding due to the greater water-holding capacity of a warmer atmosphere (Solomon et al. 2007). Some of these weather extremes have already been observed and are projected to continue. The modelling indicates that future tropical storms and cyclones could become more severe, with greater wind speeds and more intense precipitation. Studies suggest that that the average number of Category 4 and 5 storms per year has also increased over the past 30 years. In February 2011, Queensland experienced one of the largest tropical cyclones in history, Tropical Cyclone Yasi, a category 5 cyclone which was over 500km in diameter and influenced the weather of much of northern Australia.

During the first few months of 2011, New Zealand, Australia and Japan experienced a series of natural disasters that resulted in severe damage to property and the environment and the loss of thousands of lives. During January 2011, Australia and the State of Queensland in particular, was hit by damaging floods which caused billions of dollars in damage and the loss of over 20 lives. In February 2011, Christchurch New Zealand experienced a magnitude 6.3 earthquake cantered only 10 km from the city. Almost 200 lives were lost and many parts of the city and surrounding suburbs will need to be demolished. Shortly thereafter, in March 2011, large areas of northern Japan were devastated after a tsunami swamped entire towns following a magnitude 8.9 earthquake that was centred off the Japanese coastline. The death toll from the tsunami totalled almost 20,000 people (Earthquake Report, 2010).

During each of these natural disasters crowd sourced information was utilized to map the current status as it unfolded on the ground. This volunteered geographic information became an important part of the information sharing during the critical early stages of each disaster. The capacity for citizens to share information, including location information, has increased exponentially with advances in information and communication technologies and the growth of social networking platforms. Users are now playing a much more active role in participating with volunteered initiatives particularly in the provision of geographic data (Budhathoki *et al.,* 2008; McDougall, 2010)

This paper examines the use of crowd mapping during three natural disasters in 2011 and the deployment of the systems during and after the disaster. Issues that contributed to the success of the volunteered efforts will be discussed together with the broader issues of volunteered geographic information in the context of the development of spatial data infrastructures and spatial enablement.

2. Volunteered Geographic Information and Social Networking

2.1 Volunteered Geographic Information

In recent years, the maturing of mobile information services (primarily the internet), the growth of publicly available spatially enabled applications (such as Google Earth), and accessible positioning technology (GPS) have combined to enable users from many differing and diverse backgrounds to share geographically referenced information. This information has been termed by Mike Goodchild and others as volunteered geographic information (VGI) (Goodchild, 2007; Kuhn, 2007). Volunteered geographic information is not new, but it has emerged gradually from efforts in areas such as participatory GIS (PGIS) where opinions and perspectives are canvassed through GIS portals either online or within constrained environments.

Volunteered information is information that is freely shared by individuals through a variety of portals and communication channels. The volunteering of the geographic dimension of information has been facilitated through two main developments. First, geographic portals such as Google Earth and others have brought geography and spatial information to the people. Digital imagery captured by an array of satellite sensors and presented through various geographic portals has enabled citizens to identify real world features and location with relative ease. The other primary source of volunteered geographic locations is generated through Global Positioning Systems (GPS) receivers which are now readily available in smart phones. Most of this software and functionality has emerged in the past 5-7 years which is a remarkable achievement.

Volunteered geographic information represents a new and rapidly growing resource. Its near real-time capability has been utilized in the emergency and disaster management environments to broadcast the conditions and status on the ground (De longueville *et al.*, 2010; Goodchild and Glennon, 2010; Zook *et al.,* 2010). In the absence of other rapid response mapping which invariably is delayed by days or even weeks, VGI may become critical (Goodchild and Glennon 2010). VGI is also proving to be valuable where traditional sources of fundamental spatial information do not exist or are not publicly accessible. In the case of the Haitian earthquake, the disaster response resulted in an increase in access to geographic information through the assistance of platforms such as the Geocommons (Zook *et al.,* 2010). The absence or lack of accessibility to suitable geographic information can also be a motivator for the collection or utilization of volunteered geographic information.

As volunteered geographic information continues to become integrated into mainstream information platforms, issues of reliability and credibility need to be considered (Bishr and Janowicz, 2010; Flannigan and Metzger, 2008). However the quality of VGI contributions can match or exceed existing databases. The existing issues faced by users of GPS car navigation systems with errors caused by lack of data or out of date information is evidence that not all geographic databases are reliable (McDougall,2009).

2.2 Social Networking

A social network is a network of nodes formed through relationships that may have been established through friendship, ideas, values, hobbies or other linkage mechanisms. Social networking theory is the study of these networks and the mapping of these relationships as they may apply to wide range of human organizations, from small groups to entire nations (Ethier, 2009). The power of social networks is of considerable interest to researchers and organizations, particularly their power to influence group or public opinion. It has been shown that individuals will increase their interest to participate in public processes if they are connected with others with a higher level of influence (or motivation) (Boudourides, 2002). Citizen participation in social networking forums such as Facebook, Myspace, Friendster and others has grown dramatically in the past few years with many having over 100 million listed members.

Social networking has been identified by a number of industries and organizations as a potential contributor to a range of areas including innovation, building staff networks, solving complex problems or extending the market reach of products. By its very nature, social networking involves a series of one-to-one or one-to-many connections that require the active participation of individuals. During times of natural disasters, conventional emergency contact channels such as the telephone are inundated with calls. Social media via Twitter, Facebook and Youtube have become a preferred channel for communication for an increasing number of people during natural disasters. In the Australian floods, emergency services quickly moved to establish communication via Facebook and Twitter to keep residents updated on important developments.

Private businesses, such as IBM, have realized the growing importance of social media. IBM launched an internal social networking site for employees in 2007 which was designed to blur the boundaries of work, home, professional, business and fun (DiMicco *et al.,* 2008). The system, which was called Beehive, was hosted as an experimental platform for studying the adoption and usage of social networking in the workplace. Initial findings indicate that the value to employees include being able to promote ideas more effectively and to build their social capital within the organization.

An understanding and quantification of the impacts of social media and social networking can be achieved through analyzing the interactions across the network and actors. Social network analysis (SNA) is the analysis of relationships between actors in a social network and has some important implications for the sharing of information across a social network. Having power within a network may mean that an actor may potentially have better access to information, resources or social support (Mori *et al.,* 2005). This concept is important in times of emergencies where authoritative information and sources are sought by individuals.

In order to gain an understanding of the impacts of crowd mapping and social media on the outcomes of natural disasters, three recent natural disaster events were investigated. Each case is described in section three in terms of the initial and post event responses. A comparison of the three cases is then undertaken to identify the similarities and differences and to explore where these volunteered activities sit with respect to the formal disaster response frameworks.

3. Review of Recent Natural Disaster Crowd Mapping

This section reviews the events and crowd mapping that occurred during the 2010/11 Australian Floods, the 2011 Christchurch earthquake in New Zealand and the 2011 tsunami in northern Japan. A common theme among the three cases is that the Ushahidi platform was utilized during each of the natural disasters. Ushahidi is a non-profit technology company that specializes in the development of free and open source software for information collection, visualization and interactive mapping (Ushahidi ,2011). Crowdmap is an on online interactive mapping service, based on the Ushahidi platform (Crowdmap, 2011). It offers the ability to collect information from cell phones, email and the web, aggregate that information into a single platform, and visualize it on a map and timeline. Ushahidi was originally created to coordinate information relating to riots that broke out after the disputed Kenyan election in 2007. Since then, the platform has been used extensively, ranging from spreading information during the Haitian earthquake in January 2010 to dealing with snow removal in New York City.

3.1 The Queensland and Australian Floods in 2010/2011

During December 2010 to February 2011, Australia and the State of Queensland in particular, experienced a series of damaging floods which caused billions of dollars in damage and the loss of over 20 lives. Major flooding was experienced at over 30 cities, towns and rural communities over southern and western Queensland including significant inundation of agricultural crops and mining communities. Consistent rain during the Australian spring resulted in many of the large catchments becoming heavily saturated and the larger storage reservoirs and dams reaching capacity. These conditions were further exacerbated by the presence of a number of tropical cyclones which in addition to heavy rainfall resulted in significant property and landscape damage due to cyclonic winds. Damage to property, agriculture and mining production was estimated at over AUD $12 billion

In the case of the Queensland floods, the news media, particularly the radio media began to field calls from flood victims all over the state and was seeking a mechanism to geographically display these instances. In January 2011, the Australian Broadcasting Corporation launched Queensland Flood Crisis Map – a crowdmap of the Queensland floods (ABC 2011). The crowdmap allowed individuals to send flood-related information via email, text message, Twitter, or via the website itself (Australian Broadcasting Commission, 2011). This information was then available to anyone with an internet connection.

In the first days of the floods, the map provided a near real-time account of flooding across a large geographical area (over 32 million km2) including local flooding, road closures and the location of evacuation centres. As the disaster moved into the recovery phase, the information being volunteered began to change. Instead of flood locations, the volunteered information included the locations of bottled water supplies, disposal bin locations, clean team locations, and lost and found pets. During the floods almost 100,000 reports were received from various sources during a 30-day period. The crisis map allowed the reports to be classified into categories such as hazards, evacuations, help services, roads affected, property damage and trusted reports. Reports were verified where possible by volunteers from other corroborating information and in total the level of verification reported was approximately 99%.

In addition to contributing to the crisis flood map reports, social networking also played a major role in keeping people informed during the January 2011 flood. The social networking service Twitter <www.twitter.com> allowed people to post and receive short text based updates about the flood in real time. Photos and videos could also be attached to these updates. Similarly, the website Facebook <www.facebook.com> allowed groups such as the Queensland Police Service to provide flood information updates to users who browsed their Facebook page. Finally, YouTube <www.youtube.com> provided a forum for people to connect and inform through the use of user-generated and contributed videos. Photography and imagery of the floods across different regions were posted on sites such as Flickr which were linked to a location through the map. Individuals had the opportunity to add comments and additional information regarding the context of these images. The posting time was also time-stamped by the system. These images provide an excellent historic and current record of the flood events and features in the imagery can easily be used to reference flood heights at a particular time.

At the peak of the Queensland floods there were between fourteen and sixteen thousand tweets per hour on the 'qldfloods hashtag' which was used to coordinate the conversation around the flood event itself (Burgess and Bruns, 2011). These peaked at around the time Brisbane and the surrounding areas began to become inundated. Agencies and organizations alongside members of the community began using the Twitter platform as a place to distribute 'raw' footage and information, and began to trust and 'follow' particular accounts.

The response to the Queensland floods by all levels of government and the community was widely applauded. Information and mapping on the extents of the various floods across Queensland were pivotal in prioritizing resources, distributing emergency relief and clarifying the inevitable insurance issues.

Under international disaster agreements, the Australian and Queensland governments were able to access a variety of mapping resources including satellite imagery during and after the floods. This information was utilized together with high-resolution imagery to assist in the emergency efforts. A special agency called the Queensland Reconstruction Authority launched an interactive map which detailed the areas which were flooded or inundated. This was a valuable source of information for individuals, community organizations, governments and private sector organizations such as insurance firms. However, much of this official or authoritative data was not fully available to the public until some weeks after the disaster.

3.2 The Christchurch Earthquake

In February 2011, Christchurch New Zealand experienced a magnitude 6.3 earthquake which was centred only 10 km from the city. It followed an earthquake in September 2010 which had also inflicted significant damage to Christchurch. The February earthquake caused widespread damage across Christchurch, especially in the central city and eastern suburbs, with damage exacerbated by buildings and infrastructure already being weakened by the September 2010 earthquake. It was one of the most damaging natural disasters in New Zealand history with 181 people killed and over NZ $20 billion in damage.

Within a couple of hours, the Eagle Technology Group Ltd had a Christchurch Earthquake Incident Viewer up and running which showed social media information as it was being fed from the ground. The Ushahidi Christchurch Recovery Map website was launched less than 24 hours after the earthquake. The site mapped locations of services such as food, water, toilets, fuel, ATMs, and medical care. Information was gathered via Twitter messages using the #eqnz hashtag, SMS messages and email. The site was founded by a group of web professionals, and maintained by volunteers (McNamara, 2011).

Another instance of the Ushahidi crowdmap was also established by stuff.co.nz, an information and news service under the Fairfax Media group. However, after discussion it was agreed that a single crowd map instance would be more beneficial to the maximizing the efforts and reduce duplication. Esri also deployed an editable social media map viewer that organized geo-tagged Ushahidi posts and relevant YouTube videos. The crowdmap achieved over 100,000 visits during its establishment and provided a range of report notifications including road closures, hazards, emergency facilities, clean drinking water locations and damage to buildings and infrastructure. The crisis group also provided customizable printed maps from the data

3.3 Japan Earthquake

In March 2011, large areas of northern Japan were devastated after a tsunami swamped entire towns following a magnitude 8.9 earthquake that was centred off the Japanese coastline. Massive waves of water, up to 10 metres high in some parts, travelled more than five kilometres inland. The quake was estimated at over 100 times more powerful than the Christchurch earthquake and sent walls of water over towns in northern Japan including Sendai city and Kamaishi on the Pacific coast. The sheer devastation of the tsunami resulted in a death toll of over 20,000 people (National Police Agency). The physical damage to infrastructure and buildings and loss of production has exceeded US $300 billion.

Within hours of the earthquake, a member of Japan's OpenStreetMap community launched a dedicated Crisis Map for the disaster. A few hours later, Japanese students at The Fletcher School (which is where the Ushahidi-Haiti Crisis Map was launched) communicated with the Tokyo-based OpenStreetMap team to provide round-the-clock crisis mapping support. Over 4,000 reports were mapped in just 6 days and the crowd map was used by a number of foreign embassies to track the possible location of their citizens (http://irevolution.net/2011/03/17/crisis-mapping-libya-and-japan/).

The sinsai.info site established an Ushahidi instance to pinpoint locations where people may be trapped, dangerous areas that should be avoided, and supplies of food and clean water. Prior to the earthquake, Japanese volunteers had been working with Ushahidi to prepare for the possibility of an earthquake. The development work that was undertaken for the Haitian earthquake enabled the software to become much more sophisticated and much easier for people to create a version of Ushahidi tailored to their needs (http://www.technologyreview.com).

As the full destruction of the tsunami became evident, the damage to the nuclear power plant at Fukushima came under close scrutiny. In an effort to bring additional information to the public regarding the radiation levels around the plant, an organization called Safecast began mapping and publishing radiation maps across northern Japan. The group of volunteers used both fixed and mobile sensors to map the areas around Fukushima and to collect more than a million data points. The volunteers worked on the premise that it is better to have this information available to the public rather than undisclosed or unreported by governments or monitoring agencies. The Safecast system was deployed within a week of the tsunami and has been assisted by a core team of around 100 volunteers.

4. Discussion

The three natural disasters described provide a clear pattern of well-organized volunteer efforts to establish a mechanism for citizens to report their location and status and alert others of any potential areas of risk. The overall success of the initiatives has been astounding when considered in the context of each disaster. The Queensland and Australian floods had been ongoing for a period of a month or more before the more serious events occurred. The crowd map provided an opportunity for Australians and international citizens to visualize geographically the location of various flood events and the progress of the flood as it advanced down the different river catchments. Although other emergency information was available through the media, particularly via radio broadcasts, people were seeking more information about location of the flooding. The floods had also occurred over the Christmas vacation period and consequently there were many people who were travelling and were seeking locational information on the flooding to help plan their movement.

The Christchurch mapping response was also excellent, and from the reports available provided some very useful insights into the early developments of the crisis mapping system. Again the volunteer efforts were mobilized quickly through groups and organizations such as CrisisMappers (http://crisismappers.net/) and Crisis Commons (http://crisiscommons.org/about/). These groups can call upon hundreds of volunteers worldwide to mobilize the teams to commence the crowd map. Many are experienced programmers and system analysts and so technical issues can be solved through a collaborative process. In the case of Christchurch where multiple crowd maps were being deployed, the project team contacted the other groups and agreed on a single main source to maximize the effort and outcomes. The work of the crowd mapping team was handed over to the emergency response agencies which had established a more systemized map to assist in the reconstruction efforts.

In the Japanese disaster, the crisis mapping was facilitated through the Openstreetmap movement and volunteers from the Fletcher School of International Affairs, Tufts University, Massachusetts. After the initial response from the Openstreetmap community, an Ushahidi solution was established through the volunteer community connected to the CrisisMappers. The implementation required input from the Japanese community and local volunteers to process the reports.

The characteristics of the three volunteered crowdmap instances are shown in Table 1. The Christchurch map was replaced as an authoritative source reasonably quickly after the disaster as emergency response team established control. It was removed to ensure that a single point of control and contact could be established for emergency efforts. In all cases the response time for establishing these sites was well in advance to the official response mapping efforts which typically took weeks to make maps available. In the case of the New Zealand and Japanese responses the establishment time was effectively a matter of hours.

From all the available sources investigated, there is little evidence of deliberate postings of spurious information and, in general, the quality of information in respect to context and relevance is high. In the Queensland floods crowdmap, approximately 99% of reports were verified or collaborated through a large number of volunteers. In the case of the Japanese crowdmap the number of verified reports is noted as being just over 6%. The Japanese crowdmap has significantly different statistics to Queensland in both the volume and the level of verified data. The reason for the relatively low volume in Japan is not well explained but may be a combination of a cultural reluctance to share information publically, a lack of corroborating evidence and perhaps a reflection on the level of devastation and hence lack of communication infrastructure or access to the disaster area.

The verification process followed by each instance of the crowdmap is a function of the individual volunteer group. As a general rule, the Ushahidi guidelines for verification of reports recommend the following:

- Information from multiple reports;
- Multiple and different sources, e.g. messages from different phone numbers regarding the same incident;
- Message from different platforms such as phone, email, Twitter and news;
- A site administrator who can confirm reports from local knowledge or who has spoken to volunteers or authorities;
- Collaborating photos or videos; or
- Reports from a known or trusted reporter.

The high level of trusted and verified reports in the Queensland case also can be explained by the willingness for Australians to volunteer and support others during times of disaster. Australia has a very high level of volunteerism in comparison to other countries around the world. During the flood recovery stage, volunteers came from all over Australia and overseas to assist in the recovery and re-building efforts. This illustrates a willingness to assist others and to also share useful information during times of need.

Characteristic	Queensland Floods	Christchurch Earthquake	Japanese Tsunami
Site establishment time	Approximately 48hrs	12-24hrs	6-12hrs
Utilization	Alerts, photo, blocked roads, recovery points	Hazards, road closures, drinking water, building damage	Trapped people, dangerous areas that should be avoided, and supplies of food and clean water
Lifecycle	Active for approximately 5 weeks	Active for approximately 3 weeks	Active 8 months after tsunami
Reported quality	99% verified reports	unknown	6.1% verified
Availability of site	Data currently accessible	Site not available	Active
Number of reports	98,000	>100,000	>12,600

Table 1. Characteristics of Crowd Maps for the three disasters

With the exception of the Japanese crisis map, the initial maps ceased taking further reports within approximately a month of the initial disaster as emergency services and reconstruction efforts took over. In each of the three cases it was evident that the crowd sourced maps filled a gap in the emergency response efforts. In particular, in the early chaos of the disaster there is a gap before emergency response efforts establish their information and control structures.

Most emergency response efforts follow a “command and control” approach where high level command structures are established with a formal control centre where most, if not all, communication is channelled. This approach ensures that clear messages can be communicated based on all of the information available from the various response units. However, the establishment of these structures takes time and often requires usurping the powers of existing emergency and government authorities which can result in some confusion of efforts until the hierarchical control system is fully functional.

This “top down” approach has similarities to the first generational approaches of SDI development where it was necessary to establish a policy framework to provide direction from a national level. Over time, the direction setting has moved from the high level jurisdictions to the sub-national and local levels. However, with advances in information and communication technologies and the wider spatial enablement of communities, it is the citizens that are now interacting and contributing information within the SDI framework. Just as the hierarchical approaches of SDI are now being supplemented with less structured network approaches through citizens, emergency or crisis mapping is now being revolutionized through crowd sourced data provided by citizens within the disaster.

As pointed out by Tim McNamara in his commentary on the Christchurch response (McNamara, 2011) one of the points that struck him was the level of collaboration that occurred in a very short space of time amongst the volunteers. He attributes this collaboration to the open source platform that was used for the crowd mapping. Open source developers also bring with them many collaborative skills such as being able to work in many time zones simultaneously and manage issues such as remote communication and version control. These skills are extremely valuable at the time of a crisis where coordination is critical and projects are resource and time poor.

Many of the volunteers in this community bring with them excellent credentials, experience and a positive attitude. In some instances, the volunteers hold positions of influence in organizations such as Google Inc which provide a network of contacts and the ability to access additional resources or data. This is not a criticism of the excellent skills and co-operation that is present when public sector agencies and emergency response groups come together. However, the bureaucratic agencies bring with them a degree of conservatism and protocols which have a tendency to inhibit development by placing conditions and obstacles in the way.

McNamara also identified another factor that contributed to the success of the Ushahidi approach of open source and not for profit was the fact that the platform was vendor neutral. This meant that the project gained a high level of trust within the community and did not attract the issues associated with competitive vendors in the commercial environment. The neutrality enabled information to flow from a variety of organizations into the crowd map and also provided the freedom allowing the team to provide essential service information as well as information that may have been considered by an emergency management team to be non-essential.

Crowd mapping and the groups of volunteers also managed to create a degree of cultural interaction and diversity which presents both challenges and opportunities. Some of the challenges with establishing an operation within a different country requires the cooperation of volunteers and needs to respect the cultural nuances within a different culture. Some terms and practices that may be acceptable or taken for granted in one country may need to be considered more carefully in another more conservative environment. Conversely, it may be important to begin to challenge the existing norms within a particular environment in order to more effectively engage the users or the citizens in the process. The Safecast approach to collecting information on the radiation levels is an example of an approach where providing greater access to information will hopefully encourage authorities to become more accountable and open.

Crowd mapping generates a huge volume of relevant, timely and incident related information during the early stages of a disaster. This information proved extremely valuable in a variety of circumstances during the period of the natural disaster, but the information is also valuable after the event. Post disaster assessment and analysis can provide an excellent insight into how the disaster unfolded including critical events and happenings. In the case of the Queensland floods, comments from the citizens has proved useful in understanding what support was being provided on the ground and photography from the crowd sourced reports and other sites such as Flickr provide a historical record of the event and flood levels. Some of this information can be utilized by mapping agencies to map the flood heights and also to assist in insurance claims. The question arises as to how should this information be preserved and who should take the initiative to undertake this preservation.

5. Conclusions

The three case studies provide an insight into the operation and value of volunteer driven crowd sourced mapping during different natural disasters. The advances in information communication technology has made the development and deployment of a “not for profit” service not only possible, but also extremely successful. The impact on the service in the three different countries has yielded different outcomes and different approaches. In each case the crowd sourced mapping provided a unique perspective on the disaster that would not have been possible from a conventional emergency service “command and control” structure or implementation.

In a few short years the Ushahidi platform has been developed and refined to the stage where it can be deployed in a matter of minutes. Unlike vendor developed solutions, it can be rolled out with limited technical knowledge, although a support network of volunteers are standing by to provide various levels of assistance.

Proposed new functionality in Ushahidi, such as a “check-in” facility, will allow a user to identify them as being in a disaster zone for safety or security reasons. This will extend the already significant capability of this system. This proposed addition will also potentially assist in the coordination of individuals or groups within a disaster and move closer to a more useful emergency management tool.

The value and utility of crowd sourced or volunteered geographic information continues to grow in the disaster management arena. Although the crowd sourced mapping does not comfortably fit with the more conventional models of hierarchical control for information management, it has now been utilized successfully in a number of natural disasters. Crowd sourced information is now considered a valuable addition to emergency response efforts and has begun to break down the barriers in the efforts to spatially enable society. The value of the open source software and the camaraderie engendered through the open source and volunteered collaborative approach is refreshing. There is no doubt that the movement will face challenges as it continues to operate in these difficult environments, but if the past performance is any indication of future developments, the movement will have a bright future.

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