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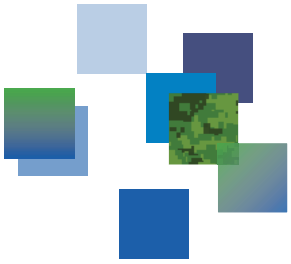

Social media in emergency management

Capability assessment

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Abstract

Emergency management and first responder organizations around the world are trying to exploit the use of social technologies to prepare for respond to and recover from crisis. Social media offer the opportunity to connect and cooperate with the networked public, take advantage of the capabilities and innovations of virtual volunteers, and to reach people quickly with alerts, warnings and preparedness messages. Canada's emergency management community has not yet fully embraced social media. This report describes an effort to understand the state of maturity of the use of social media in emergency management as well as to create a "roadmap" for an effective use of this capability in Canada. The research involved conducting an environmental scan, consultations with experts and case study analysis. We found that there exists an awareness and expertise gap between the community of internationally experienced virtual volunteers and the emergency management organizations in Canada and that the potential of social media and online collaboration remains unfulfilled. One of the main challenges to implementing an effective capability is resolving how to bridge the command-and-control, hierarchical culture of emergency management organizations to the horizontal, networked culture of the digital domain. The report offers suggestions on how to improve and mature the implementation of social media in emergency management in Canada.

Significance to defence and security

This report impacts defence and security by assessing the potential of and identifying the conditions required for improving emergency management and disaster relief through the exploitation of social media technologies and information as well as cooperation with the public, non-governmental organizations, and virtual volunteers. In particular, the report identifies the most important characteristics and conditions that an organization should address to enable an increasingly mature use of social media in emergency management (and effective partnering in its support) and summarizes them in a one-page maturity model.

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Résumé

Les organismes de gestion des urgences et de première intervention de partout dans le monde cherchent à exploiter la technologie des médias sociaux pour faciliter la préparation, l'intervention et le rétablissement en cas de crise. Les médias sociaux offrent aux organisations la possibilité de communiquer et de coopérer avec le public en réseau, de tirer parti des capacités et des innovations de bénévoles virtuels et de transmettre rapidement aux gens des messages d'alerte, d'avertissement et de préparation. Au Canada, les organismes de gestion des urgences n'ont pas encore pleinement adopté l'usage des médias sociaux. Dans le présent rapport, nous tentons de déterminer le degré de maturité de l'usage des médias sociaux dans le domaine de la gestion des urgences et d'établir une « feuille de route » qui favorisera une utilisation efficace de cette ressource au Canada. Dans le cadre de cette recherche, nous avons effectué une analyse contextuelle, consulté des experts et réalisé une étude de cas. Nous avons découvert qu'il existait un écart sur le plan de la sensibilisation et de l'expertise entre la communauté de bénévoles virtuels expérimentés à l'échelle internationale et les organismes canadiens de gestion des urgences, et que les médias sociaux et la collaboration en ligne ont beaucoup de potentiel inexploité. L'une des grandes difficultés liées à la mise en œuvre efficace d'une telle capacité est de trouver le moyen de concilier la culture hiérarchique de type « commandement et contrôle » des organismes de gestion des urgences avec la culture horizontale et réseautée de l'univers numérique. Nous suggérons des moyens d'améliorer et d'amener à maturité l'implantation des médias sociaux dans le domaine de la gestion des urgences au Canada.

Importance pour la défense et la sécurité

La recherche décrite dans le présent rapport concerne la défense et la sécurité puisque nous évaluons le potentiel et déterminons les conditions requises en vue d'améliorer de la gestion des urgences et des secours aux sinistrés par l'exploitation des médias sociaux et la coopération avec le public, les organismes non gouvernementaux et les bénévoles virtuels. Plus précisément, nous cernons les plus importantes caractéristiques et conditions dont une organisation devrait tenir compte afin de faire davantage en sorte que l'usage des médias sociaux dans la gestion des urgences parvienne à maturité (et augmenter ainsi l'efficacité de la collaboration dans ce domaine) et nous les résumons dans un modèle de maturité d'une page.

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1 Introduction

1.1 Context

Emergency management and first responder organizations across North America are adopting social technologies to reach the public and pursue a variety of operational objectives. The Calgary Emergency Management Agency (CEMA) and the Toronto Police Service (TPS) are two examples of official agencies that have built a significant social media presence and that are finding real value in engaging their communities online [1][2].

Virtual volunteer organizations, such as CrisisCommons, Standby Task Force or Humanity Road, are making a significant contribution to international disaster relief efforts and are leading the way in volunteer-driven crisis-mapping and crowd-sourcing of crisis information. Their contribution has become an integral part of the international governmental response to major disasters. For example, the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) have a partnership with the Digital Humanitarian Network[1], support research in the area of "humanitarianism in the network age"[3], and initiated a project to provide volunteer technical communities (VTCs) access to space-based information for crowd-sourced mapping [4].

Some national non-governmental organizations, such as the American and Canadian Red Cross, have taken a closer look at the role of communications and social networking technology during emergencies [5] and analyzed the consequences for their work [6]. As a result, both the Canadian and the American Red Cross have begun to develop their capacity to conduct online monitoring, engage their community on social networks, and offer opportunities to volunteer virtually. For example, the Canadian Red Cross has created the Canadian Red Cross Social Team composed of digital volunteers who act as ambassadors and message amplifiers, and involves digital volunteers in social media response in times of disaster. The American Red Cross[2] has implemented a Digital Operations Center where social media traffic relevant to its operations can be monitored and online requests for help and information can be answered or routed to the authorities.

In the United States, the challenge of connecting and coordinating virtual volunteers and official response organizations led to the creation of a commercial online toolkit for communities. Recovers.org[3] is a fee-based software platform that includes volunteer and case management, donation management, and information sharing capabilities. The platform reported on Twitter that it had signed up 23,000 volunteers in the week after Hurricane Sandy made landfall in New York and New Jersey.[4]

In 2013, a virtual volunteer group known as the Canadian Virtual Operations Support Team (CanVOST) mobilized for the first time to support the Canadian Red Cross' relief efforts related to the Alberta floods and tested their nascent concept of operations. The City of Calgary experienced the phenomenon of emergent online volunteers first-hand, when concerned and

[1] http://digitalhumanitarians.com.
[2] With support from Dell Inc. and Salesforce.com Inc.
[3] www.recovers.org.
[4] https://twitter.com/recovers_org/status/267010464788127745.

affected citizens organized spontaneously through Facebook—to form the ad hoc volunteer group "YYCHelps"—and used a variety of online tools to share information and coordinate their contributions to the clean-up operations [See Section 4.4].

1.2 The SMEM targeted investment project

Social media presents opportunities to the emergency management (EM) community to connect and cooperate with the networked public, take advantage of the capabilities and innovations of virtual volunteers to complement and improve operations, and reach more people much more quickly with alerts, warnings and preparedness messages. Canada's EM community has not yet fully embraced social media in this way. In order to address this gap, the "Social Media in Emergency Management" (SMEM) targeted investment project[5] was initiated in the spring of 2013 at Defence Research and Development Canada (DRDC) Centre for Security Science (CSS). The project was designed to:

- evaluate and demonstrate the effectiveness of social media in enabling disparate groups and individuals—including government officials, emergency managers, first responders, citizens, and virtual volunteers—to not only connect and communicate, but also to cooperate and innovate in a way that enables real-time problem-solving across the full spectrum of EM;
- provide best practices for the EM community; and
- hold an objective-based dialogue with the EM, first responder and virtual volunteer communities in order to develop an SMEM "Roadmap" for Canada.

One primary goal of the project was to facilitate more effective information exchange between the official responders, the virtual volunteers as well as the public at large, so as to enable improved situational awareness and build resilience, both at the community and the national level. A brief overview of the project is presented in the form of a quad-chart in Annex A.

1.3 The SMEM Expert Roundtable

As part of the SMEM targeted investment project, DRDC CSS partnered with CEMA to hold the project's "SMEM Expert Roundtable" that brought together subject matter experts (SMEs) from amongst EM officials, first responders, virtual volunteers and non-governmental organizations (NGOs). The workshop gave participants the opportunity to connect and bring forward critical issues, such as the unfulfilled potential of virtual volunteers and emergent volunteers from affected communities in bridging expertise and capacity gaps.

Expert input was elicited through the use of various interactive facilitation exercises. In one such exercise, the SMEs emphasized their common view that, the public and virtual volunteers are becoming an increasingly active participant in SMEM. The challenge—and opportunity—they

[5] DRDC CSS project code CSSP-2013-TI-1034.

said, was to adapt to this new reality and leverage the virtual and physical communities' capacity to help. The SMEs were in agreement that the way towards increased cooperation would depend on the ability to:

- keep it simple – the tools and processes have to be simple for the public to engage;
- develop solutions collaboratively – to avoid duplication and fragmentation;
- build relationships and trust ahead of time – not during a disaster;
- continue the dialogue and keep it open; and
- be prepared to continually learn and adapt.

The workshop also included a roundtable discussion of the challenges that need to be overcome before an effective volunteer-supported SMEM capability can be developed and implemented across Canada. The barriers to implementation that were mentioned included:

1. The intrinsic culture of emergency management not being open to volunteer-supported SMEM – there needs to be investment in establishing a level of trust between the two groups and building a culture of innovation.

2. The decision makers being generally unaware of the value of SMEM – the value proposition of SMEM needs to be clearly communicated including demonstrating benefits with quick wins.

3. Low tolerance for failure – we have to be open to failure as often there is more one can learn from failure than from success and experimentation enables innovation.

4. Scarcity of academic research in the SMEM domain – research in SMEM should be promoted and academia should be a stakeholder providing an evidence base.

5. Lack of policy for SMEM – existing plans, programs and standard operation procedures need to include the use of social media and new policies specific to SMEM needs to be developed.

6. Reliable, constant server space not being available – cloud space for community collaboration as well as fail-proof housing and back-up space for emergency systems and data needs to be established.

7. Limited availability and accessibility to open data (including infrastructure data) – volunteers need access to open data since everything they produce is based on open data sources.

8. Unavailability of training for both EM officials as well as volunteers – skillsets, expertise and credentials need to be established in order for the field to advance.

Two other facilitated sessions focused on soliciting ideas for specific SMEM-related activities and populating and validating a proposed SMEM maturity model. These will be discussed in more detail in Chapter 2 and Chapter 3 of this report.

A detailed analysis of the findings from the workshop can be found in Ref. [7]. The workshop helped to build relationships among participants and was instrumental in the identification of

successful practices and building support for continued dialogue and collaboration on maturing SMEM in Canada. The event also identified a continuing need for practical and outcome-oriented guidance to help these communities interact more efficiently and effectively on prevention, mitigation, preparedness, response and recovery.

The key strategic messages of the SMEM Expert Roundtable can be summarized as follows:

- The recent empowerment of individuals through communications technologies (including Internet connectivity, mobile technology and social networking) has enabled affected communities and virtual volunteers to play a significant participatory role in emergency management and humanitarian relief.
- Emergency management agencies should take advantage of social networking technologies by developing new approaches to engaging with the public online and exploring opportunities for cooperation with formal and informal virtual volunteer communities.
- Emergency management agencies, humanitarian relief organizations and virtual volunteer communities share the commitment to help and improve the resilience of the public; and they each bring valuable skills and expertise to the table.
- Partnerships between these diverse communities are growing and evolving in a complex, unfamiliar and dynamic space where the partners are making progress by building trust, demonstrating adaptability, recognizing relevant differences and respecting each other's shared values.

2 The opportunities of SMEM

2.1 Numbers and trends

Canada is one of the top three countries globally in terms of online engagement. According to statistics from 2013, two out of three Canadians use social networking sites with the three most popular sites being Facebook, Twitter and LinkedIn [8].

Facebook is by far the most popular social network with more than 19 million users according to statistics released by Facebook in early 2014. Fourteen million people log in every day and 10 million use mobile devices to do so. In 2012, daily Facebook usage was higher in Canada than both the global and U.S. averages [9][10].

Canadians represent three percent of all Twitter users, which puts Canada in fifth place behind the United States (51%), the UK (17%), Australia and Brazil. It is not known how many daily active Twitter users there are but a recent survey of Anglophone Canadians found that almost one in five Internet users surveyed used Twitter (including its video sharing application "Vine") [11]. Twitter's popularity appears to be rising, particularly among those who are looking for real-time news and up-to-the-minute information, for example, in a disaster situation [12]. The Calgary Police Service experienced this phenomenon first hand when its first tweet related to the 2013 Calgary flood (hashtag: #yycflood) was shared over 5,000 times and received 7,060 mentions between June 20 and June 21 [13].

LinkedIn (including SlideShare) has also seen some significant growth lately and counts more than 200 million members worldwide. Canada is now its fifth-largest market [14].

Facebook appears to have the greatest diversity in demographic representation, whereas LinkedIn and Twitter appear to be dominated by a mainly urban, well-educated and higher-income demographic. Picture and video sharing sites, such as Instagram (recently acquired by Facebook), Pinterest and Tumblr are growing steadily and have managed to build a dedicated following among some users. However, they remain relatively insignificant globally. Google's social network, Google+, is growing as a result of its integration with the Google Search engine and its link to other services, such as YouTube and the video-chat application Google Hangout, but with well under half a million users in Canada (189 million users worldwide) it lags far behind Facebook [9].

Canadians are increasingly accessing social networking sites on their mobile devices when they are on the go but also when they are watching television (so-called "second screen"). Jordan Banks, Facebook's Managing Director in Canada, said: *"Consumer behaviour is just fundamentally changing these days and so whereas it used to be that somebody would jump online maybe once a day and they'd do it from their PC, people are now online multiple times a day and they're online across a whole variety of different devices, the majority of which are mobile."[9]*

The prevalence of tablet computers and smartphones has led to a surge in mobile applications (apps), including location-based information and shopping tools, which their owners download onto their devices. This trend is reflected in application development that has been undertaken by some emergency management and humanitarian relief organizations, such as the Canadian Red Cross[6] and FEMA[7]. For example, one of the smartphone apps provided by FEMA features a "Disaster Reporter" function that allows users to take and submit GPS photo reports of disasters so they can be displayed on a public map for others to view—from virtually anywhere in the disaster zone.

The number of people who use social media is growing and their level of activity spikes during times of crisis. People use their online social networks to find and validate information, connect with family and friends and look for advice on what to do. But in many cases they also want to be actively involved. They want to communicate with officials, volunteer organizations, or those who are seen as the best crisis information resources. And they want to contribute to response and recovery efforts both virtually and physically. Researchers from the National Consortium for the Study of Terrorism and Responses to Terrorism (START) at the University of Maryland recently reported on a study of the main reasons why the public use social media during disasters and why they might not use social media [15].

Reasons the public use social media:

- because of convenience;
- based on social norms;
- based on personal recommendations;

[6] http://www.redcross.ca/what-we-do/first-aid-and-cpr/apps/first-aid-app.
[7] http://www.fema.gov/smartphone-app.

- for humor & levity;
- for information seeking;
- for timely information;
- for unfiltered information;
- to determine disaster magnitude;
- to check in with family & friends;
- to self-mobilize;
- to maintain a sense of community; and
- to seek emotional support & healing.

Reasons why the public might choose *not* to use social media:

- privacy and security fears;
- accuracy concerns;
- access issues; and
- knowledge deficiencies.

Organizations involved in crisis management and disaster relief have an opportunity to provide the information and services the public is looking for and to increase their effectiveness by addressing the barriers that prevent parts of the public from exploiting the opportunities of social networking technologies.

Surveys conducted in 2012 by the American and Canadian Red Cross shed light on the changing public expectations that have accompanied an increased use of social networking tools. For example, according to the results of the Canadian survey, 63 per cent of Canadians say emergency responders should be prepared to respond to calls for help posted on social media [16]. Other key findings of the survey include:

- A majority of Canadians who participated in the survey think emergency responders such as police and firefighters should monitor social media for emergency calls and be prepared to respond.
- One-third of respondents think emergency services would respond to a request for help posted on social media.
- About half of respondents indicated they would definitely or probably sign up for alerts via email, text message of smartphone application to receive information about disaster preparedness when there are official warnings in their area.
- More than half of respondents would use social media to alert loved ones that they are safe in the event of an emergency affecting their area.

The latest survey by the American Red Cross showed similar findings and results [17]:

- Three out of four Americans (76 percent) expect help in less than three hours of posting a request on social media, up from 68 percent last year.
- Forty percent of those surveyed said they would use social tools to tell others they are safe, up from 24 percent last year.
- The survey also identified a subsection of the population deemed "emergency social users," people who are the most dedicated users of social media during emergencies. Emergency social users are also most likely to seek and share information during emergencies. While they look for the hard facts—road closures, damage reports and weather conditions—they share personal information about their safety statuses and how they are feeling.

2.2 The use of SMEM within the Pillars of EM

There is a wide range of potential applications of social media networking technologies in disaster relief and emergency management, including the related methodologies of crowd-sourcing, big data analytics, crisis mapping and mobile digital data collection. Figure 1 shows a range of SMEM-related activities organized according to the pillars of EM. This depiction was validated and refined at the SMEM Expert Roundtable in Calgary [7]. The workshop participants identified three main areas where social media platforms and applications have been used successfully or show particular promise for (1) public information, (2) situational awareness, and (3) community empowerment & engagement. There also appears to be a growing potential for social media data in after action reviews, organizational learning, monitoring and evaluation as well as education and planning.

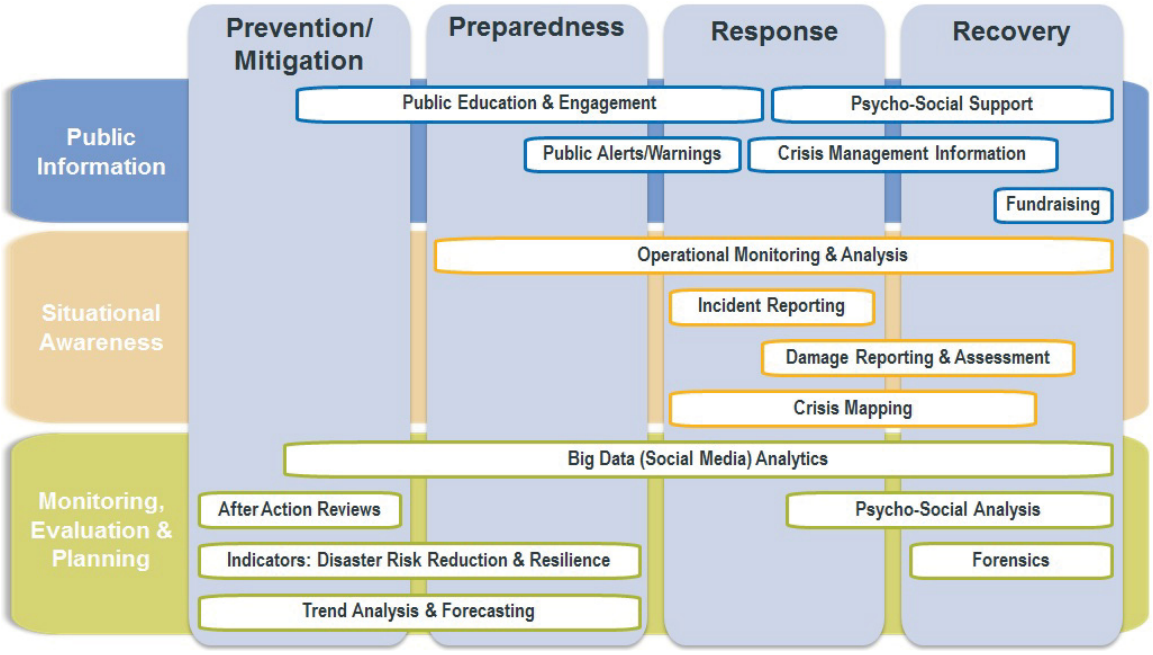

Figure 1: *SMEM opportunities within the pillars of emergency management.*

2.2.1 Public information

First and foremost, public affairs managers and public information officers see social media as an additional media channel through which they can distribute their messages to the public. They recognize that social media messages spread very quickly to a large number of people due to the prevalence of Internet-enabled mobile devices and the use of mobile applications. At the same time, crisis communicators are also aware that not everyone uses—or wants to use—social networks and that Internet connectivity may be an issue in the midst of a disaster. From the public alerting and warning perspective, social media platforms represent a significant additional communication channel to reach people on their phones. Social Media are seen as a valuable complement rather than an alternative to more traditional channels. Social media shows great promise in supporting resilience and risk reduction objectives by engaging the public in general preparedness efforts and providing citizens with timely, localized and disaster-specific risk information.

For example, National Red Cross societies have developed a number of popular mobile preparedness applications, including:

- Canadian Red Cross: First Aid App (http://www.redcross.ca/what-we-do/first-aid-and-cpr/apps/first-aid-app);
- American Red Cross: First Aid, Shelter Finder, Team Red Cross: Volunteer App, Hurricane App, Earthquake App, Tornado, Wildfire, Swim, Pet First Aid (http://www.redcross.org/prepare/mobile-apps); and
- British Red Cross: First Aid, Baby & Child First Aid (http://www.redcross.org.uk/What-we-do/First-aid/Baby-and-Child-First-Aid-app).

Apart from the development of dedicated mobile applications, typical and emerging practices for public affairs and public information include:

- crisis-related social media messages are platform-specific and deliberately designed to demonstrate account holder's expertise, build trust, effectively communicate risk, and motivate desired behaviour (changes);
- authorities use social media accounts to disseminate real-time updates as well as specific preparedness and recovery information;
- sharing of preparedness and recovery resources;
- posting of progress reports by public authorities and non-governmental relief organizations; and
- immediate correction of rumours and misinformation.

2.2.2 Situational awareness

In EM lexicon, Situational Awareness (SA) is *"[..]the continual process of collecting, analyzing and disseminating intelligence, information and knowledge to allow organizations and individuals to anticipate requirements and to prepare appropriately."[18]*

Social media streams constitute a rich source of multimedia content (text, video, voice, photos) that can be mined for valuable crisis information and used to enrich and improve the operating picture of responding organizations on a continuous basis. But the "deluge of data" also presents an information management challenge, particularly at a time of crisis when human resources and attention come at a premium. Technological improvements are being made to automate much of the task of finding, filtering and mapping relevant content but many challenges remain and no adequate and affordable tools have been implemented yet. In the meantime, customized mobile applications for crisis management make it easy for anybody with an Internet-enabled device to submit information that is already formatted for fast processing. The geo-referencing and time-stamping functionality of networked devices is used to facilitate the traceable reporting and automated mapping of disaster-related information. Ushahidi, for example, is an open source crowd-mapping platform whose mobile application "*supports loading of multiple deployments at one time, quick filtering through incident reports, exploring incident locations on the map, viewing incident photos, news article, media as well as sharing incident reports via email, sms or Twitter*"*[19]* via any mobile device that runs an Apple iOS or Android operating system. Virtual volunteer organizations have used applications like "ImageKlicker"[8] to make it possible for anyone to help identify and classify disaster-related Twitter messages [20].

Virtual volunteer organizations, such as the ones that belong to the Digital Humanitarian Network[9], are well versed in the use and exploitation of new communications technology for disaster relief and are known for their crisis mapping and crowd-sourcing support that they lend to international crisis relief operations. However, many local organizations and municipal agencies that operate in the disaster space do not have the expertise or the resources to effectively use basic social media management tools (e.g., Hootsuite, Tweetdeck, Mention, TweetReach) to identify and export relevant messages or to develop crisis-specific maps with specialized mapping platforms (e.g., Google Map Maker, Ushahidi, OpenStreetMap). And they also typically do not have the relationships or confidence necessary to consider enlisting the help of virtual volunteers. The awareness and expertise gap between this relatively small group of internationally experienced digital humanitarians and the frontline staff in many municipal and provincial EM organizations in Canada, particularly in the area of crowd-sourced social media filtering and mapping, is significant. The pressure to operationalize social media platforms and data is growing and a number of agencies and EM/relief organizations (e.g., TPS, CEMA, and Canadian Red Cross) have begun to build expertise and experiment with the use of social media for situational awareness and intelligence.

In Canada, the Canadian Virtual Operations Support Team (CanVOST) is a group of virtual volunteers from across the country that "*will support emergency management agencies and other organizations by monitoring social media (or conducting active social listening) to gather operational information and assess the situation and needs of communities/citizens affected by incidents/emergencies."[21]* The potential for the use of CanVOST's trained volunteers to enrich situational awareness is significant but their expertise and products are not yet widely accepted or even known in the relevant municipal and provincial EM agencies. The Canadian Red Cross engaged CanVOST volunteers for a limited time to support its operations during the Alberta

[8] http://crowdcrafting.org/app/MM_ImageClicker/.
[9] http://digitalhumanitarians.com.

floods in 2013. CanVOST's Patrice Cloutier considered this first brief activation of his group *"a great learning lesson for future deployment in terms of leadership cadre, team coordination and liaison requirements with requesting agencies."[22]*

The SMEM project was conceived in part to explore how groups of virtual volunteers, formal (e.g., CanVOST, SBTF, Canadian Red Cross Social Media Team) and informal (e.g., YYCHelps, emergent volunteers), might support and improve the situational awareness of emergency management agencies as well as the Canadian Red Cross given its important role in the recovery phase.

Typical and emerging practices related to situational awareness include:

- Operationalize social media information—Identify, geo-reference, validate and verify disaster information posted by the public and adjust plans, priorities and operational decision-making accordingly.
- Engage the public—Involve members of the public by posting questions they can help answer and provide opportunities to submit relevant information.
- Engage virtual volunteers to identify, filter and enrich relevant social media information and amplify important organizational messages.
- Targeted monitoring: Monitor and analyze social media with a view to identifying:
  - Significant changes in public mood and sentiment;
  - Reach and effectiveness of official information, alerts and advice; and
  - New and emerging threats and hazards that could affect the safety of relief workers, volunteers and other responders.

2.2.3 Monitoring, evaluation and planning

The use of digital networks for emergency management, situational awareness, and crisis communication comes with the possibility to collect and analyze data for the purpose of continuous improvement of messages, tactics, programs and policies—both on the ground (and in traditional media) as well as online (and in social media). Social media data is becoming a source of organizational intelligence.

Several SMEs suggested that the exploitation and use of social media should be made an integral part of After Action Reviews. They also pointed out the potential of analyzing social media data to assess the success of public information campaigns and measure the EM agencies' influence (e.g., on individuals' preparedness behaviour). Organizations that have started to use social media platforms benefit in more ways than one as this kind of data also helps to analyze the business case for maintaining or expanding the use of social media. Social technologies can also be employed after a deliberate event to crowd-source clues and evidence or answer questions related to post-event forensics.

The term "infoveillance" in the context of emergency management is used to refer to the monitoring and analysis of social media data to identify new threats, assess trends (e.g., Google

Flu Trends[10]) and help with preparedness planning. These are very recent developments that are not yet implemented on a wide scale. But forward-thinking global consultancy firms, such as IBM[11], have already developed sophisticated tools and processes for large corporate clients to analyze vast quantities of data and integrate social media intelligence into their strategic decision-making processes.

2.3 The ultimate goal: community empowerment, engagement and resilience

The fact that the availability of accurate, timely and relevant information is of the highest importance in disaster situations is not new. What is relatively new, however, is the realization that (virtual) two-way communication with the affected public may be as important to recovery as the physical provision of response and recovery services and supplies. The engagement of disaster-affected populations via social media platforms and cooperation between EM, volunteer groups, private businesses and NGOs have shown to benefit the key areas of public information and situational awareness but there is likely potential for an even greater benefit. For example, it is conceivable that the general public contribute to elements of After Action Reviews via social media and help to improve community preparedness, develop stronger partnerships, and inform more detailed response plans.

It has become routine for the American and Canadian Red Cross as well as a growing number of municipal EM agencies and first responders to go beyond listening and one-way communication on social media to enabling their communities to engage with them on social media. The public is increasingly seen not only as a valuable information resource but also as a partner whose expertise, skills and physical resources—identified, tapped, mobilized, and coordinated via social media—can greatly improve preparedness, response and recovery efforts. The public, including volunteer groups and private businesses, have a lot to offer in terms of local knowledge, creativity, innovation and capacity to which government officials may not have access to.

Government officials are beginning to advocate a "whole-of-society" approach to disaster preparedness, response and recovery where the public is seen as a valuable source of information and an active partner [23]. With respect to the general public and grassroots initiatives, the challenge for emergency managers is to find a way to connect the informality of "the crowd" with the formality of EM agencies. This is explored further in section 2.4.

Many government agencies are still reluctant to use social media over policy concerns, or more specifically the prevalent lack of policies governing its use. The challenges of implementing communications protocols that are not yet fully updated to reflect the demands of social media combined with the fast evolving nature of the technology present a risk [24]. Some government organizations have instituted multi-step processes of approving social media messages through the "chain of command" in an attempt to manage the risk [25]. Arguably, such measures make it

[10] http://www.google.org/flutrends/ca/.

[11] IBM Social Media Analytics http://www-01.ibm.com/software/analytics/solutions/customer-analytics/social-media-analytics/products.html.

difficult to unlock the full value of social networking platforms (i.e., building trust and influence). At the same time, it is recognized that inappropriate use of social media by government agencies can lead to significant liabilities that could cause more harm than good.

Social media platforms and online collaboration tools have proven to be very useful in connecting the various stakeholders and helping them to coordinate people and tasks during the response to and recovery from a disaster event. But SMEs point out that successful cooperation during a disaster requires that the necessary relationships and the trust between the individuals have been built well before the event.

Typical and emerging practices related to community empowerment and engagement include:

- developing partnerships between authorities, non-governmental organizations and private sector businesses for distribution of messages and sourcing of resources;
- using public crisis maps and promoting mobile applications to crowd-source situational awareness information, particularly during a disaster and in the recovery phase;
- making it easy for citizens to have only personally-relevant information pushed to them; and
- partnering with citizen groups, NGOs, industry and local businesses to:
  - recruit and manage volunteers;
  - bridge expertise and capacity gaps and share (digital) tasks; and
  - develop ad hoc and real-time solutions for disaster-related problems.

2.4 From hierarchy to networks

As mentioned in Section 1.3, cultural differences pose a challenge to implementing an effective volunteer-supported SMEM capability in Canada. Figure 2 shows a pictorial representation of the difference between a hierarchical, command and control-based organizational structure typical of EM organizations, and the flat, horizontal networked structure of the virtual volunteer world. While EM agencies have been built upon the foundation of military-style, top-down, rigid organizational models, the virtual volunteer networks evolved organically through grass-roots, bottom-up initiatives and resemble an ecosystem more than a traditional org-structure. These differences often lead to a culture clash when the two distinct communities attempt to intermix and work together. The tendency of the EM organizations is to try and take control and assert directive leadership through delegation of tasks under clearly established governance, roles and responsibilities, whereas virtual volunteers rely on emergence, collaboration and a de-centralized and distributed leadership style.

It may be unrealistic to expect that EM organizations will shift away from the centralized governance model and towards a more networked approach anytime soon, if ever. After all, there are many good reasons to rely on the current command and control structure during emergency response since it has proven effective in many disaster operations. Some SMEs speculate, that EM organizations will have to “evolve with the times”, but many say it may take a generational change to set this transformation in motion. One solution to overcoming the currently existing cultural barriers may be the creation of an effective interface between the two communities, such that they can connect through some kind of an intermediary. The role of the intermediary could be

played by VOST teams, such as CanVOST, composed of both volunteers and emergency managers acting in a volunteer capacity, or by non-governmental organisations (NGOs), such as the Red Cross, whose staff already has some experience working with virtual volunteers on disaster relief operations. An example of an EM organization taking deliberate action to empower and involve virtual volunteers in operations is the deployment of the Innovation Team by the US Federal Emergency Management Agency (FEMA) during Hurricane Sandy. This is described in more detail in Section 4.3 of this report.

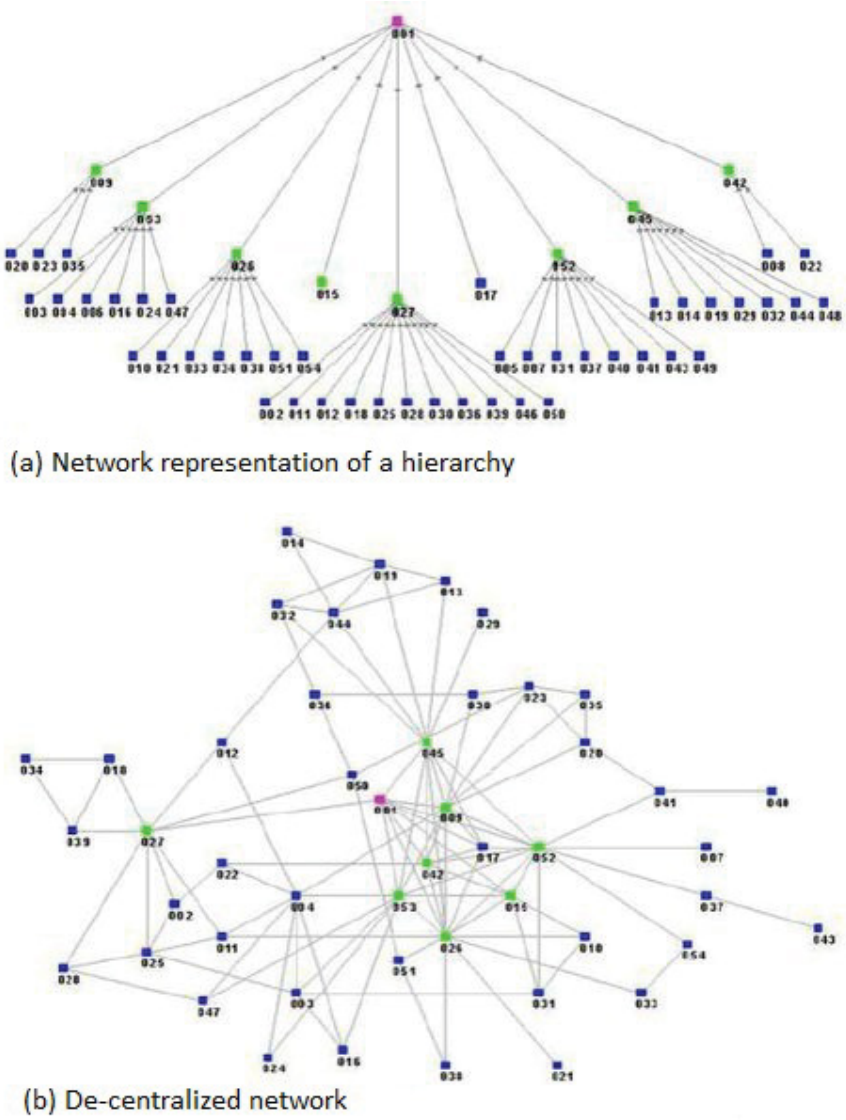

Figure 2: *Hierarchy (a) versus a de-centralized network, (b) Diagram reproduced from Ref [26].*

3 The SMEM maturity model

The SMEM targeted investment project (described in Section 1.2) identified a number of qualities, characteristics, and practices that leading SMEM practitioners and organizations have found to be helpful or even necessary, to build an increasingly mature SMEM capability. These SMEM maturity indicators have been organized in a model (Figure 3) that summarizes the main elements and characteristics along four dimensions: people, governance, technology, and implementation. Each dimension has several essential elements that take on changing characteristics as an organization implements and optimizes each element. For example, the expertise of people using social media and leading related activities not only deepens but also broadens—to include, for example, the area of virtual voluntarism—with increasingly deliberate and mature application of SMEM.

It is important to stress that the model should be viewed as a continuum along the horizontal dimensions. To that end, the four dimensions should not be viewed as being constrained and compartmentalized within the three maturity levels of "basic", "intermediate" and "advanced", but rather any intermediate and incremental level of capability is possible along a sliding scale from "basic" to "advanced" and even beyond as the capability matures.

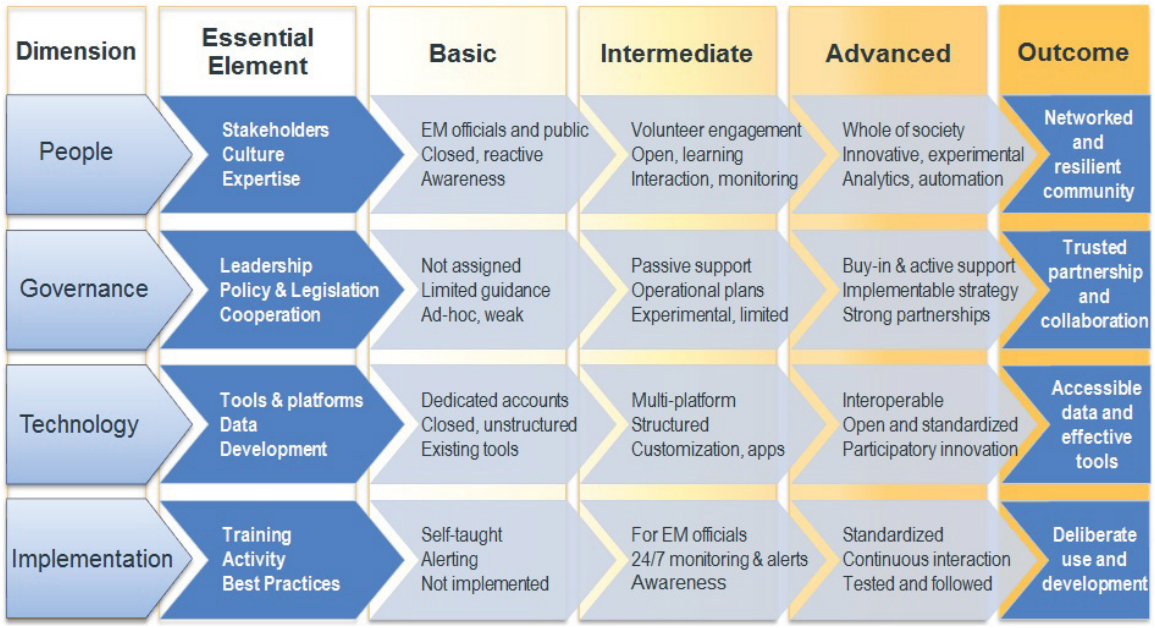

Figure 3: *The SMEM maturity model.*

It is also important to note the elements and characteristics addressed in the model are not exhaustive. Rather, the model is intentionally focused on the parts that were deemed most relevant to organizations and groups looking to strengthen their SMEM capability and embrace public (virtual) participation. The model is meant to provide an overview of the areas that will

require dedicated attention to move the use and integration of volunteer-supported SMEM towards a gradually higher degree of maturity.

Each dimension's essential elements, if addressed, will help to achieve the four maturity outcomes:

1. networked and resilient community;
2. trusted partnerships and collaboration;
3. accessible data and effective tools; and
4. deliberate (objective-based) use and development.

The model was developed based on an environmental scan, consultations with experts and case study analysis (detailed in Chapter 4). The six-step social convergence integration model developed by Partice Cloutier[12] as well as the Canadian Communications Interoperability Continuum, which is a part of the Communications Interoperability Strategy for Canada [27], were used to guide model development. The principles underlying the model are interoperability, collaboration, coordination and cooperation between all stakeholder groups involved in SMEM. Some of the questions that were considered during the development of the model were:

People

- Who are the stakeholders and new potential partners in SMEM?
- What culture, behaviour and attitude are prevalent at the basic, intermediate and advanced maturity stage (e.g., open, proactive, innovative, achievement through shared objectives)?
- What are the effects of cultural differences (e.g., objectives and motivations) between the various stakeholder communities and how do they influence possible collaboration?

Governance

- What do formal but nimble guidelines and criteria for the use of social media look like? For example, what could a guideline for alerts and warnings via social media media look like?
- What expectations do virtual volunteers have with respect to information sharing with EM officials and vice versa?
- What is needed to gain EM's confidence in social media results (validation, verification) and what are the consequences of not getting involved?

Technology

- What factors determine an agency's choice of tools and platforms? What platforms and tools are typically used at the basic, intermediate and advanced stages?
- What are the challenges in enabling the integration of public open data, private sector data and real-time crowd-sourced information for improved decision-making?
- What are the requirements for standards and data formats (open, interoperable, machine-readable)?

[12] http://www.ptsc-online.ca/blogs/crisisemergencycommunications.

Implementation

- What does a minimum level of basic but useful monitoring for improved situational awareness look like?
- What objectives should be pursued with SMEM and what outcomes are expected at each maturity stage?
- What education and training is required at each stage to build the necessary expertise of users and senior decision-makers? What is the role of exercises, simulations and experimentation?

The maturity model was expanded and modified based on the feedback received from the SME participants at the SMEM Expert Roundtable in Calgary. For example, the outcomes were added to the model after participants expressed the need to incorporate the overall goal of empowered, engaged, and resilient citizens and agile EM organizations that leverage the public's potential into the model [7].

4 Case studies

One Canadian and three international case studies were analyzed in the context of the SMEM maturity model, by looking at specific elements of the cases corresponding to the four dimensions of the model. A brief description of each of the events will be presented followed by an analysis of the People, Governance, Technology, and Implementation aspects for each case.

4.1 2010 Haiti earthquake

On January 12, 2010, a 7.0 magnitude earthquake struck Haiti, with the epicenter of the earthquake being approximately 25 km west of Haiti's capital, Port-au-Prince. The effect of the earthquake and its numerous aftershocks were devastating, with the Red Cross estimating up to three million affected people at the time of the disaster [28] and the UN later confirming over 230,000 people dead, 2.3 million people displaced [29] and declaring it one of the worst disasters the Western hemisphere has ever seen [30]. The earthquake caused major damage in Port-au-Prince, Jacmel and other inhabited parts of the region; levelling buildings, which were often poorly constructed to begin with, and taking out most of the critical infrastructure.

The international community swiftly mounted a massive response effort involving hundreds of different groups and agencies from around the world working around the clock, both on-site as well as helping remotely by soliciting donations, coordinating the supply of relief supplies, providing logistics support, etc. As in any large-scale and sudden-onset disaster of this kind, in the initial stages of the response, the relief agencies worked to obtain the information necessary to assess the damage and locate victims in order to plan the relief effort most efficiently. Many state [30] [31] that the Haiti disaster marked a turning point of sorts in the domain of disaster response because for the first time the affected population massively turned to mobile and online technologies, such as social media and SMS, to ask for help. Furthermore, thousands of people around the world responded to these calls for help by relaying, aggregating, translating and

transmitting these messages and therefore 'virtually' supporting the relief efforts. Thus the Haiti earthquake may be seen as firmly establishing social networking and the work of virtual volunteers as a valuable and potentially critical complement to official disaster response and emergency management. The case of social media and mobile technology use in Haiti motivated several developed countries, including the United States and Canada, to look seriously at the opportunities to use social media more and more deliberately for emergency management and to increase societal resilience. Surely, if Haiti, one of the poorest countries in the world [32] where access to technology is still fairly limited [33] experienced this level of online activity following a major disaster event, one can expect that a disaster in the developed world, where their use is widespread, would lead to an even increased reliance on these technologies.

4.1.1 People

The Haiti earthquake and the subsequent response resulted in the nexus of multiple stakeholder groups including, members of the community affected by the disaster, local and international government bodies and emergency responders, a multitude of humanitarian organizations, as well as virtual volunteers and concerned family members participating remotely using on-line and mobile technologies. While some of these stakeholders have worked together in the past, in the confusion immediately following the disaster, the mode of mutual engagement was unclear and most of the relationships and channels of communication had to emerge organically. The humanitarian organizations and emergency responders became quickly overwhelmed with the volume of information coming in through various channels, and were ill-prepared to generate actionable knowledge from this massive flow of data. Furthermore emergency responders on the ground did not have the tools or the capacity to intake the information coming in through social media channels. The virtual volunteer community on the other hand, was much better prepared in this regard and people around the world very quickly started to translate, aggregate, map and disseminate SMS and social media messages. However, at the time formal channels of communication between the virtual volunteers and the humanitarian organizations did not exist and so in many instances the information produced by the virtual volunteers exacerbated the information overload problem. On the other hand, when the virtual volunteers did have established relationships with officials prior to the disaster, the information they produced was invaluable to the responders. One thing that became apparent during the response phase was that trust played a big role in relationship building. While there was willingness on the part of the virtual volunteer community to participate in the official response, humanitarian staff on the ground was not as eager to include this new stakeholder group into their operations, mostly because they couldn't be sure if the information supplied by the volunteers could be trusted [30].

4.1.2 Governance

While the virtual volunteers helped out immensely during the Haiti relief effort, few made direct connections with the field staff deployed by the humanitarian organizations, which in turn prevented the field staff on the ground from fully exploiting the intelligence produced online. A need emerged, for a formal interface or channel of interaction, which could facilitate coordination between these two stakeholder groups. In order to create such a channel, the structured and hierarchical stakeholders groups such as the humanitarian organizations, emergency responders and the military, would need to figure out how to interact with the loosely network structured and ad-hoc volunteer community. This posed a complex problem and one which could not be easily

addressed in the middle of hectic relief operations, and as such, the disconnect between the groups prevailed to an extent, preventing both groups from fully benefiting from each other's work. To this day the challenge remains on how to create a governance ecosystem where all stakeholders understand their role and are able to work together effectively and efficiently [30].

4.1.3 Technology

Despite the massive damage, many of the cell towers in Haiti remained operational following the earthquake, allowing Haitians to send hundreds of thousands of pleas for help via SMS to Twitter, Facebook and wikis. The most prominent information management systems used during the Haiti disaster were Ushahidi, Sahana and the UN interagency One Response website. These volunteer-run platforms, created with open-source and mostly free software, not only augmented traditional information channels, but also became critical to effective disaster response by providing key geo-spatial situational awareness to the affected population as well as eventually the official responders. At the same time, some limitations of using these technologies became apparent including: information overload, widely varying speed of actionable information delivery and difficulty with processing information in various data standards [31]. Furthermore, these systems lacked the ability to easily interface with the systems employed by many of the relief organizations. Useful data was generated by the virtual volunteer community through aggregating, analyzing, and mapping information coming in on social media, but without a common interface or data standard this information could not be easily integrated into the official response systems, thus making it difficult for the official responders to benefit from the information [34].

Mapping and visualizing data is critical in any large-scale disaster response. In the aftermath of the Haiti earthquake, OpenStreetMap and its volunteer staff worked extensively in conjunction with the Ushahidi platform to generate near-real time, crowd-sourced, geo-tagged situational awareness which enabled targeted response, by identifying actionable needs by location [34]. Official responders began relying on the outputs of these tools when it became apparent that old maps of Haiti were no longer useful due to the change in landscape created by the earth-quake [30].

It should be noted that not all cloud technology proved useful in the response to the Haiti disaster. Web portals, for example, were not found to be useful because they tend to provide file dumps instead of a common picture and require people to piece together situational awareness by going through individual documents. Collaborative documents like wikis tended to be far more useful [30]. It should also be noted, that even with all the advances in technology, the predominant method of creating useful information still relies on people aggregating, analyzing and distilling the information to create useful intelligence within a specific context. Most systems in existence are not designed to receive a multitude of individual requests for assistance and need humans to perform data aggregation and verification.

4.1.4 Implementation

Prior to the Haiti earthquake the international humanitarian emergency responder community had no clear established objectives with respect to how social media could be incorporated into operations in a large scale disaster. The response to the earthquake made it clear that the

international humanitarian community did not have the tools and capabilities to handle the massive flow of social media information. Social Media data did eventually make its way into the relief operations in Haiti, when responders began relying on geo-spatial situational awareness products created by the virtual volunteers, but this was not deliberate or planned and rather evolved out of necessity. The response to the Haiti disaster also demonstrated that new technologies should not be introduced during active operations, but rather the capability should be incorporated into pre-disaster planning to create more efficient information flows. Furthermore, a lesson learned was that official responders have to develop new tools, systems and training to change the status quo. As for the digital volunteer community, it needs to ensure that the service it provides is reliable, consistent and sustainable, instead of relying solely on ad-hoc processes, if it is to be incorporated into official disaster planning, response and recovery. This includes developing and implementing open data standards that can be shared by both communities [30].

4.2 2011 Christchurch earthquake

On February 22, 2011, a powerful 6.3 magnitude earthquake struck Christchurch, New Zealand's second largest city, killing close to 200 people and causing widespread damage and building collapses including complete destruction of the city's central business district, parts of which remain off-limits until today [35][36]. The event was reported as likely being an aftershock of another 7.1 magnitude quake, which occurred close to the nearby Darfield approximately six months earlier in September 2010. The 2011 earthquake had more devastating consequences particularly because its epicenter was located so close to the populous city of Christchurch. The earthquake also generated a series of its own aftershocks which caused significant damage [37].

Emergency officials and members of the public reacted quickly and rescued many victims from the rubble. Although there were challenges with communication initially [38], a full emergency management structure was in place within two hours of the event, with a national response effort being coordinated from the National Crisis Management Centre in Wellington. A local emergency operations center was established in the Christchurch Art Gallery [39]. In the immediate aftermath of the event, New Zealanders turned to social media to share information and organize resources and aid. Over 5000 messages were sent through Twitter by government officials in the weeks following the disaster and 10 times as many by members of the public on February 22 alone. Furthermore thousands of local volunteers were mobilized through Face-book [40].

4.2.1 People

In the days immediately following the earthquake, Christchurch City Council set up a Wordpress site, a Twitter account and a Facebook page to communicate with the public, which were used to push out information as well as monitor the public's response. Urgent requests for assistance were forwarded to incident commanders for evaluation and action [38]. The affected community was able to not only communicate with the emergency management officials directly, but also self-organize to assist in recovery efforts, as evidenced by the 10,000 Student Volunteer Army organized via Facebook which assisted with clean-up, manned call-centers and distributed supplies [41].

Many local Christchurch residents created information resources for others in the community, collected and collated information and posted it online. Some local volunteer leaders set up websites that integrated official response information with other locally relevant data. Furthermore, the virtual volunteer community both within New Zealand and internationally aggregated and shared information from many different sources including Twitter, SMS, email and Ushahidi [38]. This online activity demonstrated the benefits of virtual volunteers in complementing the official response effort, however without easy access to local data and strategies to coordinate efforts with emergency officials, their value added was perhaps less than it could have been.

4.2.2 Governance

Official responders maintained a strong web presence throughout the crisis, but coordination with the efforts of other stakeholder groups, including the virtual volunteers, was somewhat limited. The emergency management agencies tended to follow a top-down approach in relation to the use of social media that made other stakeholders, such as the volunteers, feel undervalued and left out [40]. Nonetheless, online engagement by the emergency responders with the affected Christchurch residents was credited with facilitating the flow of aid resources and also resulted in increased trust in public officials.

As a result of having a plan in place, social media was credited with improved information sharing and enabling speedy and targeted response. During the earlier September 2010 earthquake, Emergency officials noticed high levels of activity on social networking sites like Facebook and Twitter among the affected populations, which prompted them to develop a plan for the use of social media in emergencies. As a result, the Christchurch officials quickly implemented an online media communications strategy when the February 2011 earthquake struck [38].

Coordination and information sharing between virtual volunteers and emergency officials however was somewhat lacking. Improved cooperation between these two stakeholder groups could have provided a solution to the overwhelming information needs of affected population. One reason for this disconnect could have been the mistrust in the volunteer information sources and the potential for misinformation as well as the lack of policies to support the potential engagement with online volunteer groups [40].

4.2.3 Technology

Social media played a key role in the immediate aftermath of the event by serving as the main tool for disseminating information among the affected population. The pre-existing Twitter hashtag #eqnz emerged as the main mechanism for relaying messages related to the earthquake.[13] Twitter activity averaged around 100 tweets per minute in the hours immediately following the event with the earthquake quickly becoming a ‘trending topic’. Analysis conducted following the event showed that the account that contributed most overall to the #eqnz hashtag was

[13] This hashtag first emerged during the 2010 tremor and became the most widely accepted and used hashtag for all subsequent earthquakes in New Zealand. Similarly, the value of Twitter as a useful communication tool was established during the 2010 disaster.

@CEQgovnz, which is the official Twitter account of Canterbury regions' government authorities [37]. This shows that it was not only the general public and virtual volunteers who engaged in online activity, but government officials and emergency responders were very actively using the technology as well.

Additionally, within hours of the earthquake, Ushahidi established an open source map[14] that was continuously updated with relevant geo-tagged information. This map was used extensively, including by emergency officials, until a more authoritative map[15] was posted days later by local authorities. For a time there was some competition between the two mapping sources, but since virtual volunteers did not have easy access to local data, the latter eventually became the primary source of reference [11].

A number of websites were also set-up to address the needs of the affected population and to support response and recovery efforts. For example, there were a number of sites dedicated to helping Christchurch residents find temporary accommodation and Google Person Finder, which was developed following the Haiti disaster, was also launched to help people locate their friends and family [40].

It should be noted that while social media was generally seen as extremely valuable for enhancing emergency management capabilities, many affected individuals had difficulty accessing information online because of widespread power outages and a weakened communications infrastructure. As a result, there were some reports of the needs of those without Internet access not being addressed as quickly and efficiently as those who had that access [38]. This was a reminder of the infrastructure dependency of social media and Web 2.0 technologies. Not everyone affected by a disaster will necessarily be able to benefit from information pushed out via social media channels or posted to the Web. Emergency (communication) officials have to take this into account when choosing their communication channels and adjust their plans as infrastructure is gradually restored after a disaster.

4.2.4 Implementation

The Christchurch emergency responders were well prepared to use social media in operations, in large part because of their planning efforts following the September 2010 earthquake near Darfield. The plans and objectives for using social media in communications were set out in the online media strategy, which the Christchurch officials implemented shortly following the disaster [38]. The staff performing public information functions at the Christchurch Response Center was very effective at managing a huge volume of social media communication and providing advice to the affected communities. On the other hand, while social media was monitored, there were some challenges achieving the responsiveness that social media demands while not being able to verify all information [39].

Some of the best practices and lessons learned which emerged through the Christchurch disaster include that emergency personnel need to be trained in using social media, including familiarity with pertinent hashtags, to ensure that they can follow and partake in relevant conversations.

[14] Eq.nz.org.
[15] Canterburyearthquake.org.nz.

Furthermore, emergency management officials should have an existing social media strategy, as well as an established social media presence well in advance of the event, in order to establish familiarity and trust with local communities [40].

4.3 2012 Hurricane Sandy

In late October of 2012, Hurricane Sandy made landfall on the east coast of North America. While the hurricane wreaked havoc in over a dozen US states and parts of Canada, it caused particularly severe damage on the coast of New Jersey and New York, where the storm surge hit on October 29. The heavy rainfall and extreme winds destroyed thousands of homes, caused streets, tunnels and subway lines to flood, and power was cut in and around the cities. The devastation was widespread in New York's Staten Island, where whole blocks of houses were swept away by the surge, killing 21 people. Overall, there were at least 147 deaths in the US that were directly attributed to Sandy, and the storm is estimated to have caused over $50 billion worth of damage [42].

In contrast to the two other disasters described above, this event was anticipated in advance. Weather forecasters warned that there was a 90 percent chance that the east coast of the US would be affected by the storm, and the media began issuing warnings in the week leading up to the hurricane making landfall [43][44]. US President Barack Obama signed emergency declarations on October 28 for several states expected to be most severely impacted by Sandy, and the US Federal Emergency Management Agency (FEMA) monitored Sandy closely and coordinated disaster preparedness and response operations with local emergency management partners [45][46].

4.3.1 People

All throughout the course of the events associated with Hurricane Sandy, government officials, emergency responders, business, volunteer groups, and individuals were very active on social media.

The general public used social media to contact loved ones and friends, communicate problems and needs to emergency officials, and to provide information and show support to the affected communities. This information was both passively monitored by responder agencies, as well as actively solicited through authoritative social media accounts. The response officials could not act on some of the information shared by the public due to verification issues, but the information was still helpful in illustrating trends and was used by many individuals to locate gas, food, and shelter. Virtual volunteer groups, such as Humanity Road, helped the on-line effort by aggregating information and key messages from many different sources and posting them in a centralized location. Some volunteer organizations also assisted in information verification. For example Snopes.com used crowd-sourcing to discredit many fake photos and helped to correct rumours and misinformation [47].

Emergency management agencies, particularly FEMA at the federal level, and New York City (NYC) officials locally already had an established and active social media presence prior to the storm however the level of on-line activity prompted by Hurricane Sandy was unprecedented. Over 2,000 tweets were sent from official NYC Twitter accounts, and at its peak, the city's

official Facebook page reached over 300,000 individuals. Similarly, FEMA's Hurricane Sandy widget was viewed over 2.8 million times in two months, and the FEMA website had just under one million views in that same time period [47].

Also unprecedented, was the level of engagement and leveraging of capabilities that occurred between the emergency officials and the virtual volunteer community. In many instances virtual volunteers acted as information brokers, by searching for, aggregating, verifying, sharing and posting information on-line using social media tools like Twitter, Ushahidi, Sahana, blogs, websites, etc. These efforts were either directly supporting or complementing official response operations. Organizations like Humanity Road, National Voluntary Organizations Active in Disaster (NVOAD), Geeks Without Bounds (GWOB), Occupy Sandy, and others, supported the relief effort by connecting information and resources to the affected community. Additionally, the American Red Cross deployed previously trained and certified volunteers in relaying information to and from the public [47].

Although most of the digital volunteer organizations had established relationships with the official emergency management organizations prior to the storm, some were established during the response, in an ad hoc manner. The latter scenario posed some challenges, as the more ad hoc volunteer groups were not as familiar with the roles, responsibilities and manner of operation of the official responders, which resulted in friction and frustration for both sides [47].

4.3.2 Governance

The US government had recognized the value of using social media in emergency management some two years prior to Hurricane Sandy. In December 2010, the US Department of Homeland Security established a working group, consisting of subject matter experts from the government, responder agencies, volunteer groups and academia, with a mission to provide guidance and best practices to the emergency management community on the use of social media before, during, and after emergencies.

The working group has produced a number of documents[16] that provide guidance on developing social media capabilities, tools, processes and policies. In addition to the federal initiative, NYC officials also implemented a Social Media Emergency Protocol in 2011 and extensively promoted the use of social media among city staff for communicating with residents [47]. This leadership paid off after Sandy hit, when emergency officials worked collaboratively and almost seamlessly alongside community and virtual volunteers.

FEMA also played a critical role in providing collaborative crowed-sourced solutions for preparedness, response, and recovery. This was exemplified by the deployment of an 'Innovation Team'—a multi-sector, cross functional group including both FEMA officials and virtual volunteers—to the New York area. Members of the team assisted relief efforts both remotely and on the ground by coordinating relief activities, helping to restore Internet connectivity, and directing residents to aid stations, shelters and kitchens. In November 2012, FEMA also obtained support from members of the virtual volunteer group GWOB to work in local FEMA offices and

[16] US Department of Homeland Security, "Social Media Strategy", "Next Steps: Social Media for Emergency Response", January 2012 and "Community Engagement and Social Media Best Practices", September 2012.

liaise with their staff. This group's role was to help bridge communication and coordination gaps between the formal and informal response efforts and to help streamline the information exchange between the ad hoc and hierarchical organizations. For example, when Occupy Sandy volunteers cleaned out houses, GWOB notified the city authorities doing disposal work so that they could remove refuse before it became a health concern [47].

The range of social media stakeholders involved in emergency management activities surrounding Sandy benefited from the governance arrangements, particularly the deliberately diverse and multidisciplinary connections made through the Innovation Team. However, several challenges were noted in a social media-focused Lessons Learned report published eight months after the event. These included, among others, the need to establish processes for enabling collaboration between ad hoc and non-standard technology partners and government entities, pre-deploying technologies for slow-onset events, and developing social media policies [47].

4.3.3 Technology

Hurricane Sandy caused widespread power outages and flooding, which in turn disrupted online and mobile communications. Recognizing that these means of communication were crucial to enabling effective response and recovery efforts, restoring service and providing access became a top priority. The FEMA Innovation Team partnered with volunteer groups, such as the Red Hook Initiative and Disaster Tech Labs, to quickly restore, and even expand access to mobile communications through innovative mesh network solutions [48]. The partnerships that FEMA has built with the private sector also played an important role. Cisco Systems, for example, created and deployed a tactical operations team to restore critical communications infrastructure and the company donated or loaned communication equipment to response organizations [47].

During Sandy, emergency management agencies aggregated and published information primarily on centralized portals. For example, NYC officials provided information via www.nyc.gov, and FEMA consolidated all federal content related to Sandy on www.USA.gov/sandy and information specific to recovery on www.FEMA.gov/sandy [47]. However, as mentioned in Section 3.1, emergency officials also maintained a strong presence on Twitter and Facebook. On October 29, FEMA reached approximately six million Twitter users through re-tweets by individuals and partners, with the term 'FEMA' getting 5,800 mentions on Twitter per hour. In the days following the storm making landfall, FEMA also created a rumour control website in attempt to dispel inaccurate information circulating on social media[17] [49].

The virtual volunteer community used a wide variety of online tools during Sandy, most of which were free and open-source. The volunteer group Occupy Sandy, for example, used Sahana Eden software to track requests for assistance, log inventories of supplies, follow work orders, etc. The group also maintained a WordPress site to push out information, connect individuals in need with resources, register and direct volunteers and to solicit donations [47].

As mentioned before, displaying data geographically on maps is particularly helpful in disasters and geo-tagging social media data can enhance real-time situational awareness. During Sandy several different volunteer groups helped to populate maps with information gathered through social media. Google's Crisis Map application was used extensively. One example was the

[17] www.FEMA.gov/hurricane-sandy-rumor-control.

'Hurricane Sandy Communications Map', which displayed locations of available Wi-Fi connections in areas hit by Sandy, as well as telephone outages. The map was crowd-sourced through people on the ground reporting locations and details of service. Another map, which was developed by Hurricane Hackers NYC, showed aerial imagery of hurricane affected areas with an overlay of areas where recovery efforts were taking place [47].

4.3.4 Implementation

Emergency management officials in NYC, as well as federal staff, were well prepared for Sandy, including having strategies in place for the use of social media before, during and after the event. Both local and federal officials had a prominent web presence, and had already established relationships with many virtual volunteer organizations as well as a history of communicating with the public online. For the most part, individuals knew their roles and responsibilities as well as protocols to be used during emergencies. For unprecedented and unanticipated events that unfolded, collaborative relationships allowed innovative solutions to be developed and implemented quickly, so that the needs of the affected population were addressed in a timely manner [47].

The American Red Cross played an important part in online engagement of virtual volunteers as well as volunteer training and certification. The organization's social engagement team ran three digital volunteer training courses and certified 19 individuals to use its Radian6 social media monitoring software [47].

Training of response organization staff in using social media tools still remains a challenge, as does the integration of social media with the incident command structure and emergency operations center protocols. During Sandy, emergency officials relied on virtual volunteers for providing them with briefs, including highlights from the online activity. As an example, digiDOC situational reports, created by the Red Cross social engagement team, were distributed daily to disaster relief workers and other partners [47].

4.4 2013 Calgary flood

In late June 2013, Alberta experienced heavy rainfall which led to catastrophic flooding in the city of Calgary and the surrounding area. On June 20, the City of Calgary declared a state of emergency and issued a mandatory evacuation order that affected 75,000 people living in the vicinity of the of the Bow and Elbow rivers and included a large area in Calgary's downtown core [50]. Overnight from June 20 to the 21, the flood waters spilled over to Calgary's central business district, flooded thousands of homes and commercial buildings, inundated the Calgary Zoo, threatening the lives of the animals, and reportedly filled the city's largest arena, Scotiabank Saddledome, up to the first ten rows [51][52][53].

Media outlets, relief organizations, city services, politicians but most of all Calgary's citizens used social media extensively during the response to and recovery from the floods. The Calgary Emergency Management Agency (CEMA), Calgary Police, a number of city officials, chief among those the mayor, Naheed Nenshi, deliberately included social media in their regular public communications [50][54][55].

4.4.1 People

It has been generally recognized that social media communication between city officials and the public during the flood was very effective, with success being attributed in large part to maintaining a constant and consistent flow of information. Calgary's mayor, Naheed Nenshi, who is a well-known avid user of social media, played a significant role in setting the tone for an effective flow of information by continuously engaging with citizens via Twitter and participating in daily press briefings. He once explained his motivation as follows: *"My philosophy is that everything we know should also be known by citizens as soon as safely possible. I am an advocate of sharing accurate information quickly, especially in an emergency, and City communications worked well to do exactly that."* [56] That said, SM use by the public affairs team of the City of Calgary was primarily focused on pushing out information and leading the conversation, with less emphasis on monitoring and public engagement.

The Canadian Red Cross (CRC) used social media for fundraising, information sharing, reputation management, and responding to questions from people affected by the floods. Given the volume of social media traffic, the national office of the CRC relied on their own volunteers as well as organizations like CanVOST and the American Red Cross to help monitor and filter social media traffic related to the floods, address questions from the public, and decide how to respond to calls for help. They also engaged celebrity tweeters, including Canadian singer Bif Naked, to amplify messages [57].

Finally, the citizens of Calgary embraced social media and used a variety of platforms (Facebook, Twitter, Instagram) to share information, organize community groups and offer support and resources if they had a room to spare or food to share [58]. Once the flood-waters receded and the full scale of the damage was revealed, Calgarians used SM to mobilize clean-up efforts. Notably, a local group of tech-savvy citizens launched a Facebook group that, within a day, acquired over 2,100 members indicating willingness to help. Shortly thereafter, that same group of citizens went on to launch a volunteer registration site[18] as well as a Twitter profile[19], which ultimately led to the mobilization of over 15,000 volunteers [59].

4.4.2 Governance

The social media unit within the Calgary Emergency Operations Centre (EOC) consisted of one dedicated staff member working around the clock during the crisis with additional support as necessary. The unit was part of the communications team and as such social media was used primarily to manage public affairs and provide information to citizens rather than for operational purposes. Operational staff coordinating the response on the ground had limited time to monitor or engage in social media, however there was some exchange of information that benefited incident management [54][55].

During the floods, the Municipal Emergency Plan was activated, and the reporting chain was re-configured such that messaging didn't have to be approved centrally by city officials and instead approval was led by the EOC, which made the information flow more efficient. Co-location of the crisis communication SM staff within the central EOC environment allowed for rapid verbal

[18] www.yychelps.ca.
[19] @yycHelps.

verification of information, such as road closures, and timely dissemination of information via the city's official SM channels. Furthermore, a significant amount of more general information was pre-approved for release by the EOC leadership [55].

Once operations moved into the recovery phase and the clean-up effort began, the city's SM channels became inundated with people volunteering to help in the clean-up effort. The city officials quickly realized that they did not have the capacity, tools or capability to manage the large volume of volunteers. CEMA officials approached the volunteer group YYC Helps, who by then had already developed a strong SM presence as well as a volunteer management platform. The City and YYCHelps worked together to develop a volunteer waiver form and volunteer management was taken over by YYC Helps. The official city SM channels directed all interested volunteers to YYC Helps. This partnership resulted in a well-organized and effective flood clean-up [60].

4.4.3 Technology

Since the first day of the flood, Twitter became the primary SM tool used by those seeking information updates. #YYCflood emerged as the primary hashtag, being featured an average of 32 times every minute over a 10 day period. The city officials also used Twitter, with Calgary Police initially leading the way since they already had a strong pre-established SM presence. Calgary Police actually got locked out of their Twitter account at one point, when they exceeded the maximum number of allowable Tweets. It was only due to help from a member of the public that the police account got unlocked. The city's official Twitter account followers increased by 50 percent (to 84,000) during the floods and the mayor's personal Twitter account gained over 28,000 followers [55][61][62].

City officials also used YouTube to share content of press briefings. The Public Affairs team found this to be beneficial to strengthen the City's reputation and to give citizens confidence in the decisions and actions that were taken to deal with the situation. For example, CEMA produced short videos to show citizens what it was doing on the ground and how its work benefitted the recovery. The official city website[20] crashed early on because of the huge volume of traffic to the site. A quick solution was developed which redirected people to the city's Wordpress site, where official updates were subsequently posted to the City's blog. The blog had 1.1 million visits in the immediate aftermath of the flood [55]. Similarly, the Canadian Red Cross used a blog to share updates, photos, videos, dispatched and stories to illustrate their efforts [63].

While free SM tools like Twitter, Facebook, YouTube and Wordpress were used extensively, custom-developed platforms utilized in the EOC environment, including the ESRI Emergency Management Common Operating Picture (EM-COP) and MASAS[21] proved less useful for SM monitoring. While EM-COP can accommodate Twitter data, it can only do so on an individual basis resulting in Tweets completely overwhelming the picture. As a result, commercial tools like HootSuite and TweetDeck were used instead. In the case of MASAS, which is designed for inter-agency situational awareness information sharing within the wider EM community, EOC staff found that the process of data input was too onerous in order for it to be used effectively. Another issue identified with the EM-COP platform was the inability to produce live mobile maps. Some

[20] Calgary.ca
[21] Multi-Agency Situational Awareness System, https://www.masas-x.ca/.

EOC staff members expressed frustration at the situation, since maps that were meant to be used in the field had to be first generated via the EM-COP and then printed in a large format. The large physical maps were cumbersome to handle and quickly became outdated, given the fast evolving situation. In some instances, city officials relied on a comprehensive mobile map put out by the local branch of the car sharing service car2go[22]. Interestingly, the car2go map was populated with information obtained from the city's own blog and SM feeds [54].

4.4.4 Implementation

At the time the flood hit, the city officials were in the middle of developing a crisis communications strategy. As a result, the staff ended up relying on a short publication from the UK[23], which they found useful as a guide to the fundamentals of social media in crisis communications. The city of Calgary did have a defined objective with respect to the use of SM, and it was to lead the conversation through establishing the city's corporate SM accounts as the authoritative and trusted source of information. The city officials realized that being active and engaged on social media allows control of the message. In that respect, the city officials were largely successful. Their messages were frequently shared by the public and often quoted by the media. In addition, they were quickly able to invalidate a rumour on social media that a boil water advisory had been put into effect. The EOC SM monitoring team caught the rumour and corrected the misinformation by sending out strong messages about Calgary's water being safe for consumption. This action arguably prevented people from panicking and stockpiling water [55].

One issue that arose for city staff during the flood was lack of user training on SM tools as well as awareness of best operational practices. The various levels of proficiency of different staff caused monitoring and engagement levels to vary as people changed shifts [54].

4.5 Summary and conclusion

Analysis of the people, governance, technology, and implementation dimensions of the case studies enabled the mapping of the four dimension elements associated with each event onto the SMEM maturity model. The results are shown in Figure 4 below. It should be noted that the placement of the mapping markers (stars) is subjective. It was accomplished through qualitatively comparing the information contained in the case study narratives with the descriptive elements associated with each maturity level as shown in Figure 3. A more detailed explanation of the placement of the markers on the continuum is given in the sub-sections below.

Overall, the mapping indicates that the potential of social media and online collaboration remains unfulfilled. There is room for growth and improvement in all of the four maturity dimensions and elements such as: situational awareness, engagement of the public as a source and partner, messaging, listening, monitoring, alerting, coordination, collaboration, innovation, intelligence and crowd-sourcing.

[22] https://www.car2go.com/en/calgary/.

[23] Defence Science & Technology Laboratory "Smart Tips for Category 1 Responders Using Social Media in Emergency Management", March 2012.

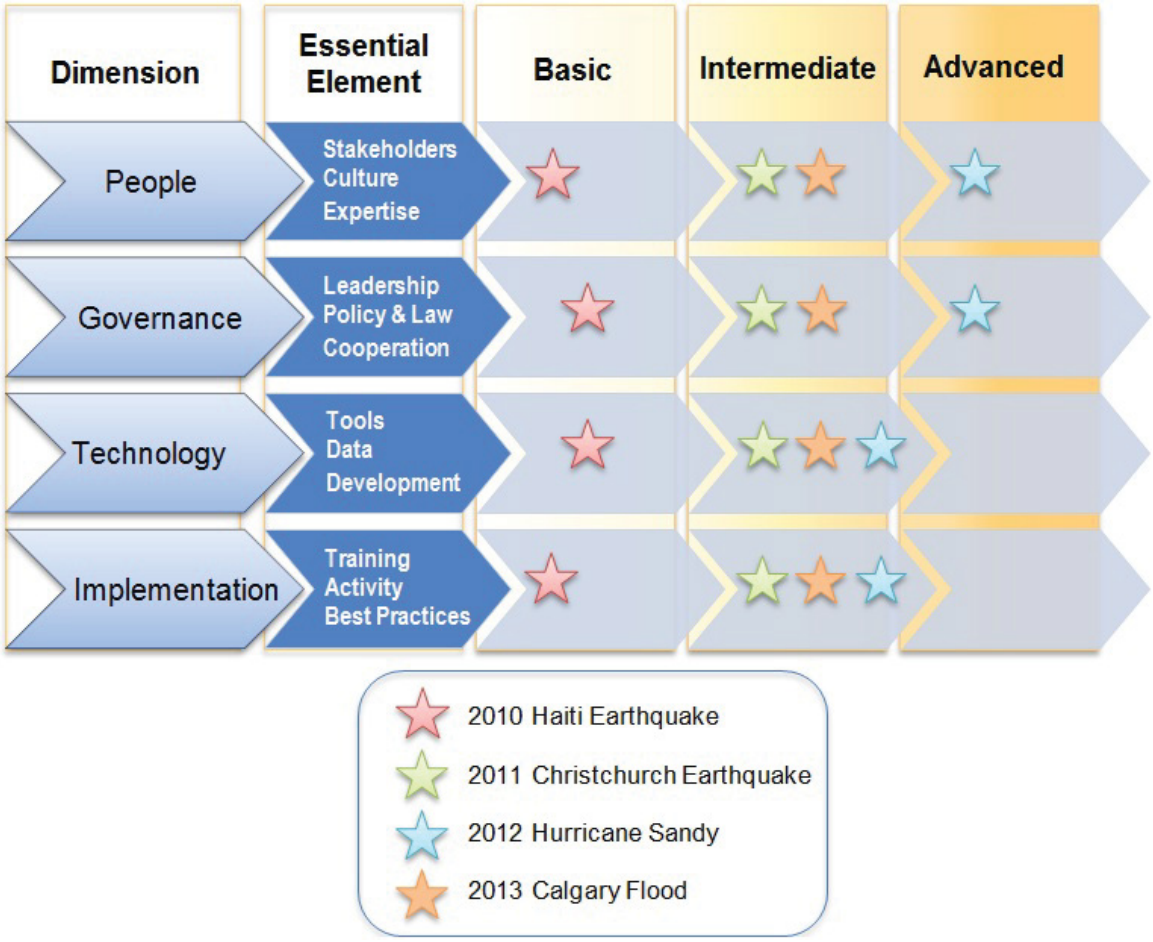

Figure 4: *The four dimensions of each case study plotted on the SMEM maturity continuum.*

4.5.1 People

The people dimension, analyzed from the perspective of the EM officials, showed a maturity evolution through the four case studies. In the case of the Haiti earthquake, the maturity is rated as 'basic' because the emergency officials, which in this case were the international humanitarian staff, displayed a closed and passive culture, which was not open to engaging with the virtual volunteers and had a difficult time communicating electronically with the affected Haitian population. The humanitarian staff had very limited social media expertise and did not engage in SMEM at all initially. The behaviour of this stakeholder group eventually extended to accommodation of the virtual volunteer community, when the relief workers realized the value of SMEM, particularly when it came to providing crisis geo-spatial information mapping support.

During the Christchurch disaster, which occurred just over a year after the Haiti earthquake, emergency officials were much better prepared to exploit social media and the level of maturity was rated as 'intermediate' in this case. The officials were familiar with SMEM and eager to implement it during response and recovery. Hurricane Sandy, which occurred eight months after the Christchurch earthquake, demonstrated 'advanced' SMEM maturity, with emergency officials

embracing both the use of social media as well as the value of virtual volunteers in complementing official response capabilities. The emergency officials demonstrated multiple examples of innovation and achievement both through their advanced use of various tools and their interaction with the virtual volunteers and the affected public.

Finally, in the case of the Calgary floods, the people maturity is rated as 'intermediate', since while SMEM was used by the city officials; it was primarily for pushing out information. There was interaction between the different stakeholder groups, with city officials engaging YYC helps to aid in volunteer management and the Canadian Red Cross engaging CanVOST.

4.5.2 Governance

In the case of the Haiti disaster, the governance aspect was clearly 'basic', as there was no policy framework or plan in existence for the use of social media in relief operations. Furthermore, there was no coordination or cooperation between the emergency officials and the virtual volunteers, and individuals had to rely on their own social networks and ad-hoc connections.

In the cases of the Christchurch earthquake, Hurricane Sandy and the Calgary floods, emergency officials had plans in place for incorporating SMEM into operations and they also had an established social media presence in advance of the disaster events. In all three cases, officials knew their roles and responsibilities when it came to the use of social media, and there were guidelines in place on how to use social media appropriately, though they were more established before the operations surrounding Sandy. Furthermore, during Hurricane Sandy, the cooperation between the emergency officials and virtual volunteers was significantly more mature than in the other two cases. While during Sandy officials worked almost seamlessly alongside virtual volunteers, in Christchurch the volunteer community was excluded from official operations. In Calgary there was limited engagement of virtual volunteers by the Red Cross, and city officials cooperated with the local volunteer group YYCHelps. Hence the Calgary ranks higher than Christchurch is the 'intermediate' governance category on the continuum, while Hurricane Sandy is rated on the lower end of 'advanced'.

4.5.3 Technology

During the Haiti earthquake, individuals relied mostly on the SMS technology and Twitter for communication and the virtual volunteer community exploited Ushahidi, Sahana and Google Maps. However, the emergency management officials' use and engagement in these technologies was either non-existent or very limited and as such the technology dimension of this case study is rated as 'basic'. On the other hand, during the Christchurch earthquake, Hurricane Sandy and the Calgary floods, emergency officials used social media extensively and virtual volunteers used more sophisticated analysis and mapping tools. While the social media platforms were not directly integrated into official systems, the emergency management staff used the outputs of these tools for situational awareness and to inform decision-making. This was especially apparent in the events surrounding Hurricane Sandy, and therefore while Christchurch, Sandy and Calgary are rated as 'intermediate' in the technology dimension, Sandy can be considered to be ahead on the maturity continuum.

An important facet, which has to be taken into account when considering the technology dimension, is access to online and mobile communication technologies. The case study narratives described how power and infrastructure failure following a disaster event can result in the loss of connectivity. In three of the cases significant numbers of the affected population were cut off from social media. However restoring connectivity quickly became an urgent issue, especially when stakeholders participating in response realized the extent to which the effected populations relied on these technologies. During Hurricane Sandy, restoring connectivity became a top priority and innovative solutions, such as mesh mobile networks, were implemented to solve the connectivity issue.

4.5.4 Implementation

Prior to the Haiti earthquake, the international humanitarian community had no established objectives with respect to the use of social media in relief efforts, nor did they have the tools or capabilities to incorporate SMEM into operations. As such the implementation aspect for this case study is rated as 'basic', though it is considered to be close to the low end of that maturity level.

In the cases of the Christchurch, Sandy, and Calgary, the objectives for the use of social media were clearly established. Hence, all three cases are rated as 'intermediate' in the implementation dimension, though Sandy may be considered as slightly ahead, because of better implementation of the training element, through exploitation of trained certified virtual volunteers.

5 Conclusion

EM and disaster relief communities face complex and ever-changing challenges that are influenced by regional and global economic, societal and technological developments. One of such developments is the widespread availability and growing use of mobile devices and social networking applications along with virtually ubiquitous access to the Internet. In combination, these have empowered Canadians to:

- connect, communicate and build relationships through online communities;
- mobilize for a cause they care about, launch online movements and overcome the collective action problem;
- access, create and publish digital information that can be instantly shared with a mass audience;
- enrich digital content with geographic coordinates and links to other contextual information; and
- record, document, and broadcast live events with their mobile devices.

These factors have enabled citizens to exert significant influence in areas of society that were previously viewed as the exclusive domain of large institutions, industry and government, including public safety and security.

The prevalence of social and mobile technologies gives EM organizations—and other stakeholders in community safety and security—an additional tool and opportunity to:

- engage directly with the individual members of the networked public and provide them with richer, timelier, targeted and thus more meaningful information;
- increase organizational and public situational awareness through Virtual Operations Support Teams (e.g., CanVOST) and other virtual volunteer groups (e.g., Canadian Red Cross); and
- provide opportunities for citizens and NGOs to participate (virtually) in preparedness, response and recovery efforts and build community resilience.

Adapting to changing public behaviours and expectations—related to the use of social media technologies—is not a choice. It is a necessity in order to remain relevant among an increasingly networked public. Our research has shown that one of the main challenges to implementing an effective SMEM capability is cultural differences between the traditional hierarchical EM organizations and the networked digital domain. Exploiting SMEM deliberately requires an EM culture that embraces openness and public accountability, appreciates the public's knowledge, expertise and connectedness, and values relations and partnerships with virtual and technical communities and others that use online technologies to support emergency management, aid and recovery. Public sector EM organizations need to examine where traditional policies and plans require updating to reflect the new reality of citizen empowerment and increased expectations of involvement. The necessary culture change can be achieved by building digital knowledge and leadership and gradually increasing the use of networked social technologies for collaboration with citizens, virtual volunteer organizations and other stakeholders. The maturity model presented in Section 4 is offered as a guide for this purpose.

What follows is a collection of guidance statements that have been developed on the basis of the research presented in this report. They are intended to help EM and disaster relief stakeholders develop an increasingly mature SMEM capability:

1. **Trusted relationships and partnerships should be built prior to a crisis**. This can be achieved by building communities through engaging with volunteers and citizens online and conducting exercises and drills involving all stakeholders.

2. **Policies, plans and guidance pertaining to the use of SMEM by organizations should be developed and institutionalized.** These policies should be agile so as to allow for the flexibility needed to account for the unpredictable nature of disaster events and the diversity of partners and stakeholders.

3. **SMEM-specific training should be made available to employees expected to engage during a crisis**. The training should range from basic training on social media tools through analytics and exploiting SMEM in operations to the strategic role of networked social technologies.

4. **SMEM should be incorporated across all aspects of the incident command structure.** Constraining the use of SMEM to public affairs limits the usefulness of SMEM in operations.

5. **Stakeholders should agree on the use of compatible and interoperable technologies and data formats**. This will maximize the contributions that can be made and the benefits that can be drawn by each stakeholder.

6. **SMEM stakeholders including EM organizations, VTCs, virtual volunteers and NGOs should agree on a set of shared principles that guide their (online) collaboration, cooperation and coordination.** This can include identifying opportunities for task-sharing and other forms of cooperation and establishing a process by which virtual volunteers are engaged and activated.

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Annex A The quad-chart for the SMEM project

CSSP-2013-TI-1034

Social Media in Emergency Management (SMEM)

Lead Organization: DRDC CSS

Partnership: Public Safety (PS) Canada, Canadian Red Cross, Calgary Emergency Management Agency (CEMA), Canadian Interoperability Technology Interest Group (CITIG)

Start-End: May 2013 – March 2015

Funds: CSSP $240,000 In-Kind $20,000

Total $260,000

Objectives:

- To exploit social media for enabling disparate groups and individuals to not only connect and communicate, but also to cooperate and innovate to support real-time problem-solving across the full spectrum of EM;
- To provide best practices for the EM community;
- To hold an objective-based dialogue with the EM, first responder and virtual volunteer communities in order to develop an SMEM "Roadmap" for Canada.

Impact on Outcomes:

The use of SMEM can build **strong communities** and increase resilience to disasters through:

- Increasing the information exchange and improving situational awareness;
- Building social capital though facilitating connectedness and community building;
- Increasing risk awareness and encouraging preparedness and mitigation activities;
- Identifying most vulnerable populations, hazard zones, and community capacities; and
- Connecting survivors with family members and aid resources.

Canada

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Annex B SMEM resources, manuals & guides

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List of acronyms

CanVOST	Canadian Virtual Operations Support Team
CEMA	Calgary Emergency Management Agency
CITIG	Canadian Interoperability Technology Interest Group
COP	Common Operating Picture
CRC	Canadian Red Cross
CSS	Centre for Security Science
DRDC	Defence Research and Development Canada
EM	Emergency Management
EM-COP	Emergency Management Common Operating Picture
EOC	Emergency Operations Centre
FEMA	Federal Emergency Management Agency
GWOB	Geeks Without Bounds
NGO	Non-Governmental Organization
NVOAD	National Voluntary Organizations Active in Disaster
NYC	New York City
SA	Situational Awareness
SM	Social Media
SME	Subject Matter Experts
SMEM	Social Media for/in Emergency Management
SMS	Short Message Service
TPS	Toronto Police Service
UN	United Nations
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
US	United States (of America)
VOST	Virtual Operations Support Team
VTC	Volunteer Technical Communities

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Emergency management and first responder organizations around the world are trying to exploit the use of social technologies to prepare for, respond to and recover from crisis. Social media offer the opportunity to connect and cooperate with the networked public, take advantage of the capabilities and innovations of virtual volunteers, and to reach people quickly with alerts, warnings and preparedness messages. Canada's emergency management community has not yet fully embraced social media. This report describes an effort to understand the state of maturity of the use of social media in emergency management as well as to create a "roadmap" for an effective use of this capability in Canada. The research involved conducting an environmental scan, consultations with experts and case study analysis. We found that there exists an awareness and expertise gap between the community of internationally experienced virtual volunteers and the emergency management organizations in Canada and that the potential of social media and online collaboration remains unfulfilled. One of the main challenges to implementing an effective capability is resolving how to bridge the command-and-control, hierarchical culture of emergency management organizations to the horizontal, networked culture of the digital domain. The report offers suggestions on how to improve and mature the implementation of social media in emergency management in Canada.

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Social media; emergency management; volunteers; social networking; first responders; disasters and resilience.

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