CHAPTER 11: SOCIAL MEDIA AND EMERGENCY MANAGEMENT

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ABSTRACT

This chapter reports on the challenges and opportunities made possible by social media in the field of emergency management. First, we consider the emergency practitioner and the challenges they face when using social media: difficulties in verifying social media data, liability risks, information overload, and a lack of resources to manage social media communications and data. To address these challenges, we propose the use of performance measures, standards, best practices, digital volunteers, training, and exercises.

Attention then turns to the research around social media in times of crisis. This research investigates public activity (citizen reporting, community-oriented computing, and collective intelligence and distributed problem solving) and demonstrates how social media have shaped—and continue to shape—perceptions around how members of the public can participate in an emergency. We then look at research that studies emergency management organizations as they seek to understand how social media might be used in their practice. We conclude with descriptions of future research directions and next-generation tools for monitoring and extracting information from social media.

Finally, we discuss the differences between practice and research perspectives and discuss how these differences can make it difficult to reach consensus regarding social media's role in emergency response. We advocate that as practice and research work together expanding the research agenda, understanding roles, building relationships, considering organizational fit, and developing best practices, they will advance knowledge about the potential and realities of social media and move toward envisioning how social media may be used as a resource in emergency management.

AN ACADEMIC'S PERSPECTIVE

Social media are Internet-based applications that promote high social interaction and user-content generation often at a one-to-many or a many-to-many scale. Examples of popular social networking applications include Facebook, Twitter, YouTube, and Flickr. Social media have visibly opened up the discussion around the matter of public participation in disaster and presented new opportunities for research. In recent years, users of social media have demonstrated how broad and ready access to other people during a crisis[1] event enables new forms of information seeking and sharing and exchanges of assistance (Hughes, Palen, Sutton, Liu & Vieweg, 2008; Palen & Liu, 2007). Through social media, a growing number of eyewitness texts, photos, videos, maps, and other information contribute to the information available around crisis events. Meanwhile, emergency management organizations are working to understand how to respond to the new content and these new communication platforms: the initial focus on developing and executing best practices for outward communications is now giving way to discussions about augmenting response efforts with inclusion of data from the public (Hughes & Palen, 2012; Latonero & Shklovski, 2011).

The purpose of this discussion is to review the research literature on social media's role in times of crisis. We approach this review from a crisis informatics perspective. *Crisis informatics* is the study of the social and technical (socio-technical) behaviors in emergency response, with a focus on the flows of information between the people and organizations involved (Hagar & Haythornthwaite, 2005; Palen, Vieweg, Liu & Hughes, 2009). Crisis informatics brings attention to members of the public as contributors and receivers in the emergency information arena and reveals the nature of information exchanges in play. In addition, as the public's role becomes more visible through the lens of social computing,[2] crisis informatics attempts to descriptively and theoretically account for social behavior that is made possible through technology.

In this discussion, we give an account of social computing research in the context of crisis events. Starting with the first observations of social media activity in crisis, we describe activities by the public (citizen reporting, community-oriented computing, and collective intelligence and distributed problem solving) and demonstrate how social media have shaped—and continue to shape—perceptions around how members of the public can participate in an emergency. Discussion then turns to consideration of emergency management organizations as they seek to better understand how social media might be used in their practice. Included in this discussion is a consideration of the challenges emergency managers face as they adopt social media: roles and responsibilities, liability, data deluge, trustworthiness of citizen-generated data, reliability of social media networks, and universal information access. Finally, we present descriptions of future research directions and next-generation tools for monitoring and extracting information from social media.

Social Media Enters the Emergency Scene

In response to Hurricane Katrina in 2005, crisis informatics research documented some of the first cases of social media use in response to a crisis event (Macias, Hilyard, & Freimuth, 2009; Palen & Liu, 2007; Procopio & Procopio, 2007; Robinson, 2009; Shklovski, Burke, Kiesler & Kraut, 2010; Torrey et al., 2007). In two studies, researchers examined blogs and online forums following Hurricane Katrina and discovered that these online communication venues provided places where displaced citizens could virtually connect with members of their geographically based communities to exchange information and cope with their loss (Procopio & Procopio, 2007; Shklovski et al., 2010). Torrey and colleagues (2007) found that several citizens used online means to coordinate disaster relief, such as the donation of clothes, toys, and other items. Additional research discovered cases where citizens used social media to help find missing persons as well as housing for victims (Macias et al., 2009; Palen & Liu, 2007). These initial studies demonstrate that through social media, citizens could potentially offer and obtain crisis-related information (Palen & Liu, 2007) as well as participate in disaster response and recovery efforts even when remotely located from physical disaster sites (Heverin & Zach, 2010; Hughes et al., 2008; Qu, Huang, P. Zhang, & J. Zhang, 2011; Vieweg, Hughes, Starbird & Palen, 2010).

After Hurricane Katrina, research continued to explore social media activity in times of crisis, but expanded this exploration to a variety of hazards. Many students took advantage of already established networks in social media applications like Facebook during the 2007 Virginia Tech school shootings; students used these applications to assess the impact of the event on their wide and diffuse social network (Palen et al., 2009; Vieweg, Palen, Liu, Hughes & Sutton, 2008). Public participation during the 2007 Southern California wildfires demonstrated how social media could function as an important "backchannel," where members of the public could informally obtain, provide, and seek information that clarified and expanded upon the information they received from formal emergency management channels (Sutton, Palen, & Shklovski, 2008). Other studies looked at the role that social media could play in repairing human infrastructure and creating a sense of normalcy amid ongoing conflict and war (Mark, Al-Ani, & Semaan, 2009a; Mark & Semaan, 2008). Qu and colleagues (2009) studied a popular online forum in China (Tianya) following the 2008 Sichuan Earthquake and found that the forum provided a place for information sharing, seeking, gathering, and integrating as well as a place where community members could provide emotional support. These research findings demonstrated social media's range of use and captured the attention of emergency managers who were beginning to consider whether social media could benefit formal response efforts.

Application to Emergency Management

It is difficult to pinpoint exactly when emergency managers started to take notice of social media and their potential. However, the authors began receiving requests in 2007 from

early adopters interested in understanding how social media could be used in emergency practice—following two particularly visible crisis events where citizens notably used social media: the 2007 Virginia Tech Shootings (Palen et al., 2009) and the 2007 Southern California Wildfires (Shklovski, Palen, & Sutton, 2008; Sutton et al., 2008). Research had shown that social media channels allowed for quick dissemination of information during a crisis (Kodrich & Laituri, 2011; White, Hiltz, Kushma, Plotnick & Turoff, 2009) as well as two-way communication between members of the public and emergency management organizations (Artman, Brynielsson, Johansson & Trnka, 2011; Hughes & Palen, 2012; Latonero & Shklovski, 2011; Palen & Liu, 2007). Furthermore, the information contained in citizen-generated data showed potential for contributing to situational awareness (Cameron, Power, Robinson & Yin, 2012; Ireson, 2009; Vieweg et al., 2010), which could benefit emergency response operations (Hughes & Palen, 2012).

However, social media adoption in formal emergency management has lagged behind that of public uptake (Hughes & Palen, 2012; Latonero & Shklovski, 2011; Sutton, 2010). In the Joint Information Center (JIC) at the 2008 Democratic National Convention[3] (DNC), Sutton (2009) and her colleagues examined if and how its staff used social media. Without clear plans for how monitoring might be done—and, critically, without clear problems arising in this particular National Security Special Event (NSSE[4]) for information officers to respond to or interact with—emergency managers fell back on standard operating procedures that emphasized traditional media monitoring (e.g. television and radio broadcasting and newspapers). Latonero and Shklovski (2011) investigated the use of social media by the Los Angeles Fire Department (LAFD) in 2009. At the time, the LAFD's active use of social media (monitoring, message distribution and response) was unusual for an emergency response organization, and Latonero and Shklovski (2011) suggest that much of LAFD's advanced adoption could be attributed to having a single social media evangelist in the department. Around this same time (in 2009), Hughes and Palen (2012) interviewed 25 Colorado public information officers (PIOs) and reported that PIOs wanted to use social media but did not have permission or support from their management to do so. In addition, many of the participants reported that they lacked training as well as the resources to commit to maintaining a social media presence between emergency events. For those PIOs who had been able to obtain the permission and resources to use social media, they were most often used for one-way message distribution, with little interactivity with their constituents.

Moving Toward Increased Public Participation

While emergency management organizations began to consider how to include social media in their communication activities, the discourse around public participation in crisis began changing. Previously in these organizations, public communication channels were imagined as one-way pathways that flowed from emergency response organizations to members of the public (Palen & Liu, 2007). However, with the emergence of social media applications,

members of the public exploited new opportunities for participating in crisis response and recovery efforts, which laid bare and propelled existing behaviors. With readily available ways to communicate with peers, to generate information that could be tactically valuable to response, and to perform support functions that could complement emergency response strategies (Meraz, 2006; Palen & Liu, 2007), crisis informatics research launched investigations of these behaviors and how they could be shaped for future visions of emergency management.

Citizen Reporting

The ability for people to report from on-the-ground during and after an event has found analogies to ideas of citizens as "sensors" (Goodchild, 2007)—members of the public who detect, measure, and report local emergency information—and citizens as "journalists" (Gillmor, 2006)—members of the public who collect, report, analyze, and disseminate news and information. In the world of emergency response, the idea of first-hand reporting—particularly in the form of visual documentation through the use of camera phones and photo-sharing sites—made an indelible impression of what the future of public participation could bring to both the tactical aspects of response (Fontugne, Cho, Won & Fukuda, 2011; Liu, Palen, Sutton, Hughes, & Vieweg, 2008), as well as the longer-term aspects of a community's cultural heritage (Liu, Palen, & Giaccardi, 2012; Liu, 2011). The ability to broadcast messages to wide or selective audiences (Dabner, 2012; Palen & Vieweg, 2008; Sutton et al., 2008) and provide commentary on events through blogs and public forums continues to reinforce the idea of highly localized but widespread "journalism" and "sensing" (Al-Ani, Mark, & Semaan, 2010; Jin & Liu, 2010; Macias et al., 2009).

Studies of disaster events around the world have documented instances and the likely ubiquity of citizen reporting. During a five-day media ban following a controversial election in Kenya, social media provided a means for citizens to act as on-the-ground reporters who provided and consolidated information (Mäkinen & Kuira, 2008). Meier and Brodock (2008) reported on this same Kenya election and found that citizen reports of protest activity and violence were published well before traditional media channels reported them, a behavior that gave rise to the Ushahidi platform, discussed later. Similarly, the first widely available video footage of the 2008 Sichuan Earthquake was shot by a Sichuan University undergraduate student with his camera phone (Wang, 2010).

Community-Oriented Computing

Social media have been described as facilitating online communities where members share and seek information during times of crisis (Qu, Wu, & Wang, 2009; Wang, 2010). As an early instance of this, following Hurricane Katrina, studies report how some New Orleans residents went online in an attempt to locate friends and neighbors—with the hope of reducing the geographical distance between their newly dispersed community (Macias et al., 2009; Procopio & Procopio, 2007). During the Southern California wildfires of 2007, the fires were so diffuse across the region that acquiring information about particular locations

and neighborhoods from traditional media sources was difficult. In this environment, innovations around social media emerged that let some mountain communities share information specific to their concerns (Shklovski et al., 2008). They were in a sense able to "project" their geographical community activities to the digital sphere, but connect on the basis of geographical bounds.

By providing community members with tools to engage in crisis preparedness, response, and recovery, social media may have a role to play in building community resilience—a measure of a community's ability to respond to, withstand, and recover from adverse situations (Belblidia, 2010; Dufty, 2012; Mark, Al-Ani, & Semaan, 2009b). Hjorth and Kim (2011) found instances, following the Great East Japan Earthquake of 2011, in which social media provided a means for residents to express emotion and to grieve with their community. Several studies examined how members of the public create collective histories of crisis events by sharing photos, videos, and personal experiences over social media (Liu, 2010; Mark et al., 2012). Social media may also create a sense of solidarity during political protests (Starbird & Palen, 2012; Tonkin, Pfeiffer, & Tourte, 2012) and times of war (Mark et al., 2009b; Mark & Semaan, 2008). In addition, studies have demonstrated that social media have a place in crisis recovery and the restoration of a sense of normalcy (Al-Ani et al., 2010; Mark et al., 2009a; Semaan & Mark, 2011).

Collective Intelligence and Distributed Problem Solving

Social media have been shown to facilitate collective intelligence—where large, distributed groups of people solve complex problems (Palen et al., 2009; Vivacqua & Borges, 2010). For example, students affected by the Virginia Tech shootings converged on popular social media sites to first report their own safety in the early, uncertain moments, and then from these data (and their absence) began compiling lists of those who had died as they learned how extensive the trauma was to their community. This happened across more than one group, and though no single list was complete, across all lists, every name was correctly identified before they were publically released (Palen et al., 2009; Vieweg et al., 2008).

Starbird and Palen (2012) examined Twitter posts (or tweets) during the 2011 Egyptian uprisings and noted how members of the crowd recommended and filtered tweets by rebroadcasting (or retweeting) them. The most frequently retweeted messages among remote, worldwide observers tended to be those with broad appeal, such as high-level news reports and messages of solidarity with the Egyptian cause, but related subsequent work on the Occupy Wall Street movement suggests that those on the ground are seeking more particular kinds of information (Starbird, Muzny, & Palen, 2012).

Citizens may also provide geographically tagged localized and distributed reports—known as volunteered geographic information—of crisis events through social media (DeLongueville, Luraschi, Smits, Peedell, & De Groeve, 2010; Goodchild, 2007). This geographic information can then be collated and mapped by volunteers who call themselves

"crisis mappers" using open source mapping software such as Google Maps,[5] OpenStreetMap,[6] or Ushahidi[7] (Goodchild & Glennon, 2010; Heipke, 2010; Norheim-Hagtun & Meier, 2010; Zook, Graham, Shelton & Gorman, 2010).

Contributions to Situational Awareness

An important contribution social media offer in times of crisis is their potential to enhance situational awareness (Ireson, 2009; Johnson, Zagorecki, Gelman & Comfort, 2011; Vieweg et al., 2010). *Situational awareness,* in the emergency domain, describes human perceptions of the multifaceted circumstances around a crisis event that allow for interpreting situations, making decisions, and predicting future outcomes. Obtaining situational awareness is vital for those dealing with crisis because these situations are unusually complex and poor decision making may lead to adverse consequences (Johnson et al., 2011; Vieweg et al., 2010).

Examples of situational awareness research include the in-depth analysis of tweets sent during the 2009 Red River floods and the 2009 Oklahoma City fires, where tweets were found by searching on relevant keywords (e.g., #redriver and #okfires). Researchers analyzed tens of thousands of tweets by hand to identify and extract information that could enhance situational awareness, such as flood-level status and fire locations (Vieweg et al., 2010). Subsequently, Project EPIC[8] (Empowering the Public with Information in Crisis) has developed a natural language processing classifier that analyzes text to help identify tweets contributing to situational awareness (Corvey, Verma, Vieweg, Palmer & Martin, 2012; Verma et al., 2011), though in general, the state-of-the-art nature of the field is such that automation behind situational awareness derivation is quite difficult to do dependably. Ireson (2009) assessed the extent to which public forum postings could add to situational awareness during the 2007 floods around Sheffield, UK, and found extractable relevant event information despite the inconsistent quality and conversational nature of the posts.

Research has demonstrated that data from social media interactions can provide situational awareness for specific crisis-related tasks and domains. Using natural language processing techniques and crowdsourcing (the process of accomplishing a task by dividing it into subtasks that can be performed by a large group of people), several research groups have developed methods and tools for detecting and monitoring epidemics through social media data analysis (Chen & Sui, 2010; Culotta, 2010; Munro, Gunasekara, Nevins, Polepeddi & Rosen, 2012) . One study used Internet reports to create early estimates of the death toll for the Great East Japan Earthquake of 2011 (Yang, Wu, & Li, 2012). The estimate was correct within one order of magnitude—an improvement over early static estimation models that can be off by as much as three orders of magnitude—and it could be updated as more information became available. Another study augments standard evacuation models with evacuee sentiment obtained from social media with the aim of improving evacuation planning (Gottumukkala, Zachary, Kearfott & Kolluru, 2012). Researchers at several

institutions have used geographic information contained in social media reports to detect earthquakes and predict earthquake impact and damage (Earle, Bowden, & Guy, 2012; Guy, Earle, Ostrum, Gruchalla & Horvath, 2010; Sakaki, Okazaki, & Matsuo, 2012).

Social Media Use in Formal Emergency Management

Many of the initial challenges that had prevented social media use in formal emergency management began eroding around 2010, though concerns about this changing socio-technical arena naturally remain. Early adopters within the emergency management community shared anecdotes and gave illustrations about valuable social media use. A growing body of empirical research documented innovative online behaviors that enlightened what future contributions of social media could be. A number of policy and research visioning meetings have been held (Burns & Shanley, 2013; Committee on Public Response to Alerts and Warnings on Mobile Devices & National Research Council, 2011; Committee on Public Response to Alerts and Warnings Using Social Media, Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences, & National Research Council, 2013; Computing Community Consortium, 2012). Emergency managers continue to face mounting pressure from members of the public to use social media (Hughes & Palen, 2012); if emergency managers do not provide adequate social media information around a crisis event, citizens may obtain their information elsewhere (Stephens & Malone, 2009). These factors made emergency management more likely to support and incorporate social media in their practice.

In this changing environment, several empirical research efforts have studied emergency management social media use. One study looked at whether international medical response teams and organizations coordinated through Twitter during the 2010 Haiti Earthquake (Sarcevic et al., 2012). Though there was little evidence of direct coordination between these international groups distributed across Haiti, the researchers identified an important pre-condition to coordination: that of online “beaconing behavior,” where responders broadcast messages in the hopes that the message would be heard by a large audience. This is taken as a sign that groups are anxious to assist, to make themselves known, and to coordinate in a highly decentralized activity. They perceive the digital sphere as being important in this regard, but it does not automatically provide the social connections that are needed (Sarcevic et al., 2012).

Another study looked at social media use by two different police organizations during the August 2011 UK riots. Each organization took a different approach to their Twitter communications (“instrumental” and “expressive”), which yielded advantages and disadvantages in terms of relationships with the public and the ability to sustain communications over a period of time when internal resources were taxed (Denef, Bayerl, & Kaptein, 2013). Briones and colleagues (2011) interviewed forty members of the American Red Cross to understand how they use social media to build relationships with their public

and found that members perceived social media as both an effective and necessary public relations tool.

Around the time of this writing, very recent research efforts include an analysis of tweets about the 2013 Boston Bombings. This analysis discovered that with the widespread attention focused on the event, emergency officials needed to tailor their Twitter communications to both a local audience seeking help and guidance as well as a remote audience wanting to know more about the attacks (Sutton et al., 2013).

In addition, new research by Hughes, St. Denis, Palen, and Anderson (2014) offers insight about the online communication behaviors of 840 fire and police departments within a 100-mile radius of where Hurricane Sandy made landfall in 2012. They found that though use of Facebook, Twitter, websites, and Nixle was relatively low overall, the ways in which departments employed the technology varied widely. Creative uses by some departments suggest new possibilities for public engagement in the future, and such variance suggests that a social media practice remains highly emergent as groups experiment with different styles of engagement.

Best Practices for Social Media Use

Much of the guidance available to emergency managers regarding social media use comes in the form of best practices—guidelines regarding what social media tools to use and how to use them (Jin & Liu, 2010; Rajan, Chen, Rao & Lee, 2010; Veil, Buehner, & Palenchar, 2011; White & Plotnick, 2010; White, 2011) . Nilsson and colleagues derive a set of considerations for using social media to warn the public about approaching crisis, noting the importance of establishing trust (Nilsson et al., 2012). Another study looks at blog usage in crisis and offers recommendations for how public relations professionals can monitor and respond to blog content (Jin & Liu, 2010). One group of researchers looked at how the public consumes and provides information over social media to draw conclusions about how crisis management communications are perceived by the public and offer guidance for how to work with social media. They note that the crisis origin, information form, and source play important roles in how information is perceived (Jin, Liu, & Austin, 2011). Latonero and Shklovski (2011) spoke with emergency managers about how they use social media, and noted the importance of having a social media evangelist to make it successful. The difficulty with these types of prescribed practices, however, is that they are often unique to the situation or the organization in which they were developed, which can make it difficult to apply them in other contexts.

Challenges to Social Media Adoption

Though many organizations seek to adopt social media, the practical matter of formally incorporating it into emergency management practice still presents challenges.

Changes in Role and Responsibility

Introducing social media into emergency response procedures changes the way responders communicate within the organization and externally to their constituents, which in turn, challenges established roles and responsibilities. Some of the structures and procedures that support emergency management organizations do not lend themselves to social media use. For example, PIOs—the public relations side of emergency management—are required to obtain permission from the Incident Commander or emergency operations center (EOC) Manager (for EOC PIOs) of the crisis response effort before they can send any information to the public, but this can be challenging if the PIO is trying to use social media. One of social media's strengths lies in the distribution of short, timely messages, something that is difficult to leverage if permission must be sought every time a message is sent (Crowe, 2010). Some emergency managers fear losing control of "the message." In the past, emergency management organizations were the primary source of official information during a crisis, but now the mainstream media are also willing to rely on citizen-generated content (Wigley & Fontenot, 2010). Members of the public, as long as they can discern reasonable credibility of the source, will also consider the viability of user-generated content (Palen, Vieweg, & Anderson, 2011). During high-response times, PIOs often monitor social media streams to ensure that information communicated by the public is correct. Even though they are not authorized to respond to these communications, they will step in to correct misunderstandings (Hughes & Palen, 2012).Observations like these highlight the need for procedural and policy changes to support the use of such emergent social media practices.

Concerns with Liability

The adoption of social media as a communication and information channel in formal emergency response efforts raises liability issues (Lindsay, 2011; Low et al., 2010; Sicker, Blumensaadt, Grunwald, Palen & Anderson, 2010). In times of crisis, the emergency management action or inaction may cause injury, death, or property damage, potentially leading to litigation. Consequently, emergency managers want to ensure that all the information they work with is accurate, complete, and does not violate citizen privacy. However, when dealing with large amounts of unstructured public data, it is difficult to determine what information meets this standard (Low et al., 2010; Sicker et al., 2010). Another liability concern arises with growing public expectation that when requests for help are made through a social media channel, there be an appropriate response (American Red Cross, 2011). Currently, very few organizations could meet this expectation in large part because online communications outstrip what can be monitored, even with technology aids (Lindsay, 2011). However, another concern is the liability incurred by not responding to requests that *do not* reach the social media sphere: are those who are most vulnerable and perhaps the most injured able to have the same "social media volume" as others?

Deluge of Data

Social media use has become so widespread that during a major crisis, the vast amount of information available becomes difficult to monitor and make sense of. For instance, during

Hurricane Sandy in 2012, Project EPIC collected over 26 million tweets in an attempt to comprehensively collect the worldwide tweet communications about the warning, onset, and two-weeks post hurricane. Such representative data sets enable rigorous data analysis of how social media were used during the event, using a specialized infrastructure designed to handle large data sets—itself a research project on its own (Anderson & Schram, 2011; Schram & Anderson, 2012). At this point in time, it is almost impossible to make sense of the large amount of socially generated data without adequate tools to filter, analyze, and visualize the data. The goal of doing this in real-time remains an objective of the technology research community.

In response to this challenge, researchers have designed and built several systems that filter and analyze social media streams in times of crisis. The Enhanced Messaging for the Emergency Response Sector (EMERSE) system classifies and aggregates tweets and text messages using supervised learning techniques so that emergency responders and members of the public can more easily access them (Caragea et al., 2011). A research group from Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) has developed a Twitter tool with burst detection, message summary, machine learning and classification, and history analysis (Cameron et al., 2012; Yin et al., 2012). Twitcident uses semantics techniques to filter tweets and provide better search capabilities to help people explore Twitter data (Abel, Hauff, Houben & Stronkman, 2012; Terpstra, de Vries, Stronkman & Paradies, 2012). All these systems demonstrate proof-of-concept of such ideas, but they are not deployable at scale.

An alternative approach to filtering large information sets is to shape the social media data itself, making it easier to parse and analyze. The Tweak the Tweet project proposes a prescriptive syntax using descriptive hashtags (e.g., #location, #status, #needs, #damage) to make tweets more machine readable and allow for automatic analysis (Starbird & Stamberger, 2010; Starbird et al., 2012). Several projects have developed methods for extracting and disambiguating location names from social media data, thus providing valuable contextual information that can allow the data to be visualized with mapping software (Intagorn & Lerman, 2011; Sultanik & Fink, 2012). Ushahidi[9] was originally developed during the 2008 post-election fallout in Kenya and allowed citizens to report and map accounts of violence online. Since that time, Ushahidi has become a computing platform that supports human-entered data and analysis in an array of humanitarian situations (Meier & Brodock, 2008; Morrow, Mock, Papendieck & Kocmich, 2011).

Trustworthiness of Citizen-Generated Data

When choosing to act—or to not act—on citizen-generated crisis information, emergency managers and citizens must assess information credibility. Despite the free, unregulated production of information in this type of environment, researchers have found that much of the information provided over social media is self-regulated, meaning that members of the

community will question and correct the information (Mendoza, Poblete & Castillo, 2010; Palen et al., 2009; Qu et al., 2009). Building upon this finding, Starbird and Palen (2010) explored the role of retweeting (rebroadcasting) and found that retweeted messages tended to correspond with information that was accurate or contributed to situational awareness. Recognizing the value of a retweet, one research group has developed a fine-grained predictive model to predict what information will be retweeted (Zhu, Xiong, Piao, Liu & Zhang, 2011). Tapia and colleagues (2011) explored how Twitter could fit the information needs of nongovernmental organizations (NGOs) in disaster and described methods to overcoming trust issues, such as using a private online environment where all users are known or using Twitter for ambient or contextual data only.

Relying on citizens to filter trustworthy information and restricting who can contribute information is not the only way of creating veracity; as an alternative, several researchers are developing computational methods that seek to automate the process of finding the most credible social media data. Xia and colleagues (2012) have developed an unsupervised learning algorithm for detecting credible information on Twitter, while another research group (Gupta & Kumaraguru, 2012) adopted a supervised machine learning and relevance feedback approach to ranking tweets using a credibility score. Preliminary evidence suggests that social media users geographically closer to the physical disaster location tend to share more accurate information (Thomson & Ito, 2012). Consequently, several efforts have created computational methods that use social media features (e.g., profile information, social connectedness, recommendation data) to identify on-the-ground social media users (Schlieder & Yanenko, 2010; Starbird et al., 2012).

Reliability of Social Media Networks

An important restriction with social media is their dependence upon network infrastructure. Depending on crisis event circumstances, physical damage to or overloading of the network may prevent the use of social media services. Palen & Liu (2007) predicted that people outside the affected area would "stage" information for when the region came back online again. We see how this played out in recent events: after the Great East Japan Earthquake, Kaigo (2012) found that social media was often used to disseminate information; while land-line telephones and broadcast television were not available, Internet access through mobile devices was quite stable. Though people had limited access to online resources in the aftermath of the 2011 Christchurch, New Zealand earthquake, others outside the outage area relayed information found online back to those affected (Sutton, 2012). In an effort to create more reliable social media networks for crises, researchers are exploring the use of cloud computing (Hertzler, Frost, Bressler & Goehring, 2011) and "delay and disruption tolerant networking" (Fall, Jannaccone, Kannan, Silveira & Taft, 2010) to support social media networks and communication needs during a disaster.

Universal Information Access

To date, little research has focused on the needs of the disadvantaged in regards to social media and crisis (Bricout & Baker, 2010; Cinnamon & Schuurman, 2012). The majority of the literature discussed in this chapter has studied populations with widespread access to social media and the hardware technology to use it. In the United States, Crutcher and Zook (2009) observed how access to Google Earth following Hurricane Katrina fell strongly along disadvantaged economic and racial lines. Elwood (2008) looked at how citizen-generated data is shaped during a crisis, and observed that what information is available as well and who it empowers or disempowers is a function of access. However, some also suggest that social media has potential to provide crisis communications in places where emergency response infrastructure is poor (White & Fu, 2012).

New Frontiers

Members of the public, social media advocates, technologists, emergency managers, humanitarian activists, and researchers continue to experiment, design, question, and develop new ways to use social media during crises.

A successful effort is Ushahidi—an open source application for collecting and analyzing citizen-generated information (Meier & Brodock, 2008). Ushahidi relies on both the public as well as "digital volunteers" to populate maps that are helpful to humanitarian efforts. Digital volunteers donate time to performing tasks that aid in crisis efforts and can be completed remotely with online applications like social media (Starbird & Palen, 2011). A spontaneous version of this activity was observed following the 2010 Haiti earthquake when remotely located citizens self-organized over Twitter to collect and donate funds to those affected by the earthquake (Starbird & Palen, 2011). A group that had coalesced prior to the Haiti earthquake also converged to help Haiti. The OpenStreetMap (OSM) community created a base layer map for Port-Au-Prince in the aftermath of the earthquake, all by the work of volunteer "crisis mappers," the "neocartographers" (Liu & Palen, 2010; Shanley et al., 2013) of the humanitarian space. Later, the Humanitarian OSM Team (HOT) evolved out of this effort to deploy on the ground to make maps usable to the international response, and later, foster community mapping activity within Haiti itself (Soden & Palen, 2014).

Digital volunteerism is related to grassroots efforts that develop applications or provide services to meet humanitarian needs. Some of the earliest groups included the Random Hacks of Kindness "barcamps" and the CrisisCommons[10] organization. These groups were composed of "technology volunteers" with software development and emergency management experience who donated their time to building tools and applications that help those affected by crisis (Boehmer, 2010). A global volunteer organization—HumanityRoad[11]—seeks to provide members of the public with crisis information by teaching people how to "crisis tweet," and by monitoring social media streams to collate information (Starbird & Palen, 2013). Similarly, the Standby Task Force[12]

organizes digital volunteers in response to humanitarian needs with a focus on crisis mapping. Organizations like these help to sustain digital volunteer efforts across time and disaster responses.

Seeking to find ways to monitor and maintain social media streams and capitalize on the behaviors exhibited by these early digital volunteers, emergency managers experimented with groups of digital workers (who are pre-selected and trusted) to manage some of the social media communications responsibility (St. Denis, Hughes & Palen, 2012). These groups call themselves Virtual Operations Support Teams (VOSTs). A similar effort by Wickler and colleagues (2011) created a Virtual Collaboration Environment that leverages Web 2.0 technologies in support of virtual experts who can participate and assist in an emergency response remotely. Following the 2011 Libya Crisis, volunteer crisis mappers collaborated with the World Health Organization to map over 600 Libyan health facilities (Chan, Colombo, & Musani, 2012).

Many questions still remain around how digital volunteer efforts can work with emergency management effectively and sustainably. The American Red Cross has established the Digital Operations Center, which employs trained digital volunteers to help with social media monitoring (Meier, 2012). In February 2013, New York City Mayor Bloomberg established a Code Corps to engage "vetted volunteer technologists to realize lifesaving City government initiatives with an emphasis on emergency and disaster recovery needs."[13] These will be critical initiatives to follow as we think about the role of planned and spontaneous digital volunteers in disaster response. The Woodrow Wilson Center for International Scholars has sponsored legal research that examines this issue in the United States, and reports that digital volunteers are not covered under Good Samaritan laws because the volunteers seek situations in which to assist. Instead, they need to reduce their liability by establishing standards of care against which they want to be evaluated (lest a court determine that after the fact) and other liability-limiting measures (Robson, 2012).

Conclusion

In the space of this section, we attempt to provide an overview of the current state of crisis informatics research and practice. Social behavior that is made possible through technology is demanding a new look at the way we conceive of information distribution in emergency response, and a new way in which we frame the "formal response" vis-à-vis the "informal response." Palen et al. (2011) see members of the public as analysts—"everyday analysts" who bring a discerning eye and desire for accurate localized information relevant to their needs to make informed decisions. We need to see the role of social media-generated information as a critical part of their engagement with emergency response. They seek information, which inspires others to provide information. The frequent and rapid interactions that occur between people in these information exchanges shape the digital representation of the disaster. The behaviors that we see exhibited today are signs of what

is to come; more critically, they provide us with the material for deliberately creating what is to come in the form of practice, policy, and technology design.

Endnotes

[1] For this discussion, *crisis* is used as a general term for mass emergencies, disasters, and other mass disruptions like extended political protests. The term *crisis*, though problematic because of other possible connotations beyond these definitions (e.g., "financial crisis," "political crisis," "mid-life crisis") has been picked up by a number of groups and writers worldwide as a multi-lingual solution for describing situations on a large social scale, and that often require humanitarian aid.
[2] *Social computing* broadly describes a field of research at the intersection of social behavior and computational systems.
[3] While the DNC was not a crisis event, DNC management used the same personnel and processes used in emergency response efforts.
[4] A National Special Security Event (NSSE) is an event of national significance considered by the U.S. Department of Homeland Security (DHS) to be a possible target for terrorism or other criminal activity.
[5] https://maps.google.com/
[6] http://www.openstreetmap.org/
[7] http://www.ushahidi.com/
[8] http://epic.cs.colorado.edu
[9] http://www.ushahidi.com/
[10] http://crisiscommons.org/
[11] http://www.humanityroad.org/
[12] http://blog.standbytaskforce.com
[13] http://www.nyc.gov/html/digital/html/codecorps/codecorps.shtml

A PRACTITIONER'S PERSPECTIVE

Social media use during the response and recovery phases of a disaster has been introduced as a means to improve the efficiency and effectiveness of the tactical response of the relief effort. It also provides a way for rapid communications for eyewitnesses, victims, and those seeking to ascertain more information about the disaster. One expanding component of social media, consistent across the nation, is the growth of social media use by the public during disasters (Brooks, 2013). Changing and evolving social media communications provide the public with ever-increasing information access (Keim & Noji, 2011). Witnesses from both public and private sectors continue to testify on Capitol Hill regarding the successful use of social media in emergencies, providing compelling examples of best practices and lessons learned. Because of an increase in social media testimony about their growing use and value, emergency management officials continue to embrace and incorporate it into their disaster relief practices. More agencies are establishing themselves as the authoritative source on social media platforms for information. However, with the positives come some negative consequences. From the practitioner perspective, it is important that all dimensions of the social media issue receive appropriate attention.

The following sections discuss practitioners' challenges with social media. Specifically, the criticality of verifying social media data, avoiding liability risks, validating credibility of sources, information overload, and the allocation of resources to manage social media. Overcoming these challenges is also addressed. The practical solutions include performance measures, standards, best practices, digital volunteers, training, and exercises. Recommendations for formal adoption of social media in emergency management will be discussed in the concluding section.

Challenges

From an operational perspective, it is important to discuss drawbacks of social media use that practitioners could experience. Challenges emerge in social media use during large-scale emergencies. They might include two critical factors that are commonplace in most disasters where social media is relied upon: extreme noise and information overload. The benefits of social media use for the public are well documented. However, the benefits for practitioners are not as clear. The speed by which social media data are generated is advantageous to the public by providing real-time information. But in the same vein, that speed of social media data, compounded by the quantity, produces a fog for decision makers. This fog of ambiguity must be resolved before it can be reasonably considered a reliable communication tool to make operational decisions.

The scope, magnitude, and complexity of emergencies drive social media use and value. Highly visible, large-scale emergencies will increase public social media traffic, as discovered through research by the Hazards, Emergency Response, and Online Informal

Communication (HEROIC) Project[1] following both the April 2013 Boston Marathon bombing and Hurricane Sandy in October 2012.

Defining an appropriate trade-off represents the critical tension between the public's desire for immediate information and the practitioner's need to ensure accuracy before disseminating information. Practitioners must make prudent adjustments, based on the situation, between command and control requirements and the need to ensure broad coordination and communication (Harrald, 2006). When too much or irrelevant information is presented, determining which pieces of information should be used to make a decision, and which should be ignored, is paramount (Sorensen & Mileti, 1987).

Social media can cloud the situational awareness picture, making it difficult for decision makers to make accurate and timely decisions. A measure of uncertainty and confusion may occur when information is too expansive, fraught with inconsistencies, delayed in arriving, or difficult to manipulate. In the search for certainty, regardless of the speed and volume of social media data, the practitioner prefers verified information before making decisions. Accurate information provides reassurance on the status of any response or recovery effort planned or in progress (Walker, 2011).

The Importance of Verification

President Barack Obama, on April 19, 2013, made the following statement in response to the capture of a second suspect in the Boston Marathon bombing:

> *In this age of instant reporting and tweets and blogs, there's a temptation to latch onto any bit of information, sometimes to jump to conclusions. But when a tragedy like this happens, with public safety at risk and the stakes so high, it's important that we do this right. That's why we have investigations. That's why we relentlessly gather the facts.*

President Obama warned the public about the dangers of relying on ambiguous social media information to draw conclusions before official word is formally released. Non-authoritative sources that accidentally, or even intentionally, disseminate unverified information may lead to the public believing the misinformation. For practitioners, it is essential that staff or qualified volunteer resources thoroughly review social media information for accuracy, before it is released.

Verifying information received from sources where no relationship previously existed is necessary given the risks for misinformation, whether accidental or intentional. Methods are needed to differentiate between erroneous, misleading, and awareness-bringing information (Dugdale, Van de Walle, & Koeppinghoff, 2012). Social media accelerates the rate by which misinformation spreads. This signifies the criticality of verifying information before taking action, as inaccurate information could endanger the safety of first responders

and the community (Lindsay, 2011). Liability and credibility issues emerge as a result of the inappropriate use of social media.

Liability

The growing use of social media in everyday life gives rise to a range of evolving liabilities (Hartwig & Wilkinson, 2011). During Hurricane Sandy, social media reports claimed that New York Governor Cuomo was trapped in Manhattan, the Metropolitan Transportation Authority (MTA) had closed the New York City subways because of flooding, the New York Stock Exchange was flooded under three feet of water, and the power to Manhattan was shut down because of high tides. This information went viral, spreading rapidly through social media and the traditional news media (Hill, 2012). These reports were false — intentional lies confessed to by the originating author (Ngak, 2012). Before Governor Cuomo, the MTA, the New York Stock Exchange, or the power company had time to refute the false reports, the information had spread uncontrollably. Eventually, officials identified the culprit of the false reports and refuted the misleading information. Although no collateral damage was recorded, injury or death could have resulted if resources had been deployed while they were legitimately required elsewhere.

In 2011, 150 representatives from the Federal Emergency Management Agency (FEMA), the American Red Cross, state and local emergency management agencies, private-sector interests, and various volunteer communities convened to discuss how social media and emerging technologies affect response operations. Participants identified liability as a major area of concern (Wardell III & Su, 2011).

Are emergency responders liable for not responding to requests for assistance via social media? What are the consequences of emergency management basing decisions on non-authoritative information? Practitioners are concerned with liability issues that range from public perception, to acting on or sharing erroneous information. Time is rarely an ally for the practitioner. While the public waits for an update from an authoritative source, they also have access to real-time information generated in social media channels that could conflict with practitioners' information once it is released. Public information through social media does not wait for the practitioner latency in communicating risks damaging their online credibility.

Credibility

Making decisions based on information from unknown sources poses unnecessary risks for practitioners, if the decisions lead to negative results for themselves, the public, or both. Consequently, practitioners remain hesitant to share unsubstantiated information unless the source is deemed reliable. It is more important for the practitioner to obtain valid information as to what is happening than it is to take immediate action (Ryan, 2013). Had law enforcement officials concluded their investigation based on information from social media platforms following the Boston Marathon bombings, not only would the wrong

suspects have been accused (Petrecca, 2013), but the credibility of the agencies would have been tarnished. With public information through social media channels being created at an accelerated rate and the associated reduction in time for verification, potential liability increases for the practitioner because of the chance of reporting erroneous information. They must attempt to maintain a proper alignment between their own online credibility and ensuring that information is accurate before release. Practitioners are held accountable for communicating details relative to the disaster, while minimizing damage to the organization, and strengthening trusting relationships with the public (Young, Flowers, & Ren, 2011).

As time lapses, practitioners face online scrutiny for delays in communicating. The public demands information immediately, and practitioner online credibility often ties directly to the length of time spent verifying information. Therefore, if practitioners can develop methods of releasing information in a timely manner, their online credibility with the public is maintained, or even improved.

Information Overload

As of 2012, Twitter had more than 200 million users worldwide and approximately 95 million tweets were shared each day (Hurtado, 2012). During a highly visible, large-scale emergency, a deluge of social media data exist, challenging the ability to analyze this data. For example, in a three-hour span on April 15, 2013 — the day of the Boston Marathon bombings — 509,795 tweets with the "#BostonMarathon" hashtag were collected by Syracuse University's School of Information Studies (Bauer, 2013). Sifting through information is time intensive (Chavez, Repas, & Stefaniak, 2010). Having no geographical boundaries, social media users around the globe can digitally converge on U.S. emergencies, adding to the overload of data. Though data aggregation tools can consolidate social media information, a human must accurately assess the validity of the data and decide whether to take action on that information (Turoff, Chumer, Walle & Yao, 2004).

Resources and time-exhausted monitoring and analyzing social media, as well as correcting misinformation, can potentially jeopardize other emergency response requirements. In addition, the complexity of emergencies can quickly overwhelm organizations and personnel. These demands for resources and time, coupled with the complexity of the emergency, can lead to poor decision making and loss of life (Taniguchi, Ferreira, & Nicholson, 2012), calling into question the value of unverified information as a basis for decision making. Filtering and extracting pertinent cues from collected information to obtain situational awareness creates a problem (Hall & Jordan, 2010). The necessity for sorting relevant and pertinent information occurs when there is either too much information, or embedded irrelevant information, facing the practitioner.

Similar to how scope, magnitude, and complexity of a disaster drive the level of response, they also contribute to the quality and quantity of social media use. During Hurricane Sandy, public attention on Twitter increased significantly (Spiro, Sutton, Johnson,

Fitzhugh & Butts, 2012). This type of increase to social media traffic calls attention to the need for resources — humans — to filter through the consolidated, yet unverified, data to determine their value in the relief effort.

Allocation of Resources

Without hiring additional staff to monitor, analyze, and communicate social media information, practitioners have difficulty with allocating limited resources toward this assignment during an emergency. For instance, 53% of 115 government agencies polled cited staffing constraints as the main reason why social media is not in their emergency communication plans (Everbridge, 2012). These constraints affect the frequency of social media use for an agency. Additionally, practitioners devote a significant amount of time and effort correcting misinformation, countering rumors, validating the accuracy of information, and dealing with those who post noise (Taylor, Wells, Howell & Raphael, 2012). The burden of staffing constraints and investment of time toward verifying information provides skeptical practitioners with further reason to hesitate in adopting social media within their environment.

The preceding section discussed several challenges practitioners face with using social media in their environment; however, there are means to mitigate them. To overcome the identified challenges, practitioners must assess the value of developing performance measures, standards, and best practices, utilizing digital volunteers, and developing training and exercise programs associated to social media.

Overcoming the Challenges

According to a 2012 ARC survey, "Social Media in Disasters and Emergencies," 77% of the 1,017 U.S. adults polled selected local emergency officials as the most trusted source on social media. During disasters, the public will give sustained attention to social media (Fraustino, Liu, & Jin, 2012). Twitter research also suggests tweets originating from traditional sources of authority will be rapidly propagated (Starbird & Stamberger, 2010). The public has come to expect emergency officials will be online, and authorities are beginning to recognize this. On the day of the Boston Marathon bombings, Boston authorities presented the public, through their Twitter accounts and traditional media environments, a clear, calm, and reassuring picture of what to do next (Sieczkowski, 2013).

Performance Measures

It is important to ensure performance measures are developed and implemented for social media. These measures will help in the development of standard operating procedures and also authenticate social media value, from an operational perspective, to skeptics. Social media success stories continue to appear; however, no standardized performance measures exist that assess social media's effectiveness for the practitioner. Practitioners should focus on the development of objectives that recognize the value of operating in the social media environment (Hoffman & Fodor, 2010). Understanding reach, engagement, and

influence of social media communications will allow an agency to define itself in all four phases of emergency management.

Performance measures gauging the effectiveness of social media during emergencies versus nonemergency times will vary dramatically. For example, tracking growth rate of followers for an agency's social media site(s) will reflect a heavy increase during the response and recovery phases as opposed to nonemergency times found within the mitigation and preparedness phases. Agencies should not judge social media's demand (Spiro et al., 2012) based on metrics solely from the preparedness and mitigation phases, but rather on metrics from all four phases: preparedness, response, recovery, and mitigation. Research projects can provide evidence that will assist agencies in determining how to effectively use social media in future disasters. For example, the HEROIC Project discovered that public attention to Boston agencies' social media accounts increased during the Boston Marathon bombings (Sutton et al., 2013).

Guidance, Standards, and Best Practices

The lack of social media guidance in emergency management has resulted in diverse and inconsistent practitioner use at the local, state, and federal levels. FEMA Director Craig Fugate encourages state and local governments to engage with the public in social media (Fugate, 2011); however, he acknowledges the lack of universal adoption (Mazmanian, 2012). A Congressional Research Service Report on social media and disasters concludes that social media use is insufficiently developed to draw reliable conclusions about its value; more research and examination of social media value to practitioners is recommended before it is fully adopted and used for emergencies (Lindsay, 2011).

Local and state emergency management agencies' inconsistent use of social media range from some using multiple social media platforms during all four phases of emergency management (preparedness, response, recovery, and mitigation), to others having a minimal presence composed of random participation. The wide and varying degrees of social media involvement, complicated by the demands of the public, pose difficulties for practitioners to meet expectations. Compounding the challenge is the lack of universal standards for social media, which could aid in addressing the expectations of the public. However, there has been progress in tackling this gap. In December 2010, DHS established the virtual social media working group (VSMWG). Since its inception, the VSMWG has published three guidance documents on the use of social media for practitioners. The guidance documents provide best practices that agencies can reference to develop their own social media strategy (Virtual Social Media Working Group & Department of Homeland Security First Responders Group, 2013).

Continuing to document best practices and lessons learned will provide further evidence to practitioners who have yet to incorporate social media into their environment. Lessons learned from Hurricane Sandy contained many successful examples of information

sharing, data aggregation, and partnerships that encourage agencies to embrace new communication and engagement methods (Virtual Social Media Working Group & Department of Homeland Security First Responders Group, 2013). These lessons learned should empower practitioners who are hesitant or skeptical in adopting social media, to reassess their position on the topic.

Digital Volunteers

The sheer volume of social media data streams in an emergency must be filtered before meaningful patterns and trends can be detected (Kavanaugh et al., 2012). Digital volunteers can assist practitioners in sifting through these data streams and they can be used as liaisons between overburdened practitioners and social media users who seek information (St. Denis, Hughes, & Palen, 2012). Digital volunteers are often found in various not-for-profit organizational structures (e.g., Community Emergency Response Teams [CERTs], American Red Cross, and the Army Corps of Engineers). In recent years, hybrid organizations—such as Virtual Operation Support Teams[2]—have formed, which focus on providing social media assistance during disasters to requesting organizations. Contributions from these organizations could benefit the practitioner and play a prominent role in moving the field of emergency management forward in adopting social media. In May 2013, Christopher Terzich, Chair of the Regional Consortium Coordinating Council, testified before the U.S. Senate Subcommittee on Emergency Management, Intergovernmental Relations, and the District of Columbia on "The Role of the Private Sector in Preparedness and Emergency Response." In his written statement, he discussed how the CERT understands community dynamics and gives responders the ability to leverage local skill and expertise. Mr. Terzich also highlighted another organization called CrisisCommons[3], which is composed of volunteers working together to build and use technology tools during emergency events.

Training and Exercises

The development of training programs and exercises is necessary to ensure social media proficiency in emergency management. These training programs and exercises should blend current emergency management training offerings with trending technologies, and include practitioners' social media best practices and lessons learned. Training offerings have progressed. The Emergency Management Institute of FEMA now offers a course titled "IS-42: Social Media in Emergency Management." Additionally, "Social Media for Natural Disaster Response and Recovery" is a FEMA-certified course listed in the FEMA National Training and Education Division catalog, offered by the National Disaster Preparedness Training Center at the University of Hawaii.

Holding virtual tabletop exercises (VTXs) represents a proven means to ensure social media proficiency. VTXs are a demonstrable technique by which performance can be measured and adjustments made. The goal of this training is to establish a user base that

could effectively and efficiently use social media during the response and recovery phases of a disaster (Everbridge, 2013).

Formal Adoption of Social Media in Emergency Management

Adopting social media in emergency management has a promising future. Discussions of how to develop social media standards, guidance, training, and volunteer assistance should be examined in forums, committees, and working groups composed of emergency management officials at all levels of government, social media subject matter experts, academia, nongovernmental organizations, the private sector, and citizens. These collaborative efforts could address challenges and determine how to incorporate social media into concepts and principles of emergency management, specifically the National Incident Management System (NIMS), while hearing how their adoption would affect the public.

Incorporating Social Media into NIMS

NIMS documentation contains only a brief section regarding the use of Internet-based technology. Also, the documentation has been updated only once since its issuance in 2004. The guidance is vague and does not offer clear direction for incorporating Internet technology (Hughes & Palen, 2012) into the practice. NIMS is a dynamic system that promotes ongoing maintenance of incident management and is reflective of best practices and lessons learned. Social media best practices and lessons learned during emergencies have without question provided an opportunity to revisit NIMS and consider making modifications. These modifications would focus on ensuring that social media is documented appropriately as a means to efficiently and effectively communicate from the practitioner perspective.

Collaboration

Social media is a permanent fixture in crisis communications. Practitioners must look at their advantages and work toward adopting them within their environment while reducing the negatives that currently exist. These collaborative efforts should include the VSMWG and the National Integration Center (NIC). The NIC was responsible for initially gathering together emergency management organizations to implement NIMS. It is only appropriate that the NIC take the lead on updating the documentation now. For social media to be formally adopted within emergency management, it requires collaboration. The challenges social media pose, and how to overcome them, have been identified and now it is a matter of taking action to accept the technology in emergency management.

Endnotes

[1] http://www.heroicproject.org/
[2] http://idisaster.wordpress.com/2012/02/13/what-is-a-virtual-operations-support-team/
[3] http://crisiscommons.org/

BRIDGING THE DIVIDE

Social media have changed and continue to change the ways in which people communicate, connect with others, and access information during mass emergency events. Disaster management practice and research have an interest in these changes because the types of interactions that social media enable could inform and even shape aspects of future emergency management.

In the United States, emergency management has explored ways that social media could be used to complement existing response efforts (Hughes & Palen, 2012; Latonero & Shklovski, 2011; St. Denis et al., 2012; Sutton, 2009; White, 2011). Emergency management at the federal level has begun to consider the role of social media (FEMA, 2013), as demonstrated by the inclusion of a social media course in official emergency management training[1] by FEMA. Discussion around how responsibility for social media will fit into response organizations and processes has also taken place at national emergency management conferences (Wardell III & Su, 2011), in online communities (e.g., Social Media for Emergency Management[2], Virtual Social Media Working Group[3]), and national labs (Burns & Shanley, 2013). Though certainly not all emergency management groups use social media in their response efforts as many challenges exist, most recognize the growing use of social media by members of the public as a new channel of communication (Burns & Shanley, 2013; Hughes & Palen, 2012)

Similarly, research has sought to observe, document, and understand social media use in times of crisis. The primary focus of these research efforts has been on members of the public and their use of social media to communicate with family and friends, share crisis-related information through text and photos, and support the needs of disaster-affected communities. Most research has focused on the role of the public because their social media-enabled behaviors and interactions are so new and rapidly evolving and needed attention to understand them. However, a small but growing area of research seeks to expand and apply these understandings by studying how emergency management organizations use social media in times of crisis.

The Divide between Practice and Research

Despite efforts toward understanding and using social media in emergency management, a divide between research and practice exists, in part because of the expected reasons for such divides in other fields—difficulties in collaboration, challenges to knowledge transfer, and disagreement of focus—but it also exists because social media are so rapidly changing. In short, emergency management needs to put plans around social media into action *now* while research is trying to anticipate its *future*—in preparation for the practical plans that will need to be put into action *then*. From these equally important agendas, we see the different perspectives of practice and research arise, which we explore here.

Practice

The practice of emergency management necessarily orients to the demands of the present and the short-term future as it seeks guidance for how to incorporate social media into emergency management. With growing public use of social media in response to crisis events, practitioners face new demands and expectations by members of the public to provide information over social media in tomorrow's next event (Hughes & Palen, 2012). Practitioners feel pressure to consider the public's social media activities and incorporate the useful and relevant information back into response efforts (Denef et al., 2013; Palen & Liu, 2007; Stephens & Malone, 2009; Tapia, Baipai, Jansen, & Yen, 2011) even though the means for adoption of social media into practice is unclear. Emergency response organizations operate under conditions of great uncertainty and urgency such that social media may or may not be useful or even operational. Concerns about the trustworthiness and veracity of citizen-generated information are constant: emergency managers are liable for the actions they take on this information and therefore they must ensure it is correct. Similar to other lines of work, emergency organizations are challenged to keep pace with rapid social media advances and to find the time and resources to maintain a social media presence—as Denef et al. (2013) discuss in their examination of police Twitter communications in the 2011 London Riots. In an interview study conducted with twenty-five public information officers (PIOs) in 2009, many of the PIOs expressed the desire to be more active on social media but found it difficult to add responsibility for a new public communication mechanism to their already busy workloads (Hughes & Palen, 2012). In addition, organizational acceptance of new technologies can be slow; leaders must be convinced that benefits outweigh the risks before technology use can be sanctioned.

Under these challenging circumstances, practitioners can struggle to distribute basic emergency information over social media streams and find themselves in a position where they must justify social media use. Consequently, emergency management tends to perceive social media as tools whose use and outcomes can be measured and evaluated dichotomously as good or bad so that decisions based on social media can be clear and defensible. However, such evaluations can be premature and limit further ideas about how social media could be appropriated by emergency management. For example, when social media use is described in a manner that allows it to be easily measured and evaluated—such as the number of messages sent or the number of people who have access to a message—it can be difficult to know what (if anything) these numbers mean when social media and the human behaviors around them continue to evolve. These metrics can lead to perceptions of poor performance and premature rejection of social media as part of emergency management practice.

The all-hazards focus in the United States further complicates matters. Whereas research needs to make distinctions between the types of disasters so that researchers can explain accurately what they see, practitioners who deal with a variety of situations are left to imagine how lessons from a tornado might map to something like a terrorist attack. The

difference between these two cases is that in the terrorist attack, the aftermath becomes a criminal investigation while in the tornado the aftermath focuses on extended human rescue and recovery. As such, the social media behaviors are quite different in the recovery phase, and yet practitioners who are looking for answers may look at the lessons of "altruistic community" and "self-policing for veracity" during the immediate aftermath of a tornado event and then claim (rightly) that these lessons do not apply in the longer-term response of a criminal investigation, where checks and balances in the information sphere are different because the agent is unknown and at large. This uncertainty catalyzes different kinds of responses in the public sphere. Sometimes the research on a topic for emergency management is missing—such as social media communication about a mass crime—because the research cannot keep pace with the new phenomena. Further, most research has focused on case studies of particular events; little attention has been paid to extrapolating online behavior and lessons across different kinds of events. Practice sometimes expects things of the research that have not yet been empirically investigated.

Research

Research tends to be oriented toward anticipating or predicting the *future.* It does this in multiple ways: some research analyzes behaviors that seem to serve as harbingers that give some hint of what is to come. Other research interprets a fuller set of behaviors on display today to develop theoretical descriptions that can stand the test of time and offer a basis for comparison for rapidly changing behaviors. Still another ongoing aim of the greater research agenda is to topically survey the many different kinds of behaviors that occur with social media across the emergency management spectrum. They might be as varied as the human behaviors witnessed in the physical world before, during, and after disaster, and so this goal is still very much in progress. Central in social media and disaster research is the understanding that the tools and behaviors are under immense change, with visible differences between disaster events over time. The volume alone of the Twitter data produced in a five-year span makes this rapid change clear: Project EPIC at the University of Colorado Boulder, for example, collected 100,000 tweets for 2008's Hurricanes Gustav and Ike; 3.3 million for the 2010 Haiti Earthquake; and 26 million tweets for 2012's Hurricane Sandy (Kenneth M. Anderson, personal communication). In other words, the research of social media and emergency management can barely keep pace with social and technical advances. In this, both research and practice share the same challenge.

This natural orientation to the future of social media use means that research results can appear detached from the immediate conditions and constraints of emergency management. Furthermore, because the unit of analysis is on social media behavior during an emergency—rather than on the entire emergency itself—some emergency managers perceive the whole agenda as a kind of social media evangelism, when in fact researchers are trying to isolate one aspect of a much larger response. Additionally, research on social media in emergencies tends to be drawn to individuals and groups that are equipped to handle social media because that is "where the action is." In other words, it is much harder

to say something about social media in emergency response in places where there is an absence of it. Research that takes social media use as its scope therefore needs to be careful that its claims do not overreach to describe universals about what was happening across the event under study, and the reader has to perceive this distinction as well. Though research can be done where social media is not in use, the research agenda has only recently become ready to contribute to such questions of technology adoption in a meaningful way, as a clearer future now exists to compare to current practical matters. In the meantime, many of the subjects explored by researchers are seen as atypical and too advanced for all practical purposes, and consequently, practitioners can find it difficult to transfer findings to practice.

Another point of disconnect lies in the potential absence of groundedness by researchers in the domain. For example, social media in disaster research conducted by computer scientists may not be attentive to the processes, protocols, and practice of emergency management. Recommendations to emergency management from such research might be absent, misguided, or impractical for the current practice. In addition, research in the relatively new field of social computing has not necessarily had much experience in the world of policy; emergency managers, on the other hand, frequently work with policy as it affects the institutional imperatives and directions under which they operate. A multidisciplinary approach to conducting research in this domain—one that includes disaster sociology, emergency management, policy making, and social computing expertise—can help alleviate these concerns; however, this approach may not be practical because it requires more time, resources, and coordination.

Bridging the Divide

In this section, we identify and discuss several ways in which practice and research can work toward bridging the divide between them. We begin by noting how the research agenda could be expanded to provide insight and guidance more directly relevant to practitioners. We then discuss how research and practice, through understanding their respective professional roles, could have more circumspect interpretations of research findings and practitioner needs. Next, we outline how researcher-practitioner relationships could create conditions for effective work, including collaboratively built tools and solutions that address the challenges that emergency managers face when aspiring to a future with a more integrated social media plan. Lastly, we consider how social media might be incorporated into emergency management policies and structures and discuss the development and sharing of social media best practices.

Expand the Research Agenda

Much of the existing research focuses on members of the public during the response phase of large-scale, high-impact crises arising from natural hazards, where social media activities are abundant, visible, and stand outside downstream issues like criminal investigations.

Little understanding exists—from an emergency management perspective—around how to apply social media techniques to different conditions (e.g., disaster types, stages, locations, demographics). Furthermore, research has only begun to understand what communication strategies are effective in a social media world. As a recent example, Sutton et al. (2013) studied Twitter communications by state and federal organizations in response to the 2010 Deepwater Horizon oil spill and found that the networked structure of Twitter user profiles affected information spread. Specifically, health and public safety organizations tended to be more centrally located within these networks, suggesting that these organizations have the potential to reach a more widespread public audience than others. Another line of research investigates diffusion of information through Twitter social networks, and finds that information by emergency agencies is more likely to be re-tweeted than other sources (Starbird & Palen, 2010), and that information from those closest to an event is more likely to be propagated than by distant, curious onlookers (Starbird, Palen, Hughes, & Vieweg, 2010).

Making research more accessible to practice, both in presentation and practical application, would also help to bridge the divide. Researchers can work toward this goal by not only presenting and publishing findings in academic venues, but also in places that reach an emergency management audience—such as meetings and workshops (e.g., Burns and Shanley, 2013) with emergency responders and emergency management conferences and publications.

Understand Roles and Build Relationships

Another step toward bridging the divide is to build a common understanding of practice and research roles regarding social media in emergency management. By understanding these roles better, practice and research will know what to expect from one another and the strengths of each can be leveraged. A role for emergency practitioners is to consider and communicate what social media tools and strategies can or cannot be reasonably adopted. Practitioners bring their expertise and their deep commitment to the calling of public health and safety to bear on priorities as an emergency is unfolding. Research strives to offer a more critical, objective view of social media use. Some of the ideas of social media held by emergency managers are opinion-based, whereas the aims of research are to find empirically based evidence. To do so, however, requires sometimes limiting the scope of inquiry at the outset, and expounding upon the conditions under which these claims may or may not hold. Practice and research need to thoughtfully consider places were social media can fit into response efforts without jeopardizing the safety and welfare of those affected by a crisis. Still, a technical education component may be required to make the incorporation of social media possible in emergency response.

A common problem between research and practice in any field is that each tends to operate independently. To help overcome this problem, researchers and practitioners can work to build relationships that encourage communication and foster collaboration. Efforts

such as the Natural Hazards Center Workshop[4] held annually in Boulder, Colorado, strive to make such relationships possible. In particular, it can be difficult to obtain research access to a crisis event in progress—a necessary precondition to transferring research results to practice. With relationships established in advance, researchers could observe and study emergency practice in situ, and emergency managers will feel comfortable allowing them to do so.

Such relationships can then engage in mutual informed development of tools and policies that support the current state of emergency practice—an effort that benefits from collaborative efforts with emergency practice. Using participatory design methods (Büscher, Kristensen, & Mogensen, 2008; Büscher, Mogensen, & Kristensen, 2009; Kristensen, Kyng, & Palen, 2006), researchers and practitioners can collaboratively explore, design, test, and implement solutions that address future emergency management needs. In this participatory design model, researchers bring the technical design and implementation expertise, and practitioners bring the domain expertise. Current tools for monitoring social media have been designed for a broad, general-purpose audience; thus, these tools do not necessarily address the particular needs and concerns of emergency managers (e.g., data veracity, traceability, and rumor management). By including emergency managers in the design aspects of the research activities, the resulting products have a better chance of more accurately suiting practice.

The changes brought about by social media have placed new demands on both research and practice. "Keeping up" is a problem for both worlds; an appreciation of this problem might pave the road forward toward joint problem-solving.

Consider Organizational Fit & Develop Best Practices

A shared focus about where social media activities could fit within formal emergency response structures and processes is critical, since where it might fit is in part determined by what those activities would be; this is both a problem for research and practice. Currently, NIMS—the management system under which all emergency response organizations are organized in the United States—lacks guidance and consideration for using social media. In particular, this lack of guidance causes confusion within the Incident Command System (ICS)—the Command and Management component of NIMS—because several roles within ICS could potentially manage social media.

One such role is that of PIO. Within ICS, the PIO's duties include distributing information to the public about emergency events, fielding questions from the public, and monitoring the public information arena so they can correct false rumors and misinformation. The PIOs need to distribute information and their orientation to the information needs of the public seem to be a natural fit for social media, and in practice, many PIOs have adopted the role of managing social media (Hughes & Palen, 2012).

However, the PIO is not the only role where social media responsibilities could lie. The Planning Section within ICS is responsible for collecting and analyzing all incident information, especially information that provides situational awareness and/or informs response efforts. Social media activity generated during an event has been shown to produce information that could contribute to situational awareness (Cameron et al., 2012; Johnson et al., 2011; Vieweg et al., 2010), and therefore the Planning Section may also be a place well suited to social media responsibilities.

By experimenting with social media and creating, sharing, and testing ideas generated from this experimentation, emergency responders can come to better understand and define future policy about where social media responsibilities within ICS (and ultimately NIMS) might lie—whether it is in the role of the PIO, the Planning Section, another role within ICS, or a new yet-to-be-defined role.

A subsequent step toward bridging the divide between practice and research is to develop "best practices" around social media that can be shared, tested, and refined within the emergency management community. Best practices are methods or techniques for accomplishing particular tasks that have consistently shown better results than other ways of completing the same tasks. Emergency practice has evolved largely through the development of best practices that emergency managers share and constantly improved upon; they feel that the best practices of today shape the emergency response processes and policies of tomorrow. Critically, however, best practices with respect to social media must be communicated in a way that ensures flexibility in their application. We see emergency management as a flexible working organization—this is a critical aim of NIMS—and so it is important to appreciate that those same expectations of flexibility must be applied to guidelines for social media because the underlying behaviors are in such flux and can touch upon so many parts of the emergency management organization. Responsibility for developing best practices falls primarily to emergency managers, as they have embedded knowledge of emergency response and the means to test and develop these practices. However, White and Plotnick (2010) advocate that research can also contribute to the development of best practices.

Conclusion

We have summarized our perspectives about the challenges that contribute to a divide between emergency management practice and research with respect to social media. Social media are rapidly evolving and, during disasters, they reflect emergency response complexities. However, we also advocate that as practice and research work together through the means outlined in this paper—expanding the research agenda, understanding roles, building relationships, considering organizational fit, and developing best practices—they will advance combined knowledge about the potential and realities of social media, and

move together toward envisioning how social media may be used as a resource in emergency management.

Endnotes

[1] http://www.training.fema.gov/
[2] http://www.sm4em.org/
[3] http://www.hsdl.org/?abstract&did=722650
[4] http://www.colorado.edu/hazards/workshop/

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