

Presented to the Interdisciplinary Studies Program:



UNIVERSITY OF OREGON  
APPLIED INFORMATION MANAGEMENT

Applied Information Management  
and the Graduate School of the  
University of Oregon  
in partial fulfillment of the  
requirement for the degree of  
Master of Science

# Best Practices for Fire Departments in the Application of Social Media in Disasters

CAPSTONE REPORT

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**Fall 2016**

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**Abstract**

This study explores how first responders can use social media to improve communication and situational-awareness during a disaster. This research is intended for fire departments seeking to implement social media into emergency management communications and strategies. The importance of the annotated bibliography is to inform the intended audience of the best practices in the use of social media in crisis situations. The materials used in this research document were published between 2007 and 2016.

*Keywords: social media, first responders, crisis communications, situational-awareness, disaster management*



**Table of Contents**

Introduction to the Annotated Bibliography .....	6
Problem.....	6
Purpose.....	8
Research Questions .....	8
Audience.....	9
Search Report .....	9
Annotated Bibliography .....	14
Conclusion.....	42
Communications.....	42
Situational Awareness.....	44
Summary.....	46
References .....	48

## **Introduction to the Annotated Bibliography**

### **Problem**

Social media was originally used by the public in disasters and emergencies to communicate and share information, but social media is now being accepted by first responders and other emergency organizations as an essential tool for disaster management (Simon, Goldberg, & Adini, 2015). A disaster is defined as a “state in which the social fabric is disrupted and becomes dysfunctional to a greater or lesser extent” (Simon, Goldberg, & Adini, 2015, p. 610). In the event of an emergency such as an earthquake or terrorist attack, the functioning of telecommunication channels such as phone lines and cellular networks can be intermittent. Phone switches and cellular communication can be compromised, which may disrupt communication in an affected area (Palen & Liu, 2007). For example, in the case of the 2011 Great East Japan Earthquake, fixed-phone lines at local area hospitals malfunctioned due to the lack of electricity and damage to physical communication lines. Even in areas that were mildly affected by the earthquake, less than 40% of the hospitals’ communications systems functioned correctly during the first three days following the earthquake (Kudo et al., 2014).

In contrast, when primary communication channels are unavailable, social media platforms and microblogs such as Twitter can play an integral role as supplemental means to inform the public (Makinen & Kuira, 2008). When power, phone lines, and Internet access are compromised, Twitter has been found to be an effective lightweight and low bandwidth communication tool (Veinott, Cox, & Mueller, 2009). Additionally, studies conducted by the Red Cross confirm that Americans are becoming more reliant on mobile device-based social media applications (apps) to seek information, obtain assistance and safety information, and report their well-being during and after a disaster (Red Cross, 2011).

Given the increased usage, governments and first responders have started utilizing social media as a tool for disaster management (Simon, Goldberg, & Adini, 2015). For instance, since the 2010 earthquake in Haiti, emergency managers have accepted social media as a method to reach citizens (Sarcevic et al., 2012). During Hurricane Sandy in 2012, emergency managers and first responders adopted the use of social media as the primary communication source to the public (Simon, Goldberg, & Adini, 2015). In terms of accessibility, social media platforms such as Twitter were available over smartphones after Japan's 2011 earthquake when phone and cable services were unavailable (Cho, Jung, & Park, 2013). Therefore, with the increased popularity of mobile device-based social media apps and the potential for high availability in a disaster, social media can provide new opportunities to enhance operational efficacy for first responders. By using social media, first responders can quickly provide critical information through improved communications and situational awareness in a crisis (Adam, Shafiq & Staffin, 2012).

In addition to enabling improved communications following a disaster, smartphones have the capability to augment situational awareness and decision-making capabilities for first responders through location-based and context-aware applications such as social media (Adam et al., 2012). In the context of disaster response, Vieweg, Hughes, Starbird, and Palen (2010) define situational awareness as components that facilitate the understanding of an emergency with respect to the tactical needs of command and control. Global positioning satellite (GPS) sensors provide geospatial location, which facilitates the first responder's situational awareness by identifying the physical location of a smartphone user. Geospatial data generated by social media provide the possibility of increased interaction with the public and enhanced monitoring of reported problems in a disaster (Alexander, 2014). Thus, analyzing geospatial data retrieved

from social media applications on mobile devices shows promise as an effective technique for communicating and responding to incidents in a large scale catastrophe.

### **Purpose of the Study**

The role of social media has changed crisis communication strategies during and after disasters (Cho & Park, 2013). Social media technologies give governments, first responders, and crisis communication groups a variety of new opportunities for contacting, educating, and influencing citizens who may find themselves in danger leading up to or in the immediate aftermath of a major crisis or disaster (Lin, Spence, Sellnow, & Laclan, 2016). The purpose of this annotated bibliography is to explore ways social media has been used by emergency managers and first responders during a disaster as a means of identifying the best practices that can be used by firefighters and Emergency Medical Technicians (EMTs) in their roles as first responders during disasters. Through review of pertinent literature, this paper applies information from past research to demonstrate how firefighters and EMTs can use social media to (a) enhance communication to the public and (b) improve situational awareness in the field during a disaster. The findings of this research pertain to fire departments that provide fire mitigation, life support, and emergency management operations.

### **Research Questions**

**Main question.** What are the best practices in the use of social media by first responders during and after a disaster to (a) improve communications with the public; and (b) achieve greater insights for decision-making abilities?

**Sub-questions.** How can fire departments implement social media analytics into their emergency management plans? Can local fire departments harness the capabilities of a

smartphone and user-generated content from apps such as Twitter to communicate with and respond to citizens during a disaster?

### **Audience**

The intended audience for this study is emergency managers that work fire service. Specifically, the audience includes fire chiefs, public information officers, public records officers, and information technology (IT) managers employed by fire departments. These stakeholders are responsible for coordinating and executing emergency operations procedures during a disaster situation. In the realm of emergency management, fire chiefs conduct routine incident training and testing where firefighters coordinate practice drills that simulate actual disaster scenarios. Public information officers and public records officers are responsible for sending and archiving information to the public during an emergency. IT managers provide technical support during disasters and ensure that redundancy is designed in to communication systems. All of these stakeholders will benefit from this study in determining the best practices in the use of social media to communicate with citizens during disaster situations. They can also use the information from the annotated bibliography to develop social media communications strategies in their emergency management procedures.

### **Search Report**

**Data collection.** The search is focused on references that provide examples of social media as a communication tool in a crisis and sources that emphasize the use of smartphone devices and social media in disasters. Three themes from the initial topics emerge: (a) social media as a communication channel in an emergency; (b) geospatial data from social media apps to augment situational awareness; and (c) user-generated content during and after a disaster. The

search is narrowed to the topics of communication outages during a disaster and the analysis of social media data to improve situational awareness. The reference pages of journals are utilized to improve search results and lead to other relevant research papers. This method provides articles that are not available in the UO Libraries or Google Scholar.

**Keywords.** The keywords used to search for sources are as follows:

- *crowd sourcing*
- *crisis communication*
- *decentralized communication*
- *disaster management*
- *emergency management*
- *Facebook*
- *first responder*
- *fire department*
- *firefighter*
- *mobile devices*
- *situational awareness*
- *social media*
- *smartphones*
- *Twitter*
- *user generated content*

**Search strategy.** The search process gathers academic articles, journals, and government publications from UO Libraries and Google Scholar. In the initial search strategy, a broad approach queries the keywords *Twitter*, *emergency*, *disaster*, and *first responder* in the UO

Libraries database. The search results return a variety of peer-reviewed literature that pertain to social media and location-aware smartphones in the context of disaster management. Given the recent popularity of social media, the search results are current as the published dates range from 2007 to 2016.

Improving the overall search strategy, the cited reference search method is applied to literature found in the UO Libraries. Cited references use the literary materials listed in a bibliography or as works cited in a publication (University of Missouri, n.d.). For this study, cited reference search is used to (a) find literature that has greater focus relative to the research topic; (b) help navigate the search process; and (c) further augment research questions and sub-questions. If the cited references are unavailable from the UO Libraries' databases, then Google Scholar is used as a supplementary search engine. However, if neither UO Libraries nor Google Scholar locate the cited reference, then the article is omitted from the search process.

**Search engines and databases.** The UO Libraries and Google Scholar are the two search engines used for the research; however, most searches are from the UO Libraries' databases. Both search sites are queried primarily using variations of the keywords. The UO databases that are queried include:

- Academic OneFile
- Academic Search Premier
- Association for Computing Machinery (ACM)
- Cambridge University Press Journals Complete
- Communication & Mass Media Complete
- DOAJ Directory of Open Access Journals
- ebrary Academic Complete

- Elsevier ScienceDirect Journals Complete
- GPO
- IEEE/IET Electronic Library (IEL) Journals
- LearningExpress
- Proquest Social Science Journals
- Wiley Online Ebooks (Orbis Cascade Alliance Pilot)

The databases from Google Scholar include:

- ACM Digital Library
- Springer Link

**Documentation approach.** All references are recorded and categorized using two methods. First, all potential references are saved in Zotero. Zotero is a software-based research tool that allows references to be stored to a single, searchable document repository. Zotero allows documents to be searched through metadata such as title, year and creator, which allows for a fast retrieval process. When performing initial searches, all references are initially saved as an Adobe Portable Document Format (PDF) to Zotero for later review. Due to reported inconsistencies of Zotero's APA citation feature, all references are cited using the Publication Manual of the American Psychological Association, 6<sup>th</sup> edition and are saved as a Microsoft Word document.

The references stored in Zotero are read to determine whether the content is relevant to the research. If the references are selected, the PDFs and their corresponding APA citations are then transferred from Zotero to the researcher's cloud-based Microsoft OneDrive account. The references are moved to Microsoft OneDrive to centralize all research documents for remote

accessibility. Within OneDrive, each reference and APA citation are indexed by the title in one of two separate categories labeled *communication* and *situational-awareness*.

**Evaluation of references.** Given that this research is conducted using Internet sources, determining whether an online source of information is credible can be difficult (Purdue Online Writing Lab, n.d.). To remove the potential for inaccuracy, the evaluation of references is based on the University of Florida's Center for Public Issues Education criteria that include the following: *authority*, *timeliness*, *quality*, *relevancy*, and *lack of bias* (Center for Public Issues Education, 2014). The *authority* of a source is evaluated by determining whether the publisher is reputable and by evaluating the author's credentials such as educational background and writing experience and determining if the author has advanced degrees and has published other books and articles. Moreover, the author's article must be a peer-reviewed and published in a scholarly journal. *Timeliness* is validated by the age of the reference. Since social media is a recent phenomenon, sources selected for this research are not older than 10 years.

The *quality* of a reference is determined by how well the paper is written. All references used for this research paper are validated for clarity, logical organization, and consistency of flow throughout the document, as well as the use of accurate grammar, punctuation, and spelling. The *relevancy* of the reference is determined by whether the content of the article pertains to social media, with preference given to sources that focus on the use of social media by first responders during and after a disaster. Lastly, lack of *bias* is ascertained through the author's intention. The author's purpose must be factual and free from opinion or propaganda (UC Santa Cruz, 2016). In addition, bias is determined if the author has an objective of selling a product or service related to the topic (Center for Public Issues Education, 2014). Thus, if the author's intention is to promote the user of Twitter, the article will be omitted from the research paper.

### **Annotated Bibliography**

The following 15 references inform the main research question of this study: What are the best practices in the use of social media by first responders during and after a disaster to (a) improve communications with the public, and (b) achieve greater insights for decision-making abilities? The subsequent references examine the use of social media in crisis situations to augment *communication* and *situational-awareness*. To address the two questions posed in the main research question, the annotated bibliography is organized into two categories. The first category includes scholarly references that explore whether first responders can utilize social media as a primary method of communicating critical information to the public during and following a disaster. The second category examines how first responders can harness social media data to improve situational-awareness following a disaster.

Each annotation is comprised of three components: (a) the full bibliographic citation, (b) the full abstract, and (c) a summary. The following abstracts are brief and authoritative statements that describe a larger body of work and may contain the thesis, background, and conclusion (UNC Chapel Hill, n.d.). The summaries explain the background of the problem and describe how the information from the article is related to the purpose of this research. The objective of each summary is to provide fire departments with key insights on how social media can be applied to communications and operational strategies in disaster management planning.

#### ***Topic 1) The Use of Social Media as a Communication Tool in Disasters***

**Alexander, D.** (2014). Social media in disaster risk reduction and crisis management. *Science and Engineering Ethics*, 20(3), 717-33. doi: 10.1007/s 11948-013-9502-z

**Abstract.** This paper reviews the actual and potential use of social media in emergency, disaster and crisis situations. This is a field that has generated intense interest. It is characterized by a burgeoning but small and very recent literature. In the emergencies field, social media (blogs, messaging, sites such as Facebook, wikis and so on) are used in seven different ways: listening to public debate, monitoring situations, extending emergency response and management, crowd-sourcing and collaborative development, creating social cohesion, furthering causes (including charitable donation) and enhancing research. Appreciation of the positive side of social media is balanced by their potential for negative developments, such as disseminating rumors, undermining authority and promoting terrorist acts. This leads to an examination of the ethics of social media usage in crisis situations. Despite some clearly identifiable risks, for example regarding the violation of privacy, it appears that public consensus on ethics will tend to override unscrupulous attempts to subvert the media. Moreover, social media are a robust means of exposing corruption and malpractice. In synthesis, the widespread adoption and use of social media by members of the public throughout the world heralds a new age in which it is imperative that emergency managers adapt their working practices to the challenge and potential of this development. At the same time, they must heed the ethical warnings and ensure that social media are not abused or misused when crises and emergencies occur.

**Summary.** Alexander evaluates the actual and possible use of social media in emergency, disaster, and crisis situations. In the context of this article, Alexander describes social media as Internet-based blogs, messaging sites, Facebook, and wikis. He discusses seven methods for the use of social media in the emergency management field:

(a) listening to public debate, (b) monitoring situations, (c) extending emergency response and management, (d) crowd-sourcing and collaborative development, (e) creating social cohesion, (f) furthering causes such as charitable donations, and (g) enhancing research.

The information in this article is pertinent to this study because the research explores the integration of social media into emergency planning and crisis management. This study concludes that 80% of the public and 69% of online users felt that emergency managers could benefit from the use of social media in a disaster. However, based on findings, many government agencies have not adopted the use of social media due to the fear of erroneous and inaccurate information. Furthermore, studies show that a government agency's operational framework must change to fully integrate social media in disaster management planning. The study identifies potential opportunities for two-way communication between the public and government agencies using social media as a delivery method.

**Cho, S., Jung, K., & Park, H.** (2013). Social media use during Japan's 2011 earthquake: How Twitter transforms the locus of crisis communication. *Media International Australia Incorporating Culture and Policy*, 149, 31-40. Retrieved from <http://go.galegroup.com/ps/i.do?p=AONE&sw=w&u=s8492775&v=2.1&it=r&id=GALE%7CA363973096&asid=10a609866ea923f80ca8c8bf6de4eef8>

**Abstract.** This article explores social media use during Japan's 2011 earthquake. In the era of social media, this earthquake provides an opportunity for analyzing the role of communication during a crisis. To explain how social media use transforms the locus of

crisis communication, we collected sufficient data on tweets in Japan from the Twitter public timeline during the earthquake and examined the Japanese government's Twitter account and its URLs. The results indicate that crisis communication on Twitter was led by peer-to-peer communication and relied on peer-generated information. In addition, the government's traditional leadership role in exercising tight control over crises and facilitating disaster communication was not clearly apparent on Twitter. By examining the shift in the locus of crisis communication through social media, this study provides new insights into the current use of social media.

**Summary.** Cho et al., examine the use of Twitter in disaster situations. Specifically, this study explains how social media is used as a primary communication method in a large scale disaster. The authors use Japan's 2011 earthquake as an example of how Twitter was used as a method to disseminate information. The results of this study indicate that communication was led by distributed communication networks and relied on user-generated content such as data embedded in Twitter messages. Per the study, there were more than 5 million Twitter users after the earthquake. The rapid growth in unique Twitter followers validated the premise that the Japanese relied on social media as a channel of crisis communication in a disaster.

This article also discusses the lack of involvement in Twitter and social media from the Japanese government prior to the earthquake. Understanding the missed opportunities for communication to citizens, the Japanese government established social media accounts for the following organizations within a month after the earthquake: (a) Prime Minister, (b) E-government group in the Ministry of Internet Affairs and Administration, (c) Ministry of Economy, (d) Trade and Industry, (e) Military, (f) Maritime Self-Defense

Forces, (g) Ground Self-Defense Forces, and (h) the Financial Services Agency. In terms of content, the Japanese government used Twitter to respond to disasters, share information on crises, offer energy security and implement anti-earthquake measures. This article is relevant for this study because it demonstrates that the use of Twitter and the ensuing adoption of social media by the Japanese government following the 2011 earthquake demonstrate the effectiveness of social media as a communication tool in a crisis situation.

**Huang, C., Chan, E., & Hyder, A.** (2010). Web 2.0 and internet social networking: A new tool for disaster management? - Lessons from Taiwan. *BMC Medical Informatics and Decision Making*, 10, 57. doi: 10.1186/1472-6947-10-57

**Abstract.** *Background:* Internet social networking tools and the emerging web 2.0 technologies are providing a new way for web users and health workers in information sharing and knowledge dissemination. Based on the characters of immediate, two-way and large scale of impact, the internet social networking tools have been utilized as a solution in emergency response during disasters. This paper highlights the use of internet social networking in disaster emergency response and public health management of disasters by focusing on a case study of the typhoon Morakot disaster in Taiwan. *Discussion:* In the case of typhoon disaster in Taiwan, internet social networking and mobile technology were found to be helpful for community residents, professional emergency rescuers, and government agencies in gathering and disseminating real-time information, regarding volunteer recruitment and relief supplies allocation. We noted that if internet tools are to be integrated in the development of emergency

response system, the accessibility, accuracy, validity, feasibility, privacy and the scalability of itself should be carefully considered especially in the effort of applying it in resource poor settings.

*Author's Summary:* This paper seeks to promote an internet-based emergency response system by integrating internet social networking and information communication technology into central government disaster management system. Web-based networking provides two-way communication, which establishes a reliable and accessible tunnel for proximal and distal users in disaster preparedness and management.

**Summary.** By developing a case study based on Typhoon Morokot, researchers Huang, Chan, and Hyder examine how emerging Web 2.0 technologies can be used to share information during a disaster. The researchers contend that establishing stable communications is one of the greatest challenges to public health officials and first responders during a large-scale disaster. The authors used the Chi-Chi earthquake in Taiwan and Hurricane Katrina in the U.S. to prove that traditional telephone, radio, and television-based emergency response is not capable of meeting communication needs between first responders and residents during a major disaster.

The purpose of the study is to describe the effects of social networking among large groups of web users during significant disasters to create a web-based emergency response system. The researchers concluded that Internet-based Web 2.0 platforms, mobile communication technologies and social networking could change how governments and communities interact. The authors contend that a web-based emergency response system would have enabled citizens affected by Typhoon Morokot to use their mobile devices to report incidents to government agencies. The authors conclude that the

integration of Web 2.0, social media, and microblogging systems can be beneficial for all stakeholders during a major disaster.

This study is important to this research paper because the reference confirms that Internet-based technologies such as social media can be used to augment communications between first responders and citizens during a natural disaster. Furthermore, the researchers also support the notion that Internet and social media are available when traditional communication methods such as telephone and television service are inaccessible. This study also addresses potential limitations of social media such as the accessibility and quality of information shared in resource-poor regions with lower socioeconomic status.

**Hughes, A. L., Palen, L., Sutton, J., Liu, S. B., & Vieweg, S. (2008).** "Site-seeing" in disaster:

An examination of on-line social convergence. In *Proceedings of ISCRAM 2008 - 5th International Conference on Information Systems for Crisis Response and Management*. (pp. 324-333). Information Systems for Crisis Response and Management, ISCRAM.

**Abstract.** On-line websites and applications are increasingly playing a role in disaster response and recovery. Yet with the wide variety of on-line grassroots activities that occur in such situations, it can be difficult to make sense of them. In this paper, we describe on-line behavior as socially convergent activity, interpreting it within existing sociological understandings of behavior in disaster events. We discuss seven types of convergent behavior and give examples of on-line activities for each type. By seeing

these activities as an essential part of the disaster social arena, we can begin to think about how to support socially convergent phenomena in new and creative ways.

**Summary.** In this article, the researchers explore online social convergence during a disaster. The conventional explanation of social convergence is the arrival of people to a physical location in the aftermath of a disaster. However, with the arrival of the Internet, the authors explore how social convergence applies to the realm of web-based applications. The researchers contend that online activity increases by citizens and disaster response organizations following a disaster. With the increase of information on the Internet in the aftermath of a disaster, the authors study socially convergent online behavior that includes how people seek information and find ways to aid others.

Specifically, the researchers focus on seven distinct sociological behaviors that include the following (a) helping, (b) being anxious, (c) returning back to the disaster scene, (d) supporting, (e) mourning, (f) exploiting, and (g) being curious.

This paper is important to this research because the authors explain how people behave online after a major disaster. Using existing social science theories, the findings support the notion that social media can be an effective platform to communicate valuable information between first responders and affected citizens during a disaster. The findings of this research indicate that human behavioral patterns are similar between people physically arriving to a disaster and those joining on an online platform to share information. The *helpful* and *supporting* information that is shared in the online communities may assist first responders to make informed decisions to assist citizens in danger. In addition, the public can engage in crowdsourcing and turn to social media as a grassroots method of sending and receiving information to aid others in need.

**Liu, B., Fraustino, J., & Jin, Y.** (2016). Social media use during disasters. *Communication Research, 43*(5), 626-646. doi:10.1177/0093650214565917

**Abstract.** This study provides insights that can inform disaster communication management, policymaking, and theory building through a nationally representative field experiment (N = 2,015 U.S. adults) grounded in media richness theory, information and communication technologies (ICTs) succession theory, and the social-mediated crisis communication (SMCC) model. Key findings include the following: (1) Significant main effects of disaster information source were detected on how likely participants were to seek further disaster information from TV, local government websites, and federal government websites; (2) regardless of information form and source, participants reported strongest intentions to immediately communicate about the disaster predominately via offline interpersonal forms rather than through online organizational and personal forms; and (3) regardless of information source, participants reported strong intentions to evacuate if instructed to do so by the government. These findings call for developing crisis communication theory that is more focused on how publics communicate with each other rather than with organizations about disasters and predict a wider variety of crisis communication outcomes.

**Summary.** Researchers Liu, Fraustino, and Jin explore disaster and crisis communication as it pertains to social media. For this study, the authors base their research on two factors that influence citizens' communicative and behavioral responses to disasters: (a) the *form* in which the disaster information is conveyed such as multimedia, text messages, or social media; and (b) the *source* of the crisis information such as the person or

organization that created the message. Based on these two factors, the authors examine the following topics in a review of literature: (a) crisis and disaster communication, (b) social media, (c) impacts of disaster information *form* on disaster behaviors, (d) impacts of disaster information *source* on crisis behaviors, and (e) potential joint impacts of disaster information form and source. The researchers identified a gap in the review of literature and posed research questions that addressed how disaster information form and source independently or jointly impact participants' intentions to seek and share information and to take protective actions. The researchers conducted a field experiment that is grounded in media richness theory, information and communication technologies succession theory, and the social-mediated crisis communication model and concluded the following: (a) participants reported intentions to communicate through interpersonal forms such as telephone calls, face-to-face conversations, texting and emailing rather than through social media; and (b) participants were highly likely to evacuate from the hypothetical disaster area if instructed by government officials.

This reference is important to this research because the findings highlight the implication of the public's interpersonal communication when responding to disaster information. In a crisis, the study shows that citizens would prefer to communicate one-on-one through telephone, email and text messages instead of communicating through organizations' online forums. This study cautions first responders to avoid the use of social media as the *sole* source of crisis communications, as their findings clearly indicate that social media was not the preferred source for sharing information among those who participated in the field study. Despite the natural tendency to favor media-rich formats, this study does validate that citizens will listen and follow government agencies in an emergency.

Therefore, this information is important when determining the effectiveness of social media as a communication tool in a disaster situation.

**Makinen, M., & Kuira, M.** (2008). Social media and postelection crisis in Kenya. *The International Journal of Press/Politics*, 13(3), 328-335. doi: 10.1177/1940161208319409

**Abstract.** This article analyzes the role of the media during the two months of postelection crisis in 2008 in Kenya. We discuss how people exchanged information during and after the media ban and analyze online discussions and media coverage. Particular emphasis is given to the role of the social media, such as Web 2.0 communication tools and services, which enable citizens to interact or share content online. Our analysis shows that during the crisis, the social media functioned as an alternative medium for citizen communication or participatory journalism. This experience has important implications for the process of democratization in Kenya.

**Summary.** This paper explores how the citizens of Kenya used social media to exchange information when the Kenyan government imposed a media ban of live broadcasts during the postelection crisis in 2007. The controversial presidential election between Kenya's president Mwai Kibaki and opposition leader Raila Odinga resulted in widespread civil unrest that left nearly 1,000 people dead and 500,000 people banished after Kibaki was declared the winner of the election but Odinga also claimed victory. After the results were announced, the Kenyan internal security minister John Michuki banned live broadcast covering the divisive election. During the media blackout, people used smartphones to send SMS messages to share sentiment regarding the election results. However, the ability to send mass SMS messages was banned by the Kenyan government

to prevent what were considered “provocative messages” (p. 329). Even with the Kenyan government’s attempt at media and mobile phone censorship, citizens turned to the Internet to share information on social media platforms such as wikis, weblogs, Facebook, Flickr, Twitter, and YouTube.

This article is essential to this research paper because the authors provide an example of how social media can be used when primary communication channels such as media and text messaging are unavailable. Per the researchers, social media proved to have an extraordinary role during the media ban and the national crisis. The researchers concluded that social media was an effective tool to share opinions, discuss political views and allow citizens to contact and help relatives in dangerous areas.

**Murthy, D., & Gross, A.** (2016). Social media processes in disasters: Implications of emergent technology use. *Social Science Research*, Social Science Research. Retrieved from: <http://www.sciencedirect.com/science/article/pii/S0049089X16306056>

**Abstract.** This article seeks to extend social science scholarship on social media technology use during disruptive events. Though social media's role in times of crisis has been previously studied, much of this work tends to focus on first-responders and relief organizations. However, social media use during disasters tends to be decentralized and this organizational structure can promote different types of messages to top-down information systems. Using 142,786 geo-tagged tweets collected before and after Hurricane Sandy's US landfall as a case study, this article seeks to explore shifts in social media behavior during disruptive events and highlights that though Sandy disrupted routine life within Twitter, users responded to the disaster by employing humor, sharing

photos, and checking into locations. We conclude that social media use during disruptive events are complex and understanding these nuanced behaviors is important across the social sciences.

**Summary.** Murthy and Gross studied the use of social media during a crisis. Based on a sociological perspective, their research focuses on how first responders and relief organizations can benefit from the use of social media in a disaster. Using Hurricane Sandy as a case study, this article explores the shifts in social media behavior in critical situations. Specifically, this research examines what type of information was shared by Twitter users during and after Hurricane Sandy. The authors observed how Hurricane Sandy interrupted Twitter's normal posting patterns and users' responses to the disaster through humor, photo sharing, and geotagging. By analyzing Twitter data for Hurricane Sandy, the authors noted that Twitter was mostly effective for fundraising efforts rather than engaging in two-way communication with the public. In particular, the researchers ultimately found that the most frequent relief-related content on Twitter originated from NBC's Coming Together telethon on November 2, 2012.

In several cases, information shared by social media users was inaccurate due to openness and lack of accountability from users. For instance, one tweet falsely claimed that the New York Stock Exchange had been flooded in 3 feet of water. For that reason, the overload of information that inundates social media during a disaster makes it challenging for first responders to differentiate useful information from noise.

This reference is important to this research because the study establishes that social media data is difficult for first responders to analyze during a disaster. Due to these challenges, it is not considered practical for first responders to use social media as an

alternative method for disaster response when normal communications fail. Rather, the authors recommend that first responders use social media as a tool to circulate critical information to the public.

**Simon, T., Goldberg, A., & Adini, B. (2015).** Socializing in emergencies—A review of the use of social media in emergency situations. *International Journal of Information Management, 35*(5), 609-619. Retrieved from:  
<http://www.sciencedirect.com/science/article/pii/S0268401215000638>

**Abstract.** Social media tools are integrated in most parts of our daily lives, as citizens, netizens, researchers or emergency responders. Lessons learnt from disasters and emergencies that occurred globally in the last few years have shown that social media tools may serve as an integral and significant component of crisis response.

Communication is one of the fundamental tools of emergency management. It becomes crucial when there are dozens of agencies and organizations responding to a disaster.

Regardless of the type of emergency, whether a terrorist attack, a hurricane or an earthquake, communication lines may be overloaded and cellular networks overwhelmed as too many people attempt to use them to access information. Social scientists have presented that post-disaster active public participation was largely altruistic, including activities such as search and rescue, first aid treatment, victim evacuation, and online help. Social media provides opportunities for engaging citizens in the emergency management by both disseminating information to the public and accessing information from them. During emergency events, individuals are exposed to large quantities of

information without being aware of their validity or risk of misinformation, but users are usually swift to correct them, thus making the social media “self-regulating”.

**Summary.** Using past experiences, researchers Simon, Goldberg, and Adini explore how social media is used in emergency situations. Recent international disasters such as the 2011 Haiti earthquake have revealed that social media is an important part of disaster management. This study describes how traditional communication channels such as telephone lines maybe overloaded during a terrorist attack or natural disaster. Despite these challenges, Internet-based communication such as social media may be available during massive outages. Therefore, during times of crisis, emergency managers can use social media to disseminate information to citizens. From a sociological perspective, the researchers also discovered that citizens affected by a major disaster exhibit altruistic behavior on social media. Citizens post information that relates to search and rescue, first aid, evacuation, and helpful resources. From a tactical perspective, social media can be used by emergency managers to improve situational-awareness by utilizing geospatial data. The authors assert that location-based data from smartphones and social media can enable emergency managers to plot where areas are compromised such as roads and buildings.

This reference is important to this research because the authors confirm that social media provides an opportunity for emergency managers to engage citizens and harness data to improve decision-making. This article supports this research in the following ways: (a) identifying communication challenges in a disaster; (b) validating the efficacy of the use of social media for emergency managers; (c) validating the use of location-based information from geolocation data on smartphones following disasters; and (d) providing

examples of the use of social media to broadcast information. Furthermore, this research provides evidence that that social media can be used as a primary method of communication when traditional systems such as media and telephone lines are unavailable.

**Sreenivasan, N. D., Lee, C. S., & Goh, D. H.** (2011). Tweet me home: Exploring information use on Twitter in crisis situations. *Online Communities and Social Computing Lecture Notes in Computer Science*, 120-129. doi:10.1007/978-3-642-21796-8\_13

**Abstract.** Microblogs have received considerable attention in crisis communication due to its real-time nature. Despite this, research has not adequately addressed how users make use of information amongst the vast amount of real-time content available in a crisis. Hence, this study aims to understand information use in crisis situations by employing microblogs. Taylor's [4] information use environment (IUE) model provides theoretical background for this study. According to this model, there are eight classes of information use. We focus on the IUEs surrounding the 2010 Icelandic volcano eruption. Our study uses Twitter to analyze users' postings related to this volcano. The types of postings were ascertained using content analysis. Our findings suggest enlightenment to be the largest category of information use. Other categories such as status messages, problem understanding and factual data were also reported. Further, humor not previously identified by Taylor [4] emerged as a substantial class of information use.

**Summary.** Sreenivasan, Lee, and Goh explore the type of information that is distributed in microblogs in crisis situations. Using the 2010 Icelandic volcano eruption, the study uses Twitter to analyze user postings related to the eruption. Using the information use

environment (IUE) model as the theoretical background for the study, eight classes of information is used to determine the type of content that was Tweeted during the disaster. The eight classes include the following: (a) enlightenment, (b) personal, (c) problem understanding, (d) factual, (e) motivational, (f) projective, (g) instrumental, and (h) conformational. The analysis indicates the primary themes can be grouped into topics such as sharing related information, providing information on issues, reporting daily activities and facts.

The article is relevant to this research because it explores how Twitter is used and the subject matter that is distributed by social media users during a disaster. Based on this study, a large portion of Twitter users shared information that pertained to the volcanic eruption. Consequently, data received from social media may serve as a two-way communication function to improve decision-making for first responders in a crisis.

### ***Topic 2) The Use of Social Media to Improve Situational Awareness in a Disaster***

**Adam, N., Shafiq, B., & Staffin, R.** (2012). Spatial computing and social media in the context of disaster management. *Intelligent Systems, IEEE*, 27(6), 90-96. doi: 10.1109/MIS.2012.113

**Abstract.** The growing trend of using smartphones and other GPS-enabled devices has provided new opportunities for developing spatial computing applications and technologies in unanticipated and unprecedented ways. Some capabilities of today's smartphones highlight the potential of citizen sensors to enable the next generation of geo-informatics. One promising application area for this is social media and its application to disaster management. Dynamic, real-time incident information collected

from onsite human responders about the extent of damage, the evolution of the event, the community's needs, and responders' ability to deal with the situation, combined with information from the larger emergency management community, could lead to more accurate and real-time situational awareness. This would enable informed decisions, better resource allocation and thus a better response and outcome to the total crisis. In this context, the US Department of Homeland Security's Science & Technology Directorate (DHS-S&T) has initiated the Social Media Alert and Response to Threats to Citizens " (SMART-C) program, which aims to develop citizen participatory sensing capabilities for decision support throughout the disaster life cycle via a multitude of devices and modalities. Here, the authors provide an overview of the envisioned SMART-C system's capabilities and discuss some of the interesting and unique challenges that arise due to the combination of spatial computing and social media within the context of disaster management.

**Summary.** Adam et al., highlight growing trends in the use of smartphone and GPS devices. By harnessing GPS and IP capabilities, new opportunities are afforded to develop spatial computing applications for use in emergency management.

To demonstrate how spatial computing and social media can improve situational awareness, the authors examine the framework of SMART-C, a social media response initiative from the US Department of Homeland Security's Science & Technology Directorate. Adam et al., explain that the objective of SMART-C is to create a two-way link between first responders and citizens that allows the following: (a) reception of early warning signals; (b) discovery of incidents and determination of how incidents progress; (c) communication of notifications to citizens for incident response and rescue; and (d)

reception of the public's feedback for post-incident analysis. SMART-C receives input from social media platforms such as Twitter and Facebook and processes data that includes the following: (a) type of event, (b) text, (c) video, (d) audio, (e) date, (f) time, and (g) GPS location. Government agencies can access SMART-C data through open source platforms, including WebEOC, a common incident-management system for emergency operation centers.

This reference is important to this research because the authors assert that real-time incident information provided by smartphone users could lead to greater situational awareness for emergency managers. The authors note that situational awareness in a disaster situation enables informed decisions, better resource allocation, and improved response to emergencies. This study validates the possibility of fire departments receiving, processing, and analyzing social media data to make informed decisions and to improve situational awareness in crisis situations.

**Appling, S., Briscoe, E., Carpenter, A., Mccook, L., Scott, G., Allen, T., . . . Oros, C. (2015).**

Social media for situational awareness: Joint-interagency field experimentation. *Procedia Engineering*, 107, 319-324. doi:10.1016/j.proeng.2015.06.087

**Abstract.** Social Media for Situational Awareness (SMSA) — the identification, tracking, and analysis of online social computing data in collaboration with other kinds of sensor data towards the derivation of 'actionable' intelligence, has recently become one of the key focuses of the Joint Interagency Field Experiment (JIFX), a regularly held event developed and facilitated by the Naval Postgraduate School. In this paper we describe: the structure of SMSA experimentation at JIFX, a situational awareness

capabilities assessment, the outcomes of a SM shared task, and an integrated-technology scenario focusing on pandemic outbreak. We discuss an outline of potential future avenues for SMSA experimental designs to aid in the assessment and promotion of the use of technology for the derivation of intelligence from non-traditional sources during crises.

**Summary.** Applin et al. examine Social Media for Situational Awareness (SMSA), which is the identification, tracking, and analysis of social media data in conjunction with other forms of sensor data to create actionable intelligence in the field. SMSA is a key focus of the Joint Interagency Field Experiment (JIFX), a group that is sponsored by the Office of the Secretary of Defense and the Department of Homeland Security. The authors: (a) examine JIFX's experimentation of nine situational-awareness parameters that were relevant to social media, (b) review social media behavior generated during Hurricane Arthur in July 2014, and (c) provide an integrated scenario that focuses on the use of social media during a pandemic outbreak. In the integrated scenario, the incident commander successfully met the objective of identifying the persons of interest from social media postings with the assistance of field personnel, mobile applications, and unmanned aerial systems.

This paper is important for this study because it supports the notion that social media data can be used to improve situational-awareness for first responders in the field.

**Dave, R., Boddhu, S. K., McCartney, M., & West, J.** (2013). Augmenting situational awareness for first responders using social media as a sensor. *IFAC Proceedings Volumes*, 46(15), 133-140. doi: 10.3182/20130811-5-US-2037.00088

**Abstract.** First responders to an emergency situation rely on ground truths measured by various sensing mechanisms for effective decision making. The sensors are typically airborne or ground based. Seamless sharing of information among users using Social networking provides for a unique type of sensor. This human-as-a sensor is already deployed in the field and only requires harvesting of the information to glean ground truth. Further, the proliferation of the smartphones and their connectivity networks has powered the ordinary individuals to share and acquire information regarding the events happening in his/her immediate vicinity in a real-time fashion. The information provided by these sensors is already annotated with descriptions such as “urgency” “critically wounded” which normally would not be found in traditional machine based sensors. Further, when appropriately employed this real-time data can support in detecting localized events like fire, accidents, shooting, etc . . . , as they unfold and pin-point individuals being affected by those events. The spatio-temporal information can be indexed, grouped and deployed on Smartphones and other devices that first responders can use in the field to augment decision making. In this vein, under SATE and YATE programs, the research team at AFRL Tec^Edge Discovery labs had demonstrated the feasibility of developing Smartphone applications, that can provide a augmented reality view of the appropriate detected events in a given geographical location (localized) and also provide an event search capability over a large geographic extent. In its current state, the application thru its backend connectivity utilizes a data (Text & Image) processing framework, which deals with data challenges like; identifying and aggregating important events, analyzing and correlating the events temporally and spatially and building a

search enabled event database. Further, the smartphone application with its backend data processing workflow has been successfully field tested with live user generated feeds.

**Summary.** Dave, Boddhu, McCartney, and West assert that social media data can improve situational-awareness for first responders. The authors note that first responders can augment emergency response through real-time event detection information from social media sources. The authors examined an experimental platform developed by AFRL Tec^Edge Discovery Labs that uses a PSSA Cloud Architecture to provide a real-time view of events in a geographical location. With the aim of improving decision-making for first responders, the software application aggregates spatio-temporal information from web-based sources that can be indexed, grouped, and deployed on computers and smartphones. The software application's PSSA Cloud Architecture was developed to support live ingestion of various data feeds including social media data through API's. The data aggregated through PSSA Cloud is processed, extracted, and validated in near real-time. To access the processed data in the PSSA Cloud, command centers such as emergency operations centers use OpenLST for larger visualization platforms. First responders can access PSSA Cloud data through PocketLSTs on smartphone devices.

This article is relevant for this study because the researchers explain how first responders can harness spatio-temporal data from social media to improve situational-awareness in the field. From a technical perspective, this study describes the software infrastructure that supports live processing of social media data through an API. The data is processed in real-time and accessed by emergency operations centers to visualize where incidents are occurring. Emergency managers and first responders can implement this technology

into their disaster management plans to improve decision-making and operational tactics during a crisis.

**Imran, M., Castillo, C., Diaz, F., & Vieweg, S.** (2015). Processing social media messages in mass emergency: A survey. *Acm Computing Surveys*, 47(4). doi:10.1145/2771588

**Abstract.** Social media platforms provide active communication channels during mass convergence and emergency events such as disasters caused by natural hazards. As a result, first responders, decision makers, and the public can use this information to gain insight into the situation as it unfolds. In particular, many social media messages communicated during emergencies convey timely, actionable information.

Processing social media messages to obtain such information, however, involves solving multiple challenges including: parsing brief and informal messages, handling information overload, and prioritizing different types of information found in messages. These challenges can be mapped to classical information processing operations such as filtering, classifying, ranking, aggregating, extracting, and summarizing. We survey the state of the art regarding computational methods to process social media messages and highlight both their contributions and shortcomings. In addition, we examine their particularities, and methodically examine a series of key sub-problems ranging from the detection of events to the creation of actionable and useful summaries. Research thus far has, to a large extent, produced methods to extract situational awareness information from social media. In this survey, we cover these various approaches, and highlight their benefits and shortcomings. We conclude with research challenges that go beyond situational

awareness, and begin to look at supporting decision making and coordinating emergency-response actions.

**Summary.** Imran et al., analyze how first responders, decision makers, and the public can use real-time information generated from social media platforms to gain insight during an emergency. The authors discuss the challenges of processing social media messages into useful information. These challenges are identified as filtering, classifying, ranking, aggregating, extracting, and summarizing social media messages. The researchers survey modern computational methods to process social media messages and highlight the strengths and shortcomings. The authors conclude that social media platforms can help support decision-making during an emergency and coordinate emergency response actions.

This article is relevant for this study because the researchers explore the value of, and challenges related to, the analysis of social media data. In terms of challenges, aggregating massive amounts of data into useful information can present a challenge to fire departments with limited resources.

**Kryvasheyev, Y., Chen, H., Moro, E., Van Hentenryck, P., & Cebrian, M. (2015).**

Performance of social network sensors during Hurricane Sandy. *PloS One*, 10(2), E0117288. Retrieved from

<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0117288>

**Abstract.** Information flow during catastrophic events is a critical aspect of disaster management. Modern communication platforms, in particular online social networks, provide an opportunity to study such flow and derive early-warning sensors, thus

improving emergency preparedness and response. Performance of the social networks sensor method, based on topological and behavioral properties derived from the “friendship paradox”, is studied here for over 50 million Twitter messages posted before, during, and after Hurricane Sandy. We find that differences in users’ network centrality effectively translate into moderate awareness advantage (up to 26 hours); and that geo-location of users within or outside of the hurricane-affected area plays a significant role in determining the scale of such an advantage. Emotional response appears to be universal regardless of the position in the network topology, and displays characteristic, easily detectable patterns, opening a possibility to implement a simple “sentiment sensing” technique that can detect and locate disasters.

**Summary.** This research paper explores whether social networking sites such as Twitter can develop early-warning sensors to improve emergency preparedness and response. This empirical research was based on the behavioral characteristics that stemmed from the *friendship paradox* phenomenon, which is an observation by Sociologist Scott Feld that assumes that *most people have fewer friends than their friends have, on average*. Using the friendship paradox as a data collection method, the researchers measured the performance of social network sensor methodologies that were comprised of over 50 million tweets posted prior to, during and after Hurricane Sandy. Using this large sample of Twitter messages throughout Hurricane Sandy, the researchers obtained the following information: (a) raw datasets, (b) location data and geocoding, and (c) relevance filtering. Analyzing the Twitter data collected, the researchers discovered information related to: (a) the lead-time in disaster awareness, and (b) emotional response from Twitter users. In terms of lead-time in disaster awareness, the findings revealed that the ability of

individuals to finding information about the hurricane was related to the size of the sample. For instance, it took users up to 11 hours to become aware of the disaster in a small sample of 500. Conversely, with a sample size of 100,000 users, the lead time advantage reduces to 5 hours. Furthermore, lead time in disaster awareness was also affected by users that were Tweeting geographically closer to the disaster area. The sentiment study revealed that emotions were the same in a disaster regardless of variances such as network centrality or sample size.

This study is important to this research because it provides an example of the rate that information is disseminated through Twitter during a crisis situation. Based on the findings, the researchers concluded that lead-times from Twitter may be adequate for individuals aiming to improve their own level of disaster preparedness such as stockpiling water, food and fuel. However, lead-times from Twitter are not sufficiently short for first responders to suggest a change emergency management strategies. Due to inadequate lead-times, this research shows that using Twitter as a standalone application may not improve situational-awareness for first responders.

Despite the outcome of the research, first responders should not dismiss the idea of using social media as a tool to improve disaster response. Greater exploration is necessary to determine whether social media data can be extracted and processed using third-party applications to augment situational-awareness in a crisis.

**Vieweg, S., Hughes, A. L., Starbird, K., & Palen, L. (2010).** Microblogging during two natural hazards events: What Twitter may contribute to situational awareness. *In ACM Conference on Human Factors in Computing Systems, CHI 2010 Proceedings: Crisis*

Informatics. 10–15 April 2010, Atlanta, Georgia, pp. 1079–1088.

doi:10.1145/1753326.1753486

**Abstract.** We analyze microblog posts generated during two recent, concurrent emergency events in North America via Twitter, a popular microblogging service. We focus on communications broadcast by people who were "on the ground" during the Oklahoma Grassfires of April 2009 and the Red River Floods that occurred in March and April 2009, and identify information that may contribute to enhancing *situational awareness* (SA). This work aims to inform next steps for extracting useful, relevant information during emergencies using information extraction (IE) techniques.

**Summary.** Authors Vieweg, Hughes, Starbird, and Palen explored how social media can be used to augment situational awareness in hazardous conditions such as a natural disaster. The researchers examined communications that transpired over Twitter in two separate disaster events that occurred in the Spring of 2009: the Red River floods in North Dakota and the Oklahoma grass fires. Using the two datasets, they analyzed the following: (a) geo-location, (b) location-referencing, and (c) situational update information. The researchers discovered that geo-location and location-referencing data from Twitter was easily identified and extracted. Using geo-location and location-referencing data, the researchers applied situational update information from their data sources to develop a communication framework to enhance situational awareness. The researchers concluded that Twitter data from the Red River floods and Oklahoma grass fires enabled them to identify pieces of information that are created during emergency situations. The authors intend to use their preliminary findings to design and implement

software-based systems that will generate information from social media data to improve situational awareness in a disaster.

This reference is important to this research because the authors validate the possibility of aggregating geo-location and location-referencing data from smartphones to improve situational awareness for emergency managers. Although the researchers did not provide a software solution to process geospatial data, the authors created a theoretical framework of how Twitter data can be used to improve situational awareness in disasters. As it applies to this research, fire departments can implement this framework as part of their communications plan to augment disaster management strategy.

## Conclusion

The annotated bibliography provides a review of scholarly literature that explores the use of social media in a disaster. The literature addresses the technical application and sociological considerations of social media in critical situations. The sources explore the relevance of social media in a disaster by identifying the following: (a) social media platforms as the primary method to share information; (b) the effectiveness of social media for two-way communications; and (c) the ability to collect and analyze social media data in real-time to improve tactical operations. The goal of this research is to analyze the findings to determine whether emergency management organizations such as fire departments can effectively utilize social media as a catalyst to (a) augment *communications* to the public during a crisis, and (b) harness social media data to enhance *situational-awareness*, thereby improving decision-making abilities.

### The Use of Social Media as a Communication Tool in Disasters

**Disseminating information.** During a significant disaster such as an earthquake, typhoon, or terrorist attack, effective communication is one of the greatest challenges for first responders (Huang et al., 2010). Referencing the Chi-Chi earthquake in Taiwan and Hurricane Katrina in the United States, Huang et al. (2010) determined that traditional telephone, radio, and television services were not capable of meeting the communication needs of first responders in a crisis. Additionally, Simon et al. (2015) note that regardless of the type of emergency, common communication lines such as telephones and basic cellular service may be overloaded due to the large number of people attempting to simultaneously access the networks.

Despite outages of traditional systems, Cho et al. (2011) discovered that web-based platforms such as social media were effective tools to exchange information when traditional methods of communication failed. Supporting this notion, Simon et al. (2015) contend that

Internet-based communication such as social media may be accessible during widespread outages. For example, when traditional communication systems are inaccessible, Mäkinen and Kuira (2008) note that Twitter can play an essential role as alternative method to inform citizens. Cho et al. (2011) confirmed that Twitter was used to share information with people that were directly impacted by Japan's 2011 earthquake.

Additionally, Huang et al. (2010) concluded that social networking tools can be used a method to share useful information with people affected by a disaster. For instance, during the Typhoon Morakot disaster, social networking was found to be a useful method to share knowledge between citizens and first responders (Huang et al., 2010). The findings of this research conclude that social media can be a useful tool for emergency management organizations to share critical, lifesaving information to citizens when a disaster renders traditional methods of communication inoperable (Cho et al., 2011; Huang et al., 2010; Simon et al., 2015).

**Two-way communication.** Hughes et al. (2008) explored socially convergent online behavior from a sociological perspective and concluded that people seek information and find ways to help others in a crisis. This altruistic behavior results in citizens sharing supportive information through social media that may improve first responders' decision-making processes (Hughes et al., 2008). From a theoretical lens, Sreenivasan, Lee, and Goh (2011) contend that a significant portion of Twitter users share information that pertains to a disaster, which may open the possibility of using social media as a two-way communication function.

However, even with people exhibiting selfless behavior during a disaster, government agencies have not widely adopted social media into their communications strategies due to the concern of receiving inaccurate information from the public (Alexander, 2014). Alexander

(2014) emphasizes that emergency management organizations must be cautious of receiving harmful information from citizens such as falsified rumors, the promotion of terrorist attacks, and messages that have the potential to undermine authority. Researchers Murthy and Gross (2016) provide an example of how an erroneous tweet falsely claimed that the New York Stock Exchange was flooded in three feet of water during Hurricane Sandy. The overload of both accurate and inaccurate information makes deciphering social media data challenging for first responders (Murthy & Gross, 2016).

Murthy and Gross (2016) analyzed social media data during Hurricane Sandy and concluded that Twitter was more effective for fundraising efforts than for two-way communications between crisis management organizations and the public. For example, after analyzing Twitter data from Hurricane Sandy, the results indicated that the most recurrent relief-related content stemmed from NBC's Coming Together fundraising telethon on November 2, 2012 (Murthy & Gross, 2016). Moreover, Liu et al. (2016) determined that people prefer to communicate one-on-one during a crisis utilizing mediums such as text, email, and phone conversations rather than sharing information through online forums such as social media. Given these limitations, using social media as a two-way communication tool may not be a preferred practice for first responders (Liu et al., 2016; Murthy & Gross, 2016).

### **The Use of Social Media to Improve Situational Awareness in a Disaster**

Adam et al. (2012) conclude that situational awareness in a disaster can lead to informed decisions, improved resource allocation, and effective response to emergencies. Further, Dave, Boddhu, McCartney, and West (2013) determined that first responders can enhance emergency response through real-time event detection data from social media. However, Kryvasheyev et al. (2013) discovered that using a stand-alone social media application such as Twitter may be an

inadequate tool to improve situational awareness. Kryvasheyev et al. concluded that the flow of information from Twitter did not provide sufficient lead times for emergency management organizations to change their emergency management strategies in response to data gleaned from tweets during a disaster. Moreover, first responders such as fire departments may be challenged with processing mass amounts of social media data (Kryvasheyev et al., 2013).

This research concludes that first responders may be challenged in attempting to use Twitter to improve situational awareness (Kryvasheyev et al., 2013). However, the annotated bibliography provides examples of third-party applications that extract social media data in real-time to improve situational awareness for first responders. For example, the literature highlights two examples of U.S. Government programs developed to analyze social media and smartphone location data for crisis management (Adam et al., 2012; Appling et al., 2015). First, Adam et al. (2012) examined the U.S. Department of Homeland Security's Social Media Alert and Response to Threats to Citizens (SMART-C) system. SMART-C is a social media response system that achieves the following: (a) enables early warning signals; (b) detects emerging emergency incidents; and (c) enables a platform to communicate notifications to citizens in a disaster. SMART-C provides analysis of social media and smartphone location data; emergency management organizations can access the data once it is analyzed through commercial desktop applications such as WebEOC. The real-time information retrieved from SMART-C can lead to improved situation awareness for first responders (Adam et al., 2012).

Second, Appling et al. (2015) explore a program called Social Media for Situational Awareness (SMSA), which is designed to identify, track, and analyze online social media data to derive actionable intelligence aimed at improving decision-making for emergency response organizations. Combining social media behavior from Hurricane Arthur in 2014 and a training

scenario using social media during a pandemic outbreak, Appling et al. (2015) concluded that SMSA enabled the training incident commander to meet the required objectives of identifying persons of interest from social media posts.

### **Summary**

The rising trend of using social media and location-aware smartphones devices has provided opportunities for creating spatial computing systems used in disaster management (Adam et al., 2012). Although social media platforms can be used to effectively share information, first responders may not have the necessary framework to extract and analyze social media and smartphone data to improve situational awareness and actionable decision-making (Kryvasheyeu et al., 2013). Imran Castillo, Diaz and Vieweg (2015) assert that the theoretical proposal of implementing social media to augment emergency response has potential; however, the efficacy of using social media to save lives and property during an emergency remains to be seen. Except for well-funded agencies such as the American Red Cross, the U.S. Federal Emergency Management Agency (FEMA), the U.N. Office for the Coordination of Humanitarian Affairs, and the Filipino Government, the use of social media is still experimental for many organizations and not yet part of their normal, day-to-day operations (Imran et al., 2015).

Conversely, Vieweg, Hughes, Starbird, and Palen (2010) validate the possibility of aggregating geospatial data from social media and smartphones through third-party systems to enhance situational awareness for emergency managers. As noted by researchers Kryvasheyeu et al., (2013) using standalone social media platforms such as Twitter may not be adequate for first responders to gather and analyze real-time data. Therefore, to harness social media data to improve emergency response, fire departments must currently rely on third party systems such as

SMART-C to process social media data and integrate software applications such as WebEOC into their disaster management strategies. Based on this research, the use of social media and mobile device data to provide first responder communication and situational awareness in a disaster holds promise and should continue to be considered by fire departments as potential tools in their crisis management planning.

### References

- Adam, N., Shafiq, B., & Staffin, R. (2012). Spatial computing and social media in the context of disaster management. *Intelligent Systems, IEEE*, 27(6), 90-96. doi: 10.1109/MIS.2012.113
- Alexander, D. (2014). Social media in disaster risk reduction and crisis management. *Science and Engineering Ethics*, 20(3), 717-733. doi: 10.1007/s11948-013-9502-z
- Appling, S., Briscoe, E., Carpenter, A., Mccook, L., Scott, G., Allen, T., . . . Oros, C. (2015). Social media for situational awareness: Joint-interagency field experimentation. *Procedia Engineering*, 107, 319-324. doi:10.1016/j.proeng.2015.06.087.
- Center for Public Issues Education. (2015). Evaluating information sources. Retrieved from <http://ce.uoregon.edu/aim/Capstone1Perm/evaluateinfo.pdf>
- Cho, S., Jung, K., & Park, H. (2013). Social media use during Japan's 2011 earthquake: How Twitter transforms the locus of crisis communication. *Media International Australia Incorporating Culture and Policy*, 149, 31-40. Retrieved from <http://go.galegroup.com/ps/i.do?p=AONE&sw=w&u=s8492775&v=2.1&it=r&id=GALE%7CA363973096&asid=10a609866ea923f80ca8c8bf6de4eef8>

- Dave, R., Boddhu, S., McCartney, M., & West, J. (2013). Augmenting situational awareness for first responders using social media as a sensor. *IFAC Proceedings Volumes*, 46(15), 133-140. doi: 10.3182/20130811-5-US-2037.00088
- Huang, C., Chan, E., & Hyder, A. (2010). Web 2.0 and Internet Social Networking: A New tool for Disaster Management? - Lessons from Taiwan. *BMC Medical Informatics and Decision Making*, 10, 57. doi: 10.1186/1472-6947-10-57
- Hughes, A. L., Palen, L., Sutton, J., Liu, S. B., & Vieweg, S. (2008). "Site-seeing" in disaster: An examination of on-line social convergence. In *Proceedings of ISCRAM 2008 - 5th International Conference on Information Systems for Crisis Response and Management*. (pp. 324-333). Information Systems for Crisis Response and Management, ISCRAM.
- Imran, M., Castillo, C., Diaz, F., & Vieweg, S. (2015). Processing social media messages in mass emergency: A survey. *Acm Computing Surveys*, 47(4). doi:10.1145/2771588
- Liu, B., Fraustino, J., & Jin, Y. (2016). Social media use during disasters. *Communication Research*, 43(5), 626-646. doi:10.1177/0093650214565917
- Kaleel, S. B., & Abhari, A. (2015, January). Cluster-discovery of Twitter messages for event detection and trending. *Journal of Computational Science*, 6, 47-57. doi:10.1016/j.jocs.2014.11.004.

- Kryvasheyeu, Y., Chen, H., Moro, E., Van Hentenryck, P., & Cebrian, M. (2015). Performance of social network sensors during Hurricane Sandy. *PloS One*, *10*(2), E0117288. Retrieved from <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0117288>
- Kudo, D., Furukawa, H., Nakagawa, A., Abe, Y., Washio, T., Arafune, T., . . . Kushimoto, S. (2014). Reliability of telecommunications systems following a major disaster: Survey of secondary and tertiary emergency institutions in Miyagi Prefecture during the acute phase of the 2011 Great East Japan Earthquake. *Prehospital and Disaster Medicine*, *29*(2), 204-8.
- Lin, X., Spence, P., Sellnow, T., & Lachlan, K. (2016). Crisis communication, learning and responding: Best practices in social media. *Computers in Human Behavior*, *65*, 601-605.
- Makinen, M., & Kuira, M. (2008). Social media and postelection crisis in Kenya. *The International Journal of Press/Politics*, *13*(3), 328-335. doi: 10.1177/1940161208319409
- More Americans Using Mobile Apps in Emergencies. (n.d.). Retrieved November 09, 2016, from <http://www.redcross.org/news/press-release/More-Americans-Using-Mobile-Apps-in-Emergencies>

Murthy, D., & Gross, A. (2016). Social media processes in disasters: Implications of emergent technology use. *Social Science Research*, Social Science Research. Retrieved from: <http://www.sciencedirect.com/science/article/pii/S0049089X16306056>

Palen, L., & Liu, S. B. (2007). *Citizen communications in crisis: Anticipating a future of ICT-supported public participation*. In Proceedings of the SIGCHI conference on human factors in computing systems San Jose, CA, (pp. 727–736).  
doi:10.1145/1240624.1240736

Purdue OWL. (n.d.). Retrieved November 18, 2016, from <https://owl.english.purdue.edu/owl/resource/553/01/>

Reddy, M. C., Paula, S. A., Abraham, J., McNeesea, M., DeFlicht, C., & Yen, J. (2009). Challenges to effective crisis management-using information and communication technologies to coordinate emergency medical services and emergency department teams. *International Journal of Medical Informatics*, 259–269. Retrieved from: <http://www.sciencedirect.com/science/article/pii/S1386505608001494>

Sarcevic, A., Palen, L., White, J., Starbird, K., Bagdouri, M., & Anderson, K. (2012). "Beacons of hope" in decentralized coordination. *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work - CSCW'12*. doi:10.1145/2145204.2145217

Simon, T., Goldberg, A., & Adini, B. (2015). Socializing in emergencies—A review of the use of social media in emergency situations. *International Journal of Information*

*Management*, 35(5), 609-619. Retrieved from:

[http://www.sciencedirect.com/science/article/pii](http://www.sciencedirect.com/science/article/pii/S0268401215000638)

[/S0268401215000638](http://www.sciencedirect.com/science/article/pii/S0268401215000638)

Sreenivasan, N. D., Lee, C. S., & Goh, D. H. (2011). Tweet me home: Exploring information use on Twitter in crisis situations. *Online Communities and Social Computing Lecture Notes in Computer Science*, 120-129. doi:10.1007/978-3-642-21796-8\_13.

University of California Santa Cruz. (n.d.). Retrieved November 18, 2016, from

<http://library.ucsc.edu/help/research/evaluate-the-quality-and-credibility-of-your-sources>

University of Missouri. (2016). Retrieved November 16, 2016, from

<https://library.missouri.edu/guides/citedrefsearch/>

University of North Carolina at Chapel Hill. (n.d.). Retrieved November 23, 2016, from

<http://writingcenter.unc.edu/handouts/abstracts/>

U.S. Department of Homeland Security (n.d.). Improving disaster response and recovery: Social media analytics and reporting toolkit. Retrieved June 1, 16, from

[https://www.dhs.gov/sites/default/files/publications/Improving Disaster Response and](https://www.dhs.gov/sites/default/files/publications/Improving_Disaster_Response_and_Recovery-Social_Media_Analytics_and_Reporting_Toolkit-CVADA-SMART-Jan2014.pdf)

[Recovery-Social Media Analytics and Reporting Toolkit-CVADA-SMART-Jan2014.pdf](https://www.dhs.gov/sites/default/files/publications/Improving_Disaster_Response_and_Recovery-Social_Media_Analytics_and_Reporting_Toolkit-CVADA-SMART-Jan2014.pdf)

Veinott, B., Cox, D., & Mueller, S., (2009). *Social media supporting disaster response:*

*Evaluation of a lightweight collaborative tool.* Paper presented at the

Proceedings of NDM9, the 9th International Conference on Naturalistic Decision

Making, London, UK, June 23e26, 307e308.

Vieweg, S., Hughes, A. L., Starbird, K., & Palen, L. (2010). *Microblogging during two natural*

*hazards events: What Twitter may contribute to situational awareness.* In ACM

Conference on Human Factors in Computing Systems, CHI 2010 Proceedings: Crisis

Informatics. 10–15 April 2010, Atlanta, Georgia, pp. 1079–1088. doi:

10.1145/1753326.1753486