

# Participatory Design for the Social Media Needs of Emergency Public Information Officers

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## ABSTRACT

This paper describes the design, execution, and results of a participatory design workshop with emergency public information officers (PIOs). During the workshop, PIOs and researchers explored ideas and designs for supporting the social media needs of PIO work. Results indicate that PIO perceptions of social media have changed as they have learned to incorporate activities of the public into their work, yet they still struggle with issues of trust and liability. Based on workshop design activities, the paper offers a set of design recommendations for supporting the social media needs of PIO work practice such as the ability to monitor, document, and report social media activity.

## Keywords

Crisis informatics, emergency management, participatory design, social media

## INTRODUCTION

The focus of this study is the public information officer (PIO)—an emergency management position that handles the public relations function of emergency response—and their use of social media. Social media have introduced new means by which PIOs can disseminate, gather, and monitor public information in times of crisis. In the past, PIOs relied more heavily upon traditional media such as newspaper, television, and radio to distribute information during an emergency event. However, with members of the public increasingly turning to online sources for information and news, PIOs have found that social media can serve as an effective communication mechanism because they can distribute information quickly and directly to the public (Hughes and Palen, 2012). Additionally, members of the public are generating and sharing information across social media streams in a wide variety of contexts (Palen and Liu, 2007; Qu, Wu and Wang, 2009; Zook, Graham, Shelton and Gorman, 2010; Hjorth and Kim, 2011; Mark, Bagdouri, Palen, Martin, Al-Ani and Anderson, 2012). PIOs seek ways to monitor and gather this publically-generated information not only for its potential to aid in response efforts but also so false rumor and misinformation can be identified and corrected (Latonero and Shklovski, 2011; Hughes and Palen, 2012).

As social media use becomes more pervasive, PIOs face increasing expectations to provide emergency public information over social media (American Red Cross, 2011) as well as mounting pressure to consider the public's online activities and incorporate the useful and relevant information back into emergency response efforts (Palen and Liu, 2007; Palen, Vieweg, Liu and Hughes, 2009). But incorporating social media into PIO work practice is not without challenges. PIOs work under conditions of great uncertainty where social media may or may not be useful or even functional (Sutton, 2012). Keeping pace with rapid advances in social media can also be challenging; new forms of social media appear daily and even existing social media continue to evolve along with users' expectations and uses of the technology. Consequently, PIOs must be aware of their community's social media use so they can develop strategies to best communicate with stakeholders (Hughes and Palen, 2012; Deneff, Bayerl and Kaptein, 2013; Sutton, Spiro, Butts, Fitzhugh, Johnson and Greczek, 2013). Further, organizational acceptance of social media can be slow; leaders must be convinced that benefits outweigh drawbacks or legal ramifications before social media use can be sanctioned and incorporated into formal processes and procedures (Crowe, 2010; Hughes and Palen, 2012).

Perhaps the biggest challenge PIOs face when attempting to use social media is the quantity of data that can be generated during a crisis event. For example, the public generated over 26 million messages during Hurricane Sandy (Hughes, Peterson and Palen, In Press)—far too many for a PIO to monitor without aid. Consequently,

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many efforts are developing tools that help to filter and parse this data in meaningful ways (Meier and Brodock, 2008; Caragea, McNeese, Jaisw, Traylor, Kim, Mitra, Wu, Tapia, Giles, Jansen and Yen, 2011a; Starbird, Palen, Liu, Vieweg, Hughes, Schram, Anderson, Bagdouri, White, McTaggart and Schenk, 2012; Cameron, Power, Robinson and Yin, 2012a). However, these efforts often tend to focus on the development of new data extraction and filtering methods and less on the needs of emergency responders.

### Addressing PIO Needs with Participatory Design

The research presented here takes a participatory design approach (Greenbaum and Kyng, 1991; Bødker, Kensing and Simonsen, 2004; Büscher, Kristensen and Mogensen, 2008; Muller and Druin, 2012) to addressing the social media needs of PIOs—one that involves the PIOs in the design process through discussion and prototyping. Engaging users in the design process for technology products they will use allows them to emphasize what is important to them and their work practice.

In Particular, the research here employs a type of future workshop—a technique for gathering researchers and end-users (in this case PIOs) to collaboratively create new ideas and solutions in the context of a workshop. Originally developed for use in German civic planning, future workshops (Jungk and Mullert, 1987) give groups of citizens with limited resources a role in the decision-making process. Future workshops are typically composed of three parts: discussion of existing problems, envisioning the future, and making an action plan (Muller and Druin, 2012).



**Figure 1: Group Discussion**

guiding PIOs to the location, leading the workshop, observing participant activity, answering questions, and collecting data. Each researcher received a notebook designed to help them understand their responsibilities and to provide a place for capturing notes.

### Agenda

The workshop began with a group discussion about PIO information practice; the goal was to better understand how these PIOs currently used social media, what their main concerns or challenges were, and what support they needed. This discussion took place in a casual environment that encouraged participation—a circle of chairs opening to a whiteboard (see Figure 1). While PIOs shared their experiences with social media, designated scribes captured the conversation on the whiteboard.

This paper describes the design, execution, and results of a participatory design workshop with emergency PIOs. Building upon previous PIO social media research (Hughes and Palen, 2012), the goals of the workshop were threefold: 1) to discover how PIO use of social media have changed since earlier investigations; 2) to understand how PIOs respond to and perceive social media use by members of the public; and 3) to develop design recommendations for future tools that address the social media needs of PIOs.

### WORKSHOP DESIGN

The workshop was a full-day event that took place in September 2011 in Project EPIC's<sup>1</sup> lab space on the University of Colorado Boulder campus. Eight PIOs—representing a range of organizations and jurisdictions—attended the workshop. Participants were chosen based on their familiarity and proficiency with social media. Half of these participants also took part in a PIO interview study about social media use (Hughes and Palen, 2012) a year prior to this event, which let workshop researchers assess how perceptions and behaviors of these PIOs around social media had changed since that time. Seven researchers helped run the workshop:

<sup>1</sup> Project EPIC (Empowering the Public with Information in Crisis): <http://epic.cs.colorado.edu/>

Following the group discussion was an individual design session using the PICTIVE<sup>2</sup> method (Muller, 1992; Muller, Tudor, Wildman, White, Root, Dayton, Carr, Diekmann and Dykstra-Erickson, 1995). PICTIVE is a participatory design method where users build low-fidelity prototypes; participants construct their prototypes with paper and other office supplies—pens, pencils, tape, scissors, markers, Post-Its, etc. Use of the PICTIVE method gave workshop PIOs an opportunity to apply insights from the group discussion and externalize their information needs through design artifacts. Further, the low-fidelity prototypes that the PIOs produced could be referred to and built upon during future prototyping and development research phases.



**Figure 2: PIO Participants Creating PICTIVE Prototypes**

prototype pre-determined design ideas. These ideas were developed beforehand based on the results of prior study (Hughes and Palen, 2012). Members of the first group designed a social media communication tool for distributing the messages they send as a PIO during an emergency event. This group finished in the time allotted with a completed prototype. Group two designed a social media tool for using members of the public to crowdsource emergency information. The second group never completed its prototype because the session time was mostly spent clarifying the design idea and discussing concerns. When the two group design sessions completed, we met together to share each group's work.

Lastly, throughout the workshop, both PIOs and researchers jotted down ideas, wants, needs, and observations on Post-It notes and placed them on the whiteboard at the front of the room. This brainstorming activity happened in the background so participants could capture thoughts as they occurred and not interrupt the flow of the workshop. Toward the end of the day, two researchers and two PIO participants organized these ideas using the affinity diagram method (Beyer and Holtzblatt, 1997) after which everyone discussed the results. This activity gave everyone a chance to summarize and reflect on the workshop experience.

#### *Data Collection and Analysis*

Throughout the workshop, several data collection activities took place. A videographer captured all sessions from two different angles while designated photographers took photos of artifacts and participants in-action. Researchers wrote observations in their notebooks, which were collected at the end of the workshop. Paper PICTIVE prototypes created by PIOs served as design artifacts which researchers collected and photographed. Notes from the whiteboard were digitally captured as well as the organized Post-It notes from the brainstorming activity.

After gathering workshop data and transcribing the video, analysis began. To meet the workshop goals, transcripts, prototypes, photos, and other data were parsed for examples of how PIO social media use had evolved and how they perceived use of social media by the public during times of crisis. Items were also extracted that inform design such as issues that might be caused or overcome by technology. After extracting this data, the data were sorted and clustered into common themes using the affinity diagram method (Beyer and Holtzblatt, 1997); the results of this analysis appear in the following section.

<sup>2</sup> Plastic Interface for Collaborative Technology Initiative through Video Exploration

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## FINDINGS

Workshop findings are reported in three subsections that correspond with the goals of the workshop: 1) insights into how PIO social media use has changed, 2) observations about how PIOs perceive citizen-based social media activity in times of crisis, and 3) design recommendations for future tools to support PIO social media needs.

### Evolving PIO Social Media Use

All workshop activities allowed researchers to probe and examine PIO work practice around social media and how their use continues to evolve.

#### *Critical Evaluation of Social Media*

In the workshop, PIOs demonstrated an increased understanding of the merits and drawbacks of social media technologies for their work compared to past inquiry (Hughes and Palen, 2012)—though this understanding is nascent. Examples include PIOs who found the Twitter search functionality helpful to discover new or critical information. Even though Twitter messages flow by quickly, the messages that contain the most important information tend to reappear. PIOs also discussed the benefits of text messaging and how it can succeed where heavier applications that rely on Internet connectivity fail. One PIO cautioned about the dangers of using third party tools that post Twitter or Facebook messages. His organization found that these tools can delay the delivery of a message by as much as half an hour, which can make the information contained in the message invalid by the time it posts. In another case, PIOs discussed how Google alerts can search keywords over time, allowing for a long-term approach to media monitoring that brings the information to the PIO instead of having to actively search for the information. This shift to recognizing the benefits and drawbacks of social media marks a change in thinking from prior examinations (Hughes and Palen, 2012), when PIOs were so overwhelmed with the additional workload of monitoring and using social media that they could not evaluate their use in an objective manner. As PIOs begin to use and critically examine social media, they can better adopt the social media tools and strategies that best fit their practice.

#### *Growing Need for Organizational Change*

Workshop conversations reflected growing recognition by PIOs that social media quicken the pace of emergency communications:

*With the [large incident] last year we would be waiting to get official information from the field and 45 minutes would pass. We had the correct information but were just waiting to get the official word, and then we would send out a press release that had 45-minute-old information.*

To improve communication timeliness, one PIO explains how protocol in her organization has evolved:

*That is changing right now because there is just no time to write that press release, have the incident commander look at it and get that approval. We've changed. We're just doing it verbally now. We will read it back, whether it's on the radio or the phone, and say, "Is this OK for release?" And we are getting that approval but it takes a long time to develop that type of trust relationship.*

But shortening response times comes with drawbacks. For example, social media and the pressure to send information quickly demand that PIOs sometimes release incomplete information to meet public expectation:

*I think that the media and our organization have to take a little bit more risk because we want to be out in front of the story and not just in a reactionary position. You want to try and be the one that is proactive, but that might mean that you don't have as much information as you would have had 5 years ago.*

Unfortunately, the benefits of early information release can be negated if it is later discovered to be false.

Additionally, pressure from citizens can drive emergency management organizations toward use and acceptance of social media:

*We've seen a dramatic turn around. The incident commander, who was the one that came down on us from day one and said "don't release a single piece of information," now comes to our meetings and asks, "how do I get my volunteer fire department on your Twitter account?" He has completely turned*

*around. He was our adversary one year ago, but now is very much a believer because I think he felt the pressure from his citizens.*

All workshop PIOs agreed that social media plays an important role in their emergency communication strategies. Some even said that at least one person should be dedicated to social media for every event. Another PIO sees value in having a person dedicated full-time to social media but felt that his employer was not ready to make it a budget priority. Even though PIOs may see the value in social media, resistance from the organization in which they work can prevent adoption.

### **PIO Perceptions of Citizen-Generated Social Data**

The second goal of the workshop was to discover how PIOs perceived the social media data generated by members of the public during a crisis event. The results are reported here.

#### *Responding to Citizen Journalism*

Workshop PIOs have seen a growing number of citizens that provide information as well as validate and correct available public information during an emergency event—known as citizen journalists (Gillmor, 2006). Through their efforts, these citizens can establish themselves as reliable, credible sources. Two PIOs gave an example of how citizens provided useful information during a 2011 spring flood:

*[PIO #1] The video during the flood was very useful; it was nice to have people hosting YouTube videos so we could see the impact. Because I think some people thought that we were over-reacting because there was no impact to them from flash floods. So to be able to see what was going on up in the canyon was really useful.*

*[PIO #2] Because our deputies and all, they are trying to do other things. They are not standing there with a flip camera showing what is happening. Yeah, you are right, that is where these folks out in the field can actually help us.*

In this case, citizen journalists covered gaps in emergency management coverage, which can be useful in large, geographically-disperse disaster events or in events where resources are stretched thin.

One PIO explained how she has adapted her practice to account for the activity of citizen journalists saying, "...as hard as it is you've got to let that citizen journalism go, because it's going to get out there." She has found that trying to control the information published by these citizens is "just not worth it." If the information is particularly damaging, her organization might release a statement, but they will not directly reply to the citizen. Thus she finds herself letting citizen journalist activity happen and at times even finds it can benefit response efforts if a citizen can tell them what is happening in an area where they do not have emergency personnel.

#### *Resistance to Citizen Participation*

Initially perceived as a failure, the second group's PICTIVE design session revealed PIO attitudes concerning social media that still prevented them from accepting certain ideas. This group attempted to design a system for soliciting and organizing volunteer assistance. At first, members of the group could only think of traditional volunteers; to them, volunteers were people who collected donations of food and clothing, or provided shelter. These types of volunteers are important, but the design idea wanted the group to also consider digital volunteers (Starbird and Palen, 2011)—people who sort, gather, and validate information using digital means. These PIOs found it challenging to imagine using digital volunteers, mostly due to perceived trust and liability issues. When assigning a task to a digital volunteer, such as finding the location of victims, they worried about whether the information that a volunteer produced could be trusted. They did not want their organization to act on information that proved untrue or worse, harmful. Because they would be relaying the information to response organizations, these PIOs viewed themselves as responsible and therefore liable for any misinformation.

The PIOs in Group Two were uncomfortable with the design concept. We discussed their concerns with using a digital volunteer workforce and spent most of the prototype design time in discussion; consequently, the design was never completed. Even though these PIOs comfortably push information to the public over social media, they perceive great difficulty in actively seeking the support of citizens to help with emergency response efforts.

### **Design Recommendations for PIO Practice**

The final goal of the workshop was to develop a set of design recommendations based on workshop discussion and prototypes for tools that would support PIO social media needs. These recommendations with their supporting evidence appear below.

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Support Public Information Monitoring & Analysis

With the introduction of social media to emergency communications, the quantity of data available can be overwhelming; thus workshop participants sought tools to cope with this problem of information overload. Participants also wanted more efficient mechanisms for sorting and filtering social media data during an emergency as well as support for aggregating and making sense of these data. While these observations are not new (Palen et al., 2009; Palen, Anderson, Mark, Martin, Sicker, Palmer and Grunwald, 2010; Caragea,



Figure 3: PIO Information Space PICTIVE Prototype

McNeese, Jaisw, Traylor, Kim, Mitra, Wu, Tapia, Giles, Jansen and Yen, 2011b; Cameron, Power, Robinson and Yin, 2012b), the workshop allowed researchers to validate their relevance to PIOs. Therefore, support for public information monitoring and analysis is included in this list of design recommendations because of its importance for any tool that would support PIO practice.

When monitoring public information, workshop participants spoke about the complexity of their

information space. They wanted to see all available data, analyze it, and make their own interpretations. Consequently, prototypes of their ideal information space included interfaces with many communication channels open and visible (see Figure 3). PIO prototypes displayed different information streams such as a local newspaper, a weather station, social media (e.g., Twitter, Facebook, Flickr, etc...), a county website, and their email. While PIOs wanted to manage information more efficiently during an emergency, they were uncomfortable with interfaces that hid the process by which data are analyzed and interpreted.

Provide ways to Organize Information

When creating prototypes of their ideal information space, PIOs mostly organized information by communication type. The prototype shown in Figure 3 demonstrates this organization scheme; separate panels

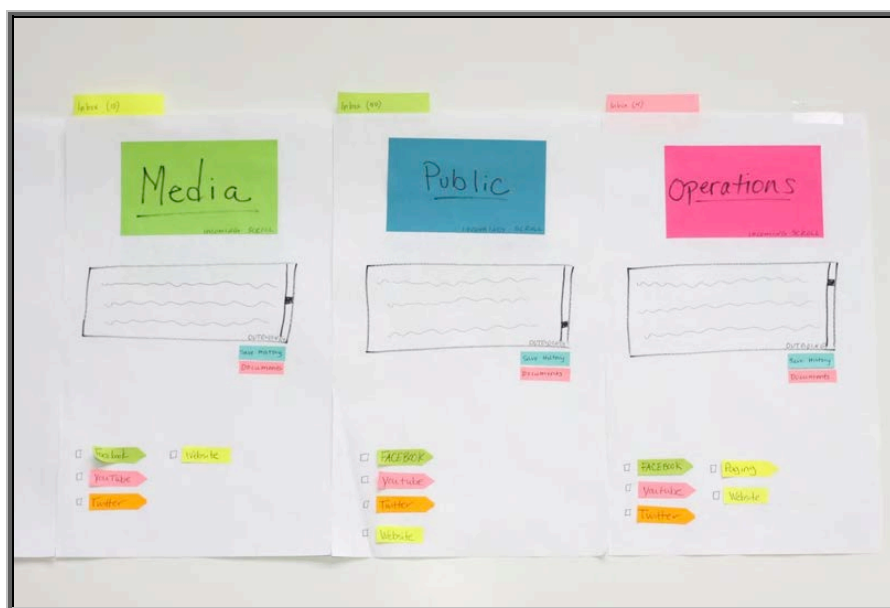


Figure 4: Group PIO PICTIVE Prototype

appear for each of the different types of communication a PIO might use (i.e., Twitter, Facebook, Skype, YouTube, email). In contrast, when PIOs talked about information, they tended to impose higher-level organization schemes on the data as they made sense of it. In the group prototype session, for example, one group organized information into the categories “public,” “media,” and “operations” (see Figure 4) because this represented the way that these PIOs conceptualized

the messages they sent and received during an emergency.

Because workshop PIOs based their prototypes on tools they already use, they found it challenging to imagine accessing information differently, which in turn limited the ways they organized and made sense of emergency data. For example, if a PIO wants to monitor Twitter, Facebook, and Youtube communications, they will usually have an application dedicated to monitoring each of these three services. Few tools provide ways to aggregate information from all three streams, and even fewer allow a user to impose high-level organization schemes on the information.

#### *Provide Report Capabilities*

As PIOs monitor social media, they often need to report what they find to other members of the emergency response team. Information provided by members of the public over social media can help emergency management understand the public's wants or needs and the misinformation that may be circulating; therefore communicating this information to those who can act on it in a timely manner is important. However, methods for capturing and reporting social media activity are currently poor. Workshop PIOs described cutting-and-pasting social media data or taking screen-shots for reporting purposes, which can be tedious and time-consuming while also presenting the information in an awkward format.

#### *Document Activity*

Emergency organizations must keep public records of their activity that can be used for after-action reviews, public accountability, and litigation purposes. Therefore, as social media become integrated into emergency response efforts, these online activities must also be documented by emergency management organizations. In a recent study of trusted digital volunteers in emergency management (St. Denis, Hughes and Palen, 2012), a key responsibility of these volunteers was to capture and archive formal responses agencies' online activity relevant to the event because the PIO and her team lacked the time to do the task themselves. Unfortunately, PIOs rarely have the time or resources to archive social media activity. Further, few tools exist for documenting this activity in the manner needed, especially across different social media platforms.

#### *Support Mobility*

Whether in the field or driving between locations, PIOs often require remote access to the information they need to perform their jobs. All PIOs have cell phones, some web-enabled and some not. Ideally they want the same level of technology support in the field that they have when in the office so they do not have to shuttle

between sites to perform all their tasks. This need for mobile support appeared in the prototyping sessions; several PIOs created prototype designs for their mobile phone (see Figure 5).



**Figure 5: PIO Prototype Designed to Look Like a Mobile Phone**

#### *Decrease or Eliminate Repetitive Tasks*

Many tasks that PIOs perform are similar across events. For example, they prepare press releases about each response that follow a particular format and style of writing. Although the details change, much of the text remains the same and templates or scripts could be created to aid in future execution of these tasks.

Also, as PIOs use social media more, they find that they repeatedly use certain types of messages. For instance, during the workshop PIOs talked about how social media allows them to post information almost immediately. One PIO went on to describe the first messages that she posts on social media during an emergency event as “lights on” communication—messages that let people know they are aware of the situation and working on it. These types of communications help, at least initially, to appease information seekers until more information becomes available and/or PIOs have more time to share information. Messages like these could benefit from templating so that they are not constantly recreated.

### *Translate Messages across Media*

Different forms of social media provide different means of communication. Twitter, for example, only allows 140 character messages, which means that lengthy press releases cannot be sent verbatim. A useful feature that one PIO prototyped would let PIOs type their message once and then translate that message to different social media formats. Message translation saves time because PIOs would not need to re-craft every message multiple times.

### *Leverage Geo-located Data*

Accurate maps are valuable tools during an emergency, yet they are hard to create and maintain. One PIO explains:

*At least in the call center, we first rely on Google maps, we would get people calling to say, I'm located on county route 102J, can I go down evacuation route 1 and then over to Lefthand canyon, and we are like "I don't know." So there were just these...tiny roads that you probably wouldn't even know. So we would just google where they are at, then later we would get the GIS folks to get us a map. That was helpful, but again it's the face of information. They produce the map. It's a nice big map and we stick it up on the wall. We use it for a couple of hours and then another area would be evacuated or an area would open up, then that nice little line they had drawn would change, or the fire perimeter would change overnight with a gust of wind. So the mapping was always behind, always.*

The social media domain has shown much potential around mapping, since maps are often integral in response efforts and citizens could and have been used to crowdsource them (Meier and Brodock, 2008; Norheim-Hagtun and Meier, 2010).

While still in the minority, geo-located social media data are becoming increasingly available as more people send communications from geo-aware devices. Workshop participants wanted to employ this geo-aware data to understand where requests for help or status reports originate; they envision a dynamic map that displays the areas of concern for an event. Geo-located data could potentially anticipate problems, help understand situational awareness, and understand how different areas are affected by an incident.

## **DISCUSSION & CONCLUSION**

This paper details a participatory design workshop that sought to better understand how emergency PIOs engage with social media and how technology design could support that engagement. The participatory design workshop revealed that PIO participants were engaging more directly with members of the public over social media than previously. They discussed pushing emergency information to the public over social media streams and gave specific examples of information generated by members of the public that have helped in their response efforts. But while the PIOs who participated in the workshop have grown comfortable with the idea that members of the public can generate useful information during an emergency, they still have reservations about the extent to which the public should be incorporated into response efforts. Specifically, the idea of soliciting help from digital volunteers raises concerns because PIOs are unsure whether they can trust unknown volunteers to provide accurate, actionable information.

Nonetheless, PIOs described ways in which they were beginning to work with members of the public. For instance, during the workshop PIOs explained how a few citizens were establishing themselves as trusted information sources by providing timely, credible information over social media streams during emergency events. Once a citizen has established credibility in this manner, PIOs may be more willing to consider this citizen a digital volunteer whom they could trust with future emergency response related tasks. Further evidence of this type of activity appeared in a recent study in which one PIO incorporated a team of trusted volunteers into her emergency response efforts (St. Denis, Hughes and Palen, 2012). Thus, PIOs are finding ways to overcome trust issues by establishing rapport with citizens who can act as digital volunteers during times of emergency.

PIOs cannot incorporate information from members of the public into response efforts when they are unsure what information the public can contribute. Workshop PIOs described feeling overwhelmed with the large quantity of data generated by the public during an emergency and the lack of tools to manage it. These poor tools can result in failure to understand how information generated by members of the public during an event could be useful. Many of the concerns seen in prototype designs and discussed during the workshop focused on PIO's inability to adequately monitor, document, report, organize, and make sense of social media data during an emergency. The design recommendations outlined in this paper offer an important step toward creating tools that address the social media needs of emergency PIOs. The next step for this research program—a step



currently in progress—is to create prototype designs that build upon these design recommendations while continuing to seek PIO feedback through prototype testing.

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## REFERENCES

1. American Red Cross (2011). *Social Media in Disasters and Emergencies*. <http://www.redcross.org/www-files/Documents/pdf/SocialMediainDisasters.pdf>.
2. Beyer, H. and K. Holtzblatt (1997). *Contextual Design: Defining Customer-Centered Systems (Interactive Technologies)*. San Francisco, CA: Morgan Kaufmann.
3. Bødker, K., F. Kensing and J. Simonsen (2004). *Participatory IT Design: Designing for Business and Workplace Realities*. Cambridge, MA: MIT Press.
4. Büscher, M., M. Kristensen and P.H. Mogensen (2008). Making the Future Palpable: Notes from a Major Incidents Future Laboratory. *International Journal of Emergency Management* 5, no. 1/2: 145 – 163.
5. Cameron, M.A., R. Power, B. Robinson and J. Yin (2012a). Emergency Situation Awareness from Twitter for Crisis Management. In *Proceedings of the 21st International Conference Companion on World Wide Web*, 695–698. WWW '12 Companion. New York, NY: ACM Press.
6. Cameron, M.A., R. Power, B. Robinson and J. Yin (2012b). Emergency Situation Awareness from Twitter for Crisis Management. In *Proceedings of the 21st International Conference Companion on World Wide Web*, 695–698. WWW '12 Companion. New York, NY: ACM Press.
7. Caragea, C., N. McNeese, A. Jaisw, G. Traylor, H.-W. Kim, P. Mitra, D. Wu, A.H. Tapia, L. Giles, B.J. Jansen and J. Yen (2011a). Classifying Text Messages for the Haiti Earthquake. In *Proceedings of the Information Systems for Crisis Response and Management Conference (ISCRAM 2011)*. Lisbon, Portugal. <http://www.iscramlive.org/ISCRAM2011/proceedings/papers/155.pdf>.
8. Caragea, C., N. McNeese, A. Jaisw, G. Traylor, H.-W. Kim, P. Mitra, D. Wu, A.H. Tapia, L. Giles, B.J. Jansen and J. Yen (2011b). Classifying Text Messages for the Haiti Earthquake. In *Proceedings of the Information Systems for Crisis Response and Management Conference (ISCRAM 2011)*. Lisbon, Portugal. <http://www.iscramlive.org/ISCRAM2011/proceedings/papers/155.pdf>.
9. Crowe, A. (2010). The Elephant in the JIC: The Fundamental Flaw of Emergency Public Information within the NIMS Framework. *Journal of Homeland Security and Emergency Management* 7, no. 1.
10. Deneff, S., P.S. Bayerl and N. Kaptein (2013). Social Media and the Police-Tweeting Practices of British Police Forces during the August 2011 Riots. In *Proceedings of the 2013 Conference on Human Factors in Computing Systems (CHI 2013)*, 3471–3480. New York, NY: ACM Press.
11. Gillmor, D. (2006). *We the Media: Grassroots Journalism by the People, for the People*. Sebastopol, CA: O'Reilly Media.
12. Greenbaum, J. and M. Kyng (1991). *Design at Work: Cooperative Design of Computer Systems*. Hillsdale, NJ: Lawrence Erlbaum Associates.
13. Hjorth, L. and K.-H.Y. Kim (2011). Good Grief: The Role of Social Mobile Media in the 3.11 Earthquake Disaster in Japan. *Digital Creativity* 22, no. 3: 187–199.
14. Hughes, A.L. and L. Palen (2012). The Evolving Role of the Public Information Officer: An Examination of Social Media in Emergency Management. *Journal of Homeland Security and Emergency Management* 9, no. 1.
15. Hughes, A.L., S. Peterson and L. Palen (In Press). Social Media in Emergency Management. In *Issues in Disaster Science and Management: A Critical Dialogue Between Scientists and Emergency Managers*, (Eds) J.E. Trainor and T. Subbio. FEMA in Higher Education Program.
16. Jungk, R. and N. Mullert (1987). *Future Workshops: How to Create Desirable Futures*. London, England: Institute for Social Inventions.

*Proceedings of the 11<sup>th</sup> International ISCRAM Conference – University Park, Pennsylvania, USA, May 2014*  
S.R. Hiltz, M.S. Pfaff, L. Plotnick, and P.C. Shih, eds.

17. Latonero, M. and I. Shklovski (2011). Emergency Management, Twitter, and Social Media Evangelism. *International Journal of Information Systems for Crisis Response and Management* 3, no. 4: 1–16.
18. Mark, G., M. Bagdouri, L. Palen, J. Martin, B. Al-Ani and K. Anderson (2012). Blogs as a Collective War Diary. In *Proceedings of the 2012 Conference on Computer Supported Cooperative Work (CSCW 2012)*, 37–46. New York, NY: ACM Press.
19. Meier, P. and K. Brodock (2008). *Crisis Mapping Kenya's Election Violence: Comparing Mainstream News, Citizen Journalism and Ushahidi*. Harvard Humanitarian Initiative. Boston, MA: Harvard University. <http://irevolution.wordpress.com/2008/10/23/mapping-kenyas-election-violence>.
20. Muller, M.J. and A. Druin (2012). Participatory Design: The Third Space of HCI. In *Human Computer Interaction Handbook*, (Ed) J. Jacko. CRC Press.
21. Norheim-Hagtun, I. and P. Meier (2010). Crowdsourcing for Crisis Mapping in Haiti. *Innovations: Technology, Governance, Globalization* 5: 81–89.
22. Palen, L., K.M. Anderson, G. Mark, J. Martin, D. Sicker, M. Palmer and D. Grunwald (2010). A Vision for Technology-Mediated Support for Public Participation & Assistance in Mass Emergencies & Disasters. In *Proceedings of the 2010 ACM-BCS Visions of Computer Science Conference*, 1–12. Edinburgh, UK: British Computer Society.
23. Palen, L. and S.B. Liu (2007). Citizen Communications in Crisis: Anticipating a Future of ICT-supported Public Participation. In *Proceedings of the 2007 Conference on Human Factors in Computing Systems (CHI 2007)*, 727–736. New York, NY: ACM Press.
24. Palen, L., S. Vieweg, S.B. Liu and A.L. Hughes (2009). Crisis in a Networked World. *Social Science Computing Review* 27, no. 4: 467–480.
25. Qu, Y., P.F. Wu and X. Wang (2009). Online Community Response to Major Disaster: A Study of Tianya Forum in the 2008 Sichuan Earthquake. In *Proceedings of the 2009 Hawaii International Conference on System Sciences (HICSS 2009)*, 1–11. IEEE Computer Society.
26. St. Denis, L.A., A.L. Hughes and L. Palen (2012). Trial by Fire: The Deployment of Trusted Digital Volunteers in the 2011 Shadow Lake Fire. In *Proceedings of the Information Systems for Crisis Response and Management Conference (ISCRAM 2012)*. Vancouver, BC. <http://epic.cs.colorado.edu/wp-content/uploads/TrustedDigitalVolunteersStDenisHughesPalen.pdf>.
27. Starbird, K. and L. Palen (2011). “Voluntweeters:” Self-Organizing by Digital Volunteers in Times of Crisis. In *Proceedings of the 2011 Conference on Human Factors in Computing Systems (CHI 2011)*, 1071–1080. New York, NY: ACM Press.
28. Starbird, K., L. Palen, S.B. Liu, S. Vieweg, A.L. Hughes, A. Schram, K.M. Anderson, M. Bagdouri, J. White, C. McTaggart and C. Schenk (2012). Promoting Structured Data in Citizen Communications During Disaster Response: An Account of Strategies for Diffusion of the “Tweak the Tweet” Syntax. In *Crisis Information Management: Communication and Technologies*, (Ed) C. Hagar, 43–63. Cambridge, UK: Chandos Publishing.
29. Sutton, J.N. (2012). When Online Is Off: Public Communications Following the February 2011 Christchurch, NZ, Earthquake. In *Proceedings of the Information Systems for Crisis Response and Management Conference (ISCRAM 2012)*. Vancouver, BC. <http://www.iscramlive.org/ISCRAM2012/proceedings/227.pdf>.
30. Sutton, J.N., E. Spiro, C. Butts, S. Fitzhugh, B. Johnson and M. Greczek (2013). Tweeting the Spill: Online Informal Communications, Social Networks, and Conversational Microstructures during the Deepwater Horizon Oilspill. *International Journal of Information Systems for Crisis Response and Management* 5, no. 1: 58–76.
31. Zook, M., M. Graham, T. Shelton and S. Gorman (2010). Volunteered Geographic Information and Crowdsourcing Disaster Relief: A Case Study of the Haitian Earthquake. *World Medical & Health Policy* 2, no. 2 (July 21): 7.