CONNECTING GRASSROOTS TO GOVERNMENT FOR DISASTER MANAGEMENT

Workshop Overview

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Impetus for Workshop

The last decade has seen the widespread proliferation of social media technologies[1] and crowdsourced[2] data production. The distributed nature of these technologies and practices is such that they allow diverse stakeholders to participate, often from remote locations. This capacity has led to their increased use in disaster planning, management, and response, allowing responders, victims, and volunteers to produce and share large amounts of information quickly. Technologically, this has been enabled by the development of Application Programming Interfaces (APIs)[3]; growth in mobile phone adoption and capabilities; and Web 2.0 development[4]. Institutionally, this capacity has developed in the context of policies established for Global Positioning System (GPS) usage; policies for digital data ownership and copyright; and early best practices for crisis mapping and other forms of data collation. Crowdsourcing methods and diffusion of social media technologies have led to the production of large amounts of data from diverse perspectives being produced in disaster situations. This capability extends to all phases of disaster management, including prevention, preparedness, response, and recovery.

[1] Social media technologies are web-based applications for sharing multimedia with contacts. These technologies include such applications as Facebook, Twitter, smart phone "apps", and Google's MyMaps.
[2] Crowdsourcing is the process of allowing an unspecified number of people to voluntarily contribute toward solving a problem, usually by means of the web. A relevant example is Ushahidi, a website and software program that georeferences text messages (SMS) sent to an emergency number, plotting them on a map made available to disaster responders. This process ideally results in large numbers of people contributing massive amounts of data.
[3] APIs are software-specific code that allows one to access modules of software and data. For instance, using Google Maps's API, one can utilize Google's map interface and stylize data points using Google's markers. Sometimes APIs allow one to access data residing in a company's database.
[4] Web 2.0 represents the shift on the web from static information delivery to dynamic, interactive, user-generated content. Web 2.0 examples include social media applications, blogs and commenting, and dynamic website information.

These developments have led to the paradox that drives "Connecting Grassroots to Government for Disaster Management": Disaster responders and other stakeholders can be awash in information and yet still lack the tools and frameworks necessary to make critical, timely decisions. Addressing this challenge requires gathering policymakers, researchers, agencies, software developers, and disaster responders to collaborate around needs and strategies while developing lines of constructive conversation and practice. During the course of this workshop these stakeholders will address a wide range of questions that work toward this collaboration.

This report details the questions and conversations this workshop hopes to address, along with the backgrounds, motivations, and future research directions of each. These questions include: Can citizens generate inputs to critical decisions? If so, with what kind of speed and what degree of accuracy? What does the research show, and how are the best ideas being translated into practice? How have agencies successfully navigated potential roadblocks to the use of citizen-generated information, such as privacy, procurement, or the Paperwork Reduction Act? When and how is it possible to innovate through open and participatory design with citizens and communities?

Data Efficiency and Accuracy

Crowdsourcing and social media's use in multiple disasters has led some to suggest that these social media-abetted behaviors can enable quick and accurate data production (Palen et al. 2009; Starbird et al. 2010; Zook et al. 2010).Technologies such as Twitter, Google Maps, and Ushahidi have been touted by some for their broad use and efficiency in disasters across quite diverse contexts, including both developing countries (Heinzelman and Waters 2010; Meier 2010; Starbird and Palen 2011; Zook et al. 2010) and developed countries (M. Goodchild and Glennon 2010; Meraji 2011). Despite increases in data production capabilities, the capacity to interpret and utilize this data efficiently remains a concern (Computing Community Consortium 2012). Many concerns have also been raised regarding the credibility and accuracy of data produced by the social media-abetted crowd, particularly when such data need to enable quick decision-making in disaster management (M. F. Goodchild and Glennon 2010; Li and Goodchild 2010; Flanagin and Metzger 2008).

Efficiency

Although crowdsourcing and social media have enabled large amounts of data to be produced quicker than earlier technologies and modes of data production, decision-makers may encounter difficulties transforming the data into usable formats and manageable chunks. This is not an entirely technical problem, as institutional and social contexts and arrangements factor into these dynamics. The contexts and arrangements include, specifically, such processes as data-sharing agreements, open innovation directives, propitious policy-setting, appropriate and efficacious connections, and willingness to share data and software/hardware. This leads to several questions: What information do local and federal government decision-makers need for disaster response and research, and to make necessary connections between multiple stakeholders? How do information needs differ for on-the-ground responders, back-office decision-makers, and those conducting research? How can practitioners, policy-makers, and researchers work together quickly to ensure efficient data production and usage?

Upon its production, data needs to be distributed to governments and decision-makers in a way that is usable, posing another challenge. Currently, most crowdsourcing applications make minimal use of dividing and distributing tasks, thus increasing the likelihood of duplicating efforts (Gao, Barbier, and Goolsby 2010); a notable exception is the task management software used by the Humanitarian OpenStreetMap team (Aldrich 2012; see also http://tasks.hotosm.org/about). While apportioning has always occurred in disaster contexts, technological developments and appropriate government policies can streamline the process and increase efficiency. Accordingly, what is the current state of technological development in this area? What needs to be done to encourage further development? Answering these questions will require addressing the distinct needs of responders, decision-makers, technology developers, and researchers.

Accuracy

Crowdsourcing distributes data production widely, often to laypeople rather than traditionally-recognized "experts." While this has enabled exponential growth in the amount of data produced, it raises concerns about the accuracy of such data. The degree to which crowdsourced data may be accurate has long been a concern, with a traditional fit-for-use criteria often deemed most appropriate (M. Goodchild 2007; Grira, Bédard, and Roche 2010; Flanagin and Metzger 2008; Mummidi and Krumm 2008). Means to verify data are currently being developed, yet the degree to which responders may rely on this data remains a topic of research (Haklay 2010; Jain 2007; Roche, Propeck-Zimmermann, and Mericskay 2011). There is some evidence to suggest that in high-volume data production areas, accurate locations may be calculated from many non-accurate data points (Mummidi and Krumm 2008), and USAID reported an 85 percent accuracy rate in a recent case study of crowdsourced data (US Agency for International Development 2012).

Determining the accuracy of data can mean re-thinking what counts as "accurate." First, disaster contexts create needs at several scales, including needs specific to individual people all the way up to needs general to entire cities or regions. What may be an accurate location at one scale may not be accurate at another. Second, some needs in disasters may not necessarily require precise Cartesian notions of accuracy, perhaps being more fuzzy or structural. These needs could include disrupted community relationships and interpersonal networks, feelings of stability or fear, and broader political and economic interruptions. The challenge this presents, then, is to think of ways to represent the place-based nature of these phenomena in ways that aid on-the-ground responders, while acknowledging the complex and non-Cartesian nature of many disaster-based needs. This will have real, material impacts on the ways crowdsourced data informs disaster management strategies.

Evaluation Frameworks[5]

Despite the pressure to construct standardized quantitative measures to evaluate information effectiveness, these types of evaluation frameworks should be avoided. Disasters are complex and rarely have dynamics similar enough to warrant the use of measures used in other disasters. Instead, disaster responders should seek to improve the conditions faced by victims, in an inductive and synthesizing manner. Instead of relying on modes of need communication used in previous disasters, any reasonable form of such communication or information analysis should be considered for use. At times this will mean repeating methods used in previous disasters, while at other times it will mean tasking several methods toward the same problem. In other words, causality is highly dependent on local dynamics that emerge in individual disasters.

To avoid these challenges and seek to understand volunteered information production, some have attempted to elicit socio-behavioral patterns. These semi-controlled experiments, such as DARPA's[6] Red Balloon Challenge and Rutgers's Hat Chase[7], have lent insights into how people can use social media to solve problems in a distributed problem-solving environment. However, the controls introduced, as well as the staged nature of such events, abstract from the disaster response context in such a way that these lessons probably do not neatly translate into usable lessons in disaster response settings. These controls include incentive structures for participation, publicity and clean pre-existing organization, and less-consequential implications for decisions made. In essence, lessons learned from these experiments have limited value when applied to mass emergency settings. Thus instead of answers, we are left with questions that must be addressed empirically.

Some have advocated an "action research" orientation (International Institute for Environment and Development 2009) for increasing efficacy of advanced technologies in disaster response. Action research in this case can contribute strong ethical frameworks to the operations of responders, ensuring that the intentions of data production are to cause as little harm as possible and to instead "do good;" each setting will likely necessitate a unique approach to this challenge. In this approach, the impetus is not to *measure* the worth of data, but instead to make data *worthwhile*. This approach requires reiteration and calibration for each particular setting, empirically-informed and weighted toward design rather than evaluation.

Traditional evaluation frameworks may stifle new technology adoption in disaster management. Instead, approaching evaluation frameworks in an iterative manner emergent in each context will enable new technologies and strategies to be engaged.

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[5] Much of the material in this section was provided by Leysia Palen, University of Colorado—Boulder EPIC Project.

[6] The Defense Advanced Research Projects Agency (DARPA) is an agency in the Department of Defense that has been instrumental in developing technologies used by the military.

[7] See: http://www.engadget.com/2009/12/06/mit-based-team-wins-darpas-red-balloon-challenge-demonstrates/ and http://sm.rutgers.edu/hats/

Some Research Challenges

Several research challenges have been noted over the past few years. Empirically, it has been suggested that researchers document characteristics of crisis mapping situations: who maps from where, how people organize themselves, what kinds of information are produced, and how people make judgments about the accuracy of information (Palen et al. 2010). A recent report by the Computing Community Consortium (2012) highlights the significant contributions computation makes to disaster management. Not only is computational power a necessary prerequisite for aggregating and analyzing the data produced, but natural-language algorithms and complex behavioral models can help process and make sense of the data. The report recommends combining computation with physical and social science research, attending to the various scales at which data is produced and relevant, constructing real-time models, developing computational methods and metrics, and training/educating in computer software. Additional to computational power are the necessary trained, certified, or educated people to utilize the technology, channel the information flow, analyze the results, and recommend actions.

The limits of some social networking platforms for disaster management place constraints on the amounts and types of information communicated. The particular effects of these constraints, however, are not completely understood (National Research Council 2011). In what specific ways does a 90-character limit on text (SMS) messages, or a 140-character limit on Twitter tweets, impact the public's response and utilization of the conveyed information (Hughes and Palen 2009)? Can these limits preclude particular kinds of warnings or information? Message dissemination practices across various platforms are also not well understood (National Research Council 2011). Do too many messages discourage the public from taking them seriously? Does this differ across various potential media? What level of geographic targeting is necessary for the messages to be relevant, and how strongly does this depend on the type of disaster? How do people determine the credibility of information gathered from social media? Can social media be a more effective information delivery device than traditional notification media (e.g., e-mail, telephone calls)? Does the answer to this question vary by demographic characteristics? The Commercial Mobile Alert System, directed by the Federal Emergency Management Agency , is an example of a system directly implicated by the answers we offer to these questions (Steen 2012).

Finally, other suggested research issues include verifying information and source veracity, and mechanisms for increasing veracity; new methods for data collation and aggregation; implementing and incorporating both human and machine computation; and making these applicable to emergency response contexts. Importantly, many actors should here be seen as synthesizers, or curators, of information. During the process poor data may be rejected, corroborations are detected, and a vast amount of raw information is re-presented in manageable and useful ways. Real-time synthesis may include this exploration of data, but also determining which software packages will be most efficacious across the multiple parties at work, and which dynamics are important to record and communicate. In short, research is needed to think about synthesis, how it has been achieved in the past, what its basic dimensions might be, and what approaches are needed to make it work in each individual context. Additional pressures on synthesis are placed by the critical time constraints under which responders work.

Legal and Policy Issues

Privacy and Confidentiality

Everyday use of social media tools and crowdsourced datasets raises concerns about privacy and confidentiality (Acquisti and Gross 2009; Boyd 2011; Boyd and Crawford 2012; Obermeyer 2007). Efforts to protect these priorities are complicated when populations are vulnerable during disasters (Li and Goodchild 2010). Privacy and confidentiality impact related legal and policy issues including data access and retention, intellectual property, and data quality. Data sharing, access, and retention can put vulnerable populations at risk (Fordham CLIP forthcoming). Disaster recovery involves sensitive data, such as missing persons information (Fordham CLIP forthcoming). Complicating this, crisis mappers and on-the-ground responders sometimes aggregate several disparate datasets (Fordham CLIP forthcoming); a single dataset may not erode privacy, combining several creates greater risk (Elwood and Leszczynski 2011). How can decision-makers, on-the-ground responders, researchers, and volunteers work together to protect privacy and confidentiality, while maintaining high-quality datasets and respecting intellectual property in cases where authorship is not known? Are there ways to maintain privacy and confidentiality within crisis mapping?

Privacy means different things in different contexts. Best practices and ethical standards are currently being deliberated in the crisis mapping community (see for resources: http://geodatapolicy.wordpress.com/2012/02/14/ethical-issues-and-mapping/). Questions revolve around what model of privacy ethics crisis mappers should follow (Raymond, Howarth, and Hutson 2012), how "consent" and "confidentiality" should operate (Meier 2012), and how to ensure broad adherence to privacy standards (Gellman et al. 2012, forthcoming). What precedents, standards, or conventions should guide crisis mappers' approaches to privacy? Are there existing models or should new ones be developed? If the latter, which privacy frameworks should be adopted and adapted?

Liability

Because disaster management involves life-or-death decisions, tort liability should factor strongly into legal and policy frameworks. Courts and policymakers have left many liability questions unanswered, with some legal scholars suggesting particular cases where crisis mapping groups could potentially be held liable. Robson (2011) suggests these situations could include when 1) an organization undertakes rescue, 2) puts a person in danger, and when 3) a special relationship exists between parties. As many liability issues have not been adjudicated, several questions remain open. To what degree should crisis mappers be held liable for decisions based on their maps? What liability should exist when mapping is delegated to volunteers? How can crisis mappers work with on-the-ground responders to reduce liability?

Paperwork Reduction Act (and OMB Social Media Memo)

The Paperwork Reduction Act (PRA) may restrict agencies' full utilization of social media (Bastian and Byrne 2012). The PRA requires a federal agency to notify the public before gathering any sort of information, with some exceptions. In 2009, President Obama issued a memorandum to federal agencies to increase government transparency and foster increased public participation. In response to this memo, Cass Sunstein (2010b; 2010a) of the Office of Management and Budget stated that much information gathered via social media and web-based content is exempt from the PRA. However, some forms of crowdsourced data collection may fall under PRA regulations, placing a burden on federal agencies who wish to take advantage of these technologies (Bastian and Byrne 2012). Depending on the information collected, the specificity and breadth of questions, and the forum through which information is collected (e.g., Twitter, www.whitehouse.gov, or a publically-funded web mapping interface), disaster management via crowdsourced social media may or may not be subject to PRA.

Intellectual Property

Crowdsourced data production raises several important questions regarding intellectual property. These questions relate to ownership, usage rights, and interoperability. Copyright and terms of use are used to protect data as well as derivative products such as maps and commercial activity. OpenStreetMap recently shifted their copyrights, from allowing sharing under the same copyright, to one allowing sharing under any copyright as long as enhancements are also shared (OpenStreetMap Foundation 2012). The former was developed for artistic works while the latter rose out of database protection interests. Both allowed free and publicly downloadable data under these constraints. In contrast, Google's analogous product MapMaker operates under a copyright that does not allow an individual to own the data mapped, or to download that raw data[8].

Copyright interoperability has also raised some concern, since some disaster response work necessitates large heterogeneously-sourced data that may contain incompatibilities. Simple data procurement can lead to complex copyright and intellectual property situations (Onsrud 2010). An overarching scheme for copyright protection and data distribution should be established, which would streamline data usage. How can crisis mapping communities, policymakers, and on-the-ground responders coalesce around advantageous copyright and intellectual property frameworks? What decisions and conversations need to occur before such policies are put in place? What is holding back these parties from implementing new such copyright and intellectual property practices?

[8] See http://wiki.openstreetmap.org/wiki/Google_Map_Maker

Models of Successful Collaboration

Perhaps the most beneficial aspect of the "Grassroots to Government" workshop will be the sharing of successful mechanisms for collaboration. New technological developments have enabled higher degrees of collaboration than in the past, but challenges remain (Harvard Humanitarian Initiative 2011). Notably, these collaborations seem to be highly context-dependent, yet lessons learned might streamline future collaborative efforts. The sharing of success stories will move us in that direction. Who was enrolled in successful collaborations? What specific factors led to successful collaboration? What did this "success" entail?

Technology can play a central role in collaborative efforts by extending communicative abilities (Harvard Humanitarian Initiative 2011). Crowdsourcing and social media further have the potential to extend collaborative capacities to the public and disparately-located volunteers (McClendon and Robinson 2012; Roche, Propeck-Zimmermann, and Mericskay 2011; Starbird and Palen 2011). What role do social media technologies, specifically, play in enabling successful collaborations? What technological constraints remain to hinder collaboration? How have these constraints been overcome in the past? How have collaborations successfully been extended to broad constituents in the past? Looking forward, virtual operations support teams (VOSTs) may be an influential example of successful collaborations. VOSTs are networks of people connected through and working through social media during disaster management and recovery (Reuter 2012; St. Denis, Hughes, and Palen 2012). Each team is delegated a task in support of affected areas, and response strategies are managed through a tiered responsibility structure. VOSTs have been successful largely because they network trusted individuals to work together and use reliable, trusted data.

There has been strikingly little research conducted on the role of policymakers in enabling and establishing successful collaborations for crowdsourcing and open innovation. How can policymakers facilitate innovation and maximize its potential for successful collaborations? What impact has been seen from the Administration's "Open Innovator's Toolkit?"[9] Must they construct substantially new structures and protocols, or work within existing frameworks?

Current State of Technology and Future Development

New technologies are constantly being developed to address the major problems disaster responders face (Okolloh 2009; PopTech 2011). Other technologies developed for different purposes, such as Twitter, have been adapted to aid disaster management (Hughes and Palen 2009; Liu and Palen 2010; Starbird and Palen 2011). Adapting "big data" production technologies for disaster management necessitates enrolling computational abilities to sort, standardize, and apportion data and action (Computing Community Consortium 2012). Concurrent to technological enrollment in disaster response are "analog," on-the-ground responders that long antedate social media technologies; social media thus forms a component of

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[9] See: http://www.whitehouse.gov/open/toolkit

a larger disaster management strategy (O'Neill and O'Neill 2012). What constitutes the bleeding edge of disaster management technology? What problems have various groups identified as the research agenda for the next 5-10 years? What hindrances stand in the way of substantial innovation?

Recognizing that technology is a component of a larger process, its development cannot be divorced from the institutional and social-political contexts in which it is developed. This means that technology development must bring together programmers and on-the-ground responders, as well as policymakers, researchers, agencies, and volunteers. Agencies and policymakers can create a hospitable climate for developing disaster management technology, or one that hinders such development. How can policymakers, software developers, and researchers foster the development of technologies and collaborations that more directly address the needs of on-the-ground responders?

Transforming new research findings, outcomes and open innovation into pilot projects and eventually into enterprise-level tools and methods can be a difficult task. Tasks and workflows may change, and research may uncover more beneficial processes. How does an agency turn new capabilities into official processes? How does an agency look out 10-20 years and build processes with uncertainty and adaptation as part of the design?

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