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Connecting Grassroots to Government for Disaster Management:

Workshop Summary

by Ryan Burns
and Lea A. Shanley
Rapporteurs

Wilson Center | COMMONS LAB

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CONNECTING GRASSROOTS TO GOVERNMENT FOR DISASTER MANAGEMENT: WORKSHOP SUMMARY

Commons Lab
Science and Technology Innovation Program
Woodrow Wilson International Center for Scholars
One Woodrow Wilson Plaza
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Washington, DC 20004-3027

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The Science and Technology Innovation Program (STIP) analyzes the evolving implications of such emerging technologies as synthetic biology, nanotechnology, and geo-engineering. STIP's research goes beyond laboratory science to explore new information and communication technologies, sensor networks, prediction markets, and serious games. The program provides critical yet nonpartisan research for the policymaking community and guides officials in the design of new governance frameworks. It gauges crucial public support for science and weighs the overall risks and benefits of technology for society at large.

COMMONS LAB

The Commons Lab of STIP advances research and policy analysis of emerging technologies and methods—such as social networking, crowdsourcing, and volunteered geographic information—that empower individuals ("citizen sensors") to collectively generate actionable scientific data, to augment and support disaster response and recovery, and to provide input to government decision-making, among many other activities.

http://CommonsLab.WilsonCenter.org

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About the Authors

Ryan Burns joined the Woodrow Wilson Center in 2012 as a research assistant. Ryan is a fifth year Ph.D. candidate in the Department of Geography at the University of Washington–Seattle and a fellow in the Simpson Center for the Humanities Graduate Certificate in Public Scholarship program. A graduate of Eastern Kentucky University (B.A., 2006) and San Diego State University (M.S., 2009), he is interested in the social and political implications of new mapping and spatial data production technologies. Specifically, he looks at how these technologies are being used to inform disaster management strategies, what differential geographies these uses produce, and how policymakers can adapt to this new interface with the public.

Ryan holds two leadership positions with the Association of American Geographers: secretary and treasurer for the Geographic Information Systems and Science specialty group and member of the leadership board of the Socialist and Critical Geography specialty group. He is currently organizing a special issue of *ACME: An International E-Journal for Critical Geographies* that looks at the politics of knowledge production in the "geoweb," and another special issue of *GeoJournal* on Big Data in geography.

Lea A. Shanley directs the Commons Lab within the Science and Technology Innovation Program of the Woodrow Wilson International Center for Scholars. In 2010, Lea was a postdoctoral fellow on the Mapping Science Committee of the National Academy of Sciences, where she co-directed two reports: *Precise Geodetic Infrastructure: National Requirements for a Shared Resource* and *New Research Directions for the National Geospatial-Intelligence Agency*.

In 2009, Lea was an American Association for the Advancement of Science/Agronomy Society of America–Crop Science Society of America–Soil Science Society of America Congressional Science Fellow and primary science adviser to the Chair of the Senate Subcommittee on Science and Space. She managed priorities for federal research and development, and she crafted and negotiated legislation addressing earth observation governance, oceans issues, and hazards research and mitigation. Previously, she had conducted community-based participatory action research in geographic information science at the University of Wisconsin–Madison. This research engaged local and tribal communities in the development and use of GIS-based decision support systems, enabling collaborative decision-making for improved emergency management, resource management, and land use planning.

Acknowledgements

The Commons Lab within the Science and Technology Innovation Program, Woodrow Wilson International Center for Scholars, held a two-day policy roundtable entitled "Connecting Grassroots to Government for Disaster Management." The meeting was held September 13–14, 2012, in Washington, D.C., at the Wilson Center. Approximately 95 practitioners, policymakers, researchers, and technology developers participated, representing a diverse range of sectors, including emergency management agencies, local and federal government, universities, nongovernmental organizations, industry leaders, and digital volunteer groups. The participants discussed the opportunities, challenges, and gaps in the use of social media and other mass collaboration technologies for disaster management. The objectives were to build an interdisciplinary community of interest, to prioritize key issues for future research, and to identify possible solutions. A copy of the agenda and a copy of the moderator and panelist biographies can be found in Appendixes A and B, respectively.

The Wilson Center acknowledges and greatly appreciates the work of the steering committee that helped to design this workshop. Lea A. Shanley, Director of the Commons Lab within the Science and Technology Innovation Program, Wilson Center, and John Crowley, Public Policy Scholar for the Commons Lab and Research Coordinator for the Crisis Dynamics Program, Harvard Humanitarian Initiative, served as the workshop moderators and co-chairs of the workshop steering committee. John Bwarie, Strategy and Communications Officer for the Science Application for Risk Reduction (SAFRR) Project, Natural Hazards Mission Area, U.S. Geological Survey; Michael Goodchild, Emeritus Professor of Geography, University of California, Santa Barbara; Gisli Olafsson, Emergency Response Director, NetHope; Leysia Palen, Associate Professor of Computer Science, University of Colorado, Boulder; Eric Rasmussen, Vice President, AccessAgility, and Managing Director, Infinitum Humanitarian Systems; Christopher Strager, Director of the National Weather Service, Eastern Region, National Atmospheric and Oceanic Administration; Bartel Van de Walle, President, International Association for Information Systems for Crisis Response and Management (ISCRAM), and Associate Professor of Information Management, Tilburg School of Economics and Management, Tilburg University, served as the members of the steering committee. All generously gave of their time and expertise, providing ideas and feedback on the agenda, and identifying and inviting speakers and attendees. Committee members also served as moderators for many of the sessions.

The Wilson Center would like to thank the moderators and panelists who presented material to initiate the discussion and orient attendees for each session. In addition, the workshop would not have been as interesting or as productive without the important contributions of the 95 people who attended the event in person, as well as the 707 unique visitors who participated in the event via live webcast from 30 countries, including the United States,

Venezuela, Canada, France, the United Kingdom, Ireland, the Netherlands, Sweden, Germany, Kenya, and Taiwan. Many of these folks and others also offered their ideas and questions via email and social media, generating more than 13,000 tweets using the hashtag #dg2g. Several of the participating organizations also provided posters and demonstrations to showcase recent research, experimentation, and pilot projects. Zachary Bastian, Eric Rasmussen, Rebecca Goolsby, Gisli Olafsson, and A. Riley Eller wrote white papers and a presentation to provide context and starting points for the session discussions. A summary of the social media engagement for the workshop also was compiled. These are

included in the appendixes C through H.

The Wilson Center is thankful for the collaboration and support of our co-hosts: the National Association of Public Safety GIS (NAPSG) Foundation; the International Association for Information Systems for Crisis Response and Management (ISCRAM); the University of Colorado, Boulder's Project EPIC; and NetHope.

The Wilson Center also greatly appreciates the generous co-sponsorship of Esri, which is an industry leader in geographic information systems, and TechChange, which provides scalable and interactive technology training for social change.

The staff of TechChange provided in-kind social media support for two panel sessions through a customized platform that they had developed to ingest comments and monitor social media feeds, engaging both their students and people globally in 30 countries for real-time Q&A with the panelists and in-person participants. The keynote sessions were "Agency Vision and Decision-Maker Needs" on September 13 (http://techchange.org/live-events/wilson-center-agency-vision-and-decision-maker-needs/), and "Connecting Grassroots to Government through Open Innovation" (http://techchange.org/live-events/wilson-center-connecting-grassroots-to-government-through-open-innovation/) on September 14, 2012.

Finally, the Wilson Center's Commons Lab staff initiated, planned, and coordinated the workshop: Lea Shanley, Director, Commons Lab; Alyson Lyons; Lead Program Assistant; Joe Filvarof, Program Assistant; Ryan Burns, Lead Research Assistant; Elise Barry, Lead Intern; and Jason Kumar, Research Assistant. We would especially like to thank Alyson Lyons for her hard work, patience and expertise, helping to make this a highly successful meeting. We also would like to thank Zachary Bastian and Aaron Lovell of the Commons Lab for their editorial support and our Audiovisual and Communication departments for their assistance.

Wilson Center staff prepared this summary report following the meeting. It represents the findings of the workshop participants as interpreted by the rapporteurs. This summary report was reviewed in draft form first by the panel moderators and subsequently by

participants of the workshop in an open "community review." The purpose of this review process was to provide candid and critical comments that will assist the institution in making sure the published summary meets institutional standards of objectivity, evidence, and responsiveness. We wish to thank the following for their participation in the review of this workshop summary and appendices:

- Leysia Palen, Associate Professor of Computer Science, University of Colorado, Boulder
- Nigel Snoad, Product Manager, Crisis Response, Google
- Kate Starbird, Assistant Professor, University of Washington, Seattle
- Kris Eriksen, Public Information Officer, Portland National Incident Management Organization, U.S. Forest Service
- Sean Gorman, President and Founder, GeoIQ and ESRI
- Catherine Graham, Vice-President and co-founder, Humanity Road
- Robert Munro, Chief Executive Officer, Idibon
- Jeff Phillips, Emergency Manager Coordinator, Los Ranchos de Albuquerque; Founder, Virtual Operations Support Teams; and member of Social Media 4 Emergency Management
- B.K. DeLong, Business Analyst, Rakuten Loyalty
- Luiz Bermudez, Director of Interoperability Certification, Open Geospatial Consortium
- George Chamales, Principal, Rogue Genius LLC
- Ali S. Khan, M.D., M.P.H., Assistant Surgeon General (Ret.) and Director, Office of Public Health Preparedness and Response, Centers for Disease Control and Prevention
- Shadrock Roberts, Senior GIS Analyst, GeoCenter, U.S. Agency for International Development
- Michael Gresalfi, Senior Advisor, Chemical, Biological, Radiological, Nuclear, Explosive (CBRNE) & Whole Community, Response Directorate, Federal Emergency Management Agency
- David Applegate, Associate Director for Natural Hazards, U.S. Geological Survey
- Aiden Riley Eller, Vice President of Technology and Security, CoCo Communications
- George Rice, Executive Director, Industry Council for Emergency Response Technologies
- Michael Goodchild, Emeritus Professor of Geography, University of California, Santa Barbara
- Shoreh Elhami, Citywide GIS Manager, City of Columbus, Delaware General Health District; URISA's GIS Corps
- E. Lynn Usery, Research Physical Scientist and Director, Center of Excellence for Geospatial Information Science, U.S. Geological Survey
- Bruce Heinlein, Director of Human Geography, Joint Program Office, National Geospatial Intelligence Agency

Although the reviewers listed above provided constructive comments and suggestions, they were not asked to endorse, nor did they see, the final draft of the workshop summary report before its release. The Wilson Center was responsible for making certain that an independent examination of this summary report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authors and the Wilson Center.

Contents

Foreword

As our society, and indeed the entire global population, becomes more interdependent, there is a growing recognition that the disasters we face, both natural and man-made, increasingly challenge us when facing complex cascading events. Many recognize the need to more fully engage the "whole community," including individuals, social and fraternal organizations, non-profits, private industry, and others as partners in responding to, and recovering from, large complex disasters. One element of this more inclusive emergency preparedness strategy is a recognition of the need to more effectively call upon technologies, and technology providers, to contribute to the development and application of more efficient and effective disaster management and humanitarian aid practices.

At the Federal Emergency Management Agency (FEMA), we are committed to engaging all facets of our society, including digital volunteer organizations that support crowdsourcing, social media, and crisis mapping, as essential contributors to the larger emergency management enterprise. Through our Innovation Team and Think Tank forums, and as informed by our Strategic Foresight Initiative, we at FEMA are committed to more fully engaging the whole community in achieving response and recovery core capabilities, as expressed within Presidential Policy Directive #8, our recently updated national preparedness doctrine.

I was pleased to participate in this two-day workshop, "Connecting Grassroots to Government for Disaster Management," organized and hosted by the Commons Lab of the Woodrow Wilson International Center for Scholars. The workshop was identified as a forum where "responders and researchers could come together and share lessons learned, pressing needs, and new developments." Clearly, this objective was fully achieved, as nearly one hundred academics, analysts, digital volunteers, and first responders came together and, in two short days, were able to effectively collaborate

and tackle a multitude of topics that hold much promise as we strive to improve disaster management and humanitarian response practices and policies.

I was heartened to find consensus in the room that, while technology can assist disaster responders by providing multiple perspectives, thus increasing situational awareness, technology is not an end in itself. Indeed, as discussed in this report, technology must fit into response strategies in order to be useful and each disaster comes with its own set of conditions and complexities, which must be addressed. Also, as discussed in this report, crowdsourcing approaches need to be sensitive to the unique character of each disaster. We also need to more fully consider the different forms of crowdsourcing, and the different kinds of data that can help to close high-priority response and recovery capability gaps.

The obstacles identified during this workshop were many and varied, including agency policies and institutional resistance; biases in the quality and distribution of data; uncertain legal contexts; and continuing concerns about the quality of collected data. We have much to discuss further in follow-on workshops and forums, as together we continue to advance the practice of emergency management, with the full inclusion of the whole community!

Michael J. Gresalfi, Ph.D.

Senior Advisor
CBRNE & Whole Community
Response Directorate
Federal Emergency Management Agency
Department of Homeland Security

Executive Summary

The growing availability and use of social media and other mass collaboration technologies present new opportunities and challenges for disaster management. Platforms now exist that permit collection of data from broad constituencies and rapid communication with endangered communities, but this new interface between the informality of "the crowd" and the formality of policy frameworks raises important questions. These questions pertain to best practices, ways to integrate crowdsourced data with more traditional sources of data, and the identification of tools and approaches that should be leveraged in particular contexts. Groups engaging with these tools to support disaster response are often from disconnected industries and institutions, compounding the challenges.

The "Connecting Grassroots to Government for Disaster Management" workshop was held to identify, assess, and address these opportunities and challenges. The workshop brought together the formal disaster response community, technology developers, digital volunteers, academic researchers, and the private sector. This report documents the conversations that emerged in this workshop, with particular attention to confirmed or disputed presuppositions, priority research opportunities, and the formal response community's needs and capabilities.

Factors obstructing the adoption of crowdsourcing, social media, and digital volunteerism approaches often include uncertainty about accuracy, fear of liability, inability to translate research into operational decision-making, and policy limitations on gathering and managing data. Prior to the workshop, many in the formal response community assumed that such obstructions are insurmountable and, therefore, that the approaches could not be adopted by the response community. However, it became clear during the workshop that these approaches are already being integrated into disaster response strategies at various scales. From federal agencies to local emergency managers, officials have begun exploring the potential of the technologies available. Stories of success and failure were common, but out of both came policy, research, and technological implications. Panelists shared strategies to overcome barriers where it is appropriate, but resisted change in areas where policy barriers serve a meaningful purpose in the new technological environment.

Some panelists challenged traditional ways of measuring "accuracy" and the assumption that it is possible to replicate responses across diverse disaster

situations. Other panelists conveyed important legal information regarding digital volunteer groups, many of whom were represented at the workshop and tended to work under the assumption that they have legal protection. Many also were not aware of the serious security risks that technologies may present, from hacking, to volunteer endangerment, to sabotage.

The workshop charted new territory for the field, prioritizing academic and applied research opportunities and challenges. In particular, the communities expressed a need for more "space to fail"; safe sandboxing arenas where the stakes are low and nascent technologies can be tested. More research is necessary to understand disasters and disaster management as integrated social, technical, computational, and design systems.

Workshop participants identified the following activities as some of the more urgent research priorities:

- Create durable workflows to connect the information needs of on-the-ground responders, local and federal government decision-makers, and those conducting research so that each group gets what it needs and benefits from collaboration.
- Develop methods and processes to quickly validate/verify crowdsourced data.
- Establish best practices for integrating crowdsourced and citizen-generated data with authoritative datasets. Construct methods and processes that can streamline this integration.
- Decide on the criteria for "good" policies, and with this information, determine which policies need to be adapted or established. Develop ways for agencies to look ahead 5 to 10 years in their policymaking in view of the anticipated rapid technological change.
- Determine where government agencies can effectively leverage social networking, crowdsourcing, and other innovations to augment existing information or intelligence and improve decision-making. Conversely, determine where it is not appropriate.

Introduction

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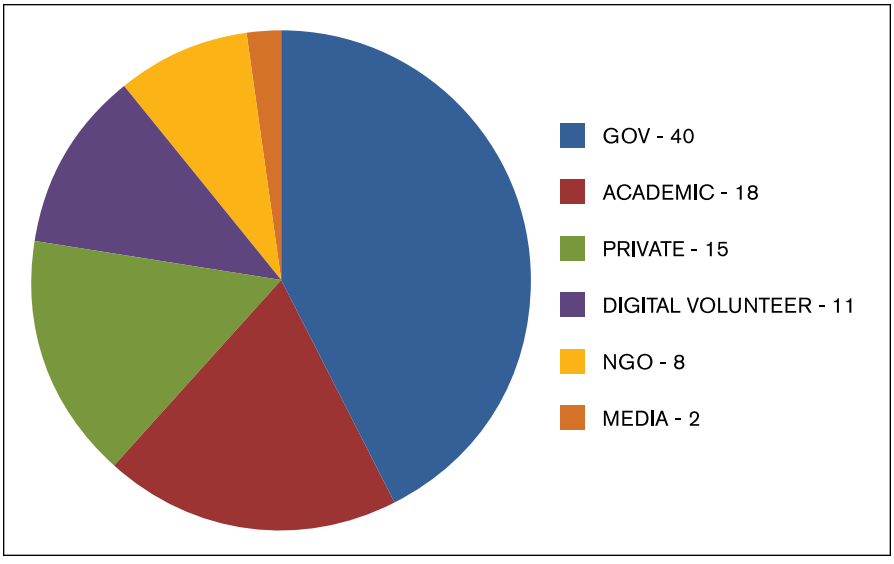
Impetus for Workshop

The growing availability of social media and other mass collaboration technologies presents new opportunities and challenges for connecting stakeholders' information needs and adapting to formal policy structures. To address these and other challenges, the Commons Lab within the Science and Technology Innovation Program, Woodrow Wilson International Center for Scholars, formed an ad hoc steering committee to help plan a two-day workshop entitled "Connecting Grassroots to Government for Disaster Management." This workshop facilitated a roundtable discussion among 95 participants—policymakers, researchers, technology developers and users, "boots-in-the-field" practitioners—representing government, universities, emergency response organizations, nongovernmental organizations (NGOs), private sector, and digital volunteer communities (see Figure 1).

Figure 1. Pie chart showing the sector of workshop participants



Summary Organization

Participants discussed the opportunities, challenges, and gaps in the use of social media and other mass collaboration technologies for disaster management. The objectives were to begin to build an interdisciplinary community of interest—connecting grassroots groups to government—to prioritize key challenges for improving the effectiveness of these methods and technologies for disaster management, and to identify possible solutions to obstacles. The agenda for the workshop appears in Box 1-1.

Workshop Vocabulary

During the sessions, the steering committee noticed that participants were using key terms related to crowdsourcing and crisis mapping inconsistently. To avoid confusion, we have attempted to provide a set of definitions for these terms (see Box 1-2). The term *crowdsourcing* in particular generated much debate; therefore, we have provided a possible typology of the processes encompassed by the term (see Box 1-3).

Box 1-1. Workshop Agenda

Connecting Grassroots to Government for Disaster Management:
A Policy Roundtable

Commons Lab of the
Science and Technology Innovation Program

The Wilson Center
Ronald Reagan Building
1300 Pennsylvania Ave, N.W.
Washington, DC

September 13–14, 2012

AGENDA

Thursday, September 13, 2012

8:30 AM — Welcome and Introduction

- Michael Goodchild, Member, Committee on Connecting Grassroots to Government for Disaster Management, University of California, Santa Barbara
- John Crowley, Co-Chair, Committee on Connecting Grassroots to Government for Disaster Management
- Lea Shanley, Director, Commons Lab, Science and Technology Innovation Program, Woodrow Wilson Center

8:45 AM — Session 1: Agency Vision and Decision-Maker Needs (Keynote)
Moderated by Alex Howard, Government 2.0 Washington Correspondent, O'Reilly Media

- Charles Werner, Fire Chief, Charlottesville Fire Department, Charlottesville, VA
- Bruce Heinlein, Director of Human Geography, Joint Program Office, National Geospatial-Intelligence Agency
- David Applegate, Associate Director for Natural Hazards, U.S. Geological Survey

10:00 AM — Session 2: Crowdsourced Data Quality
Moderated by Sean Gorman, Chief Strategist, DC Development Center, Esri

- Muki Haklay, Professor of GIScience, Extreme Citizen Science (ExCiteS) Research Group, Department of Civil, Environmental and Geomatic Engineering, University College, London
- Robert Munro, Chief Executive Officer, Idibon
- Kate Starbird, Assistant Professor, University of Washington, Seattle
- E. Lynn Usery, Research Physical Scientist and Director, Center of Excellence for Geospatial Information Science, U.S. Geological Survey

11:00 AM — Session 3: Data Collection and Management
Moderated by Nigel Snoad, Product Manager, Crisis Response, Google

- Tim Brice, Senior Meteorologist, National Weather Service, National Oceanic and Atmospheric Administration
- Kris Eriksen, Public Information Officer, Portland National Interagency Fire Center, National Incident Management Organization, U.S. Forest Service
- Shadrock Roberts, Senior GIS Analyst, GeoCenter, U.S. Agency for International Development
- Chris Vaughn, Remote Sensing Coordinator, Federal Emergency Management Agency

1:00 PM — Session 4: Evaluation Frameworks, Performance Metrics, and Impact
Moderated by E.J. Ashbourne, Senior Operations Officer and Director, Global Health Information's Forum, World Bank

- Bartel Van de Walle, Associate Professor, Department of Information Management, Tilburg University; President, International Association for Information Systems for Crisis Response and Management
- Taha Kass-Hout, Director, Division of Informatics Solutions and Operations, Public Health Surveillance and Informatics Program Office, Centers for Disease Control and Prevention.
- John Vocino, Senior Analyst, U.S. Government Accountability Office
- Leysia Palen, Associate Professor of Computer Science, University of Colorado, Boulder

2:00 PM — Session 5: Public and Volunteer Engagement (Keynote)
Moderated by Ali S. Khan, M.D., M.P.H., Assistant Surgeon General (Ret.); Director, Office of Public Health – Preparedness and Response, Centers for Disease Control and Prevention

- Rob Baker, Program Developer, External Projects Team, Ushahidi; Member, Humanitarian OpenStreetMap Team
- Jeff Phillips, Emergency Manager Coordinator, Los Ranchos de Albuquerque; Founder, Virtual Operations Support Teams; Member, Social Media 4 Emergency Management
- Laurie Van Leuven, Operations Research Analyst, Scientific Research Corporation

Box 1-1, continued

- Jen Ziemke, Assistant Professor, International Relations, John Carroll University; Co-Founder and Co-Director, International Network of Crisis Mappers; Fellow at the Harvard Humanitarian Initiative–Crisis Mapping and Early Warning

3:30 PM — Session 6: Research Challenges

Moderated by Michael Goodchild, Emeritus Professor, Department of Geography, University of California, Santa Barbara

- Dave Ferguson, Deputy Director, Science and Technology Office, U.S. Agency for International Development
- Robin Murphy, Raytheon Professor, Department of Computer Science and Engineering, Texas A&M University
- Leysia Palen, Associate Professor of Computer Science, University of Colorado, Boulder
- Bartel Van de Walle, Associate Professor, Department of Information Management, Tilburg University; President, International Association for Information Systems for Crisis Response and Management

4:30 PM — Session 7: Research-to-Operations

Moderated by Eric Rasmussen, Vice President, AccessAgility; Managing Director, Infinitum Humanitarian Systems

- Ray Buettner, Director, Field Experimentation and Associate Professor, Department of Information Sciences, Naval Postgraduate School
- Captain Xenophon (Yo) Gikas, Fire Captain, Operations Control Division, Los Angeles Fire Department
- Frank Lindsay, National Aeronautics and Space Administration Applied Sciences Program–Disasters Program
- Will McClintock, Director, SeaSketch, Marine Science Institute, University of California, Santa Barbara; Member of the Center for Marine Assessment and Planning; Senior Fellow at the United Nations Environmental Program of the World Conservation Monitoring Center

Friday, September 43, 2012

9:30 AM — Welcome and Introduction

- Lea Shanley, Director, Commons Lab, Science and Technology Innovation Program, Woodrow Wilson Center

9:35 AM — Session 8: Legal and Policy Issues

Moderated by John Crowley, Public Policy Scholar for the Science and Technology Innovation Program, Woodrow Wilson Center; Research Coordinator for the Crisis Dynamics Program, Harvard Humanitarian Initiative

- David Kaufman, Director, Office of Policy and Program Analysis, Federal Emergency Management Agency
- Stephanie Grosser, Communications Specialist, Presidential Management Fellows Program, U.S. Agency for International Development
- Edward Robson, Esq., Robson & Robson, LLC
- Robert Gellman, Esq., Privacy Consultant, Missing Persons Privacy Project

11:05 AM — Session 9: Security of Crowdsourcing
Moderated by Eric Rasmussen, Vice President, AccessAgility; Managing Director, Infinitum Humanitarian Systems

- George Chamales, Principal, Rogue Genius LLC
- B.K. DeLong, Principal and Lead Analyst, Extropic Technology Consulting
- Aiden Riley Eller, Vice President of Technology and Security, CoCo Communications

1:00 PM — Session 10: Connecting Grassroots to Government through Open Innovation (Keynote)
Moderated by Gisli Olafsson, Emergency Response Director, NetHope

- Christopher Fabian, Co-Lead, Innovation Unit, United Nations Children's Fund (UNICEF)
- Nigel Snoad, Product Manager, Crisis Response, Google

2:00 PM — Prioritizing Grand Challenges (Plenary)
Moderated by David Applegate, Associate Director for Natural Hazards, U.S. Geological Survey

2:45 PM — Vision for the Future

- Gisli Olafsson, Emergency Response Director, NetHope

3:30 PM — Next Steps and Close

- Lea Shanley, Director, Commons Lab, Science and Technology Innovation Program, Woodrow Wilson Center

Box 1-2. Workshop Vocabulary: Definitions of Key Workshop Terms

Crisis mappers. Individuals and groups who produce maps, data, imagery, and information in emergencies, using mobile and web-based applications. These outputs are used to effectively respond to natural disasters, social and political crises, and many other types of emergencies.

Crowdsourcing. Usually understood as tasking a large number of distributed, uncoordinated individuals with a particular task, which could include data production, data processing, problem solving, or devoting computing resources. Many instances under the "crowdsourcing" umbrella term, however, differ from this definition (see Box 1-3).

Digital volunteers (also known as volunteer and technical communities). Individuals and members of organizations who for no monetary compensation contribute to crowdsourcing efforts in digital environments. These people are generally tasked—activated—by establishment humanitarian and disaster relief organizations, such as the U.N. Office for the Coordination of Humanitarian Affairs and the Assessment Capacities Project (ACAPS).

Box 1-2, continued

Disaster. "A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources."[a]

Disaster management. "The body of policy, administrative decisions and operational activities required to prepare for, mitigate, respond to, and repair the effects of natural or man-made disasters."[b]

Emergency management. "The organization and management of resources and responsibilities for addressing all aspects of emergencies, in particular preparedness, response and initial recovery steps."[c]

Open innovation. A group of practices, policies, licenses, and ethics that stress technology sharing, collaborative problem solving, software code openness, modular technology development, and process transparency.

Social media. Web platforms intended to extend social networks into digital spaces. These sites may have personal, professional, or interest-based orientations. Popular examples include Facebook, LinkedIn, Yelp, and MeetUp.

Social network analysis. The process of summarizing, visualizing, and statistically exploring a social network to identify and understand key actors, relationships, dynamics, and information spread, as well as changes in any of these variables.

Social networking. "The process of creating, maintaining, or altering one's connections with others, and to one's advantage, by using the connections to share or gain resources, to collaborate with or influence others, or to mobilize activities" (Magsino 2009, 2).

Standby Task Force (SBTF). A web-based network of people who can be activated to assist in disaster or crisis management. The SBTF can assist with information production, translation, geolocation, and visualization.

Virtual Operations support Team (VOST). A loosely coordinated group of people that emerges in disaster response contexts to manage an organization's social networking and crowdsourcing capacities during the disaster. For instance, a VOST might gather information from, and publish information to, a city's Facebook page or Twitter account (Reuter 2012).

Volunteered Geographic Information (VGI). Data with a locational component, produced by laypeople rather than professional mappers, usually with the aid of web mapping platforms, smartphones, and global positioning systems (Goodchild 2007). This term has been questioned because of its implied voluntary nature (much of these data are collected without the users' knowledge), its association with laypeople (many of those involved in this mode of data production are professionals merely utilizing new technologies), and its narrow focus on the data (termed "information") rather than the new hardware, software, and spatial practices that enable it.

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a. United Nations Office for Disaster Risk Reduction, http://www.unisdr.org/we/inform/terminology.
b. U.S. National Library of Medicine, http://www.nlm.nih.gov/tsd/acquisitions/cdm/subjects28.html.
c. United Nations Office for Disaster Risk Reduction, http://www.unisdr.org/we/inform/terminology.

Box 1-3. Crowdsourcing Typology

The term *crowdsourcing* encompasses many different activities. Below are listed some of these activities and a potential typology for describing the field. The lists are adapted from Shanley (2012) and Franzoni and Sauermann (2012).

Activities

Data or photo collection
Classification
Computational resources
Content analysis
Idea generation
Knowledge sharing
Mapping
Microtasking
Pattern recognition
Problem solving
Programming
Rating and reputation
Technology testing

Potential Typology

Crowd creation
Crowdfunding
Crowd mapping
Crowdvoting
Hack-a-thons
Data mining
Field reporting
Prediction markets
Prizes and challenges
Serious games

Day 1 Morning Sessions

2

Session 1: Agency Vision and Decision Maker Needs

Key Issues

Operational impact: Does crowdsourcing improve operations? How can it be most effectively leveraged?

Accuracy: Have agencies and responders noticed accuracy problems in crowdsourced data?

Impediments: What impediments would agencies and responders like to see addressed? What policies can be clarified or updated to improve the integration of crowdsourcing and social media into response strategies?

Panel Discussion: Key Points

The first panel discussion, moderated by Alex Howard of O'Reilly Media, was a conversation among the following:

- David Applegate, Associate Director for Natural Hazards at the U.S. Geological Survey (USGS)
- Bruce Heinlein, Director of Human Geography at the National Geospatial-Intelligence Agency (NGA)
- Chief Charles Werner, Fire Chief of the Charlottesville, VA, Fire Department.

The panelists were provided guiding questions beforehand: what information do local and federal government decision-makers need for disaster response and research? How do information needs differ for on-the-ground responders, back-office decision-makers, and researchers? Where might government agencies effectively leverage the power of social networking, crowdsourcing, and other innovations to augment existing information or intelligence and improve decision-making? What agency policies will need to be adapted or established? What is the strategic vision for the next 5 to 10 years?

The following summarizes the key points raised by panelists:

- **Crowdsourcing can generate impressive results in the right situation.** Applegate conveyed the impressive success of a long-standing USGS project entitled "Did You Feel It?" This application crowdsources earthquake reporting to an online audience; anyone can report what he or she felt during an earthquake. More than two million reports have been filed on this website, with 40 earthquakes receiving more than 10,000 reports each (Applegate 2012).

  Heinlein described how the NGA teamed with the Federal Emergency Management Agency (FEMA) to analyze social media to compensate for satellite image deficiency following the 2011 hurricane Irene. Cloud cover was too dense for useful satellite imagery, so the NGA turned to social media for real-time information production. The data were stripped of personally identifiable information in accordance with the Privacy Act of 1974, and only location and description were retained. This allowed the NGA to increase its situational awareness and provide intelligence to FEMA and other responders.

  Werner noted that social media were used to assess the seriousness of the 2011 earthquake near Charlottesville, Virginia.[1] Officials there found that integrating public knowledge into their response strategies had a significant, positive, and widespread impact on operations.

- **Integrating the public into information-gathering processes can have broad impacts.** Werner said that by taking advantage of social media and crowdsourcing, "we're able to impact the workflows of other organizations." Data and technology sharing can make these impacts more efficient and effective.

1. See http://www.washingtonpost.com/earthquake-rattles-washington-area/2011/08/23/gIQATMOGZJ_story.html.

It's almost getting to the point where you could consider yourself irresponsible for not taking those tools into advantage.

- **Legal impediments may hinder the effective use of social media in disaster response.** The Privacy Act of 1974 was mentioned as a minor hindrance to the efficient use of crowdsourced data, but panelists noted that they have been able to work within this limitation fairly easily. Another potential deterrent identified by both Howard and Werner is the concern that the use of social media creates the expectation of response; the public may report needs on their social networking sites and expect responders to quickly address that report.. This expectation has potential implications for liability.

- **Institutional impediments also slow the adoption of new technology for disaster response.** For instance, one panelist noted that increases in efficiency may be limited by institutions' ability to analyze, synthesize, and respond to the data produced. According to this way of thinking, increased data *availability* is a separate concern from increased *efficiency*; available data are of little use without the ability to synthesize and understand those data.

- **It can be difficult to keep up with technology development.** With the proliferation of new social networking and crowdsourcing platforms, emergency managers find it difficult to decide which tools they should incorporate into their practice. They fear investing in the wrong technology, particularly in light of training requirements, budgetary limitations, and staff constraints.

- **Crowdsourcing, social media, and crisis mapping can improve operations.** The potentially increased usefulness of data production and harvesting through social media was a recurring theme throughout the workshop, but was most salient in the panel dedicated to agency vision and decision-maker needs. Disaster responders repeatedly affirmed the increased utility of social media data, even suggesting that their use has now become crucial for responders. Werner claimed that "it's almost getting to the point where you could consider yourself irresponsible [for] not taking those tools into advantage."

Box 2-1. Application Areas of Crowdsourced Data

- Hazards science
- Hazards detection
- Public safety and crisis information
- Tracking of what the "crowd" is discussing
- Public engagement and trust building
- Encouragement of transparency
- Emergency warnings and alerts
- Situational awareness
- Requests for assistance
- Damage estimates
- Location of missing persons
- Identification of rumors and viral information
- Recognition of hidden problems
- Determination of who is influential
- Leveraging of the "Capable Crowd"

- **Data may be more accurate than one anticipates.** Heinlein noted that accuracy has not been a strong concern, as the data are never used as a stand-alone product. In other words, "if you have a text, or a [Twitter] tweet from somebody and you have a location, and you're going to go do a rescue, you're not going to do the rescue based on that sole piece of data." Additionally, Heinlein commented that his group has not seen much incorrect or misleading information reported in social media. However, mechanisms and software are not yet capable of identifying that small amount of incorrect or misleading data, and this is a potential area for future research.

- **Technology is always only part of a solution.** Workshop participants noted that social media are unlikely to become stand-alone information collection systems, but will instead be used to complement and enhance traditional data production sources.

Outcomes and Takeaways

Panelists all agreed that, given proper calibration and tailoring to each unique situation, crowdsourcing, social media, and crisis mapping can all contribute to a more efficient and effective disaster response strategy. **Agencies and responders need to consider these approaches as they apply their own disaster response strategies (see Box 2-1).**

Panelists reported a number of impediments that have slowed the adoption of innovative technologies. These impediments arise from institutional culture and legal policy resistances. **Agencies should consult with their legal counsel, the digital volunteer community, and local responders to see which policies, laws, regulations, and procedures should be updated or changed.**

There was general agreement that crowdsourced data tend to be more accurate than early fears suggested. Later panels also showed that data that may be considered "inaccurate" for one purpose can often be re-appropriated for another usage. **Agencies and**

responders should not let fear of inaccuracies stand in the way of adopting crowdsourcing, and instead should work to filter, correct, appropriate, and account for inaccurate data.

Session 2: Crowdsourced Data Quality

Key Issues

Efficiency: Are crowdsourcing approaches and social media platforms more efficient sources of data generation than traditional forms of information collection? How can agencies increase their efficiency using these new tools?

Accuracy: How do responders gauge the accuracy of crowdsourced data? Can we make "inaccurate" data useful instead of discarding them?

Quality: How can responders and agencies evaluate a contributor's reputation? How can crowdsourcing approaches through social media and other platforms be transformed into workflows for agencies and responders?

Background

The use of crowdsourcing and social media in disasters has led some to suggest that these technology-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 for their broad potential uses and efficiency in disasters across quite diverse contexts, both in developing countries (Heinzelman and Waters 2010; Meier 2010; Starbird and Palen 2011; Zook et al. 2010) and developed countries (Goodchild and Glennon 2010; Meraji 2011).[2] Despite increases in data production capabilities, the capacity to interpret and use these data efficiently remains a concern (Computing Community Consortium 2012). Many other concerns have been raised regarding the credibility and accuracy of data produced by the social media–abetted crowd, particularly when such data are necessary to enable quick decision-making in disaster management (Flanagin and Metzger 2008; Goodchild and Glennon 2010; Li and Goodchild 2010).

Efficiency

Crowdsourcing approaches and social media platforms make it possible to develop large amounts of data quicker than earlier technologies and modes of data production. However, decision-makers may encounter difficulties transforming the data into usable

2. Ushahidi is an online data collection, curation, and mapping platform that is tailored for use in disaster management, humanitarian management, and social conflicts, although broader uses exist. See http://www.ushahidi.com.

formats and manageable chunks. This problem is not entirely a technical one, as institutional and social contexts and arrangements factor into these dynamics. Specifically, data-sharing agreements, open innovation directives, policies, institutional connections, and willingness to share software and hardware all have an impact. If data production, sharing, and usage are social and institutional problems, a few questions should guide research in this area: What information do local and federal government decision-makers need for disaster response and research, and where are the information gaps that crowdsourced data might complement or fill? How do information needs differ for on-the-ground responders, back-office decision-makers, and researchers? How can practitioners, policymakers, researchers, and digital volunteers work together quickly to ensure efficient data production and usage?

Once produced, data must be distributed to governments and decision-makers in a usable way. The most widely promoted crowdsourcing applications for humanitarian circles make minimal use of dividing and distributing tasks, thus increasing the likelihood of duplicating efforts (Gao, Barbier, and Goolsby 2010). Two popular crowdsourcing platforms for humanitarian work, OpenStreetMap and CrowdFlower, both have sophisticated microtasking abilities (Aldrich 2012; see also http://tasks.hotosm.org/about). Although task apportioning has always occurred in disaster contexts, technological developments and appropriate government policies can streamline the process and increase efficiency. What is the current state of technological development in this area? What will encourage further development? Answering these questions will require addressing the distinct needs of responders, decision-makers, technology developers, and researchers.

Figure 2: OpenStreetMap interface over Gulu, Uganda

© OpenStreetMap contributors. Available at http://www.openstreetmap.org/?lat=2.7702&lon=32.2832&zoom=13&layers=M

What the crowd is good at reporting and what the crowd is good at processing isn't necessarily what the responders need.

Accuracy

Crowdsourcing distributes the responsibility for data production widely, often to lay-people rather than traditionally recognized "experts." Although this approach has enabled exponential growth in the amount of data produced, the accuracy of crowdsourced data has long been a concern, with a traditional fit-for-use criteria often deemed most appropriate (Flanagin and Metzger 2008; Goodchild 2007; Grira, Bédard, and Roche 2010; Mummidi and Krumm 2008). Means to verify data are currently being developed, yet the degree to which responders may rely on these 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). The U.S. Agency for International Development (USAID), for example, reported an 85 percent accuracy rate in a recent case study of crowdsourced data (USAID 2012).

Determining the accuracy of data can mean rethinking the scope of accuracy. First, disaster contexts create needs at several scales, ranging from the specific needs of individual people all the way up to the general needs of entire cities or regions. An accurate location at one scale may not be accurate at another. Second, some needs in disasters may not require precise Cartesian notions of accuracy, perhaps being more ambiguous or structural. These needs could include disrupted community relationships and interpersonal networks, feelings of instability or fear, and broader political and economic disturbances. The challenge is 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.

Panel Discussion: Key Points

Moderated by Sean Gorman, Chief Strategist for the District of Columbia Development Center at Environmental Systems Research Institute (ESRI), the second discussion included the following panelists:

…there isn't such a thing as just [a] 'crowd.' It's actually a lot of different groups and different characteristics.

- Muki Haklay, Professor of GIScience at University College, London
- Robert Munro, Chief Executive Officer at Idibon
- Kate Starbird, Assistant Professor at University of Washington, Seattle
- E. Lynn Usery, Research Physical Scientist at the USGS

One of the primary obstacles to government agency use of crowdsourced data is the lack of trust in the source of the information and in the accuracy of the data provided. This session's panelists focused on the following questions: How does the efficiency, accuracy, and quality of crowdsourced data compare with those of other datasets? Under what circumstances might crowdsourced data be more useful than other resources? What tools and methods have been developed for validation and verification of crowdsourced data?

- **There is no single, all-encompassing definition of the term *crowdsourcing*.** In response to an issue originally raised by Starbird, the panel questioned whether the term describes outsourcing labor (either to large or small groups of people) or whether it also might include citizen reporting and problem solving or harvesting data from social networking websites. Munro further asked what the role of volunteerism, in contrast with paid work, should be. Haklay was more skeptical about the idea of crowdsourcing altogether: "There isn't such a thing as *just* [a] 'crowd.' It's actually a lot of different groups and different characteristic[s], and you need to figure out what exactly you are talking [about] and what kind of information that you need." For instance, Usery noted that in the case of the USGS, crowdsourced transportation data like road centerlines were of a lower quality than building structure footprints. He also said that Dr. Barbara Poore of the USGS has a forthcoming paper that identifies at least 10 types of crowdsourcing with different kinds of data produced by each.
- **Agencies should take advantage of the diversity of social media tools.** Panelists said that, although many disaster responders focus specifically on data being produced in Twitter, a number of available technologies show promise for the

field. Munro reported that Facebook and Internet Relay Chats (IRCs) dramatically improved the crowdsourced response to the 2010 earthquake in Haiti,[3] but contrary to popular reporting. Twitter did not play a significant role (Munro 2012). It might be impossible to use some strategies in other places with Twitter as the only data source. Starbird reiterated the many benefits of Twitter, however, such as openness, search capacity, and semi-structuring techniques like hashtags and specific user call-outs.

- **Crowdsourcing can increase efficiency.** Many panelists said that using appropriate crowdsourcing techniques increased the efficiency of their operations. Usery said that the USGS was successful in leveraging volunteer efforts for the National Map, noting that it would have been impossible for a dedicated staff member to accomplish what the National Map accomplished with volunteers. He said that 89 percent of the generated data met National Map Accuracy Standards[4] before peer review, which jumped to 91 percent after peer review. The level of efficiency achieved depends on the volunteers and methods used. Munro reported that the time required to geolocate an unstructured short message service (SMS) message in Haiti was four hours for an internationally based volunteer versus 4 to 4.5 minutes for someone from Haiti with local knowledge.

  Panelists and the disaster response community retain a great diversity of opinions regarding open access to data and software. With many exceptions, there is a general tendency toward cautiously opening access. Improving data portability[5] can help make crowdsourced data more efficiently usable across various applications, such as analysis, derivative works, and visualization. A common perception, especially among private companies, is that data and their applications will lose value if data are not kept behind a paywall. Advocates of the open source movement have argued that this is not the case (Lessig 2004; Stallman 1992; Stallman 2010).

  Alongside increased portability should be increased discoverability and increased accessibility. In disaster management situations, those in charge of data production and

3 IRCs are spaces for instant messaging groups of people. They are similar to Skype groups but rely on open protocols and different technologies. A number of software programs can connect to an IRC, whereas only the Skype software can connect to Skype groups.

4 For these standards, see http://nationalmap.gov/standards/pdf/NMAS647.PDF.

5 "Portability" refers to conforming to open data standards, interoperability, and open copyrights (e.g., Copyleft, Creative Commons, GNU).

collection should remember that multiple audiences are likely to see the data and to use the information for diverse purposes beyond the immediate disaster. For example, application programming interfaces (APIs) open opportunities for innovation and extensive utilization,[6] but typically limit the potential audience to developers. If data are shared, they should be downloadable in multiple common and open formats. Opening data does raise further concerns for privacy and security; if data are opened at first but later determined to be sensitive, they could be harder to contain and protect.

- **Folksonomies emerge organically in disasters.** Starbird suggested that crowds tend to develop "folksonomies"—data categories, tags, and modes of communicating—that describe what they see happening in a particular disaster, but are not necessarily most useful to on-the-ground responders. Starbird noted that folksonomies help develop categories and themes specific to each situation. However, this form of information processing often fails to meet disaster responder needs.

- **Crowdsourced data are often as accurate as authoritative datasets.** Disaster responders often say that they are most concerned about the accuracy and reliability of the crowdsourcing technologies, but panelists were optimistic in reporting their own observations. As already mentioned, Usery found a 91 percent accuracy rating in the crowdsourced data on the National Map. Although Haklay reported a measurable deterioration in accuracy of crowdsourced data as one moves farther from the city center, as well as deterioration in places of lower socioeconomic demographics, he suggested that a combination of OpenStreetMap and Ordnance Survey data could correct this problem in both central city and suburban areas. Haklay has published this argument elsewhere (Haklay 2010, 2012, 2013). Munro used the online crowdsourcing program CrowdFlower in the aftermath of the 2010 floods in Pakistan, which produced higher quality data than would have been expected from a trained professional. Another panelist pointed to a crowdsourcing project that resulted in an 84 percent spatial data accuracy rating—more accurate than most (see Roberts, Grosser, and Swartley 2012). Furthermore, one panelist noted that software bugs—not malicious individuals—generated false reports in one deployment of Ushahidi.[7]

  Crowdsourced data are not simply one-way communications. Munro pointed out that accuracy was a non-issue in SMS-based reporting following the earthquake in Haiti. With hundreds of Haitian Creole speakers working on Mission 4636 at any one time,[8] they simply called the senders directly to resolve any ambiguous or

6 APIs are software-specific code that allows access to modules of software and data. For instance, using Google Maps's API, one can use Google's map interface and stylize data points using Google's markers. Sometimes APIs allow one to access data residing in a central database.

7 Several journalistic news sources documented individuals who generated false images and reports in the Hurricane Sandy aftermath.

8 Mission 4636 was an initiative created to assist those responding to the 2010 earthquake in Haiti. Among other functions, it established a dedicated SMS number for Haitians to report needs to responders and aid providers. See http://www.mission4636.org.

No emergency response is going to happen while the tornado is on the ground half a block away, but you can get information from social media.

contradicting reports, and these cases did not occur in large enough numbers to disrupt the workflow. In other words, in some crisis contexts, multiple layers of complexity could be instituted to improve data quality and trustworthiness.

- **Crowdsourcing leaves gaps in whose voices are captured and represented.** According to panelists, many researchers, policymakers, and on-the-ground responders assume that, because almost anyone *can* contribute to crowdsourcing projects, everyone *does* contribute. In reality, research has shown that there are significant gaps between those who do not participate, those who participate a little, and those who participate a great deal. Within these groups there are demographic and social characteristics that might influence a person's level of participation, yet have not been fully explored. Haklay has shown relationships between proximity to the city center and positional accuracy, attribute accuracy, and completeness. As mentioned earlier, he found that crowdsourced data are most thorough and accurate in inner-city areas with relatively affluent demographics. Haklay warned that this results in a "cacophony of the strongest, where they can shout louder and they might divert resources." The representativeness of crowdsourced data has been an ongoing conversation outside the workshop as well (Gorman 2011; Haklay 2012; Meier 2012a).

  Additionally, some research has shown that study results vary according to the breadth of the data sample coming from social media (González-Bailón et al. 2012). In other words, whereas some patterns might be identified using Twitter's "sprinkler" (i.e., a basic Twitter API search, which gives relatively few results) as a study sample, different patterns might emerge when using Twitter's "firehose" (i.e., the full stream of data produced on Twitter). That is not to say that using the "firehose" results in more "accurate" patterns, but simply to point to potential sources of bias. The lesson here is to be cognizant of a study sample's influence on the results of the study.

- **Some information conveyed in social media may be exaggerated.** In some types of social media, there may an incentive not to deliberately introduce false information, but to exaggerate. Munro argued that on Twitter, the number of tweets

competing for responders' attention and resources encourages people to sensationalize the information that they convey. With researchers at Stanford University, he has shown that the most commonly reported events in social media during disasters are often events that did not actually occur (Munro and Manning 2012). As information is amplified and spread, it may lose the originator's intent and may continue to exist beyond its temporal usefulness. If the same information is reported in multiple ways or edited after the original report, it may give the impression of continued needs, even if those needs have already been addressed.

- **There is little evidence on which to base a comparison of the rates of false reports from different sources.** Limited research exists contrasting the rates of false information reports in social media with the rates of such reports in traditional data production channels. Haklay said that some have seen crowds self-correct to mitigate the effects of vandals; Starbird added, however, that there can be a time lag before the correction occurs, which can be problematic in time-sensitive contexts such as disaster response.

Outcomes and Takeaways

Panelists generally agreed that it is important to consider the different forms of crowdsourcing and the different kinds of data that can be produced with each. **Research is needed to systematically explore which decision-maker needs would benefit most from a crowdsourcing approach to data production and analysis, and the areas where crowdsourcing might not be appropriate.**

As in other panels, it was reiterated here that incorrect and misleading data did not become a problem in most cases. In other words, according to one panelist, "I've seen no strong evidence that information reported through social media is inherently more unreliable than [that reported] through traditional channels." Decision-maker and responder needs are communicated **to volunteer and technical communities on an ad hoc basis without standards or smooth workflows; future research could establish procedures for connecting those with needs to those who can address those needs**.

In general, the panelists agreed that the reputation of the individual contributor provides the strongest indication of the quality of the contribution. In some cases, reimbursing contributors for their time can improve overall data quality, but most projects do not have budgetary resources for this option. However, Munro noted that the cost of managing volunteers has in some cases been greater than the cost of employing professional crowdsourced workers. For example, according to Munro, the U.N. Office for the Coordination of Humanitarian Affairs spent thousands of dollars managing full-time volunteers (and ultimately had to hire employees) for the Libya Crisis Map, in contrast with an approximately $800 cost for using paid workers (Munro 2013). Thus, the challenge for organizations may be to determine how to allocate and distribute budgetary resources, rather than finding additional financial resources.

Some social networking sites provide a proxy for reputation. For Twitter the number of followers or re-tweets can indicate quality, while on Facebook the number of "likes" or the number of comments on a post can serve as an indicator of quality. **More research is needed to determine effective ways of evaluating reputation and the connections between reputation and quality.**

Session 3: Data Collection and Management

Key Issues

Integration: How can agencies and disaster responders integrate crowdsourced data into their datasets and operations?

Networks: Where have agencies established durable networks of trust and cooperation for using crowdsourcing strategies?

Models: What can be done to adopt models for crowdsourcing, integration, and network building?

Background

Although the number of crowdsourcing disaster management projects is increasing, there is little research systematically exploring the ways in which organizations make use of these data alongside the data that they obtain from traditional sources. Some organizations have produced reports detailing single projects. Bastian and Byrne (2012) described how the Federal Communications Commission (FCC) used a crowdsourcing approach to determine the distribution and location of broadband access across the United States. This strategy integrated citizen input and iterative software design into the FCC's standard models of data collection and management. The process engaged an "agile" software development approach that built the software design iteratively in response to people's feedback.

The report by Bastian and Byrne (2012) also detailed the FCC's navigation of federal legal and policy structures. In relation to disaster contexts, some agencies use social media simply to improve their situational awareness and to communicate that information to broad audiences (Rive et al. 2012; Rivera 2012), processes that require few formal frameworks for guidance. More complex projects, such as the USGS National Map, have made it clear that few standardized models exist for integrating volunteered data with authoritative datasets.

The USGS's "Did You Feel It?" project is an example of an agency-led citizen science project that has implications for disaster management (Young et al. 2013). By enabling lay individuals to record and report their perceptions of earthquakes, the USGS is able to more fully understand the impact of an earthquake—and, thus, to determine how

emergency managers should respond. These reports, which ideally capture how much shaking, damage, and disruption was experienced at a particular location, not only can aid response, but also can factor into planning and evaluating risk.

The lack of standardized models may obstruct the further adoption and development of these techniques among agencies. At this point, little systematic research has been conducted to examine the ways in which agencies and responders include volunteered and crowdsourced data into their decision-making processes and directed resource distribution. Such research will enable responders and agencies to develop durable and official processes and frameworks for future projects. Questions driving this research could include the following: What methods and processes have federal agencies put in place to encourage the use of crowdsourcing and social media tools and methods? What issues emerge when using fused datasets to make operational decisions?

Panel Discussion: Key Points

The third session, moderated by Nigel Snoad of Google's Crisis Response, consisted of contributions from the following:

- Tim Brice, Senior Meteorologist at the National Weather Service of the National Oceanic and Atmospheric Administration
- Kris Eriksen, Public Information Officer at the U.S. Forest Service
- Shadrock Roberts, Senior GIS Analyst at USAID
- Chris Vaughn, Remote Sensing Coordinator at FEMA

Once an agency can assess data quality, how can the agency integrate crowdsourced data with authoritative datasets? Most integration of datasets into federal decision-making has happened because of personal relationships between agency personnel and crowdsourcing communities. Until these workflows are transformed into durable, official processes, they are ad hoc and fragile. What methods and processes have federal agencies put in place to support crowdsourcing and other open innovation tools and methods?

- **The public generally overestimates danger.** In disasters, the public may misperceive the amount of danger present in their location. According to Eriksen, "we can have ash falling on a town dark enough to put out the street lights, and there's no fire within 50 miles of them"—which can lead people to post distracting information to their social media sites. Likewise, Brice said that the specificity people use in social media varies widely, with some people reporting general weather conditions while others post specific locations and a precise weather event such as "I work at the midtown mall, and there's a tornado just touched down across the field from us." This diversity means that there is a range of usefulness of the data produced in social media.

- **Institutional resistance slows the development of the field.** Many panelists mentioned that they have faced institutional resistance to social media in data collection and management. At times it results from the lack of any terms of service and potential legal roadblocks. Without clear legal security and advisability, there is no strong incentive to engage with social media. Brice has been advised not to use Pinterest or Skype for the National Weather Service because the agency does not have terms of service with either.

  Also, despite the increased use of social media in disaster response, many institutions claim that there have been no exemplary successful case studies. Throughout the workshop, attendees suggested that a single "success story" may be enough to convince their institutions to use social media. However, institutions may not have the resources to devote to a new method of data collection and management, such as social media, when the longevity of these tools may not yet have been demonstrated. Moreover, pages on the social networking site Google Plus have been brought down by management personnel because of a lack of agency approval frameworks.

- **Stronger measures are needed to protect personal and personally identifiable information.** Panelists agreed that more measures should be taken to protect personal—and personally identifiable—information. Agencies can do this with technological "fixes" most immediately, but legal, institutional, and political cultures, norms, and frameworks all must be adapted to these new tools and methods. Even publicly available social media data, including many tweets, require "scrubbing" to remove this type of information.

- **It takes a concerted effort to coordinate volunteers and first responders.** In some emergencies, crisis maps appear in an ad hoc, uncoordinated manner; in contrast, humanitarian agencies usually need a structured, coordinated crisis mapping initiative. An audience member asked how to best coordinate the multiple and often conflicting response efforts in an emergency, and the panelists offered different answers for the different stakeholders present in an emergency response. Roberts said that responders can direct more of their efforts toward sharing their data, rather than securing map ownership and trying to coordinate the responders on the map. Vaughn noted that technology developers need to connect with responders to provide only the useful data; in the Hurricane Isaac response, too many

geographic information system (GIS) layers were imported for the responders to make sense of on-the-ground conditions. Dan Sui, professor of geography at Ohio State University, asked how to coordinate public participation; he told how volunteer responses to an earthquake outside Sichuan City, China, actually obstructed official response efforts. Vaughn answered that if agencies communicate quickly where and how they are responding to an emergency, it can be hoped that volunteers will understand that their help is not needed in a particular way.

Different coordination models have been proposed to help with the diverse goals and tasks taken on by responders. The VOST (Reuter 2012; St. Denis, Hughes, and Palen 2012), for instance, has been proposed as one way of using social media in emergency management; similarly, the Humanitarian OpenStreetMap Team and the Standby Task Force are both volunteer organizations that are tasked with mapping, data production, and data processing in crises (Aldrich 2012; Chapman 2010; Standby Task Force 2012). Still, the field has a long way to go before tasks are effectively and efficiently divided and distributed (Gao, Barbier, and Goolsby 2010).

- **We do not know if crowdsourced data are less credible than that from other data sources.** As in other panels, the question of information credibility played a strong role in the discussion. Eriksen and Roberts, noting that few have researched the amount of inaccurate or misleading information present in crowdsourcing projects, asked whether our perceptions of inaccuracy are themselves exaggerated. Is there any more error or misleading information in data that are crowdsourced compared with data gathered in, more traditional ways? Roberts said that USAID's crowdsourcing project accuracy assessment showed an 84 percent accuracy rate, which is high for most spatial data (Roberts, Grosser, and Swartley 2012).

  No accuracy assessment is made in many spatial data projects. Roberts said that, when he and others spot-checked incoming data to ensure their quality, they found no misleading or significantly inaccurate data. Further, Snoad mentioned a study that showed corrections to accidentally spread inaccuracies actually travel across social networking sites faster than the original information.

  It is worth noting that the security of crowdsourcing data—ensuring credibility and use by benevolent parties, and maintaining privacy—is a major topic of research (Chamales and Baker 2011; Goolsby 2012). The later session dedicated to the

topic (see "Session 9: Security of Crowdsourcing") shed much light on the question of data credibility in crises.

- **Liability and related legal concerns need to be addressed.** Many agencies hesitate to push information to social networking sites because of liability implications. Eriksen said that this concern stops the U.S. Forest Service from more fully integrating social media into their response strategies, particularly in forest fire response efforts. Also, the Forest Service does not want to encourage firefighters to take pictures and post to social networking sites when their efforts could be devoted to fighting the fire itself. Brice noted that one reason the Hurricane Center of the National Weather Service does not give advance warning of hurricane watches is that such warnings could encourage looters to disregard the potential danger and go into disaster areas to loot evacuated homes and businesses.

Outcomes and Takeaways

Much institutional resistance to the use of crowdsourcing and social media in disaster responses stems from unfamiliarity with the potential benefits of working with these data and tools. **Agencies that have had success with crowdsourcing and social media can publish reports on their successes to increase awareness and share ideas.**

To date there are few legal guidelines for either protecting privacy or establishing agencies' liability in crowdsourcing projects (Reidenberg et al. 2013; Robson 2011). As a result, responders and agencies are without proper guidance for their use of social media and crowdsourcing, particularly in contexts where the stakes are high, such as in disaster responses. **Law researchers can provide agencies with guidance on how to effectively and safely use social media and crowdsourcing within the confines of existing law.**

Different coordination strategies and organizations, such as the VOST and the Standby Task Force (see definitions in Box 1-2), are used to divide and distribute tasks in disaster response efforts. Given the complexity of response efforts, more work is needed to transform these into official, durable processes. **In the meantime, panelists suggested that agencies can begin working with social media simply by focusing efforts on data sharing. More broadly, to facilitate engagement with these technologies, agencies and responders can direct efforts and resources toward sharing their data with other responders.**

Day 1 Afternoon Sessions 3

Session 4: Evaluation Frameworks, Performance Metrics, and Impact

Key Issues

Evaluation: What have different agencies, researchers, and disaster responders meant by the term *evaluation*?

Metrics: What metrics have agencies, researchers, and disaster responders used to evaluate their data, the impact of their projects, or the impact on their field?

Success stories: How can agencies, researchers, and disaster responders share success stories to encourage higher adoption rates?

Background[1]

Measuring the value of social media platforms and their data has for the most part been problematic, according to Dr. Leysia Palen, University of Colorado, Boulder. Disaster events are complex and difficult to understand in the moment. It is challenging to create and evaluate "metrics" that make it possible to determine if the presence of a new sociotechnical solution is a help or a hindrance. To rely solely on the kinds of metrics that can be applied identically in each context posits an objective reality that does not exist. In other words, causality in each disaster is highly dependent on local dynamics. Instead, disaster responders and other stakeholders should recognize that they are involved in *creating* solutions tailored to the problems of each disaster's victims. Instead of relying on communication used in previous disasters, any reasonable form of communication or information analysis should be considered. At some times, this will mean repeating strategies; at other times, it will mean using new approaches.

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1 Some of the material in this background section has been provided by Leysia Palen.

Attempts to overcome the challenges of measuring the value of social media platforms have had limited success. To understand behaviors around volunteered information production, some researchers have attempted to elicit sociobehavioral patterns. The goals of these projects usually revolve around simulations to predict sociobehavioral phenomena in disaster events. These semicontrolled experiments, such as the Red Balloon Challenge of the Defense Advanced Research Projects Agency (DARPA) and the Hat Chase of Rutgers University,[2] have provided insights into how people use social media to solve problems in a distributed fashion outside the emergency context. However, the controls used by these simulations to create a sense of urgency moved the tasks away from the disaster context. These controls established incentive structures for participation that do not match the incentive structures in disaster settings. The simulations created artificially competitive arrangements around the pursuit of fixed intelligence, which contrast with the cooperative structures that exist around the pursuit of uncertain and rapidly changing intelligence. Thus, the lessons learned from these simulations do not neatly translate to actual emergencies. Therefore, they have limited applicability to disaster contexts.

Some have advocated an "action research" orientation for increasing the efficacy of advanced technologies in disaster response (International Institute for Environment and Development 2009). Action research requires strong ethical frameworks, ensuring that the new forms of data production are beneficial. The development, use, and research of social media solutions in an action research model would be done rapidly, iteratively, and as collaboratively with responders and victims as situations allow. It requires that both developers and users of crowdsourced information are in a "quick response" mode, immersed in the situation for which they are designing solutions. By building for emergency responses, researchers ideally will move solutions toward a steady state of quality and flexibility for future disasters. In this approach, the impetus is not to measure the worth of the data, but instead to make the data worthwhile. It requires reiteration and calibration for each particular setting, empirically informed and weighted toward design rather than evaluation.

Standardized, top-down evaluations may stifle technology development and diffusion in disaster management. Approaching evaluation frameworks in an iterative, design-focused manner will enable viable sociotechnical approaches to disaster response.

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

Panel Discussion: Key Points

This panel discussion was moderated by E.J. Ashbourne, Senior Operations Officer and Director of the Global Health Information's Forum at World Bank, and the following panelists participated:

- Taha Kass-Hout, Director of the Division of Informatics Solutions and Operations at the Centers for Disease Control and Prevention (CDC)
- Leysia Palen, Associate Professor at University of Colorado, Boulder; Director of Project EPIC; and Director of the ConnectivITy Lab
- Bartel Van de Walle, Associate Professor at Tilburg University; President, International Association for Information Systems for Crisis Response and Management
- John Vocino, Senior Analyst at the U.S. Government Accountability Office

Ashbourne began the conversation by saying that widespread metrics for measuring project impacts do not yet exist, and she asked panelists to address this lack. Other questions included: What forms of monitoring and evaluation could be effective? What do we want the impact to be? How can we develop an iterative research and implementation design process with a positive measurable impact? How do we define success?

- **Success can be defined in many ways.** The strongest theme to emerge from this panel was that it is difficult to define *success*. Ashbourne commented that success at one moment in time may not be so successful when evaluated in later stages of a disaster response. Should success be limited to directly comparable, quantitative measures that evaluate data? Or should success include broad, non-numeric characteristics comparable loosely across different projects? Can projects in different contexts be compared directly? Van de Walle discussed how measuring success may differ for each disaster response and even at different stages within a single response. Palen suggested that performance metrics should be built from the ground up for each response, although informed by previous lessons. As noted earlier, these metrics should not be used to evaluate technologies' worth, but instead to make the technologies worthwhile. For Kass-Hout's work at the CDC, a simple and important success metric is the amount of time required to detect a disease outbreak.
- **Disasters are complex, and variability is high.** Many variables that influence a disaster response's success may be unique to that particular disaster and, thus, not directly transferable to other disasters. This uniqueness makes it difficult to design frameworks for evaluating success across different projects. Van de Walle suggested that it may be useful to first define the phrase *performance metrics*, as a flexible definition may allow cross-project comparisons. Palen pushed this idea forward by suggesting responders consider new comparison techniques, because the predominant quantitative and formulaic approaches limit what is considered

It is not enough for citizen data to be available through robust systems. If citizen seismology is to translate into an improved emergency response, emergency responders themselves must know about the data and trust the information enough to use it to make decisions on the ground.

"success." In response to a question from the audience, Palen clarified that she did not mean that it is difficult to compare different data generated for the same disaster. Instead, she argued it is difficult to compare impact across different projects because of the unique nature of each disaster.

- **Crowdsourcing can increase the speed of information collection and distribution.** Using social media and crowdsourcing strategies may increase the speed at which data become available and, thus, the amount of time available to make critical decisions. Kass-Hout said that the CDC has begun using social media data, which has decreased disease detection times. In 2010, detection time for the severe acute respiratory syndrome (SARS) virus decreased from 167 to 20 days. Although crowdsourcing *can* increase speed, the earliest reports of outbreaks often appear in traditional media before there is a reliable social media source (Munro et al. 2012). Discussions between the audience and the panelists went further by suggesting that, although social media may quicken disaster responses, comparisons of success across projects should consider speed as one of many other, equally important factors.

- **We still lack evaluation frameworks appropriate for social media.** The panelists all agreed that current frameworks for evaluating success are insufficient, but there are guidelines that could inform development. This situation, some participants indicated, is not unique to the application of social media in disaster response; no community has evaluation frameworks from which the social media community can borrow and adapt features to develop an appropriate framework of its own. Vocino noted that the GAO is currently identifying "success metrics" that might be used in the GAO's analysis, such as the 31 National Preparedness Goals and the performance measures from the Government Performance Results Act.[3] Ashbourne and some in the audience agreed that already a significant amount of time and resources are spent notifying countries of the success of each project.

3 *Government Performance and Results Act, 1993*, Pub. L. 103-62, 103rd Cong., 1st Sess. (January 5, 1993). Office of Management and Budget.

According to Ashbourne, as many as 230 indicators have been requested for a single project. At this point, Vocino suggested building a list of best practices and developing success frameworks from that list.

The panelists did not bring up some evaluation frameworks that have been proposed in the broader crisis mapping community. Ushahidi, in collaboration with fellows at the Harvard Humanitarian Initiative, developed a three-stage evaluation framework to determine the success of Ushahidi deployments (Leson 2012). Similarly, evaluators developed a set of questions they used to determine the impact and effectiveness of the Ushahidi Haiti project (Morrow et al. 2011).

- **The different approaches and vocabularies used in disaster response present a variety of challenges.** As mentioned earlier, defining "success" can be a challenge, as can reconciling different stakeholder expectations in disaster response. For instance, Ashbourne argued that the language expected by policy-makers ("outputs") often bypasses the kinds of expectations held by on-the-ground responders ("impacts"). When trying to measure the success of a project, it is important to first consider what needs to be measured to answer the questions of interest. According to these panelists, the metrics will differ widely on a case-by-case basis. Thus, rigid, top-down measurements of success do not adequately capture the diversity in each project.

Outcomes and Takeaways

The panelists agreed on the broad notion that diverse evaluation frameworks are greatly needed to determine whether the goals of each individual disaster response project, as well as those of the stages within a project, have been achieved. More specifically, researchers could devise a highly adaptable set of evaluation frameworks that account for the diversity of "success" metrics in the field. These frameworks should further account for the diversity of activities within each response. **Future research can connect policymakers with on-the-ground responders to develop frameworks that meet both groups' needs.**

There are performance metrics that could be borrowed from other sources, and some metrics will likely be more important than others. Disaster responders are more likely to aim for having an impact rather than delivering outputs. **Researchers and policymakers need to list and prioritize the important metrics that can show both "impact" and "outputs." Further, researchers can provide an overview of the field: Who is using which frameworks, and how can we draw lines of connection across them?**

The panelists stressed that each disaster comes with its own set of conditions and complexities, which can result in very different outcomes. Crowdsourcing approaches should be sensitive to the unique character of each disaster. **Responders and**

agencies should not expect that an approach used successfully in one disaster will transfer directly to another disaster.

Session 5: Public and Volunteer Engagement

Key Issues

Roles: Where might engaging the crowd complement formal response efforts? What are the different ways in which agencies have engaged the public through social media and crowdsourcing approaches? Are these roles useful?

Compensation: How have contributors, including volunteers, been compensated?

Sustainability: How can we make these approaches sustainable?

Background

The fact that laypeople can easily produce, process (e.g., translate, sort, verify), and share information is one of the most profound developments in the emerging field of crisis mapping. Some federal agencies and disaster responders have taken advantage of this development by tasking volunteers with data production and processing, while others have begun harvesting information already being produced and shared in social media. Additionally, many are utilizing these tools to distribute information on their own webpages and social media sites, requesting public feedback in some cases.

Engaging the public and volunteers in this way raises a number of issues for federal agencies. The Office of Management and Budget (OMB) must approve federal projects gathering data from more than eight members of the public, and despite federal memos (i.e., OMB 2010a; 2010b) some agency staff remain uncertain about the applicability of the Paperwork Reduction Act (PRA) for crowdsourcing in disaster relief.[4] Because of this uncertainty, most government agencies have limited experience working with crowdsourcing efforts.

Much of the literature on crowdsourcing, crisis mapping, and social media in emergency management has touted the benefits of new technologies for giving voice to the public. However, little critical reflection has been given to policy or the problems with operationalizing these strategies.[5] Research has focused on ascertaining the data accuracy, credibility, usability, rather than the social, institutional, and political barriers to the use of the technologies. Thiese potential barriers constitute a gap between the public, disaster responders and federal agencies that constrains full technology utilization. It also has

4 *Paperwork Reduction Act, 1980*, Pub. L. 96-511, 96th Cong., 2nd Session (December 11, 1980). National Register.

5 For notable exceptions, see Haklay 2012 and 2013.

implications for inequalities that may be produced or extended as a result of adapted relief strategies.

Panel Discussion: Key Points

This panel discussion was moderated by Ali S. Khan, M.D., M.P.H., Assistant Surgeon General (Ret.) and Director, Office of Public Health Preparedness and Response, CDC. The following panelists participated:

- Sara Jayne-Farmer, Chief Technology Officer at Change Assembly; Core Team member, Standby Task Force
- Jeff Phillips, Emergency Manager Coordinator of Los Ranchos de Albuquerque; Founder, Virtual Operations Support Teams;, and member of Social Media 4 Emergency Management
- Laurie Van Leuven, Operations Research Analyst at Scientific Research Corporation
- Jen Ziemke, Assistant Professor at John Carroll University; Co-Founder & Co-Director of International Network of Crisis Mappers; Fellow at the Harvard Humanitarian Initiative

The public can contribute as passive sensors or volunteer as data interpreters, data collectors, and problem solvers. However, the federal government is prevented in many ways from interacting directly with the public involved in open innovation and crowdsourcing. For some agencies, replying to a post for clarification on a social media website violates agency policy. Yet, engagement with the public and digital volunteer communities is a key attribute of successfully developing the best ideas and building repositories of up-to-date data. What are potential models for successful participatory engagement? What are effective techniques for engaging and motivating digital volunteers? What types of organizational structures, protocols, and processes have proven effective for this kind of engagement?

- **Crowds can be tasked with diverse roles.** The panelists said that the greatest benefit of social media and crowdsourcing is the ability to engage the public in many different processes. Ziemke and Van Leuven noted that the public not only produces usable information in emergencies, but also self-corrects incorrect or misleading information. The lag time between the creation of false data and correction is a window many are working to minimize. Phillips added that his coordination strategy, the Virtual Operations Support Team (VOST; see Box 1-2), is designed to allow the crowd to monitor and engage with social media during disasters, relieving responders of this burden.

Panelists in other sessions also built on this idea, listing broad tasks that crowds can tackle: (1) processing data into useful formats, (2) geocoding tweets and SMS messages, (3) categorizing data and aerial photography, and (4) spreading information across social networks. These activities are in addition to the most common uses of crowds in disaster management: producing data and passively receiving information distributed by responders.

- **For sifting through data, computer algorithms can be combined with volunteer efforts.** The public produces large amounts of data in disasters. The amount of data is often large enough to require new forms of real-time analysis and processing that are still in the development stages. Van Leuven and Farmer are both developing algorithms and technologies necessary to sort through data and determine the pieces that are useful. However, because efficient natural language processing algorithms and technologies are still in the distant future, volunteers are having a larger impact on this form of natural language processing.

- **Contributors should be compensated.** Although volunteers do some of the work of crowdsourcing, many contributors are formally employed to do this work—either by the activating agency, the nonprofit organizations who contribute labor, or emergency responders. Ziemke reminded the audience that finding funds to compensate these contributors can be a challenge. Because of budgetary constraints, most crowdsourcing projects "can't even buy them [volunteer contributors] a $20 gift card at Target." Even when people contribute voluntarily, Farmer emphasized that providing appreciation and gratitude helps to avoid contributor fatigue and to increase the likelihood of their continued participation. According to Van Leuven, individual volunteers may burn out in a prolonged response, but the public in general is "not going to get burnt out by being a volunteer that gets called on too often."

  In response to the danger of volunteer burnout, the Standby Task Force has implemented a number of precautionary steps. They limit the number of hours that a volunteer contributes, and they provide psychological and physical support (Jarmolowski 2012). The Digital Humanitarian Network has likewise developed a useful guide to working with volunteer and technical communities, which touches on non-monetary compensation (Capelo, Chang, and Verity 2012).

- **The sustainability of crowdsourcing and social media–based approaches is not yet known.** The sustainability of crisis mapping, social media, and crowdsourcing depends on new members' supplementing the supply of labor. Contributors may participate in only a few projects, so inflows of new contributors will promote the longevity of the crowdsourcing approach. Some panel participants expressed concern that it would be impossible to sustain such an inflow of contributors and feared that the number of volunteers currently working would decline over time. Ziemke said one potential way of sustaining contributions is to integrate crisis mapping into higher education curriculums. Farmer gave a complementary opinion, one that places more of the onus on organizational tactics: "If you've got a well-run

organization, if it's a well-organized deployment and people know their contribution to it, they will keep coming back." Others suggested that the volunteer model is, in fact, unsustainable and that the general ways in which disaster relief happens must change. All panelists agreed that methods and processes for increasing the sustainability of the field are needed.

- **Data contributed by the public and volunteers are of varying usefulness.** As in the other sessions, the panelists in this session noted that the public's behavior influences the usefulness of the data. Van Leuven said,

  "I sometimes show a … YouTube video that captured some type of a road closure where there had been a landslide and some of the road had eroded, or had been damaged, and there were fiber-optic lines exposed. Versus another Flickr photograph that I came across that shows a tree leaning on a power lines, and the description was so vivid: This is the worst damage in our neighborhood from Hurricane Irene. It happened on this date at this time, on Broadway between 30th and . . . 31st … and the shot was taken at this time, showing these power lines."

- Dr. Khan noted that in an emergency federal agencies possess categories of information that serve different purposes. Some may be useful for the public, while other data must be protected by keeping them confidential.

- **Technology should support local responders.** Technologies should be seen as complementary to human aspects of disaster management, not separate from them. In other words, new technologies should address an existing need of the disaster management community. Technology helps only if it works well with practitioners, social networks, and agency policies. According to one audience member who reiterated the complex social networks that make disaster management successful, "We need to have the ability to *support* their local governments."

Outcomes and Takeaways

While technology can assist disaster responders by providing multiple perspectives, thus increasing situational awareness, technology is not an end in itself. **Technology must fit into response strategies in order to be useful**.

In this session, the panelists reiterated a theme heard from other panels. The crowd can perform a number of tasks, including data production, data processing, self-correction, and dissemination of information from agencies to communities. Responders and agencies should take advantage of this broad range of capacities to complement their own information-gathering efforts. **Responders and agencies can think broadly about ways to incorporate public, volunteer, and the crowd's activities**.

At this point, it is unclear whether crowdsourcing, social media, and digital volunteerism are processes here for the long run or if people will eventually contribute

less. **Research is needed to determine how viable these approaches are and where the barriers of entry to crisis mapping can be lowered to retain or attract new volunteers**.

The level of accountability for participants may influence the quality of data produced in crowdsourcing projects. An individual whose reputation is at stake may have an incentive to produce reliable and useful information. However, research has not fully explored the relationship between risk to reputation and quality of information or the ways in which accountability may increase data quality. Further, research has not yet explored whether reputation and accountability would be more reasonable metrics across the crowdsourcing board or only for specific kinds of projects. **These linkages should be investigated. In the meantime, agencies can try integrating measures of accountability and reputation into their use of crowdsourced data and social media**.

Session 6: Research Challenges

Key Issues

Research directions: Where is research headed? What are responders' research needs, and how are academic researchers accommodating those needs?

Connections: How do we bridge any gaps between current research and on-the-ground emergency response needs?

Academic challenges: What do academic researchers need in order to make their research more relevant to the operational needs of disaster management? What stands in the way?

Background

Those working to integrate crowdsourcing, crisis mapping, and social media into crisis responses face several key research challenges. According to Palen *et al* (2010), researchers have identified important 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 the information?

A recent report by the Computing Community Consortium (2012) highlights the significant contributions machine computation makes to disaster management. Computational power is a 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 makes three recommendations: (1) combine computation with social science research; (2) attend to the various scales at which data are produced

and relevant; and (3) construct real-time models, develop computational methods and metrics, and train/educate personnel in computer software.

The limits of some social networking platforms for disaster management place constraints on the amounts and types of information that can be communicated. The effects of these constraints are not completely understood (National Research Council 2011). In what specific ways does a 160-byte limit on text (SMS) messages, a 90-character limit on alerts and warnings sent as SMS messages (National Research Council 2011), or a 140-character limit on Twitter tweets affect the public's response and use? Can these limits preclude particular kinds of warnings or information? Research is showing that individuals typically do not respond to single warnings, but instead assemble information from multiple sources to inform their action (Hagar and Haythornthwaite 2005; Mark and Semaan 2008; Palen, Vieweg, and Anderson 2011; Sorenson and Sorenson 2007). The practical challenge becomes, How can public emergency responders diversify the ways their information is distributed?

An individual's response to receiving messages on the same subject across various platforms is not well understood (National Research Council 2011). Do too many messages discourage the public from taking them seriously? Does the response 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 FEMA, is an example of a system directly affected by the answers to these questions (Steen 2012).

Finally, other research efforts should be directed toward verifying information and source veracity, developing new methods for data collation and aggregation, implementing and incorporating both human and machine computation, and applying these to emergency response.[6] Many crowdsourcing projects should be seen as synthesizers of information. During the process, poor quality data may be rejected, corroborations detected, and a vast amount of raw information presented in manageable and useful ways. Research on real-time synthesis may include exploring data. It may also involve determining which software packages will be most effective and which disaster dynamics are important to record and communicate. In short, research is needed on synthesis: how it has been achieved in the past, what its basic dimensions might be, and what will make it work in each individual context. The critical time constraints under which responders work further emphasize the importance of synthesis.

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6 Michael Goodchild, personal communication (8/30/2102), and Leysia Palen, personal communication (8/31/2012).

So instead of social media as a thing foisting itself onto emergency management … we can ask instead what … can be supported by remote work?

Panel Discussion: Key Points

This panel discussion was moderated by Michael Goodchild, Emeritus Professor of geography at University of California, Santa Barbara. The panelists included the following:

- Dave Ferguson, Deputy Director of the Office of Science and Technology at USAID
- Robin Murphy, Raytheon Professor of computer science and engineering at Texas A&M University
- Leysia Palen, Associate Professor at University of Colorado, Boulder; Director of Project EPIC; and Director of the ConnectivITy Lab
- Bartel Van de Walle, Associate Professor at Tilburg University; President, International Association for Information Systems for Crisis Response and Management

Social media, crowdsourcing, and other open innovations create new and unsolved research challenges around wide-ranging issues such as pattern recognition, validation, visualization, and cybersecurity. What is the state of the art? What problems have various groups identified as the research agenda for the next 5 to 10 years?

- **For computer scientists a major challenge lies in developing algorithms to handle extreme complexity.** Disasters contain a significant degree of complexity and their own sets of conditions. Echoing earlier sessions, Murphy suggested that responders must essentially re-learn lessons for each disaster, because "a disaster is a nonlinear, highly large interdependency type of problem." Much computer science research is going into developing the computer systems and human–computer interfaces that will serve as effective models for this complex arena.
- **Some research is focusing on the use of technology to support remote collaborative work.** To reduce place-constrained and in-person work, researchers are looking into opportunities for people to contribute remotely. Palen summarized this field by asking, "So instead of social media as a thing foisting itself

onto emergency management … we can ask instead what … can be supported by remote work?" By refocusing it in this way, responders can move beyond the fascination with today's particular platforms and instead highlight the long-term benefits of social media: remote, distributed support that off-loads the work of in-place disaster responders and victims. This research aligns with the goals and frameworks of crowdsourcing. In many projects, crowdsourced efforts amount to remotely produced or processed datasets. Ferguson noted that technology can be used to streamline communications between disparately-located disaster responders and beneficiaries.

- **A forum is needed to connect the research community with the on-the-ground response community.** Much of the panel's discussion pertained to the connections that academic researchers can make with disaster responders. Specifically, it focused on how these researchers can produce materials that have a direct impact on disaster response. An audience member asked how on-the-ground responders can inform researchers about their needs and about the tools and capacities that would improve their response strategies. The question implied that researchers usually explore problems that responders do not consider a top priority and develop technologies that responders do not need or will not use. Panelists expressed some desire to see disaster responders become more engaged—in reading and in valuing—the work of academic researchers. Van de Walle called this a "two-way communication problem." According to Ferguson, the fact that responders generally tend to articulate solutions to problems rather than framing the *problem itself* for researchers fuels this challenge. Most agreed that this problem is slowly being addressed by such venues as this Connecting Grassroots to Government workshop. These sorts of meetings build connective tissue that should improve the situation in the future.

  Outside the workshop, many academic researchers have noted an occasional disconnect between their collective practices and the communities that they study. Researchers have proposed a number of potential models to remedy this problem and more closely align their research with their communities. Palen proposed an *action research* orientation, and it has been advocated in the wider academic community (Burns 2012a; International Institute for Environment and Development 2009). Also within the wider academic community, the idea and practice of *public scholarship* has begun to have a significant impact (Burawoy 2005; Mitchell 2008; Pulido 2008; Warner 2002). Public scholarship, like action research, encourages research that directly benefits the communities being studied. *Participatory design* also could be a useful research method for connecting researchers with the needs and practices of responders.

- **Some aspects of the academic model must evolve to meet the needs of disaster response.** A university-based audience member brought up some structural academic traditions that contribute to the disconnect between research and responses, citing lengthy peer review processes as one example. If a

peer-reviewed journal article takes more than a year to appear in print, how can those studying disaster management expect their work to be applied to fast-changing disaster response circumstances? Another audience member suggested that some universities are averse to sending scientists into risky situations such as disasters, although little evidence for this aversion was provided.

The frustration with slow-moving academic processes appears in recent shifts in traditions. Many in the digital humanities are developing alternative models for disseminating the results of their research.[7] These models include portfolio-based projects, open-access publishing, and blogging about their research (Bessette 2011). For those in disaster management, such models may not seem particularly innovative or useful. What is encouraging about this development is that it allows new forms of information distribution, making interfaces with responders easier.

- **Funding for research is limited and takes too long to procure.** Within traditional models, it takes much too long to secure disaster management research funding. In the United States, the National Science Foundation has a "Rapid Response" grant, but according to Murphy, it takes an average of two months to apply, obtain approval, and receive the funds. This elapsed time makes the research less relevant to responders. More streamlined funding models are urgently needed.

- **The private sector can address problems too expensive and time-intensive for budget-strapped nongovernment organizations to address.** Eric Rasmussen said some responders see a strong role for the private sector in the development of disaster relief technologies. Some social media data visualization technologies developed in the private sector, such as GeoFeedia,[8] BuzzFeed,[9] and Radian6,[10] already exist and are being used. However, one audience member who runs a language technology company asserted that natural language–processing technologies are far behind what disaster responders need.

Outcomes and Takeaways

The most important outcome of this session was the lesson that both on-the-ground responders and academic researchers feel a disconnect between their own needs/ideas and the deliveries/communications of the other party. **Responders and researchers need spaces to come together and share lessons learned, pressing needs, and new developments.** Workshops such as Connecting Grassroots to Government, the International Conference of Crisis Mappers, and the Information Systems for Crisis Response and Management offer venues for this sort of collaboration.

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7 See, for example, http://www.jenterysayers.com/portfolio/.

8 See http://corp.geofeedia.com/.

9 See http://www.buzzfeed.com/.

10 See http://www.radian6.com/.

Research programs are headed in two complementary directions. First, computer science researchers are developing algorithms and models to handle the extreme complexity and time scales of disaster response. Second, researchers are exploring ways that technology can enable remote work, potentially through crowdsourcing initiatives. **Responders should engage and inform these research efforts to maximize the usefulness of their results.**

Researchers expressed frustration with many of the traditional frameworks for research and research outputs. Many academic models should change to facilitate quicker funding and knowledge dissemination. **Researchers need (1) ways to access funds quickly to engage with disasters in real time and (2) alternative models of publishing that decrease the time required to disseminate research results.**

The following emerged as some of the more urgent research priorities as identified by the participants in this workshop:

- Create durable workflows to **connect the information needs** of on-the-ground responders, local and federal government decision-makers, and researchers so that each group get what they need and benefit from collaboration.
- Develop methods and processes to quickly **validate/verify** crowdsourced data.
- Establish best practices of **integrating crowdsourced and citizen-generated data** with authoritative datasets. Construct methods and processes that can streamline this integration.
- Decide on the **criteria for "good" policies**, and with this information, determine which **policies need to be** established or **adapted**. Develop ways for agencies to look ahead 5 to 10 years of technological change with their policymaking.
- Determine **where government agencies can effectively leverage social networking**, crowdsourcing, and other innovations to augment existing information or intelligence and improve decision-making. Conversely, determine where it is not appropriate.

Session 7: Research to Operations

Key Issues

Automation: What is the state of the art in automated detection technologies? Are they sufficient, and if not, where do they need to go?

Technology sharing: Why does openness matter? What needs to happen before agencies are willing to more fully open their technologies for sharing?

Translation: What effective strategies have agencies been using to translate research to operational impact?

Background

After the completion of the research process, the results must be translated into tools, methods, and operations. Mankins (1995) proposed the Technology Readiness Levels framework, which depicts 10 stages of technology development from conception to system launch. It is a multifaceted process, involving prototyping, sandboxing, evaluation, fine-tuning, and distribution. Sandboxing involves deploying a prototype in a virtual environment, where the stakes are low and "bugs" can be identified. Developers can evaluate the prototype based on the results. Potential users may also evaluate the prototype, either early in the development phase or in "beta" mode prior to the full, stable release. Once the prototype has been fine-tuned, developers face the challenge of getting their tools, methods, or operational models to their target users. Some new technologies are intended to affect institutional cultures and norms. Particularly for federal agencies, adopting new technologies and approaches is fraught with institutional barriers.

Some proposed approaches may streamline the translation of research into operations. First, Bastian and Byrne (2012) documented the "agile development" approach adopted by the FCC in its production of the National Broadband Map. In this project, the FCC gathered stakeholder input early in the development process and used this input to inform later stage development iterations. Rather than chart the entire course at the outset, the FCC began without concrete development plans in mind. This iterative process resulted in a final product that addressed the specific needs of its users. Second, interest in "modular development" has grown in recent years (Bastian and Byrne 2012). In this process, different developers produce small parts of a larger technology. For instance, the front end of a platform can continue development if the back end developers are removed. Third, there has been an increase in "hackathons," where subject-matter experts meet with technology developers to collaboratively develop technologies or software code within a short timeframe to address a pressing need. For disaster management, CrisisCommons hosts hackathons called CrisisCamps,[11] and Geeks Without Bounds holds hackathons regularly,[12] as does Random Hacks of Kindness[13] (Aldrich 2012).

Traditional methods for moving from research to operations are too slow and ungainly for the rapidly changing context of disaster management (Rasmussen 2012). Models for research and development were developed with the assumption that time would be abundant, which is clearly not the case in a crisis. However, smaller components of larger projects are now freely available in the disaster technology development community, and the currently available alternative development models show promise. Even so, many have suggested that the best model is to develop the technologies beforehand to minimize necessary adjustment times for deployment in a disaster.

11 See http://crisiscommons.org/.

12 See http://gwob.org/.

13 See http://www.rhok.org/.

Panel Discussion: Key Points

This panel discussion was moderated by Eric Rasmussen, Vice President of AccessAgility, and Managing Director of Infinitum Humanitarian Systems. Participants included the following:

- Ray Buettner, Associate Professor at the Naval Postgraduate School
- Captain Xenophon "Yo" Gikas, Fire Captain at the Los Angeles Fire Department
- Frank Lindsay, Applied Sciences Program—Disasters Program, National Aeronautics and Space Administration (NASA)
- Will McClintock, Director of SeaSketch; Project Scientist at the University of California, Santa Barbara

Transforming research and innovation into pilot projects and eventually into enterprise-level tools and methods can be difficult. How does an agency turn new capabilities into official processes? How does an agency build processes with uncertainty and adaptation as part of the design?

- **Automated detection technologies are in the works, but more are needed to relieve the workload delegated to people.** As in the other panels, algorithms—because they are automated and because they are typically developed prior to disasters—were held to be the solution to many problems faced by disaster responders. Lindsay described some of the algorithms developed by NASA that have since been transferred to daily operations by the U.S. Forest Service, such as that for the automated detection of wildfire outbreaks. Using these algorithms, organizations in South Africa have established an automated SMS system that alerts people when fires have erupted. Other automated systems may be developed in the realms of natural language processing and pattern detection.

- **Crowdsourcing can enable participatory governance.** McClintock told how his laboratory's software, SeaSketch,[14] was developed because a formal top-down planning effort on the part of the state of California failed in the eyes of the public. The state's proposed solution had crossed into common recreational and commercial areas, and the public protested this plan. To avoid further conflicts, planners wanted the public to provide what they would consider ideal marine protection areas. The public mapped more than 30,000 marine protected areas using this platform, which planners then used to establish protected areas that most benefited everyone.

- **Standards streamline data and technology sharing.** Panelists agreed that standards for data and technology readiness facilitate the sharing of data and the adoption of new technologies. Standards help agencies and relief workers avoid duplicating data collection efforts and ensure that data are used for the purposes for which they were collected. Standards also give end-users confidence in technology's ability to address their problems and become part of a workflow. According to Buettner, "Standards for information data exchange are very important. … If we all had a shared open standard … then we start to build a collective base of knowledge to share." Additionally, standards enable archivists and librarians to build collections accessible to all. Buettner complained that some in the crowdsourcing and social media fields use a dataset for a single project and then lock the data away, keeping others from putting the data to good use for other purposes.

  Addressing the problem of cross-project data exchange, Gikas informed the audience of the Emergency Data Exchange Language, "a standardized way of exchanging information." Unfortunately, the standard is underutilized in the community.

- **Open-source software and technologies may be preferable to proprietary systems in disaster response.** However, integrating technologies is a complex and demanding process, and the costs often outweigh the benefits. Workshop participants discussed the virtues of applying open-source technology solutions to the problems faced by the field, but many apparently conceptualized the phrase *open source* in different ways, which became clear when an audience member asked for clarification regarding open-source *software* in contrast with *technologies* and *corporations owning open-source software*. Each of these aspects of "open source" has implications for the integration of technologies into workflows. McClintock said SeaSketch is built using open-source tools, but that installing it requires too much customization to make it a viable option for most agencies. An audience member stressed that moving open-source technologies to a workable product being used in the field is an incredibly complex and difficult process. In general, though, the panelists simply noted that agencies and responders need to be aware of the potential challenges faced in using open-source **technology.**

14 See http://mcclintock.msi.ucsb.edu/projects/seasketch.

- **Technology Readiness Levels impact new technology adoption.** The most widely used standard to communicate the level at which a technology stands is the standard proposed by Mankins (1995), in which technology development moves from level 1, basic principles observed and reported, to level 10, deployment. Panelists said repeatedly that these levels indicate to end-users when a particular technology is ready for use and can be trusted to work as advertised. One audience member suggested that federal agencies are unlikely to adopt a new technology unless that technology has been developed to at least level 8.

- **Sandboxing and "space to fail" are essential in the transfer of research results to operations.** There was much discussion of the need for low-stakes space for testing new technologies. Panelists called this a "safe space to fail;" the successes and failures at this stage allow technology modification before it is deployed in a disaster management context. The RELIEF program held at Camp Roberts, cited by the panelists as a good example, is an experimental technology testing ground designed to help diverse agencies and stakeholders test technologies related to humanitarianism and disaster relief before they are deployed in an emergency.[15] Buettner offered the Department of Defense's 42,000 acres of testing space as well.

Outcomes and Takeaways

Technologies need to be tested many times before they are deployed in a high-stakes disaster response. This testing requires both physical space and virtual space, as well as the ability to assemble the intended end-users. **Agencies, disaster responders, and technology developers need to determine the best spaces for this testing, partly by organizing meetings at which information about new technologies can be exchanged.**

Automated technologies, such as algorithms, computation, and natural language processing, can assist emergency responders. **Technology developers need to think of innovative methods and processes to increase automated detection capacities.**

Improved data standards and implementation will help all parties involved in disaster response. **Responders should become familiar with the Emergency Data Exchange Language and consider implementing or improving on it. More–and improved–standards are needed to streamline the process of data and technology sharing.**

15 See http://www.nps.edu/Academics/Schools/GSOIS/Departments/IS/Research/FX/RELIEF/TNTReliefLocal.html.

Day 2 Morning Sessions

4

Session 8: Legal and Policy Issues

Key Issues

Privacy: How have agencies dealt with the policies and issues related to the management of personally identifiable information (PII) with respect to crowdsourced data?

Legal barriers: What are the potential legal and institutional barriers to agencies' use of crowd-generated information, such as the PRA? How have agencies successfully navigated these roadblocks? What federal policy issues need further analysis? What are potential pathways forward?

Liability: What steps have digital volunteer groups taken to minimize their legal liability? What liability laws apply to digital volunteers?

Intellectual Property: How can groups and individuals protect their intellectual property in a crowdsourced data production environment? What kinds of copyrights have organizations used?

Background

Privacy and Confidentiality

Everyday use of social media tools and crowdsourced datasets raise concerns about privacy and confidentiality (Acquisti and Gross 2009; boyd 2011; boyd and Crawford 2012; Obermeyer 2007). Efforts to protect privacy and confidentiality are particularly complicated during disasters, when populations are vulnerable (Li and Goodchild 2010). Legal and policy issues related to privacy and confidentiality can have an impact on data access and retention, intellectual property, and data quality. Disaster recovery involves data that some parties consider sensitive, such as missing persons information (Reidenberg et al. 2013). Although missing persons data are not legally defined

as "sensitive" in most jurisdictions, they may include data sensitive for some individuals and may be understood informally as sensitive in some contexts. For example, data may be informally considered sensitive when they convey information about undocumented immigrants or people wanting to protect their anonymity.

Crisis mappers and on-the-ground responders sometimes aggregate disparate datasets. A single dataset may not erode privacy, but combining several can increase the risk of problematic use (Elwood and Leszczynski 2011). Crisis and missing persons data often flow across national borders and may be subject to different data protection regulations, including limits on the export of data to other countries. Response organizations and digital volunteer groups must work to find a balance between protecting privacy and safety on the one hand and facilitating critical information sharing on the other. Research is needed to inform the development of privacy guidelines and best practices tailored to crowdsourcing and crisis mapping approaches.

Broadly defined, privacy means different things in different settings. Those in the crisis mapping community are currently debating best practices and ethical standards.[1] Questions revolve around the models of privacy and ethics that crisis mappers should follow (Raymond, Howarth, and Hutson 2012), the requirements for "consent" and "confidentiality" (Meier 2012b; Munro 2013; Searle and Wynn-Pope 2011), and the best ways to ensure broad adherence to privacy standards (Reidenberg et al. 2013). Crisis mappers must defer to the laws in their respective jurisdictions, of course. Beyond this basic approach, what precedents, standards, or conventions should guide crisis mappers' approaches to privacy? In most countries, there are standards and frameworks that guide initial practices so that the community need not try to formulate an entirely new framework. In fact, a major issue for the community is how to operate within these existing privacy standards and frameworks.

Liability

Because disaster management involves life-or-death decisions, organizations should consider tort liability when setting their organizational policies and take steps to mitigate this liability where possible. 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; 2012a) suggested that these situations could arise when (1) an organization undertakes rescue, (2) an agency puts a person in danger, and (3) a special relationship exists between parties. The third situation arises usually when there is some relationship of dependence, such as that between common carrier–passenger, hotel operator–guest, business–customer, parent–child, or teacher–student. Many liability issues have not been adjudicated: To what degree should crisis mappers be held liable for decisions based on their

1 See for resources: http://geodatapolicy.wordpress.com/2012/02/14/ethical-issues-and-mapping/.

maps? What tort liability should exist when mapping is delegated to volunteers? How can digital volunteers work with on-the-ground responders to reduce liability?

Paperwork Reduction Act (and OMB Social Media Memo)

The PRA may restrict agencies' full utilization of social media and crowdsourcing approaches. Under the PRA, a federal agency must notify the public before gathering any sort of information, with some exceptions. In 2009, President Barack Obama issued a memorandum to federal agencies to increase government transparency and foster increased public participation. In response to this memo, the OMB (2010a; 2010b) stated that much of the 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, which places a burden on federal agencies. Depending on the information collected, the specificity and breadth of the questions, and the forum through which information is collected (e.g., Twitter, www.whitehouse.gov, or a publicly funded web mapping interface), disaster management via crowdsourced social media may or may not be subject to the PRA.

Intellectual Property

Crowdsourced data production raises several important questions related to the ownership, usage rights, and interoperability of intellectual property. Copyright and terms of use protect not only data, but also derivative products (e.g., maps) and commercial activity. OpenStreetMap recently shifted its copyrights from a Creative Commons license, which allows sharing under the same copyright, to an Open Data license, which allows sharing under any copyright as long as enhancements also are 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. 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 (Maron 2010; OpenStreetMap Foundation 2013).

Copyright licensing interoperability also has raised concerns, as some disaster response work necessitates large quantities of heterogeneously sourced data that may not be compatible. Simple data procurement can lead to complex copyright and intellectual property situations (Onsrud 2010). An overarching scheme for copyright protection and crowdsourced data distribution should be established, which would streamline data usage. How can crisis mapping communities, policymakers, and on-the-ground responders coalesce around a framework? What collaboration must occur before such policies are put in place? What is holding back parties from implementing new copyright and intellectual property practices?

Panel Discussion: Key Points

John Crowley, Research Coordinator for the Crisis Dynamics Program, Harvard Humanitarian Initiative, moderated this panel discussion. Panelists were the following:

- Robert Gellman, Esq., Privacy Consultant, Missing Persons Privacy Project
- Stephanie Grosser, Communications Specialist, Presidential Management Fellows Program, USAID
- David Kaufman, Director, Office of Policy and Program Analysis, FEMA
- Edward Robson, Esq., Robson & Robson, LLC, Tort Liability for Digital Volunteers

Social media, crowdsourcing, and other open innovations challenge current policies around procurement, privacy, liability, data access and retention, intellectual property, data quality, and even the PRA. What are the major administrative hurdles that must be addressed? How have agencies dealt with the policies and issues related to the management of PII? What federal policy issues need further analysis? What are potential pathways forward?

- **Existing policy barriers must be addressed responsibly.** Grosser noted that crowdsourcing projects come up against many existing policies regarding sensitive information distribution and data quality standards, but that these barriers can be addressed and the project can continue. To use crowdsourcing for the georeferencing of USAID project records, Grosser had to have volunteers waive any rights to compensation and affiliation with the U.S. government. She stripped the records of any PII and calculated the accuracy of the results. This activity took some effort, but 117,000 records were processed in about 16 hours. Kaufman added that there are significant barriers to the use of private sector and nonprofit/volunteer efforts in crowdsourcing and crisis mapping, noting that agencies are often rigid and stable in ways that are not amenable to rapid technological change. It is up to individual agency workers to push the envelope of technology adoption. To this end, Kaufman suggested a "show me" policy; if new ideas are discarded due to policy barriers, individuals should ask to see where the barrier is formally established in written agency policies. If a policy barrier does not appear in writing, there may be space for innovation. However, Kaufman said that it is also up to the individual to push back when the policy barriers are not formal, but cultural or perceptual.

  Policy barriers should be critically investigated to determine which ones protect users, volunteers, and individuals or groups. In these cases, it may be necessary to leave them as they are or to adapt them in a responsible way. Opening data access should not be seen as unequivocally 'good,' but should be critically assessed depending on the context, use, target population, and more. Many examples exist in which open data led to negative consequences for people whose identities were exposed (Chamales 2013; Goolsby 2013; Morozov 2012; Munro 2013).

- **Emergency managers must think about how people will access information.** Kaufman noted that more people are accessing information on mobile devices such as smartphones and tablets. To accommodate this shift, FEMA revamped the way in which it distributes data and information, as well as the way in which the public requests help from FEMA. This involved upgrading DisasterAssistance.gov.

- **Laws around liability, privacy, and data sharing must be clarified, particularly in the United States.** For instance, many digital volunteer organizations currently can mitigate potentially problematic situations by registering as a nonprofit organization or by obtaining indemnification from the government agency or NGO requesting their services, yet most are unaware of this (Robson 2012a). Although many potential setbacks are institutional and cultural rather than legal or policy, individuals often are unaware of explicit limitations on their work; Kaufman suggested that those working for the federal government request formal written documentation of restrictions if they meet resistance.

- **Good Samaritan laws do not apply to digital volunteers, but the Volunteer Protection Act might.** Robson stated that Good Samaritan laws, intended to protect volunteers in emergencies, do not protect digital volunteers. Digital volunteerism fails to pass two criteria of these laws. First, the laws usually apply to people who—by coincidence—happen upon someone in need of help, whereas digital volunteerism is usually a coordinated and deliberate effort. Second, Good Samaritan laws usually apply when the helper occupies the same physical space as the beneficiary; digital volunteerism is often a remote activity. Digital volunteers who are associated with, or a member of, a registered nonprofit organization may be protected by the Volunteer Protection Act. However, in an unincorporated association of individuals, which describes many digital volunteer groups, any member may be liable for the actions of any other member.

- **Compared with other developed countries, the United States is lacking in broadly applicable privacy laws.** In a report to be published through the Commons Lab, Gellman noted that only two federal laws protecting individuals' privacy are likely to be relevant in this arena. The first law, the Health Insurance Portability and Accountability Act, applies only to health care providers and health plans, and the second law, the Privacy Act of 1974, applies only to federal agencies. Gellman said that before federal agencies can collect personal information, they must complete certain requirements; for example, they must publish a notice in the *Federal Register* and define in advance how the information will be disclosed outside the agency. The absence of other privacy restrictions makes is possible to use crowdsourcing and social media in disaster management outside of federal agencies. Compared with the laws of other countries, laws protecting privacy in the United States are spotty in coverage, applying only to specific classes of record keepers or specific types of PII.

Outcomes and Takeaways

Recent case studies are clarifying the legal frameworks in which digital volunteers and the organizations using crowdsourced data operate (e.g., Reidenberg et al. 2013; Robson 2012b). Even so, a significant amount of ambiguity about liability, privacy, and data sharing remains. **Data protection officials need to clarify the ways in which**

PII can be collected and used with respect to social media and crowdsourcing approaches to disaster management.

There is evidence that federal agencies are more likely to take risks in adopting new technology when they are aware of similar cases in which the adopted technology has been successful. In other words, the more success stories shared, the more important our work will be to agencies and responders. **Those who have implemented successful projects need to spread word of their work, either through publishing, presenting results in workshops and conferences, or networking with other agencies.**

Agency norms, practices, and approaches may have enough flexibility for individuals to implement social media and crowdsourcing innovations. This can be accomplished by accelerating the pace of changes and by listening to the needs of the public. **Agencies should allow more flexibility in their policies so that their workers can adopt innovative approaches to technology integration into disaster management.**

When considering policy shifts, agency officials should assess security, privacy, and data protection concerns. At times, the greater risk posed to groups and individuals will outweigh the benefit of shifting policy.

Session 9: Security of Crowdsourcing

Key Issues

Securing platforms: What are the security vulnerabilities of social media and crowdsourcing and their implications?

Human behavior: How much do human behavior and norms affect security? What can be done to alter them?

Best practices: What are the best practices for addressing these vulnerabilities?

Background

Crowdsourcing and crisis mapping projects often occur in places where the population is already vulnerable. Individuals contributing information may be susceptible to physical attack, political repression, sexual harassment, or violence. The fact that these projects are deployed in large-scale natural, political, and social crises accentuates the vulnerabilities. Crisis mapping contexts are particularly dangerous situations, and measures must be taken to protect the communities involved. For instance, if hostile organizations or individuals were able to identify those who submit sensitive information in crises, the submitters could be at risk. Reporters may be put in physical danger or

otherwise be prevented from passing along information, as was the case in the 2010 floods in Pakistan (White 2010). Likewise, civilians may be put in danger of arrest, torture, or murder. For disaster responders, the limitation becomes: How do we verify and validate crowdsourced data, while protecting the identity of the individuals or groups?

Chamales and Baker (2011) identified five potential vulnerabilities in crisis mapping situations:

1. Identification of reporters and vulnerable groups. Individuals and groups producing information about crises may open themselves up to harm. If these data are not protected, they may be accessed by malicious groups.
2. Control of communications networks. If malicious groups take control of communications networks, crisis mapping may become unavailable, the means of communicating important information may not function properly, or information may be intercepted.
3. Programming flaws in crisis mapping platforms. Such flaws may open up the crisis map to hacking, to data leaks, and to security breaches.
4. Identification and infiltration of crowdsourced workforce. Even those working remotely may open themselves to danger by contributing to a compromised crisis mapping project. Security vulnerabilities may further enable malicious entities to pose as part of the crowdsourced workforce, opening the platform to further deterioration.
5. Use of unverified reports. Although the risks that arise from using unverified reports are unknown, emergency responders could potentially act on unverified reports to distribute resources. If these unverified reports were submitted by malicious groups or individuals, responders will be operating in a very risky situation.

Beyond simple technological problems, this list shows the deep *human* dimensions to the security of crowdsourcing. It has been suggested that these two factors, technological and human, must go hand-in-hand in evaluating and maintaining secure systems (Goolsby 2012, 2013). Goolsby (2013), for instance, has shown that social conflicts and cyberattacks are mutually implicated—that one causes the other, and vice versa. Chamales (2013) showed how technological vulnerabilities often result from human behavior, not solely from software bugs.

Emergency responders, humanitarian workers, and agencies need to be aware of these potential problems and actively maintain the security needed to protect the communities with which they work.

Panel Discussion: Key Points

This panel discussion, moderated by Eric Rasmussen, Vice President of AccessAgility and Managing Director of Infinitum Humanitarian Systems, involved the following participants:

- George Chamales, Principal at Rogue Genius LLC
- B.K. DeLong, Principal and Lead Analyst at Extropic Technology Consulting
- Riley Eller, Vice President of Technology and Security at CoCo Communications

Federal information security experts often try to *eliminate* risk. However, because crowdsourcing requires a greater degree of openness, it entails developing practices and technologies to *manage* risk. What are the emerging standards for crowdsourcing? How should federal agencies approach the use of crowdsourcing data to make decisions under conditions of uncertainty? How different is this situation from the usual 'fog of war' that surrounds disasters?

- **Both open-source and proprietary options provide benefits.** The panelists suggested that different incentive structures exist for open-source and proprietary cybersecurity options, and that each has a set of benefits. Neither one is inherently "better" than the other.

- **Cybersecurity and human security are ongoing processes, not a purchasable product.** Relationship management, as a concerted effort, goes a long way toward securing systems and data. Single reports detailing security status do not have as great a positive impact as repeated, reiterative consultations with a security expert. DeLong said that three things are necessary to establish the trustworthiness of crowdsourced volunteers and data: (1) application fostering, (2) relationship management of people, and (3) metrics programs for process improvement. Chamales offered one example, noting that shortly after a new fleet of Apache helicopters had arrived at a military base in Iraq, a targeted mortar attack destroyed four of them; officers hypothesized that the soldiers had geotagged photographs of the helicopters and posted them on social networking sites, and these geotags were extracted and used to inform the targeted attack (see Tomkins 2012). The lesson to be learned from Chamales's anecdote was that security is as much about ongoing behaviors as it is about a software product.

- **Relationship management needs to happen long before emergencies.** Eller insisted that "relationship management, if it starts after the crisis has begun, … it's way too late. Relationship management needs to be 80-plus percent stable before the crisis arrives." Previous panelists had mentioned similar sentiments with regard to technology development. Preparedness is an essential cornerstone of the rest of the disaster management process.

- **Human security matters most in political conflicts.** Security is particularly important when working in conflict zones or with vulnerable populations. Recent digital volunteer deployments to Libya, Syria, and Egypt were offered as examples of contexts where human security is critically important. Even though disaster responders cannot become completely invulnerable, certain measures should always be taken to protect them and the populations with which they work. Travel to politically unstable or authoritarian nations also may put data and technologies at risk;

Eller gave examples of volunteers' recent experiences in China and their increased vulnerability resulting from their physical location.

Although the panelists focused their discussion on political conflicts, much work has gone into the security of data in other contexts. In fact, it is arguably short-sighted to focus only on political conflicts, because security is also a distinctly important factor in natural disasters (e.g., missing persons), international development, and public health situations.

- **Cybersecurity breaches happen when malicious individuals and groups want to have an operational impact.** Responders and humanitarian workers should be particularly cautious when they have a significant impact on conflict zones. Chamales said that Syrian activists were recently targeted when an infiltrator spread harmful files in a Skype chat.[2] The more potential impact a group or organization has, the more likely they will be targeted.

Outcomes and Takeaways

Most people think of cybersecurity in terms of a software purchase or a visit from a security expert. The panelists agreed that we should instead understand it as a complex and ongoing process that includes software, but more important, includes human behavior, connectivity between different platforms (such as geotagged photos posted automatically to social networking sites), and ongoing maintenance. **All practitioners need to remember that security is a multifaceted process that brings these dimensions together and monitor them all in their projects.**

Digital volunteers are deployed in contexts where the communities are particularly vulnerable. These individuals cannot always know the full implications of their work, but measures must be taken to shield the people and groups who contribute to crisis maps. **Responders and agencies need to fully and continually evaluate the security of their platforms, communications channels, datasets, and staff.**

Working on the process of security long before an emergency will help build the relationships and practices that will be needed in the emergency. Relationships and technologies do not shift substantially during disasters; thus, crowdsourcing and security should be part of the daily operations of organizations, groups, and agencies. **Organizations, responders, and agencies need to begin adopting new and innovative technologies, practices, and relationships before disasters occur.**

There is no such thing as a "perfectly secure" system. In many ways, security is a trade-off with functionality. Instead of trying to achieve a perfectly secure system, agencies should try to develop systems that work well enough for their operations. **Agencies should aim to achieve the maximum amount of security that allows them to continue functioning efficiently and effectively, but not a "perfectly secure" system.**

2 See https://www.eff.org/deeplinks/2012/07/new-blackshades-malware for more details.

Day 2 Afternoon Sessions 5

Session 10: Connecting Grassroots to Government through Open Innovation

Key Issues

Guiding principles: When should agencies use competition or collaboration? What are the best methods and models for organizing collective work? What main challenges do responders and policymakers need to overcome if open innovation is to play a wider role in federal problem solving?

Integration: In what ways can open innovation principles improve on disaster management strategies? How can these principles be integrated and operationalized?

Background

Although it has become the focus of recent attention, open innovation is not particularly new (Chesbrough 2003; Chesbrough, Vanhaverbeke, and West 2006). Its concepts were widely adopted in the federal government following a presidential memorandum in 2009 (Obama 2009; Orszag 2009), and since then, approaches to open innovation have become more diverse (Chesbrough 2012). Generally, "open innovation" refers to a process of technology development that is more likely than traditional procedures to incorporate target audience members' feedback and more amenable to sharing code, software, and practices. Institutionally, these principles have been mobilized in large-scale collaborative problem solving and discourses of "government transparency." Often, open innovation concepts are used in competitions between technology developers to see who can develop the "best" solution to a problem. Ideally, this approach will encourage contributions across traditional disciplinary and industry borders while increasing transparency.

The U.S. federal government has provided an Open Innovation Toolbox for agencies.[1] Still, collaboration in disaster management often involves large numbers of international and nongovernment organizations guided by strict restrictions on procuring and using data. As a result, there has been some confusion about how to use open innovation ideas and approaches while remaining within the confines of an organizational structures.

Panel Discussion: Key Points

This panel discussion was moderated by Gisli Olafsson, Emergency Response Director of NetHope, and included the following panelists:

- Christopher Fabian, Co-Lead, Innovation Unit, UNICEF
- Nigel Snoad, Product Manager, Crisis Response, Google

Federal procurement rules are often oriented toward controlling fair competition between entities that are unlikely to collaborate. Open innovation often takes the opposite approach: aggregating multiple tools to solve complex problems through collaboration of organizations across specializations. When should agencies use competition or collaboration? What are the best methods and models for organizing collective work? From the perspective of leaders in government, what are the main challenges that must be overcome if open innovation is to take a wider role in federal problem solving? Who are the key players in the federal technology space, and how can they work toward open innovation for disaster response?

1 See: http://www.whitehouse.gov/open/toolkit

- **Innovation happens locally.** The greatest promise of open innovation is that it enables the bottom-up generation of ideas. Fabian quipped that all UNICEF's top-down development plans have failed when they did not engage with the end-users properly. In other words, Fabian said, "Be user-centric."

- **Five principles must guide open innovation.** Fabian conveyed five principles that guide UNICEF's approach to open innovation. He stressed that these are not "silver bullets." Rather than focus on concrete solutions, they frame general ethics of practice:

  1. **Be user-centric.** Design with the user community in mind, as they will be responsible for the long-term maintenance of the technology. Snoad also touched on this point, calling it "reverse-incubation" in the sense that agencies go into the field and help the communities develop their own solutions.
  2. **Build scalable solutions.** Solutions to problems must be scalable; it should be possible to implement them in small projects that benefit thousands of people, as well as in large projects that benefit millions. This scalability and localization potential will also help local people take over the technology once developers leave.
  3. **Fail often.** Fabian said that UNICEF fails often, quickly, and openly, which minimizes the amount of damage done by the failures.
  4. **Be open.** UNICEF works only with organizations that use open-source technologies or otherwise distribute their code. However, data ownership is retained by the organization that produced it, not by UNICEF.
  5. **Collaborate.** Collaboration increases efficiency, usefulness, and robustness. Despite UNICEF's large budget, it makes more fiscal sense to produce components of larger projects and allow other organizations to contribute the remaining parts.

- **Project leaders and emergency managers work to *enable* rather than *produce* results.** Snoad said that the best way to ensure the long-term viability of a project is not to come into the field to accomplish things on your own, but instead to facilitate local communities' capacity building and development. Snoad stated:

  "If we step back a bit then you will enable a whole ecosystem to potentially flourish... The real prerequisite is actually the intention that I'm enabling rather than doing. And that's a very different change in mindset. And similarly, rather than sourcing directly, I'm enabling the sourcing. I'm enabling these things to get connected. And so that's again a very different mindset than going directly and asking people questions... Because then it means that communities can potentially source themselves."

- **There are a number of ways to decrease institutional resistance to open innovation.** Snoad suggested changing expectations and being open to challenging recommendations. For instance, the problems identified by outside organizations might relate to anything from software fixes to marketing strategies. Suggestions are not always easy to accept or to address. Fabian suggested that

organizations simply implement the open innovation approach and then use their success as an example in the future. As an academic, Fabian said, his primary goal in the Design for UNICEF course he teaches is pedagogy, not the production of workable solutions to existing problems. Still, he hopes some of the innovations taking place in academia will be easily translatable to the humanitarian space.

Outcomes and Takeaways

Sustainable innovation happens when local communities participate in the process. **Local communities should be made integral components of the open innovation process. Agencies and responders need to actively and deliberately integrate communities into every stage of technology development.**

The panelists here stressed the virtues of open-source approaches to technology development and use. Open software and data standards should *inform* agency activities. Other agencies are less likely to work with those who operate closed systems. **Agencies should consider opening their software, data, or both, under open-source licenses, fair use agreements, and open standards.**

Technology in itself is not a solution; it must be integrated into broader institutional cultures, norms, and practices. Thus, because local communities will eventually adopt and use the technology, local communities should guide appropriate technology development. **Agencies and responders should see their roles as facilitators in this process, enabling communities to establish their own networks, technologies, and practices, rather than as doers.**

Session 11: Plenary Discussion and Vision for the Future

The aim of the plenary discussion was to summarize the key lessons, challenges, and takeaways from the workshop, and to prioritize them for agencies, disaster responders, researchers, and decision-makers. This session steered away from introducing new ideas and, instead, built on previous sessions. The audience participated extensively in this session, noting where they felt the workshop had been most useful. Collaboratively, the participants tried to work out where the field needs to move in the future and how to get there.

David Applegate, Associate Director for Natural Hazards at the USGS, moderated the session and offered the following key ideas to kick off the discussion:

- Standards allow multiple stakeholders to communicate across diverse backgrounds, as well as to share technologies, data, and workflows. Industry-wide standards can smooth the transition from traditional modes of disaster management to a mode that uses social media and crowdsourcing.

- The global nature of digital volunteering means that we can capitalize on the participation of enormous numbers of people. We should take advantage of this, "pulling innovation in from around the world."

- In the spirit of earlier comments urging the integration of technology into workflows, a big challenge going forward is in "connecting the online and the offline." Technology should not be developed as a stand-alone product, but instead should be developed iteratively, in collaboration with end-users, to generate improvements within existing workflows and practices.

- Integrating crowdsourced data with traditional and official datasets will be a big challenge, but will have a potentially large payoff. Applegate described this disconnect between crowdsourced data and official datasets as a "threshold" that we need to figure out with crowdsourced data. After the threshold is crossed integrating one with the other will be streamlined.

- The field needs frameworks for evaluating the reliability of crowds in particular contexts. Whether the task is to generate new data, harvest data being produced, or process data, "how do you get to the point where the government can rely on crowdsourcing?"

- Applegate suggested that much of the work performed in crowdsourced projects can be uninteresting: "How do you remove some of the drudgery to encourage volunteers" to participate? Along these lines, "gamification" has been proposed as a potential method for sustaining volunteer efforts over longer periods of time (Burns 2012b).

- Despite the promise of crowdsourcing in general, crowds may perform some tasks better than others, and even then the particular kind of crowd that one engages may influence the results of the project. Once a project is under way, real-time error correction should take place to improve the results of the project. Applegate asked, "How do you make better use of the volunteer technical expert communities and accelerate the error correction process?"

  The audience not only built on some of these challenges, but also summarized the challenges in their own ways, bringing up important steps that the field needs to take in order to streamline development.

- Those working to integrate crowdsourcing and social media into disaster management need a common, discoverable space for sharing ideas, stories, project outcomes, research results, and new technological developments. The audience agreed that some combination of a listserv, shared bibliography, and recurring workshops would greatly benefit the field. To this end, the Commons Lab has established a publicly accessible bibliography for these topics.[2] From the audience,

2 See http://www.zotero.org/commonslab.

Dan Sui of Ohio State University mentioned that at the 2012 Conference on Public Participation in Scientific Research,[3] there was some discussion of setting up a national organization on citizen science, which would overlap with the themes and topics discussed at Connecting Grassroots to Government.

- Several panelists offered spaces for collaboration, testing, and sandboxing**.** Chris Fabian of UNICEF offered assistance and facilities, as did Cat Graham from Humanitarian Road. Luis Bermudez from the Open Geospatial Consortium (OGC) said that the OGC has "test beds" for government agencies and disaster responders to test the usefulness of standards in deployments. Kris Eriksen mentioned that the National Incident Management System provides assistance in many small-scale disasters in which researchers and technology developers could beneficially test new technologies and capabilities.

- Agencies should capitalize on students' interest in crowdsourcing and social media. Leysia Palen said that current graduate students will make up the pool of human capital for the field over the next several years and that we should build support structures around academia to bring in some of that potential. David Green agreed, saying that the American Meteorological Society recently held a focus group in which experts asked graduate students questions regarding their learning needs, their learning habits, and common curriculum structures (Horel, Ziegenfuss, and Perry 2013). Further, an interdisciplinary academic education was stressed as a virtue for training students to become crisis mappers.

3 See http://www.birds.cornell.edu/citscitoolkit/news/copy_of_2012-citizen-science-meetings.

Conclusion

6

Social media, crowdsourcing, and other mass collaboration technologies hold much promise for disaster management and humanitarian response. Participants in the workshop mentioned many ways in which these technologies are already having an impact on response strategies, long-range planning, research agendas, and professional network building. The degree to which they are effective varies across industries and federal agencies. Future work, however, is seeking to increase the across-the-board impact.

Substantial hype continues, including claims that these technologies have revolutionized disaster management and humanitarian response. These claims are exaggerated. Significant challenges to the incorporation of these technologies into traditional management and response remain and should not be overlooked. Important steps must be taken to streamline responders' use of the technologies and to ensure that the technologies are used to their greatest benefit. Obstacles identified include agency policies and institutional resistance; biases in the quality and distribution of data, as well as in who participates; potential security issues; uncertain legal contexts; and continuing concerns about the quality of these data.

This report has made several suggestions to researchers, policymakers, disaster responders, and software developers. Most suggestions, while based directly on the workshop conversations, are pervasive in discussions beyond the workshop. Thus, we can conclude that these suggestions are not only representative of the field, but also necessary to help the field progress. Looking forward, the following are some of the more urgent priorities that emerged during the workshop:

- Create durable workflows to connect the information needs of on-the-ground responders, local and federal government decision-makers, and those conducting research so that each group get what they need and benefit from collaboration.
- Develop methods and processes to quickly validate/verify crowdsourced data.
- Establish best practices of integrating crowdsourced and citizen-generated data with authoritative datasets. Construct methods and processes that can streamline this integration.

- Decide on the criteria for "good" policies, and use this information to determine which policies need to be adapted or established. Develop ways for agencies to look ahead 5 to 10 years in their policymaking and address rapid technological change.
- Determine where government agencies can effectively leverage social networking, crowdsourcing, and other innovations to augment existing information or intelligence and improve decision-making. Conversely, determine where it is not appropriate.

Caveats aside, we are optimistic that these challenges can be addressed and that these new approaches can contribute to more efficient, more effective disaster management and humanitarian aid practices. We are excited by the promise this work holds, and work toward collaboratively cultivating meaningful impacts.

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Appendices

Appendix A

Workshop Agenda

Connecting Grassroots to Government for Disaster Management: A Policy Roundtable

Commons Lab of the Science and Technology Innovation Program
The Wilson Center
Ronald Reagan Building
1300 Pennsylvania Ave NW
Washington, DC

September 13-14, 2012

Thursday, September 13, 2012

8:30 AM – Welcome and Introduction

- Michael Goodchild, Member, Committee on Connecting Grassroots to Government for Disaster Management, University of California, Santa Barbara
- John Crowley, Co-Chair, Committee on Connecting Grassroots to Government for Disaster Management
- Lea Shanley, Director, Commons Lab, Science and Technology Innovation Program, The Wilson Center

8:45 AM – Session 1: Agency Vision and Decision Maker Needs (Keynote)

Moderated by Alex Howard, Government 2.0 Washington Correspondent, O'Reilly Media

- Charles Werner, Fire Chief, Charlottesville Fire Department, Charlottesville, VA

- Bruce Heinlein, Director of Human Geography, Joint Program Office, National Geospatial Intelligence Agency
- David Applegate, Associate Director for Natural Hazards, U.S. Geological Survey

10:00 AM – Session 2: Crowdsourced Data Quality

Moderated by Sean Gorman, Chief Strategist, DC Development Center, Esri

- Muki Haklay, Professor of GIScience, Extreme Citizen Science (ExCiteS) Research Group, Department of Civil, -Environmental & Geomatic Engineering, University College London
- Robert Munro, Chief Executive Officer, Idibon
- Kate Starbird, Assistant Professor, University of Washington, Seattle
- E. Lynn Usery, Research Physical Scientist and Director, Center of Excellence for Geospatial Information Science (CEGIS), U.S. Geological Survey

11:00 AM – Session 3: Data Collection and Management

Moderated by Nigel Snoad, Product Manager, Crisis Response, Google

- Tim Brice, Senior Meteorologist, National Weather Service, National Oceanic and Atmospheric Administration (NOAA)
- Kris Eriksen, Public Information Officer, Portland National Interagency Fire Center, NIMO Team, US Forest Service (USFS)
- Shadrock Roberts, Senior GIS Analyst, GeoCenter, US Agency for International Development (USAID)
- Chris Vaughn, Remote Sensing Coordinator, Federal Emergency Management Agency (FEMA)

1:00 PM – Evaluation Frameworks, Performance Metrics, and Impact

Moderated by E.J. Ashbourne, Senior Operations Officer, and Director, Global Health Information's Forum, World Bank

- Bartel Van de Walle, Associate Professor, Department of Information Management, Tilburg University, and President, International Association for Information Systems for Crisis Response and Management, Tilburg University, and President, International Association for Information Systems for Crisis Response and Management

- Taha Kass-Hout, Director, Division of Informatics Solutions and Operations, Public Health Surveillance and Informatics Program Office
- John Vocino, Senior Analyst, U.S. Government Accountability Office
- Leysia Palen, Associate Professor of Computer Science, University of Colorado, Boulder

2:00 PM – Public and Volunteer Engagement (Keynote)

Moderated by Ali S. Khan, MD, MPH, Assistant Surgeon General (Ret.) and Director, Office of Public Health —Preparedness and Response, Centers for Disease Control and Prevention

- Rob Baker, Program Developer, External Projects Team, Ushahidi; and Member, Humanitarian OpenStreetMap Team
- Jeff Phillips, Emergency Manager Coordinator, Los Ranchos de Albuquerque, NM, Founder, Virtual Operations Support Teams (VOST), and member Social Media 4 Emergency Management
- Laurie Van Leuven, Operations Research Analyst at Scientific Research Corporation
- Jen Ziemke, Assistant Professor, International Relations, John Carroll University, Co-Founder & Co-Director, International Network of Crisis Mappers, and Fellow at the Harvard Humanitarian Initiative – Crisis Mapping & Early Warning

3:30 PM – Research Challenges

Moderated by Michael Goodchild, Emeritus Professor, Department of Geography, University of California, Santa Barbara

- Dave Ferguson, Deputy Director, Science & Technology Office, U.S. Agency for International Development
- Robin Murphy, Raytheon Professor, Department of Computer Science and Engineering, Texas A&M University
- Leysia Palen, Associate Professor of Computer Science, University of Colorado Boulder
- Bartel Van de Walle, Associate Professor, Department of Information Management, Tilburg University, and President, International Association for Information Systems for Crisis Response and Management

4:30 PM – Research-to-Operations

Moderated by Eric Rasmussen, Vice President, AccessAgility, and Managing Director, Infinitum Humanitarian Systems

- Ray Buettner, Director, Field Experimentation and Associate Professor, Department of Information Sciences, Naval Postgraduate School
- Captain Xenophon (Yo) Gikas, Fire Captain, Operations Control Division, Los Angeles Fire Department
- Frank Lindsay, NASA Applied Sciences Program—Disasters Program
- Will McClintock, Director, SeaSketch, Marine Science Institute, University of California Santa Barbara; member of the Center for Marine Assessment and Planning; and Senior Fellow at the United Nations Environmental Program of the World Conservation Monitoring Center

Friday, September 13, 2012

9:30 AM – Welcome and Introduction

- Lea Shanley, Director, Commons Lab of the Science and Technology Innovation Program, Woodrow Wilson Center

9:35 AM – Legal and Policy Issues II

Moderated by John Crowley, Public Policy Scholar for the Science, Technology and Innovation Program, Woodrow Wilson Center; and Research Coordinator for the Crisis Dynamics Program, Harvard Humanitarian

- David Kaufman, Director, Office of Policy and Program Analysis, DHS Federal Emergency Management Agency
- Stephanie Grosser, Communications Specialist, Presidential Management Fellows Program, United States Agency for International Development
- Ed Robson, Esq., Robson & Robson, LLC, Tort Liability for Digital Volunteers
- Robert Gellman, Esq., Privacy Consultant, Missing Persons Privacy Project

11:05 AM – Security of Crowdsourcing

Moderated by Eric Rasmussen, Vice President, AccessAgility, and Managing Director, Infinitum Humanitarian Systems

- George Chamales, Principal, Rogue Genius LLC
- B.K. DeLong, Principal and Lead Analyst, Extropic Technology Consulting
- Aiden Riley Eller, Vice President of Technology and Security, CoCo Communications

1:00 PM – Connecting Grassroots to Government through Open Innovation (Keynote)

Moderated by Gisli Olafsson, Emergency Response Director, NetHope

- Christopher Fabian, Co-Lead, Innovation Unit, UNICEF
- Nigel Snoad, Product Manager, Crisis Response, Google

2:00 PM – Prioritizing Grand Challenges (Plenary)

Moderated by David Applegate, Associate Director for Natural Hazards, U.S. Geological Survey

2:45 PM – Vision for the Future

- Gisli Olafsson, Emergency Response Director, NetHope

3:30 PM – Next Steps and Close

- Lea Shanley, Director, Commons Lab, The Wilson Center

Appendix B

Moderator and Panelist Bios

DAY 1: Thursday, September 13, 2012

Welcome and Introduction

Lea Shanley directs the Commons Lab within the Science and Technology Innovation Program of The Wilson Center. Rapidly evolving information and communication technologies, including social media and mobile phones, coupled with new methodologies like crowdsourcing, have placed the collective "wisdom of the crowd" and power of mass collaboration into the hands of average citizens and organizations. The Commons Lab advances research and independent policy analysis on emerging technologies and methods—such as social media, crowdsourcing, and crowd-mapping—that empower individuals to monitor their environment, collectively generate actionable scientific data, and augment and support disaster response. Prior to this, Lea was a Postdoctoral Fellow on the Mapping Science Committee of the National Academy of Sciences, where she co-directed two reports: *Precise Geodetic Infrastructure: National Requirements for a Shared Resource*; *and New Research Directions for the National Geospatial-Intelligence Agency*. In 2009, Lea was an AAAS/ASA-CSSA-SSSA Congressional Science Fellow and primary science adviser to the Chair of the Senate Subcommittee on Science and Space. She managed the Senator's priorities for federal R&D and crafted legislation addressing earth observation, oceans issues, and hazards research and mitigation. Previously, Lea conducted community-based participatory action research in geographic information science at the University of Wisconsin-Madison.

John Crowley explores the policy and technology interface between the formal humanitarian system and emerging technology communities like OpenStreetMap and Ushahidi, with the aim of improving coordination between actors in the humanitarian system. As a researcher at the Harvard Humanitarian Initiative, John was the lead author of the 2011Disaster Response 2.0 study for the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), which proposed a framework for dialogue between the international humanitarian system and emerging technology communities. At the National

Defense University, John coordinates the Camp Roberts RELIEF experiments in a partnership with the Naval Postgraduate School. John is an alumnus of the Kennedy School of Government's Mid-Career MPA program, where he was the Robert C. Seamans, Jr. Fellow in Science, Technology, and Public Policy. He holds an MA in History of Ideas from the University Professors at Boston University, and a MusB in Cello Performance and Music History & Literature from the Boston University School of Music.

Keynote Discussion: Agency Vision and Decision-Maker Needs

David Applegate is Associate Director for Natural Hazards at the U.S. Geological Survey. In that role, he leads USGS hazards planning and response activities and oversees the Coastal & Marine Geology, Earthquake Hazards, Global Seismographic Network, Geomagnetism, Landslide Hazards, and Volcano Hazards Programs. He co-chairs the National Science and Technology Council's interagency Subcommittee on Disaster Reduction and co-leads the Department of the Interior's Strategic Sciences Group. Prior to joining USGS in 2004, he worked on science policy at the American Geological Institute for 8 years and before that served with the U.S. Senate Committee on Energy and Natural Resources as the American Geophysical Union's Congressional Science Fellow and as a professional staff member. Born and raised in Chambersburg, Pennsylvania, Applegate holds a B.S. in geology from Yale University and a PhD, also in geology, from the Massachusetts Institute of Technology.

Alexander B. Howard is the Government 2.0 Washington Correspondent for O'Reilly Media, where he writes about the intersection of government, the Internet and society, including how technology is being used to help citizens, cities, and national governments solve large-scale problems. He is an authority on the use of collaborative technology in enterprises, social media and digital journalism. He has written and reported extensively on open innovation, open data, open source software and open government technology. He has contributed to the National Journal, Forbes, the Huffington Post, Govfresh, ReadWriteWeb, Mashable, CBS News' What's Trending, Govloop, Governing People, the Association for Computer Manufacturing and the Atlantic, amongst others. Prior to joining O'Reilly, Mr. Howard was the associate editor of SearchCompliance.com and WhatIs.com at TechTarget, where he wrote about how the laws and regulations that affect information technology are changing, spanning the issues of online identity, data protection, risk management, electronic privacy and cybersecurity. He is a graduate of Colby College in Waterville, Maine.

Bruce B. Heinlein serves as the Intelligence Community Lead for Human Geography and as the Director, National Geospatial-Intelligence Agency's Human Geography Joint Program Office. In this capacity, Mr. Heinlein orchestrates Human Geography activities for the Intelligence Community. Prior to assuming his current positions, Mr. Heinlein served as the NGA Director's senior representative to the U.S. Strategic Command at Offutt AFB in Omaha, NE. He served a NGA assignment in Afghanistan. Mr. Heinlein joined the NGA in August 2006 after a 26-year career as a U.S. Air Force Intelligence

Officer. While an Air Force Officer, he served tours in the Defense Intelligence Agency, National Security Agency and two Unified Commands, U.S. Strategic Command and U.S. Central Command (Operation IRAQI FREEDOM). Mr. Heinlein's commanded the 67th Information Operations Group and the 94th Intelligence Squadron and participated in Operations ALLIED FORCE, ENDURING FREEDOM, and IRAQI FREEDOM. His Search and Rescue/Disaster Relief work began while in the Air Force and is credited with a 1985 "Save" of a downed civil student pilot in Nevada. He is a commercial multi- and single engine pilot and a Civil Air Patrol as a Search and Rescue pilot. He holds several Incident Command System qualifications and has participated in the Hurricanes Rita and Katrina response, the Texas/Oklahoma Fire Watch of 2005-6, and in the 2011 Missouri River Flooding response. Mr. Heinlein holds two baccalaureate degrees from the University of Southern California, a Master's Degree in Public Administration from Golden Gate University, and Masters of Science Degree in Strategic Studies from Air University.

Charles Werner is a 38 year veteran (34 years in Charlottesville) of the volunteer and career fire rescue service. Presently serves as the fire chief for the City of Charlottesville, Virginia. He currently serves on numerous local, state and national public safety leadership, communications and technology committees. At the national level, Chief Werner serves on the Department of Homeland Security (DHS) SAFECOM Executive Committee, DHS First Responder Resource Group, DHS Virtual Social Media Working Group, International Association of Fire Chiefs Technology Council and is on the board of directors for the National Alliance for Public Safety GIS (NAPSG). Chief Werner is a contributing editor to Firehouse Magazine, Firehouse.com, Urgent Communications Magazine and has authored over 90 nationally published articles. Charles' work has been recognized through numerous local, state and national awards and he was selected as the 2008 National Fire Chief of the Year by Fire Chief Magazine.

Crowdsourced Data Quality

Sean Gorman is a researcher and practitioner in the field of data science with a specialty in location based analytics. Currently, he is the Chief Strategist for ESRI's DC Development Center. Previously he was the founder of GeoIQ, which was subsequently acquired by ESRI. The development of the GeoIQ platform is in part a fusion of Sean's background and interest in human geography, GIS, humanitarian relief, statistical mechanics, social media, and making the world of data (especially the geospatial variety) available to the public. Through the development of GeoCommons, and working with other geo-community projects, the GeoIQ team has helped influence the growing field of crowdsourcing for geographic data. Sean was also previously worked in academia serving as a research professor at George Mason University, and worked in industry as the as VP of R&D for GeoTel and Director of Strategy for iXOL. His academic research was focused on security, network analysis and geospatial technologies, and has been featured in Wired, Der Spiegel, ABC, The Washington Post, Business 2.0 and CNN. He has published over 25 academic articles in a variety of journals on topics ranging from crowdsourcing to complexity science, as well as authoring the

book *Networks, Complexity, and Security*. He served as a subject matter expert for the Critical Infrastructure Task Force and Homeland Security Advisory Council, and was selected as one of the "Top 35 Entrepreneurs Under 35" by BisNow on Business. Sean received his PhD from George Mason University as the Provost's High Potential Research Candidate, Fisher Prize winner and a INFORMS Dissertation Prize recipient.

Muki Haklay is a professor of Geographic Information Science at University College London and the co-director of the UCL Extreme Citizen Science group, which is dedicated to allow any community, regardless of their literacy, to use scientific methods and tools to collect, analyse, interpret and use information about their area and activities. His research interests include Public access and use of Environmental Information, Human-Computer Interaction (HCI) and Usability Engineering aspects of GIS; and Societal aspects of GIS use – in particular, participatory mapping and Citizen Science.

Robert Munro is the CEO of Idibon. His background is as a computational linguist specializing in processing digital communications among under-resourced populations. He has worked in commercial and not-for-profit technology for over ten years, from search engines in Silicon Valley to solar-power infrastructure in Sierra Leone. He coordinated Mission 4636, which is still the largest humanitarian crowdsourcing deployment to date, and works at the forefront of combining crowdsourcing and natural language processing for scalable information processing. He has a PhD from Stanford University.

Kate Starbird is an Assistant Professor at the Department of Human Centered Design and Engineering (HCDE) at the University of Washington. Dr. Starbird's research, which is situated within the fields of HCI and CSCW, examines interaction and collaboration as enabled, supported, and structured by social media and other online tools. She investigates both large-scale and small group, online interaction within the context of crises and other mass disruption events, studying how digital volunteers and other members of the connected crowd work to filter and shape the information space. Dr. Starbird recently completed her PhD research on "crowdwork, crisis and convergence" at the University of Colorado, working as a member of Project EPIC. As part of that research, she co-created the "Tweak the Tweet" concept and deployed that innovation for more than 30 events between 2010 and 2012.

E. Lynn Usery is a Research Physical Scientist and Director of the Center of Excellence for Geospatial Information Science (CEGIS) with the U.S. Geological Survey (USGS). He worked as a cartographer and geographer for the USGS (1977-1988) researching and developing automated cartographic and geographic information systems. He was a professor of geography at the University of Wisconsin-Madison and the University of Georgia. He returned to the USGS in 1999 and established a program of cartographic and geographic information science (GIScience) research that evolved into CEGIS. He was President of the University Consortium for Geographic Information Science (UCGIS) and the Cartography and Geographic Information Society (CaGIS). He was editor of the journal *Cartography and Geographic Information Science.* Dr. Usery is currently the Chair of the U.S. National Committee to

the International Cartographic Association. He is a Fellow of CaGIS and the American Congress on Surveying and Mapping, and was elected to the first class of Fellows of UCGIS. He has been selected for the CaGIS Distinguished Career Award for 2012. Dr. Usery received his BS in geography from the University of Alabama and MA and PhD degrees in geography from the University of Georgia. His current interests and research are in theoretical GIScience including geospatial ontologies and semantics, data models, data integration, and grid computing for spatial data.

Data Collection and Management

Tim Brice graduated from the University of Missouri in 1992 with dual Bachelor degrees in Journalism and Atmospheric Science. Tim joined the National Weather Service in 1994 and has served in the El Paso area office for the last 18 years. His passion during that time has been to help the NWS explore, develop and integrate the latest technologies into its operational settings. He is currently helping the Weather Service use social media to receive and disseminate weather information. He also serves as the El Paso office's GIS, web page, social media and hydrologic focal points.

Kris Eriksen began working in fire in college where she got her degree in Organizational Administration and a minor in Journalism. She has more than 15 years in corporate public relations and 12 years as a reporter. She began her 28 years in fire for the 2nd time, in 1984. Kris has been deployed with the Alaska Type 1 Incident Management Team, as well as other National Type 1 and 2 teams, responding too many of the nation's largest wildland fires and all-hazard assignments. She was responsible for creating the first multi-agency Fire Information website (NMFireinfo) in New Mexico in 2006. She successfully set up and ran a two state, multi-jurisdictional Joint Information Center during the largest fire siege in Georgia/Florida history in 2007. She also worked with the FEMA Region 10 Public Affairs Cadre for six years handling public information & media functions during floods, tornados, earthquakes and hurricanes nationally. Kris began working on the Portland NIMO team in May and her role outside of fire, focuses on working with National Forests and their stakeholders/cooperators, to improve pre-season collaboration and communication. She has also taken the lead among national Public Information Officers in pushing for the use of Social Media on incidents. She has piloted the use of VOS (Virtual Operations Support) on wildland fires and helped create and train 3 more VOS teams, now in use on National Incident Management Teams. Her focus is on trying new tools (for crowdsourcing, live-streaming, documentation, etc) to find a good fit for wildland fires, and sharing that information nationally with Public Information Officers.

Shadrock Roberts is a Principal GIS Analyst at USAID's GeoCenter, which builds GIS capacity within the Agency and USAID Missions. Shadrock is also a PhD candidate at the University of Georgia's Department of Geography where he studies the use of geospatial tools and volunteered geographic information (VGI) for humanitarian operations. The substantive nature of his work is a geographic approach to studying refugee

and internally displaced populations. He is currently focused on developing analytical products and VGI for improved development interventions at USAID. Prior to joining USAID, Shadrock developed remote sensing methods for refugee enumeration in protracted refugee camps at the Centers for Disease Control and Prevention and co-founded Quartier par Quartier: a participatory mapping project to survey humanitarian needs in response to the 2012 Haiti Earthquake. Shadrock actively engages volunteer and technical communities to leverage the power of crowdsourcing and has managed projects with his colleagues in the Standby Task Force and GISCorps.

Evaluation Frameworks, Performance Metrics, and Impact

Elizabeth (EJ) Ashbourne is currently a Senior Operations Officer in the Office of Corporate Reform at the World Bank. Prior to this, EJ held the position of Lead, Global Health Information Programs for the World Bank and the Health Metrics Network of the World Health Organization. Among many projects, she is led the work on eHealth and mHealth in the Health Anchor of the Bank, and contributed to research on a common metric for donor agencies, development partners and countries to measure their investment in health information. Prior to this, she managed the work of the international pillar in the World Bank's Results Secretariate. She spent the previous seven years working closely on issues specific to engaging the private sector in the fight against HIV/AIDS. As the focal point for private sector partnerships with the World Bank's Africa Region HIV/AIDS programs, her role was to develop and implement the mechanisms through which the private sector can access financial and technical resources from the Bank's $1.5billion investment in HIV/AIDS. She has worked in some 24 countries in Africa, and provided technical assistance in another 8. In addition, EJ facilitates global corporate relationships with the Bank on issues of global health, specifically in the area of eHealth, in Africa and the rest of the world. EJ holds an MA in International Education, with an emphasis on Organizational Management from American University, in Washington DC, and a BSc in Communications and History from Ithaca College, Ithaca, NY.

Taha Kass-Hout is the Director of the Division of Informatics Solutions and Operations at the US Centers for Disease Control and Prevention (CDC). He previously served as Deputy Director for Information Science in the Division of Notifiable Diseases and Healthcare Information (DNDHI). He has more than 15 years of professional experience in health, public health, and informatics. While DNDHI Deputy Director, he managed the BioSense Program where he oversaw the Program's many features that assist state health departments and CDC in data collection, standardization, storage, analysis, and collaboration. BioSense is the first Department of Health and Human Services (HHS) program hosted completely in the Internet cloud, in alignment with the White House cloud initiative. Taha chairs the White House Office of Science and Technology Policy (OSTP) Biosurveillance S&T sub-committee dealing with "detecting aberrations from the norm." He managed CDC's Distribute project. First used during the influenza H1N1 pandemic, Distribute has been further developed

by CDC in partnership with the International Society for Disease Surveillance. In December 2009, Distribute was acknowledged by the White House OSTP as a model case study for open government because of the project's voluntary participation, low cost to acquire data, and exceptional public transparency. He was active in responding to the 2003 SARS outbreak, where he led the informatics and information response for the National Center for Infectious Diseases at US CDC.

Leysia Palen is an Associate Professor of Computer Science at the University of Colorado, Boulder and a faculty fellow with the Institute for the Alliance of Technology, Learning and Society (ATLAS) and the Institute of Cognitive Science (ICS). She is the Director of the Connectivity Lab and the NSF-funded Project EPIC: Empowering the Public with Information in Crisis. She examines socio-technical systems, including coordination in on-line settings as wells as the impacts of social computing in off-line arenas and social structures. Her most recent work is in the area of crisis informatics, though she has worked in aviation, digital privacy behavior, personal information management, mobile technology diffusion, health care, and cultural heritage. Prior to her appointment at Colorado, she completed her PhD at the University of California, Irvine in Information and Computer Science and her undergraduate education in Cognitive Science at the University of California, San Diego. In 2006, Professor Palen was awarded a National Science Federation Early CAREER Grant for her "Data in Disaster" proposal to study information dissemination in disaster events. In 2005-2006, Professor Palen was a visiting professor at the University of Aarhus, Denmark.

Chris Vaughan was recently appointed as FEMA's first Geospatial Information Officer. In this role, he will champion and coordinate geospatial technologies within FEMA's response and recovery programs as a means to improve information sharing with the emergency management community. Prior to joining FEMA in 2010, Chris worked for the National Geospatial-Intelligence Agency as an Imagery Analyst supporting various DHS missions to include the Homeland Security Infrastructure Program (HSIP). While at NGA, Chris also deployed in support of various GEOINT operations that supported FEMA's Urban Search and Rescue Incident Support Teams. Mr. Vaughan has a Bachelor of Arts in Sociology as well as a Master of Science in Counseling Psychology from Lee University in Cleveland, TN.

Bartel Van de Walle is a tenured Associate Professor at the Department of Information Management, Tilburg School of Economics and Management at Tilburg University (the Netherlands), visiting professor at Harbin Engineering University (China) and guest professor at the Universita della Svizzera Italiana in Lugano. He served as a staff advisor on science policy to the Flemish minister of science and innovation in 2010-2011, and is board member of the Flemish Institute for Technological Research (VITO) since 2010. Bartel co-founded the international Information Systems for Crisis Response and Management (ISCRAM) Community in 2004, and has since co-organized special sessions, tracks, international workshops, conferences and PhD Summer Schools in Europe, the USA and China. Bartel was elected founding chair of the Board of the ISCRAM Association, established as an international non-profit

organization in Belgium in 2009. In 2005, Bartel received a prestigious Marie Curie Fellowship for his research on threat rigidity and computer-mediated communication and decision making. He received his MSc and his PhD in Applied Mathematics and Computer Science from Ghent University (Belgium). His dissertation research was on decision support for individuals and groups, two areas which are still at the core of his current research interests at the intersection of information and communication technologies and the (humanitarian) crisis management domain.

John Vocino is currently a Senior Analyst for the U.S. Government Accountability Office (GAO) in the Homeland Security and Justice division, as an expert on emergency preparedness issues. Recently, he served a one-year congressional detail to the Senate Subcommittee on Disaster Recovery and Intergovernmental Affairs. There he helped develop Subcommittee hearings and other oversight activities on: the use of social media tools in emergency management; the response to, recovery from 2011 disasters; the role of mitigation, and; FEMA program efficiency. John's 25-year body of GAO work has focused on the intergovernmental relationships and effects on state and local governments across federal domestic policies and programs including emergency management, social services and community development. John is an expert in federal grant programs and funding distribution models. Prior to joining the GAO, he served as a county planner and project administrator for St Bernard Parish, Louisiana. He was St. Bernard's first emergency management planner and helped develop the first hurricane evacuation plans for the 10 parishes that make up southeastern Louisiana. Other duties included planning administration and budgeting of the county's transportation, transit, public works, and recreation programs. John holds a Master of Public Administration from the University of New Orleans' College of Urban and Regional Affairs, and a B.A. in Political Science from the University of Wisconsin-Parkside.

Public and Volunteer Engagement

Rob Baker is the Senior Program Developer for Ushahidi and a member of the Humanitarian OpenStreetMap Team (HOT). His work with both organizations has focused on mobile and mapping solutions for crisis response and election monitoring, primarily in Central Africa and the Middle East, with a focus on community engagement, outreach, and developing educational materials. Prior to this recent work, he was the Senior Developer of Web and New Media for Oxfam America.

Ali Khan is a retired U.S. Assistant Surgeon General and the director of the Office of Public Health Preparedness and Response at the Centers for Disease Control and Prevention, also known as the CDC. He is responsible for all of CDC's public health preparedness and response activities and served as one of the main architects of CDC's bioterrorism preparedness program. Over the past 21 years with CDC, he has led and responded to numerous high profile domestic and international public health emergencies; written over 150 publications; and consulted for multiple U.S. organizations including NASA and the World Health Organization.

Jeff Phillips is a local Emergency Manager in New Mexico and former Chief of Response and Recovery at the New Mexico Dept. of Homeland Security and Emergency Management (NMDHSEM). He has a Master's Degree in Public Administration and Bachelor of Arts in Economics. Jeff has been practicing Social Media in his Emergency Management program since 2009 and is a founding member of the #SMEM initiative (November 2010). Jeff developed and utilizes the Virtual Operations Support (VOST) concept of recruiting, organizing and tasking 'trusted agents' to perform as social media and new technology 'force multipliers' in emergency operations and has led six VOST activations in the past year.

Laurie Van Leuven has more than 12 years of operational experience in Emergency Management and Critical Infrastructure Security. She is a Homeland Security subject matter expert at Scientific Research Corporation, often focusing on the use of social media tools during emergency operations. In 2010, she was named a Naval Postgraduate School/Center for Homeland Defense and Security Alumni Fellow and in this capacity worked at the Federal Emergency Management Agency's Headquarters in Washington D.C. Prior to this, she served as a strategic advisor and manager, responsible for critical infrastructure protection and emergency management missions at the City of Seattle, Public Utilities Department. She has extensive experience in essential utility service delivery, COOP programs, risk management, vulnerability assessments, strategic and emergency planning, incident management within an EOC environment, sector interdependencies, and local and State collaboration. Ms. Van Leuven earned her Master's degree from the Naval Postgraduate School and holds a Bachelor's degree in Communications from the University of Washington.

Jen Ziemke is one of the leading scholars in the field of crisis mapping. Her research applies spatial and temporal econometric analysis, dynamic visualization, and in-depth historical and archival research to develop unique crisis maps that reveal underlying complex processes. Jen is Co-Founder & Co-Director of the International Network of Crisis Mappers, Co-Curates the International Conference on Crisis Mapping (ICCM) series & teaches Political Science as Assistant Professor of International Relations at John Carroll University (JCU). She is also a Crisis Mapping and Early Warning Fellow at the Harvard Humanitarian Initiative (HHI) and consults for a number of international organizations in the US & Europe. She received her PhD in Political Science at the University of Wisconsin-Madison.

Research Challenges

Michael F. Goodchild is Emeritus Professor of Geography at the University of California, Santa Barbara, where he also holds the title of Research Professor. Until his retirement in June 2012 he was Jack and Laura Dangermond Professor of Geography, and Director of UCSB's Center for Spatial Studies. He received his BA degree from Cambridge University in Physics in 1965 and his PhD in geography from McMaster University in 1969, and has received four honorary doctorates. He was elected member of the National Academy of Sciences and Foreign Member of the Royal Society of

Canada in 2002, member of the American Academy of Arts and Sciences in 2006, and Foreign Member of the Royal Society and Corresponding Fellow of the British Academy in 2010; and in 2007 he received the Prix Vautrin Lud. He was editor of Geographical Analysis between 1987 and 1990 and editor of the Methods, Models, and Geographic Information Sciences section of the Annals of the Association of American Geographers from 2000 to 2006. He serves on the editorial boards of ten other journals and book series, and has published over 15 books and 500 articles. He was Chair of the National Research Council's Mapping Science Committee from 1997 to 1999, and of the Advisory Committee on Social, Behavioral, and Economic Sciences of the National Science Foundation from 2008 to 2010. His research interests center on geographic information science, spatial analysis, and uncertainty in geographic data.

David Ferguson is Deputy Director of USAID's Science and Technology office focused on applied research and challenge models for development. Before joining USAID in September, 2009, he worked on international development over the previous 5 years as an independent consultant at the nexus of development, technology, and the private sector. His first career was 27 years at AT&T. He led AT&T's Professional Services Division, developing it into a US$200M profitable entity. He was based in Hong Kong for seven years and focused on the developing markets of China, India and Indonesia, for telecommunications services investment opportunities. He built seven joint ventures during this period. His technical expertise includes Information and Communications Technology (ICT) for development, economic growth through private sector engagement, and government technology and telecommunications policy and regulation.

Robin Roberson Murphy is the Raytheon Professor of Computer Science and Engineering at Texas A&M, Director of the Center for Robot-Assisted Search and Rescue, and the Center for Emergency Informatics/Emergency Informatics EDGE® Innovation Center. She received a B.M.E. in mechanical engineering, an MS and PhD in computer science in 1980, 1989, and 1992, respectively, from Georgia Tech, where she was a Rockwell International Doctoral Fellow. She has over 100 publications on artificial intelligence, human-robot interaction, and heterogeneous teams of robots including the textbook, Introduction to AI Robotics. Her insertion of ground, air, and sea robots at disasters including the 9/11 World Trade Center disaster, Hurricanes Katrina and Charley, the Tohoku tsunami response, and Fukushima has led to numerous professional awards, including IEEE Fellow and Motohiro Kisoi award (2010), as well as being declared an Innovator in AI by TIME, an "Alpha Geek" by WIRED Magazine and one of the Most Influential Women in Technology by Fast Company. Dr. Murphy serves on several government and professional boards, including the Defense Science Board and the IEEE Robotics and Automation Society. She recently co-chaired the NSF/CCC Workshop on Computing for Disaster Management.

Leysia Palen

Bartel Van de Walle

Research-to-Operations

Raymond Buettner is the first Director of Field Experimentation at the Naval Postgraduate School from 2009 to the present. He teaches in the Information Sciences Department. He is the Chair of Technical Operations, in which he liaisons between NPS and the Joint Staff J39.He is the Principal Investigator for multiple research projects with budgets exceeding $3 million dollars a year, including the TNT, RELIEF, and JIFX projects. From 2007-09, Dr. Buettner specialized in systems engineering applications, information operations, and field experimentation. He served as the Deputy Director of the Department of Defense's Information Operations Center for Excellence where he focused on graduate education and cyber issues. From 2003 to 2005, Dr. Buettner served on the faculty at the Naval Postgraduate School (NPS) and was the Information Operations Chair. He established himself as one of the nation's foremost experts in the area of influence modeling and in this capacity he was engaged at the direct support of national authorities during the EP-3 collision incident and the post-9/11 response. He also served as the Deputy Director of the Cebrowski Institute for Information Innovation and Superiority. He is the founder and Chief Technology Officer for Secure Cognition, Incorporated. He also founded Hybrid Knowledge LLC, a technology and consulting firm. Dr. Buettner is a retired Naval Officer and served for nearly 23 years. He holds a Master of Science in Systems Engineering degree from the Naval Postgraduate School and a Doctorate degree in Civil and Environmental Engineering from Stanford University.

Xenophon "Yo" Gikas is a 26 year veteran with the Los Angeles Fire Department. He is currently assigned to Operations Control/Metro Fire Communications. Throughout his career he has held numerous titles and positions including: Communications Officer, Chief Officer's Staff Assistant, Firefighter, Dispatcher, and Urban Search and Rescue Commander. Captain Gikas is currently leading two technology programs for the fire department: the automatic vehicle location project and the development and integration of audio visual and decision support systems within the fire departments brand new "state of the art" command and dispatch center. He is active in many technology projects, workgroups, and committees at all levels and currently serves on the DHS First Responder Resource Group and the Southern California Leadership Team for NAPSG. He is a frequent speaker on the subject of interoperability and the use of standards to achieve mission critical success. Captain Gikas attended the University of California at Los Angeles and California State University at Northridge earning a Bachelor of Science degree in Business Administration. He is a Communications Specialist and Technical Rescue Specialist for FEMA's California Task Force 1 and has responded to some of our nation's largest disasters.

Francis E. Lindsay, PhD, is the Disasters Program Manager for NASA's Applied Sciences Program. In this role, Dr. Lindsay leads the Program's efforts to promote the integration of Earth science data and information for disaster forecasting, mitigation, and response. He oversees the Disaster portfolio of competitively selected and directed projects focusing on improving our national and international planning for and response to disasters across the globe. He is also the NASA representative for disasters work on several national and international bodies including the OSTP Subcommittee on Disaster Reduction and the Committee of Earth Observing Satellites comprised of the world's space faring nations. He received a Ph.D. in Geography from the University of Maryland and a Masters degree in Geography from the University of Massachusetts, Amherst. Dr. Lindsay has worked in the NASA Data System Program for nearly ten years as a Program Manager before joining the Applied Science Program. He has extensive experience with geospatial data spanning both remote sensing and GIS-based applications. Before joining NASA Dr. Lindsay managed one of the largest civilian remote satellite data distribution centers based at the Institute for Advanced Computer Studies in Maryland and was an Assistant Professor of Geography at the University of New Hampshire, Keene.

Eric Rasmussen is a medical doctor currently serving as Research Professor for Environmental Security and Global Medicine at San Diego State University, as an Affiliate Associate Professor of Medicine at the University of Washington, and as Managing Director at Infinitum Humanitarian Systems, a Social Business specializing in vulnerability reduction for systems and populations. He previously spent 25 years in the Navy, with positions that included Chairman of an academic Department of Medicine, Fleet Surgeon for the US Navy's Third Fleet, and more than 15 deployments to Bosnia, Iraq, Afghanistan, Katrina, Banda Aceh, and elsewhere. After retiring from the Navy he spent several years as the CEO of the Google-founded NGO called InSTEDD before accepting his current positions. He also now serves on a number of Boards, including Committees within USAID and the National Academy of Sciences.

Will McClintock is a researcher at the University of California Santa Barbara, Marine Science Institute, and a Senior Fellow with the United Nations Environment Program - World Conservation Monitoring Center. From 2004-2011 he was Director of the MarineMap Consortium (marinemap.org), a collaboration of developers from The Nature Conservancy, Ecotrust at the University of California. Dr. McClintock's lab develops web-based applications for the collaborative design and evaluation of plans for managing ocean space. In October, 2012, his lab will launch SeaSketch (seasketch.org), a bleeding-edge web application for stakeholder engagement in world-wide marine spatial planning. Dr. McClintock received a B.A. in Biology from Earlham College, an M.S. in Behavioral Ecology from the University of Cincinnati, an M.A. in Counseling Psychology from Pacifica Graduate Institute and a Ph.D. in Ecology, Evolution and Marine Biology from the University of California Santa Barbara.

DAY 2: Friday, September 14, 2012

Welcome and Introduction

Lea Shanley

Legal and Policy Issues II

John Crowley

Robert Gellman is a privacy and information policy consultant in Washington, D.C. He advises companies, organizations, trade associations, government agencies, foreign governments, and advocacy organizations how to develop, analyze, implement, and maintain policies for personal privacy and fair information practices. A graduate of the Yale Law School, Gellman has worked on information policy issues for more than 30 years. He spent 17 years on the staff of a Subcommittee in the House of Representatives responsible for privacy, freedom of information, health record confidentiality, and other information policy matters.

Stephanie Grosser serves as the communications specialist for USAID's Development Credit Authority. In this role, Stephanie finds creative and innovative ways of telling the story of credit guarantees as a powerful tool to unlock private resources for development. Earlier this year Stephanie worked with USAID's GeoCenter to lead the U.S. Government's first-ever crowdsourcing event to clean and open a dataset. Prior to joining USAID, Stephanie was the Assistant Director at the Hebrew Immigrant Aid Society where she worked to promote refugee and immigrant rights. She received a bachelor's degree in foreign service from Georgetown University and a master's degree in government from Johns Hopkins University

David J. Kaufman was appointed Director of FEMA's Office of Policy and Program Analysis (OPPA) in September 2009. In this position he is responsible for providing leadership, analysis, coordination, and decision-making support to the FEMA Administrator on a wide range of Agency policies, strategy, plans, programs, and key initiatives. Mr. Kaufman has extensive experience with homeland security and emergency management issues. He has been a member of the faculty at the Naval Postgraduate School's Center for Homeland Defense and Security, where he has taught in the Center's graduate and executive level education programs, was the Safety and Security Director for CNA, and non-profit think-tank, and has previously served in several senior positions in the U.S. Department of Homeland Security and in FEMA.

Edward S. Robson counsels emergency service organizations in a variety of matters, including the development of risk management policies, internal governance, and government relations. He has defended emergency service organizations against civil liability, civil rights, First Amendment, and employment claims. Mr. Robson is also the author of a number of articles addressing the legal issues facing emergency service organizations.

Security of Crowdsourcing

George Chamales has spent the last decade working in a wide range of positions in the computer security field for both the US government and private industry. He is an active member of the crisis mapping community, where he develops new tools and capabilities, co-founded the Crisis Mapper's Standby Task Force, and has provided technical support to crisis deployments in Libya, Sudan, and Afghanistan.

B.K. DeLong has been working in information security/IT risk management for over 13 years and is currently Principal at Extropic Technology Consulting. In an industry known for applying standard solutions, Mr. DeLong has built a career on bringing unique solutions to the table. He presently works with Fortune 500 companies, consulting firms, vendor companies, non-profits, government entities and new start-ups who are seeking his insights on the current challenges of today's technology landscape. Prior to starting ETC, he worked with KLC Consulting on third-party vendor risk and educating executives & senior-level practitioners on the threat that comes from relying on information stored & software developed by outsourced entities if not properly managed. Prior to his work with KLC he spent several years as an analyst and client services specialist with InfoSec and IT Risk research firm IANS, managing a group of leaders from over 50 Fortune 500-sized security teams, providing them with decision-support research and insights. Mr. DeLong has a BA in Information Technology from the University of Massachusetts Amherst and has been trained in Disaster Response by both the American Red Cross and FEMA.

A. Riley Eller is a seasoned software developer whose work appears in millions of entertainment, communication, and consumer electronics products. His contributions to the emerging computer security establishment include seminal inventions such as automatic protocol testing and trust in decentralized networks. Known in the hobby community as "Caezar", his annual Challenge events produce novel solutions to problems as broad as insect colony defense, Cisco router penetration, and the first public discussion of distributed denial of service attacks (which preceded the actual attacks by 5-7 months). As a security strategist, he advises the largest companies in the world. As a director at Geeks Without Bounds, he mentors the smallest unfunded development teams. Riley's passion is interpersonal development among the young and brilliant, which leads him to all corners of the globe in an effort to reach and teach them all.

Eric Rasmussen

Keynotes: Connecting Grassroots to Government through Open Innovation

Christopher Fabian is the co-lead of UNICEF's Innovation Unit in NY, which identifies, prototypes and scales new partnerships, processes and technologies in support of UNICEF's 135 country offices. Christopher co-created the Design for UNICEF course at NYU's ITP program and believes that authentic and humble engagement of academia, private sector and development can create powerful solutions for those most in need. Specializing in the confluence of design, technology and development

Christopher has been with UNICEF since 2006. His academic background is in Philosophy and Critical Theory from the American University in Cairo, Trinity College, Dublin and The New School. Prior to UNICEF, Christopher founded technology start-ups in East Africa and the Middle East.

Gisli Olafsson has been the Emergency Response Director of NetHope since November 2010. In his current role he is responsible for emergency preparedness and emergency response activities related to Information and Communication Technology (ICT) within the NetHope member organizations. Gisli has over 17 years of experience in the field of disaster management and is an active member of the United Nations Disaster Assessment and Coordination (UNDAC) team, a team of experienced disaster managers which are on stand-by to deploy anywhere in the world on a 6 hour notice to coordinate the first response of the international community to disasters on behalf of the UN Office for Coordination of Humanitarian Affairs (OCHA). In recent years Gisli has participated in disaster field missions in connections with floods in Ghana (2007), Cyclone Nargis in Myanmar (2008), Hurricane Ike in Texas (2008), Sichuan Earthquake (2008), Pandemic Outbreak (2009), West Sumatra Earthquake (2009), Haiti Earthquake (2010), Japan Earthquake/Tsunami (2011) and Horn of Africa Famine (2011).

Nigel Snoad is Product Manager for Google Crisis Response team, which is changing how citizens stay informed during crises by providing information and tools to help people collaborate during emergencies and build resilient communities. Before joining Google in 2011, he led R&D on humanitarian systems at Microsoft and spent several years at the United Nations helping lead pandemic contingency planning and the UN Joint Logistics Center's responses in Iraq, after the 2004 tsunami and in Darfur. Nigel has taught courses in Humanitarian Design at Parsons the New School for Design, partnering with groups like the World Bank and the Red Cross to develop innovative design-thinking approaches to complex humanitarian and development problems. Nigel has a PhD in complex adaptive systems from the Australian National University and has held research fellowships at the Santa Fe Institute and Stanford University.

Plenary Discussion: Prioritizing Grand Challenges

David Applegate

Vision for the Future

Gisli Olafsson

Appendix C

Crowdsourcing Public Participation: Administrative Considerations

By Zack Bastian, Early Career Scholar, Commons Lab

Published in Burns, R. and Shanley, L.A. 2013. Connecting Grassroots to Government for Disaster Management: Workshop Summary. Washington, DC: Commons Lab of the Woodrow Wilson International Center for Scholars

Crowdsourcing Public Participation: Administrative Considerations

As more citizens go online, so has the government. Agencies maintain their own websites along with a presence on social media platforms. Typically these sites are used to publicize agency news and tell the agency's "story". Some have looked beyond this surface-level engagement and investigated the opportunity to glean volunteered mission-relevant data from users. While a chance to improve outcomes with rapid public input is exciting, agencies must respect federal administrative restrictions such as the Paperwork Reduction Act (PRA). This guide will provide a basic overview of the PRA and recent Office of Management and Budget (OMB) memoranda relevant to public engagement.

The Paperwork Reduction Act

The PRA sets limits on the information agencies can collect and mandates a process before new collections.[1] An agency must complete Form 83-1, Paperwork Reduction Act Submission, and submit it to the OMB.[2] The agency describes the information, why it is needed, and the burden on citizens who provide it.[3] The PRA has been updated, directing agencies to show proper consideration for privacy and confidentiality,[4]

1 Paperwork Reduction Act, 44 USC § 3501, http://archives.gov/federal-register/laws/paperwork-reduction/.

2 Office of Management and Budget Form 83-1, http://www.whitehouse.gov/sites/default/files/omb/inforeg/83i-fill.pdf.

3 44 USC § 3507(a)(1)(D).

4 Ibid., § 3501(8)(a).

security,[5] and transparency.[6] The process takes a minimum of 120 days. It requires publication in the Federal Register,[7] and an opportunity for public comment. [8]

This delay and administrative burden causes a cost-benefit analysis. Any new collection of information includes a lengthy application process and some expense. However, the OMB has issued a series of statements providing exemptions and guidance on how agencies can utilize crowd platforms.

Information Collection under the Paperwork Reduction Act

Published on April 7, 2010, "Information Collection under the Paperwork Reduction Act" provides an overview of the PRA in hopes of encouraging "transparency and openness."[9] An agency activity requires OMB approval via PRA procedures only if it qualifies as a collection of information. Information is defined as "any statement or estimate of fact or opinion, regardless of form or format, whether in numerical, graphic, or narrative form, and whether oral or maintained on paper, electronic, or other media."[10] This definition seems dauntingly broad, but the PRA considers many types of useful data to not be "information",[11] and exempts some collections from OMB approval.[12] This provides a good start towards understanding the administrative obligations of the PRA.

Social Media, Web-Based Interactive Technologies, and the Paperwork Reduction Act

The next OMB document provides agencies more specific input on how the PRA can involve web-based interactions.[13] Rather than relying on the lengthy and contentious process of statutory updates, the OMB examines various activities and finds existing parallels in the PRA. For example, open questions posed by agencies with unstructured responses on social media sites, blogs, content-sharing sites, or message boards are considered equivalent to a "general solicitation."[14] A general solicitation is a request for "facts or opin-

5 Ibid., § 3501(8)(b).

6 Ibid., § 3501(8)(c).

7 Ibid., § 3507(a)(1)(D).

8 Ibid., § 3507(b).

9 Information Collection under the Paperwork Reduction Act, OMB Memorandum, http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/PRAPrimer_04072010.pdf.

10 5 C.F.R. 1320.3(c).

11 5 C.F.R. 1320.3(h).

12 44 U.S.C. § 3518(c). 44 U.S.C. § 3502(3)(A).

13 Social Media, Web-Based Interactive Technologies, and the Paperwork Reduction Act, OMB Memorandum, http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/SocialMediaGuidance_04072010.pdf.

14 Ibid.

ions…provided that no one person is required to supply specific information…other than necessary for self-identification."[15] Thus, the OMB exempts many activities from the PRA.

Paperwork Reduction Act – Generic Clearances

The schedule of PRA approval can obstruct an agency's ability to quickly gain public input. However, an agency may lay groundwork allowing for a quicker process. This is explained in the OMB Memorandum, "Paperwork Reduction Act – Generic Clearances."[16] An agency to obey the standard notice and comment process,[17] but upon approval, this information collection clearance provides for expedited review by the OMB.[18] Generic clearances have two characteristics. First, "the need for and the overall practical utility of the data collection can be evaluated in advance." Second, "the agency cannot determine the details of the specific individual collections until a later time."[19] By completing this review, agencies can establish categories of information requests and create a fast lane for quick approval. The OMB includes examples of granted generic clearances in the memorandum's appendix.[20]

Frequently Asked Questions related to Challenges and Prizes

A broad federal priority has been to encourage the use of challenges and prizes as a way to "increase their ability to promote and harness innovation."[21] Thus, the OMB provides a list of frequently asked questions on how these activities might invoke the PRA.[22] Generally, the need for PRA approval turns not on the platform the agency uses to issue a challenge, but instead the type of information the challenge requires from the public.[23] The OMB also allows agencies to undergo the previously mentioned generic clearance process to receive approval for a broad category of challenges.[24]

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15 5 C.F.R. 1320.3(h)(10).

16 Paperwork Reduction Act – Generic Clearances, OMB Memorandum, http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/PRA_Gen_ICRs_5-28-2010.pdf.

17 44 U.S.C. § 3506(c)(2)(A); 44 U.S.C. § 3507(a)(1)(D).

18 Paperwork Reduction Act – Generic Clearances.

19 Ibid.

20 Ibid.

21 Guidance on the Use of Challenges and Prizes to Promote Open Government, OMB Memorandum, http://www.whitehouse.gov/sites/default/files/omb/assets/memoranda_2010/m10-11.pdf.

22 Frequently Asked questions related to Challenges and Prizes, OMB Memorandum, http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/challenge-and-prizes-faqs.pdf.

23 Ibid.

24 Ibid.

Guidance for Online Use of Web Measurement and Customization Technologies

A bedrock technical tool for interactive web browsing is the HTTP cookie: a tiny bit of data stored to a user's browser. On return visits, the website can "remember" the user's previous activity or preferred settings.[25] This memorandum rescinded the federal ban on government use of cookies for limited purposes. Agencies "may use web measurement and customization technologies for the purpose of improving Federal services online," but may not track individual user activity outside of the website or application, share data without user consent, or collect and use personally identifiable information.[26]

Guidance for Agency Use of Third-Party Websites and Applications

Before utilizing a third-party website or application, this memorandum requires that agencies obey the Privacy Act[27] and undergo a Privacy Impact Assessment on how their activity might involve personally identifiable information.[28] The OMB also mandates that agencies assess whether the platform's Third-Party Privacy Policy is appropriate.[29] The federal government has also acknowledged that consumer-level Terms of Service agreements for many platforms are unacceptable for agencies. The GSA has negotiated modified agreements with service providers, allowing agency use.[30]

Managing Government Records Directive

This recent memorandum promotes broad efforts for digitization and archival of historic items via the National Archives and Records Administration (NARA).[31] NARA has engaged an interested crowd of citizens to produce useful results via NARA's Citizen Archivist Dashboard.[32] There, anyone can join a wide range or archivist efforts. NARA has collaborated with other agencies; the National Oceanic and Atmospheric Administration harnessed the crowd to transcribe newly digitized historic ship logs.[33]

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25 "HTTP cookie," *Wikipedia*, http://en.wikipedia.org/wiki/HTTP_cookie.

26 Guidance for Online Use of Web Measurement and Customization Technologies, OMB Memorandum, http://www.whitehouse.gov/sites/default/files/omb/assets/memoranda_2010/m10-22.pdf.

27 5 U.S.C. § 552a.

28 Guidance for Agency use of Third-Party Websites and Applications, OMB Memorandum, http://www.whitehouse.gov/sites/default/files/omb/assets/memoranda_2010/m10-23.pdf.

29 Ibid.

30 Apps.gov, Social Media Apps, https://www.apps.gov/cloud/cloud/category_home.do?&c=SA.

31 Managing Government Records Directive, OMB Memorandum, http://www.whitehouse.gov/sites/default/files/omb/memoranda/2012/m-12-18.pdf.

32 Citizen Archivist Dashboard, http://www.archives.gov/citizen-archivist/.

33 Bob Berwyn, "Climate: Citizen scientist to help transcribe historic ship's logs," *Summit County Citizens Voice*, October 30, 2012, http://summitcountyvoice.com/2012/10/30/climate-citizen-scientist-to-help-transcribe-historic-ships-logs/.

This memorandum and accompanying initiatives could provide exciting opportunities for citizen involvement in important agency projects.

The Importance of Collaborating with Agency Counsel

The preceding demonstrates OMB administrative policy has worked to enable agency engagement and activity on the platforms that citizens use every day. However, it is important to emphasize that any plan must include collaboration and cooperation with agency counsel. An agency lawyer has both the training and the responsibility to determine the legality of activities. Their understanding of an agency's unique role and responsibilities can facilitate efforts that are truly appropriate. The failure to responsibly plan and cooperate with counsel could mean that valuable data might go unused. Well-intentioned engagement could be wasted because of poor planning. All activities that involve innovative use of new technology should be conducted carefully.

There are additional avenues for addressing questions related to the PRA. Agency OMB/OIRA desk officers can be a great place to start with issues not covered or explicitly answered in the OMB publications. Additionally, the email addresses included in OMB memoranda are monitored by staff who are happy to help.

The OMB has recognized that modern technology gives agencies an opportunity to work with the public in new ways. Their output shows that incorporating new tools is not impossible. But there is no substitute for orderly deliberate decision making. No matter the platform or tool, any interface with citizens should be preceded by consideration of agency responsibilities.

Appendix D

Research to Operations: Moving Ideas from Concept to Deployment

By Eric Rasmussen, MD, MDM, FACP, Vice President, AccessAgility, and Managing Director, Infinitum Humanitarian Systems

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September 6, 2012

The exponential growth of connectedness and computation has transformed how stakeholders in disaster response translate research into operations.

It is no longer sufficient that we apply traditional methods. We can no longer just design sample surveys to identify problems and initiate a slow sequence of hypothesis testing, field-based pilots, and graduated roll-outs leading, slowly, to deeply-funded and inflexible Programs of Record. While some domains may still yield success through the use of such methodologies, it's rarely optimal anymore. The tempo at which both problems and solutions are advancing is far too fast for investigations measured in years to yield the best answers. By the time the first pilot project nears evaluation phase, the solution set to the original problem may well have altered to irrelevance through technological advance, overtaken by a calculus predicted by Gordon Moore and Ray Kurzweil.

That said this rate of change can be harnessed for good. When ideas are harvested from those closest to the problem, with support from a range of resources that cut across formal boundaries and sectors, the process can show sterling—sometimes astonishing—results. Ideas from fields that would never be explored in traditional acquisition can be applied creatively, taking a solution from one branch of science into another, following non-linear pathways of leaps and tunnels.

We can now ask users for ideas the same way we've historically asked them for descriptions of the problem. We can combine users with domain experts, artists, social scientists, policy makers, and technologists simultaneously, informing each of the other's

strengths and limitations and setting them to work together. Using new tools they can pursue parallel iterations and consider multiple ideas, capitalizing on complexity, creativity, and the synergy that emerges when humans strive toward a common good.

We can also sometimes find the unsuspected genius in the metaphorical haystack, the one rare human that can cut through the fog to find a uniquely valuable solution unapproachable through conventional methods. As we explore these new techniques we're learning how true the saying, "given enough eyeballs, all problems are shallow."

There seem to be only a few havens where such research—leading from crowdsourced ideas to operational deployment—is taking place, These are places where top-down implementation has not gone well or is hopelessly inefficient, and an alternative solution to a persistent and urgent problem is required. This panel session will highlight three examples:

1. **STAR-TIDES:** STAR-TIDES is a project at National Defense University exploring novel methods for providing seven core infrastructures (clean water, renewable energy, efficient lighting, resilient shelter and so on) to vulnerable populations. Instead of following a traditional acquisition model, STAR-TIDES harvests methods and tools from a collaborative social network and evaluates these approaches independently in environments that model real-world conditions. As of August 2012 several ideas have appeared in STAR-TIDES events that have subsequently been deployed to areas of exceptional need. One example is a new portable water purification system based on photoactivated nanofibrils successfully deployed in March 2012 for a cholera outbreak in Accra, Ghana.
2. **Sea Sketch:** Another example is Sea Sketch, a crowdsourcing tool for defining marine preservation areas off the California coast. Online public modeling resulted in ocean areas selected for preservation by the people of California far in excess of the original hope.

   Of note, the first legislated preservation model, based on good science but implemented top-down without public input, had resulted in stakeholder pushback severe enough to have that first law annulled. When a public website was established that showed (1) the science, (2) the many overlapping stakeholder concerns, and (3) a writable map, 16,000 potential plans were drawn using what later became SeaSketch and were submitted by citizens. After a public vote for best option the eventual legislation was accepted by stakeholders without protest, despite a preservation area four times larger than anticipated.

3. **RELIEF:** RELIEF is an international humanitarian response field exploration held periodically in the desert scrublands of Southern California and hosted by the Naval Postgraduate School in Monterey. The most recent RELIEF event brought more than 200 participants from a wide range of organizations into the field, including government agencies, industry, academia, NGOs, and a few refugees from garage workbenches, addressing a set of problems that required multiple stakeholders collaborating across multiple sectors toward composite solutions.

> Past RELIEF efforts have built several examples of grassroots-to-government bridging, including a process allowing lead federal agencies to release satellite imagery to the disaster response "crowd". Most recently, RELIEF participants applied crowdsourcing techniques within FEMA and the Civil Air Patrol to improve imagery collection and analysis during disaster response operations.

This workshop looks at several pieces of that. It explores "Grassroots to Governance" with particular attention to the effective use of crowdsourced information in disaster response. The need is great. Humans are facing complex problems that are not yielding to traditional solution methods, and the rate of change is very quick. To ensure that our nation and our species can survive a world that is headed for crises beyond the scale of today's understanding, we need to harness our collective intelligence to the necessary research.

And we'll find unexpected pearls. Mark Twain, in his story "Letters from the Earth," had a Junior Devil writing to God about the beauty of Shakespeare's poetry. God replied "Yes, Shakespeare is good, but truly, the finest poet I ever made was a mechanic in Philadelphia". Such invisibility, such waste of human capital, is no longer necessary, nor is it expected by the majority of the public. More than two billion people in the developed world routinely present themselves in a public forum, 800 million of them on Facebook alone. They expect to communicate with each other frequently through several channels, and they certainly expect that professionals and policy makers will be at least as competent at connectedness and community support. Fortunately, exceeding their expectations is neither difficult nor expensive.

And there is another consideration. It now seems mathematically probable that computer processing power will equal the neuronal firings of the human brain within our lifetime. The result of that enormous computational power is difficult to predict. It seems clear, though, that we will have "big data" and "big iron" available to us for exploring solutions to both severe resource shortfalls and technological abundance within the near future. One of the great questions is how to apply this computational power in ways that incorporate those who understand the problem best. We need to augment the human intellect in ways that enable us to tackle problems that even now are risking political stability and might eventually threaten our species.

Seen in this light, participation in the research, development, testing, and deployment of solutions for humanitarian support could be considered a right of the communities we're hoping to serve. If that's so, learning how to move ideas from concept to implementation within those communities we serve is a skill worth honing.

Appendix E

Letter on Security in Crowdsourcing

By Rebecca Goolsby, Ph.D., Office of Naval Research

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My article on cybersecurity, crowdsourcing, and social cyber-attack is delayed as my team begins to piece together the recent events in Assam, India that led to ethnic violence between the Bodo people and the Muslims only a few weeks ago. This is a subject that I have long had an interest in, owing to the significant implications of these new patterns of behavior, new forms of community, and new problems in crime and malicious mischief that the virtual world is experiencing everywhere we look. Consider this an informal letter/email on my thoughts on the subject that you may share as you wish, not as a publication, but as food for thought.

Information sharing has a spectrum of social impact, from the very "white," "clean," and humanitarian efforts such as disaster relief, coordination of humanitarian activities, and the promulgation of truthful information to topics more grey and even dark. This type of messaging seeks to bolster social order, relieve suffering, and promote positive social bonds. Counter-messaging, the refutation of bad information, lies, and mischief is a bit grey, colored by the propaganda that it seeks to refute. Its objectives are a bit more biased, to promote one's own "story" against the claims of others who seek to use deceit or misrepresentation to get their views across. Propaganda of every stripe–attempts to rally the base or influence others–gets a bit greyer still, with the objective of swaying others toward a particular agenda. The creation of hoaxes and scare-mongering campaigns seek to subvert public order, generate and exploit the resulting chaos so as to benefit or gain in some way. This is something of a new black art.

The use of "Photo-Shopped" images–pictures which have been altered in order to create fear and chaos–has been used before, particularly in Middle East affairs, where one

group or another alters images to suggest that police brutality, mob violence, or other acts occurred in one place and at a given time (when, in fact, the pictures were from a different place, time, and situation). Savvy social media enthusiasts know how to use "reverse image search" to find the true origins of photos—and to be skeptical of images found on the Internet. New entrants into the world of social media are not aware of these capabilities and can be readily fooled—as was the case in Assam. The use of MMS (multimedia mass texting, where images were sent to cellphones, rather than through the Internet directly) was an interesting addition. Details are scant, but it is possible that social media might have played a role, as social media enthusiasts often link their phones and emails to their accounts and often, unthinkingly, allow third-party apps (programs) to access their information—and provide links to their friends' information, which would be a good way to seed a snowball of interconnecting links. If my social media pal appeared to send me images, then I might trust that to be a true indication of what was going on near me (or near them)—when in fact it was some malefactor who poached his information and his connection to me.

It is unclear to me whether this happened in Assam. We're trying to figure that out, from a distance (myself, Dr. Huan Liu from Arizona State University, and others), but it is hard because Facebook and Twitter blocked the false content. Since they were a conduit---but not the primary conduit—for the false information, it was difficult to find this crisis at the time it broke. Discussions were in a minor language—Bengali—and thus the discussion of these images and the (false) situations they depicted did not overlap very much into English-speaking communities. The scare-mongering campaign was designed to capitalize on the social uncertainty among the Muslim community following several actual incidents in the previous weeks, leading to mass exodus to refugee camps only weeks before. That the attack was on the last day of Ramadan—a celebration of the Islam faith—was telling. Terrorists are historically interested in symbolic acts and time components figure prominently in their symbolic language.

The capability of crowdsourcing such an attack is now everywhere. Through social media, hate speech proliferates with the capability of reaching hordes of interested mischief makers who are comfortably anonymous and hard to track. Social cyber-attack as a means to bully, trick, and sow uncertainty in tense situations is not going to go away. It is not a matter of finding "the one guy behind all this" anymore, as malcontents, "trolls," and malicious actors are legion, connected in loose cyber-communities and technically capable. "Robot Twitter accounts" and other "zombie" systems can extend the reach of individuals and when these techniques are shared among like-minded anarchists and zealots, the capability of a small minority is magnified. They are thus able to pump their apparent numbers up and spread the risk of being caught around. With this capability of hiding behind dozens, even hundreds or thousands of identities, the risk of discovery is lowered, and the capability to develop an extensive cadre of cooperating "cyber-hoodlums" is growing. For those of us old enough to remember "phone phreaking" (http://en.wikipedia.org/wiki/Phreaking), this is not a new thing. The super "phreaks" can and do hide among the many, many "script-kiddies" capable of learning simple pranks and thus sowing mischief, hate, and chaos—chaos that the truly harmful

players can exploit financially, politically, or socially. Trying to find "that one guy behind it all" is to engage in a game of "whack-a-mole" with literally hundreds, thousands, and even millions of shadow puppets. It would be more profitable to try to discover clever ways of figuring out who benefits, but even then, that's a fairly small number.

There is research on this in a number of places and it would make for a useful workshop if the organizers were careful to look at the SOCIAL, as well as the TECHNICAL, aspects of this, for that is where the vulnerability is, in the connections among this shadow community. Further, the need to substantively educate the public, especially first responders, whose worlds are usually in a state of uncertainty, danger, and incipient chaos, about the need to be circumspect and savvy in information sharing, for they may be particularly at risk for exploitation, hoaxes, and scams. A crowd that carefully self-polices is the absolute best defense, as government cannot be everywhere—but the crowd certainly is.

Appendix F

Vision for the Future White Paper: "Humanitarian Response in the Age of Mass COllaboration and Networked Intelligence"

By Gisli Olafsson, NetHope, Inc.

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Abstract

The current humanitarian response system is based on institutions created during the Industrial Age. It was built when connectivity was a very scarce resource and information sharing was something that only happened during meetings. The increased resiliency of mobile communication networks and the proliferation of satellite-based network connectivity have lead to information being much easier to share. At the same time, the rise of social networks and the explosive growth of mobile ownership amongst the affected communities have led to a new way of communicating. Furthermore the large institutional humanitarian response organizations are no longer the only responders, with multiple smaller organizations also responding. This paper looks at the opportunities new technologies have provided in rethinking the humanitarian response system and how new approaches may address some of the key issues faced in large-scale disasters in recent years.

Keywords

Humanitarian Response, Mass Collaboration, Networked Intelligence.

Introduction

We are at a turning point in our history. With many of the institutions we have relied upon failing to meet their obligations, the effects of population growth, climate change, urbanization, globalization, and economic instability means that those organizations cannot continue to do business like they have done for the last 50 years. At the same time, we are seeing a convergence of a technological revolution (often referred to as the Internet Revolution), a social revolution (the growth of social networks), and the rise of the Digital generation (people who have grown up on the Internet). These times are therefore both creating new threats and opportunities and it is crucial that we don't ignore these factors and keep trying to do things the same way we have always done them.

In the field of humanitarian response we have seen the same signs. The way things were done 5-10 years ago no longer work effectively, in part because of the higher numbers of and the greater diversity of response organizations. At the same time the capabilities of the affected population to directly communicate with the outside world have greatly improved. With the massive growth of mobile phone ownership, the ability to reach out to people and not only provide them information to make better decisions, but also to get in return their input creates new opportunities for addressing humanitarian response in a new way, has improved.

In 2010 the United Nations Foundation (UNF) and United Nations Office for Coordination of Humanitarian Affairs (UN OCHA) asked the Harvard Humanitarian Initiative (HHI) to bring together some of the brightest minds in the humanitarian world and write a report called Disaster Relief 2.0 (Harvard Humanitarian Initiative, 2011). This was groundbreaking in many ways because it pointed towards new ways that the traditional humanitarian community could work with the new digital generation of humanitarian volunteers.

A lot has happened since the report was written. We have seen the award-winning ways (International Association of Emergency Managers, 2011) the volunteer community helped the humanitarian community get a comprehensive overview of the situation in Libya as the civil war broke out. We saw a massive triple-strike disaster hit a very high tech country and citizens utilize technology to share information with each other (Miettinen, 2011). Finally have seen a massive regional long-term disaster unfold in the Horn of Africa and people wondering what can be done to provide assistance and why it was not responded to earlier.

Rethinking the humanitarian response system

Back in 2005, following the South East Asia Tsunami, some of the leading organizations in the humanitarian community came together and initiated what became widely known as The Humanitarian Reform (Adinolfi, Bassiouni, Lauritzen, & Williams, 2005). This reform came about because the old model of doing things was no longer applicable, especially in large-scale disasters, and there was a need to rethink how we

handled some of the core issues faced when trying to coordinate the multiple organizations involved in dealing with large-scale humanitarian disasters.

In the humanitarian space, just like in most other areas, the changes we have experienced in the last decade are bigger than in the 50 years proceeding that period. It is therefore important for us to start the discussions now on how we need to reform or possibly reboot the humanitarian system for the coming decades. Under the leadership of UN OCHA, the Inter-Agency Standing Committee (IASC) has started a process they call the Transformative Agenda to address some of the issues that have been found in the humanitarian reform by refining it, mainly through clarification of roles and responsibilities.

But the danger is that the Transformative Agenda is trying to repair a system that is built on the principles of the industrial age, while what is really needed is apply the seven principles of the age of networked intelligence as defined Tapscott and Williams (2006). These principles are innovation, collaboration, openness, interdependence, integrity, self-organization and sustainability. At the same time it is important that we also don't lose sight of the traditional humanitarian principles.

In this paper we will go through each one of the Information Age principles and discuss what effect applying them to humanitarian response will have.

Innovation

We need new, innovative ways to approach to deliver the services needed in the aftermath of a disaster or crisis. Instead of distributing food vouchers to affected populations, we could top up their mobile banking accounts with funds to buy food. Instead of flying in food from abroad, we could utilize technology to help local producers close to the affected area transport and sell their food in areas where food is needed. We could create trading platforms for non-governmental organizations (NGOs) and UN agencies to buy commodities directly from local producers. We could leverage the transportation networks and sales channels of companies like Coca-Cola to get the commodities transported faster.

We need to target the aid we give in more innovative ways. We need to leverage mobile phone technology to determine with greater precision directly from the affected communities the actual needs—not just guess based on not-so-accurate needs assessment surveys. We know communication is aid and we must figure out innovative ways to increase and harness the information flow and establish the channels of communication (Infoasaid, 2011).

We must look towards open innovation models that allow us to leverage the expertise of people outside of the traditional humanitarian response community to address these complex issues we face. Through collaborative and open innovation, we can find solutions that utilize outside of the box thinking to come up with solutions we inside the humanitarian community would never have thought of.

Collaboration

The word collaboration comes from the Latin word "collaborates," which means to work together. Webster defines it as "*to work jointly with an agency or instrumentality with which one is not immediately connected*" (Merriam-Webster, 2011). In the humanitarian world we have more focused on coordination than collaboration in the past. Webster defines the verb coordinate as the act "*to bring into common action, movement, or condition.*" This has often caused issues dealing with other organizations such as the military and the government civil protection because in those organizations things are done through a "command and control" culture.

Interestingly most humanitarian organizations internally have a rather strong culture of "command and control" through their bureaucracies of management levels. But when they interact with other organizations in the field they refuse to adhere to any kind of command and control structure, but have agreed to coordinate with each other albeit some more reluctantly than others. The big issue however is that the mechanisms for coordination are breaking down as more and more organizations get involved and as the scale of the emergencies faced grows each year.

The great research of Professor Emeritus Dennis Mileti of University of Colorado at Boulder showed us that one of the biggest obstacles to collaboration during disasters are organizations (Mileti, 1999). When disasters strike, organizations tend to fight for attention from the media and the public, fight political turf battles, and try to utilize a disaster to proof their importance and existence. A great example of this can be found in any country in the world where you can ask a police department if they like their fire department or vice versa. The same also holds true in the international arena where the large UN agencies and the big NGOs fight endless turf battles while people are suffering. But luckily, as Dennis pointed out in his research, people come to the rescue (Kim, 2004). It is through individuals in these organizations that collaboration happens, often against the political will of the organization.

In this age of networked intelligence and mass collaboration, we must find innovative ways to leverage social networks (both technical and non-technical) to improve this collaboration that is already happening at the individual level. Leadership within the humanitarian organizations must allow for these individual acts of collaboration to happen and in fact they should be encouraging them. It would also be very interesting to see what happened if the donor community would encourage collaboration in all projects they support.

In one of his early TED lectures, Clay Shirky (2005) points out that the old way of coordinating is by creating institutions. But since communication costs are going down drastically, there is another option, putting the coordination into the infrastructure by designing systems that coordinate the output of the group as a byproduct of operating the system without regards to institutional models.

Let's take a concrete example from the humanitarian world of how this might work. Humanitarian response is all about matching needs of the affected communities with the response capabilities of the humanitarian organizations responding. The institutional way of performing this match is to define a lead organization (cluster lead) that is responsible for bringing together all the interested parties (cluster members) to a meeting (cluster meeting). This happens as often as is required to get each one of them to report on what they have found the needs to be and then report how they are responding to meet that need. If the cluster lead is doing a good job, they get a good matrix of needs and responses and can then help identify duplication of efforts and gaps in the response.

This model stems from the time communication between the different organizations was difficult/expensive and communication with the affected communities was something you only did during needs assessment missions. But in a world of networked intelligence, where the affected communities have a capability to communicate their needs directly and where the response organizations can easily/cheaply communicate with each other, the model can be self-coordinating.

Through increased information sharing and better communication it is possible to take collaboration within humanitarian response to the next level and overcome many of the issues faced with current models of coordination.

Openness

Today an enormous amount of effort is spent on accountability of humanitarian work. This stems from decades of waste and corruption that unfortunately was quite commonplace. But the methods for averting corruption that were to put in place led to a very rigged accountability processes. At the same time, very few of the humanitarian organizations are transparent about how they spend the money they raise. Of course, most of them publish reports, but detailed information about expenditures may be difficult to find.

In the age of networked intelligence, transparency is a new form of power. Rather than being something to be feared, transparency is becoming central to successful organizations. Open organizations perform better (Tapscott & Williams, 2006), so smart NGOs are choosing to be more transparent. One could say they "undress for success."

It is not difficult to imagine what would happen if all humanitarian organizations were open and transparent about their work and those who provide them with money (both the public and governments) could see in detail how those funds are being used. Instead of massive overhead from accountability processes, it would be possible to introduce full openness. This openness will also lead to people finding new and more efficient ways to address the issues faced. If someone notices that a large portion of funding goes towards a particular task in the relief operation, then that immediately becomes an opportunity to find new and more efficient methods.

Interdependence

When the cluster system was introduced seven years ago, it helped improving the coordination of humanitarian response because it brought into the cluster all the organizations working on a particular subject area, such as health, education, etc. However, one of the drawbacks we have seen is that the work of each of the clusters has become more compartmentalized than before. Inter-cluster communication and information sharing is not functioning properly in most emergencies. Humanitarian response, however, is very interdependent. If you don't ensure good sanitation and hygiene, then you will see health deteriorate. If you don't provide enough food and water to people, then you will see malnutrition increase. In many cases, you have humanitarian organizations that fully understand this interdependency and therefore work within multiple clusters within the same area.

So what can be done to address this? One approach might be to split work based on geographical areas, rather than clusters. An organization then becomes responsible for providing all services to the community in a particular area. If they don't have the specialty to provide a particular service, then they collaborate with another organization that specializes in that field. This way the organization that is responsible for the area can ensure that all the interdependent factors are being addressed and that there are no gaps in the response effort.

Integrity

Integrity is all about doing the right thing, even when nobody is watching. It is possible to leverage the age of networked intelligence to ensure that integrity is an overarching principle that everyone follows. There are multiple examples already of how humanitarian organizations are utilizing technology to monitor their own performance and integrity (Save the Children, 2010). With cell phones now doubling as cameras and video recorders, you never know when someone might actually catch an organization compromising its integrity. This constant monitoring by beneficiaries and citizen reporters should lead to increased integrity in humanitarian response, even if we loosen the strict models we follow today.

Self-Organization

Following a sudden disaster, there is great chaos as the people affected by the disaster try to find ways to survive and the large swarm of relief organizations descends upon the affected area. In our attempt to deal with this chaotic system, we try to enforce structure through "humanitarian response systems" that enforce hierarchies upon environments that are not hierarchical in nature. The key reasoning behind hierarchical responses is that information about the overall situation is only available from the top down.

In their seminal paper (Alberts & Hayes, 2003), Alberts and Hayes discuss how the very structured and hierarchical command and control model of the military needs to evolve because better access to information, even on the battlefield, allows for more rapid and context sensitive decisions to be made at the field level. One of the key points they make is that while strategic direction should come from the top down, the tactical decisions need to be made "*at the edge*" by those on the battlefield.

We can learn a lot from their paper and apply it to humanitarian world. If it is possible to provide field workers with the same level of access to information as people in HQ have and if they are provided with the right strategic decisions, then it is possible to empower them to not only make decisions locally but also to organize locally how they interact with others.

If it is possible to provide everyone with information about what everyone else in the area is doing and allow for them to link up with others working on similar activities, then self-organization would start occurring naturally. The key to this, however, is the ability for organizations to easily report on their activities and areas of interest. If they had a simple way of doing this, then it is very likely all of them would feel very inclined to do so because it is in their own self-interest to avoid duplication and identify gaps in the response.

At the same time it might be possible for the affected communities to quickly see what is happening in their area, who is working there, and where there are gaps. That would either allow them to lobby for more focus on unmet needs or to self-organize to help address that need in their own community. Today's humanitarian response system is too closed and doesn't allow for inclusiveness of new humanitarian organizations, let alone the affected communities themselves. It is essential this changes.

Sustainability

In recent decades we have seen increased focus on disaster risk reduction activities, but most of these are still in their infant stages and only at the governmental level. In recent years, we have also seen increased use of the term resiliency when talking about how to better prepare communities for potential risks.

The long-term focus on risk reduction and resiliency will certainly help us minimize the threats nature throws our way, especially when dealing with the sudden onset disasters such as earthquakes, tsunamis, and floods. But when dealing with long-term disasters such as drought, we must look for sustainable ways to prevent them from leading to even more complex emergencies such as famines.

But we must also think about sustainability when it comes to providing the humanitarian relief itself. Instead of endlessly transporting large amounts of relief items halfway across the world, we must identify ways of utilizing more local and regional resources for help. This, in turn, can help the local economy and economies in the region grow through production and provision of those relief items. In the famine in Ethiopia in the

late 1980s, there was enough food available within the country itself – it simply was not available in the areas where the drought and famine was worst. Yet instead of transporting food from other parts of the country, relief organizations transported relief items from other continents and markets for local food in the non-affected areas tumbled.

The only way to create sustainable disaster risk resiliency is to ensure it is community driven. We must give the affected communities better tools to prepare for, respond to, and rebuild from disasters. We must build local capacity and expertise in dealing with the hazards people live with. In the end, we must work ourselves out of a job by making disaster prone countries more resilient and better prepared to respond themselves to disasters they face.

Conclusion

The main purpose of this paper is to get the reader to think about how the humanitarian system might be adapted to more modern ways of addressing the complex problems that everyone faces in the humanitarian world. Some of the ideas presented in this paper may seem a bit too radical for now, but as the digital generation takes over from the pre-digital generation in the humanitarian world many of the ideas could be implemented. It is important to remember that the organizations doing humanitarian work today are not going to change by themselves - it is through the people inside and outside of those organizations that this change must happen and hopefully that in turn over time leads to at least some of the organizations to start thinking in new terms.

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Appendix G

The Eller HADRIM Framework: "Humanitarian Assistance and Disaster Recovery Information Management Model"

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Abstract

This paper presents a model for secure information management in complex, multi-agency humanitarian assistance and disaster relief (HADR) missions. To the greatest extent possible, the operations that comprise this plan are transparent to both the response teams in the field and the affected community they are supporting. This puts the responsibility for an agency's information technology management processes dominantly within the home office where there is time to act with deliberation.

Motivation

The success of HADR missions is proportional to the quality of information available to relief coordinators at any given moment. To the extent that information technology can achieve high levels of quality, with a rated Force Effectiveness Multiplier (FEM) greater than 1.0, it should be deployed with all due haste. Unfortunately there are many more ways for data feeds, support tools, and reporting requirements to unintentionally decrease effectiveness with FEM less than 1.0. Therefore, coordinators must demand a quality process to ensure that every information element proposed — hardware, software, human, and process — can be shown to increase effectiveness reliably. The

consequence of a careful information management program is that the operation can consistently eliminate obstacles to success through this agile security process.

Objective

Based upon the need to utilize information technology to improve force effectiveness, we conclude that the goal of this model is to

"Control the impact of information on force effectiveness."

Methodology

Taking a page from formal control theory, we must recognize that the variable under control (FEM) cannot be changed more quickly than the manager can detect the effects of decisions made. Therefore, the process must operate on a sufficiently long cycle that new policies are not judged prematurely. This leads to a three stage, iterative model:

- Setting policy,
- Executing the plan, and
- Measuring the results as evidence for the next iteration

In addition to executing the plan in situ, we need to recognize that preparation is equally relevant. Specifically, we must prepare through the following activities:a

- Material caching,
- Budgeting,
- Developing relationships, and
- Surveying the physical and digital landscape to understand the changing world.

Finally, because plans are only as good as they are flexible, it is important to understand that the mission command staff are always the final arbiter of correct actions. This may be the case even in direct contravention of any plan element. While this surely poses a risk to the implementation of information security, it is a frank assessment of the nature of the mission and must not be "toughened" during process review. If policy authors would mandate specific behavior, they must persuade the mission staff by clear presentation of historical evidence, it is incumbent upon the writer to educate those staffers with evidence and reasoning.

Security domains

In order to implement access controls, we must first define certain domains between which boundaries will be constructed and secured. These security domains may be virtual, as in the contents of a database, or they may be physical, like a data center. Generally, virtual domains have an inherent reliance upon the physical security that

prevents access to the machines which host the sensitive information. Since the purpose of this framework is to maximally leverage information, the foundation of all security described herein should be seen as a pairing of restricted access to information and extremely restricted access to physical hosting areas.

1. Affected area

During a HADR mission, the most general security area is the affected terrain. This framework assumes that no access control to this area can be achieved. While the majority people in this domain are probably in need of assistance during the recovery effort, we also assume that some groups in the area may have malicious intent toward the mission staff and any volunteers who would assist.

2. Mission encampment

For the safety of all concerned, we must restrict access to personnel, supplies, and the command center. With an established perimeter and appropriate entrance screening, we can operate in the affected community and yet control interaction with adversarial parties. Securing this domain should be an ongoing effort, beginning immediately upon deployment and evolving along with the situation. To secure this domain, consider the following list of concerns and mitigations:

a. Perimeter incursion - fencing

b. Reconnaissance from without — opaque fencing

c. Crossing the fence from within — monitoring device with motion detection

d. Volunteer entry — photo identification only; passwords too hard to remember, biometrics irrefutable

e. Access probing (malicious volunteers, identifying "collaborators" who pass within) — offer a duress "button" and greatly increase caution when it is pressed.

f. Vehicular overrun — in cases where highly adversarial populations may use car bombs or other incendiary devices, follow the "green zone" model of concrete obstacles to deny vehicle access.

g. Wireless snooping - GSM, Wi-Fi, and other wireless data connections must be deployed in a secure fashion to prevent access from outside the encampment.

3. Mission operation center

Mission planning information must be secured from all non-essential personnel as it may be lethal in the hands of opposing forces. Thus, deep inside the mission encampment is the operations domain. It should be in a position that would make it as difficult as possible to reach from outside the encampment. To secure this domain, consider the following techniques:

a. Access control - Photo ID badges

b. Extremely sensitive situations - Daily password rotation, to be briefed each morning to the minimum feasible group

c. Weapon, medicine, or other highly valuable stores - 24 hour guard, potentially armed; or, secure access technology like a “man trap”.

4. Organizational headquarters

The “home office” of the leading operation team. This is usually distant from the affected area, and connected via “umbilical” data links such as shortwave radio or satellite uplink. The headquarters, at least its data center, must be at least as secure as the mission operation center. Otherwise, the intelligent adversary will simply invade the mission from a great distance. The means to secure a daily use facility is outside the scope of this document, but a majority of all defensive spending should focus on this most durable domain. Especially sensitive information regarding volunteers in affected areas MUST NEVER be stored outside this domain. Access MUST be rigorously controlled.

5. Human Information Database

The “crown jewels” of any organization are its people. Securing personally identifiable information (PII) about the staff, volunteers, staff, and affected individuals is the most important role for HADRIM. Without trustworthy protection of the people, every other goal of the HADR mission is in jeopardy. The canonical store should follow rules equivalent to the best commercial offerings; as an example, consider the Amazon One-Click system where the payment system can only be controlled from a web browser but card information cannot be retrieved. This is probably not achievable with open source tools and best effort planning, but instead requires very diligent implementation by an experienced security engineer or architect.

Roles

This model assumes that involved parties are already busy with their work. To implement these recommendations, then, requires HADR teams to increase their ranks by one member. The new Integration Engineer role is complex and nuanced, and should be seen as a technical leadership career. These technical managers need to understand subjects as diverse as the Incident Command System, UN relief agency charters, international response team mandates and resources (e.g. the Icelandic Urban Search and Rescue Team, the Israeli Eye Injury Management Teams, the US Disaster Mortuary Assistance Teams), local transportation, communications, and data capabilities, network engineering, recognized inter-agency rivalries, recurrent response team personnel, collaboration and mediation skills, physical self-reliance, personal and data security protocols, media crucible techniques, and agile software development for field conditions. Agencies need to develop individuals with this level of training.

With the addition of the HADR Integration Engineer, much of what follows becomes feasible.

Stage 1: Preparation

Preparing for situational information management is broken into three distinct activities with associated goals:

Stage 1:

Activity 1.a: Software design

Developing the ability to visualize data as needed by the deployed staff. Any deployed software must be maintained by a durable entity such as a commercial, governmental, or non-profit agency. No software can be deployed that violates this rule without unacceptable risk.

Activity 1.b: Data surveillance

As there are many durable sources of information on which HADR missions rely, especially weather and geospatial information services, it is valuable to fully integrate these sources with the software developed in Activity 1.a above. However, many other data sources are more dynamic than agency process can manage. For that reason, it is crucial that the software be configurable by technicians in the field to use ad hoc data sources as they are discovered. And since any method of data access, like a given NOAA web service, may fail, it is important that field-selected data sources can be configured flexibly and with minimal technical skill.

Activity 1.c: Relationship management

Trust is an important characteristic of successful missions; effectiveness drops when there is mistrust between the people involved at any level and on any topic. Managing relationships with the many people involved in potential future missions can protect the software, information, and people in the affected area. Education and role-playing in collaboration and mediation, formal agreements, and Customer Relationship Management (CRM) software can each be used to assist with this crucial and under-supported activity.

Goal 1.c.11: Engage software developers

As all software used in this model must be managed by a trustworthy entity, it is crucial to connect volunteer software developers with those entities early and with clear development standards for the software engineers involved on both sides. A reasonable standard would be reaching out to every relevant developer at least once each year. Encourage development organizations to adopt a security maturity model (such as the Building Security In Maturity Model) by preferring contributions made by more mature contributors if the options are otherwise equivalent.

Goal 1.c.2: Engage open data providers

Staying abreast of developments in the open data movement and digital sensor market is crucial if Activity 2 is to succeed. Challenging volunteers to test any agency's

assumptions about each data type and source is a sensible means of improving awareness and preparedness as capabilities change. Test the information catalog at least once each year. Audit each data source at least once to validate that appropriate security, redundancy, virtualization, and/or field deployability claims can be substantiated.

Goal 1.c.3: Engage global volunteers
Identifying and connecting with volunteers around the globe can create the seeds of trust by liaising between responders and the affected community. Online forums, chat rooms, video conferences, and video games can be used to increase the sense of community and engagement. Reach out to every member of a global volunteer seed network three or four times each year. Give the most active contributors additional responsibility to coordinate with others in their area for training and sandbox exercises.

Stage 2: Integration

Every response has unique features that contain context for information. One simply cannot reliably predict which data sources will be available or how each information element should be interpreted in a given mission. Therefore, most of the data sources connected to visualization software must be connected in an ad hoc fashion.

Of course, a few durable sources like weather should be pre-configured by default with highly reliable and independently maintained source feeds. To manage those data sources that appear during the response, become indispensable, and were not known before deployment, one or more Integration Engineers must be deployed with a response team to integrate the prepared tools with available data sources and feed those to other relevant teams throughout the response.

Activity 2.a: Data Reconnaissance
By continuously re-evaluating the data sources already cataloged in Activity 1.b, the Integration Engineer can develop a situation-specific information catalog current at the onset of any event. This will be the scope of the data that will be available at the onset of the mission. It should be briefed in an accessible and replicable format as “Best Available” to teams attending the first field-based Humanitarian Update brief.

Activity 2.b: Software Integration
As an Incident Commander or volunteer recognizes that a given view or function will be of use for the mission, that should be passed as a requirement to the Integration Engineer. Once the tool has been connected to the appropriate data sources, the working software can be deployed and briefed to fellow responders as a resource.

Activity 2.c: Activate Local Volunteers
Communicate the extents and goals of the mission to the community developed in Activity 1.c so that local volunteers can quickly engage the affected population and begin to develop the relevant lines of local communication. This cannot proceed until

the integration stage is relatively complete; the volunteers must be connected to the process only after it is up and running.

Goal 2.a.1: Rapid Command Activation
Upon deployment, the mission commander must produce a list of necessary catalog elements. Within 12 hours, integration of this first set of tools should be complete and handed off to the commander.

Goal 2.a.2: Timely Completion
Within 24 hours of deployment, all of the remaining tools listed in the catalog should be integrated and delivered.

Stage 3: Implementation

After preparing and integrating, the mission proceeds.

Activity 3.a: Technical Logging
Every information technology component (software and hardware both) must support high resolution activity logs for post hoc analysis. Every action performed by each user must be recorded. Every computer-to-computer interface message SHOULD also be recorded.

Activity 3.b: Event Logging
To provide context to the technical log, the human activity log must also be made available to analysts after the fact in Stage 4.

Goal 3: Failures must be captured
While it is impossible to predict how a given scenario will interfere with the best laid plans, the goal of logging is to capture the historical record in sufficient detail that most problems can be observed in the log.

Stage 4: Analysis

Discover inefficiencies and failures of the model. Recommend changes for the next iteration.

Activity 4.a: Historical reconstruction
Technicians transform the human and machine logs into a single narrative that attempts to capture the sense of the situation rather than every precise detail. Each input fact and narrative element must be connected in a manner that can later be used for forensic analysis.

Activity 4.b: Information management process review
Assemble a panel from members of the mission as well as software developers, data providers, and volunteers from the affected community. The committee's role is to provide commentary and guidance for improving the effectiveness of human, software, and data elements of future missions.

Activity 4.c: Corrective improvement
Implement the recommendations of the review committee.

Goal 4: Timely guidance for future missions
The review committee should seek to meet early, work with due urgency, and present their findings quickly. Ideally, this report will be made available to all parties within 90 days of the first de-escalation of each mission.

Key Performance Indicators

The efficacy of this process must also be evaluated and improved over time. As such, it must generate useful metrics along the following lines. Success Thresholds should be re-evaluated periodically, as a quality process will improve over time. The values presented here are mere suggestions. These indicators do not and cannot define success! Success can only be found in the health and well-being of the affected population. Instead, use measures like these to help identify process weaknesses.

Indicator 1: Software uptime

Total number of hours of proper software function for each component, divided by the duration of the mission. To be computed by comparing service start and stop events in the event log.

Success Threshold: 95%

Indicator 2: Information availability

For each data element recorded in the Activity I.b catalog, the proportion of hours that source was available to the mission. To be computed as the proportion of successful data source connection requests compared to all data source connection requests.

Success Threshold: 95%

Indicator 3: Information reliability

Proportion of data elements requested by software to the number of those elements delivered without error. To be computed as the proportion of successful data access requests to the total number of data access requests.

Success Threshold: 99%

Indicator 4: Volunteer activation time

The mean time between the first request for volunteer services and their arrival at a determined gathering location. To be calculated from the volunteer check-in log.

Success Threshold: 48 hours

Indicator 5: Decision latency

The mean time between data availability (which begins when a useful fact first arrives at a software tool through a data interface) and the first activity recorded that makes use of each datum. To be computed as the average time between commands issued and the most recent event presented in the user interface at the time of each command.

Success Threshold: 5 minutes

Indicator 6: Command activation time

The interval from first arrival on scene until completion II.a.

Success Threshold: 6 hours maximum

Indicator 7: Data-tool integration latency

Time to integrate each data source with each software tool. To be computed as the duration between the completion of 2.a and the completion of 2.b, divided by the number of data source and application interconnections.

Success Threshold: 30 minutes per connection

Indicator 8: Logging utility

The proportion of failures or defective behaviors reported that can be accurately reconstructed from the event log. Ideally, the log will permit complete, accurate forensic reconstruction of each failure. To be computed from the post hoc software development activities by polling the software developers and/or quality engineers.

Success Threshold: 95%

Appendix H

Social Media Engagement Summary

September 13-14, 2012

Commons Lab of the Science and Technology Innovation Program

The Wilson Center
Ronald Reagan Building
1300 Pennsylvania Ave NW
Washington, DC

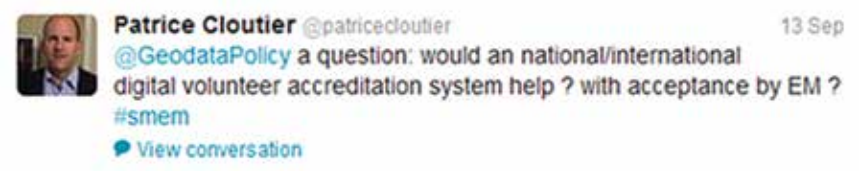
Social media was used extensively in the "Connecting Grassroots to Government" workshop, enabling feedback and participation from diverse locations. Two social media platforms were engaged to incorporate these voices: TechChange and Twitter. TechChange's platform allowed an online audience to watch the Wilson Center's live video broadcast, follow the Twitter feed for workshop hashtag #DG2G, and submit comments and questions for the panelists. Questions from viewers were sent to a designated email address, and while email is not a social media, these questions were re-posted on Twitter and read aloud in the workshop. Before the event our workshop was publicized on several popular blogs, which increased awareness and participation. Some 422 viewers from more than 30 countries also watched our live video feed. During the workshop over 1,510 unique tweets and 569 retweets were sent with our designated #DG2G hashtag.

Twitter Interaction

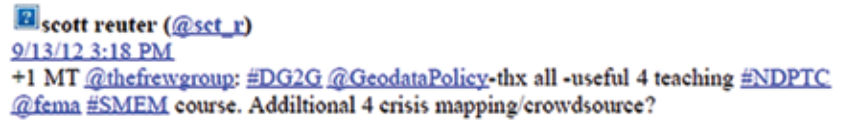
Participants' and viewers' contributions on Twitter ranged widely. Some tweeted summaries of what they heard.

Others publicized their participation to their networks.

Questions – either meant to be asked of the panelists or mere ruminations – sometimes appeared. Panelists alternately answered questions from the in-person audience and those following online.



Many tweets were compliments or applause from those who found the workshop useful. Sometimes these tweets were addressed toward the workshop organizers, but others were directed at the panelists and moderators.



Some participants made announcements or pointed to resources that had some significance for the panel or the workshop.

Gus (@hashonomy_gus)
9/14/12 3:14 PM
Commons Lab releases report on liability for digital volunteers in disasters ... hashonomy.com/Og3d/ #smem #dg2g (via @GeodataPolicy)

J. Chris Pires (@JChrisPires)
9/15/12 10:48 PM
"@paulblaser: Big Data, How to Detect Relationships Between Categorical Variables - ow.ly/1OvwE0"

Live Webcast Exposure

The live video feed was viewed extensively across the globe. Our media and technology partner, TechChange, enrolled the participation of about 150 students from 30 countries (Figure 1); these students submitted questions for the panelists via our designated email address.

Figure 1. Locations of students watching live video feed

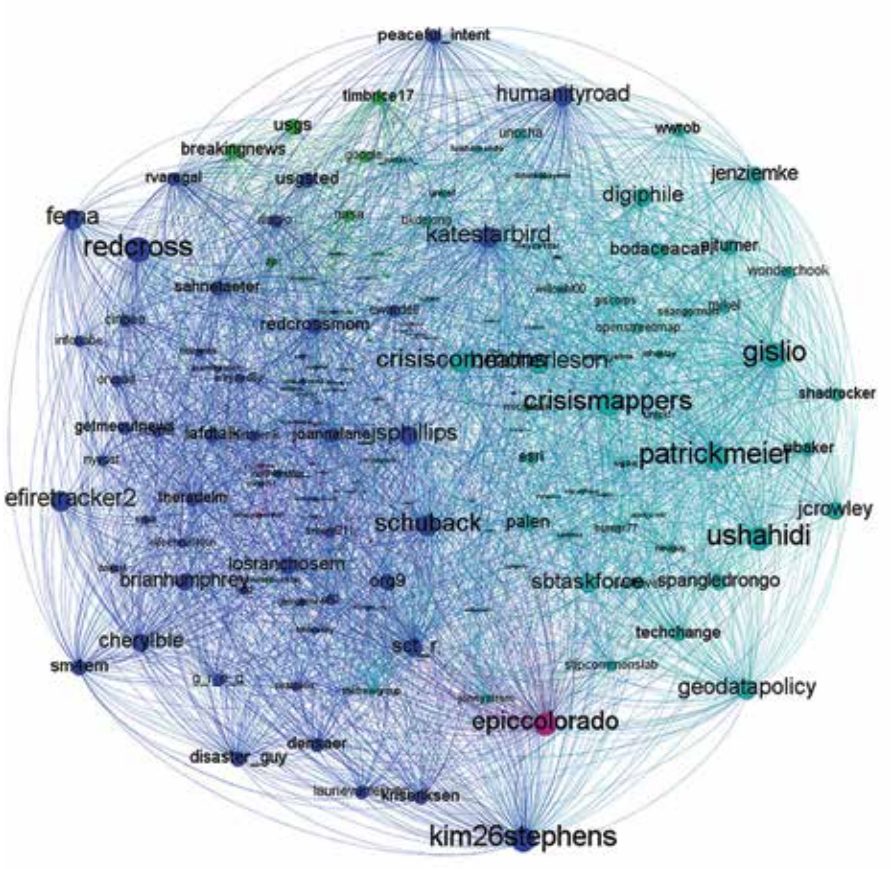
The widespread use of our video feed became more evident when technical difficulties occurred. Several tweets and comments reported their difficulties viewing the video.

Social Network Analysis

Three social network analyses have been posted since the workshop, which visualize and analyze Twitter-based participation in the workshop.

The first analysis (Figure 2) visualizes the structure of the Twitter-based community of those who participated in the #DG2G hashtag. The size of the handle represents that person's number of followers. The colors represent different "communities" identified; there are seven total, but two dominate: disaster relief and crowdmapping. The Wilson Center tweeted from two accounts: Lea Shanley (@GeodataPolicy) and Ryan Burns (@ryanburns77)

Figure 2: Social media in emergency management (SMEM) community structure



The second report provides more detailed statistics and analysis capabilities using the TAGSExplorer interface, which allows one to visualize several dimensions of the data-set. For instance, one can visualize the relationships within the corpus of tweeters and retweeters (Figure 3). By clicking on a user within this visualization, you can see their original tweets as well as their replies and mentions (Figure 4).

Figure 3. Tweeters and retweeters using #DG2G hashtag

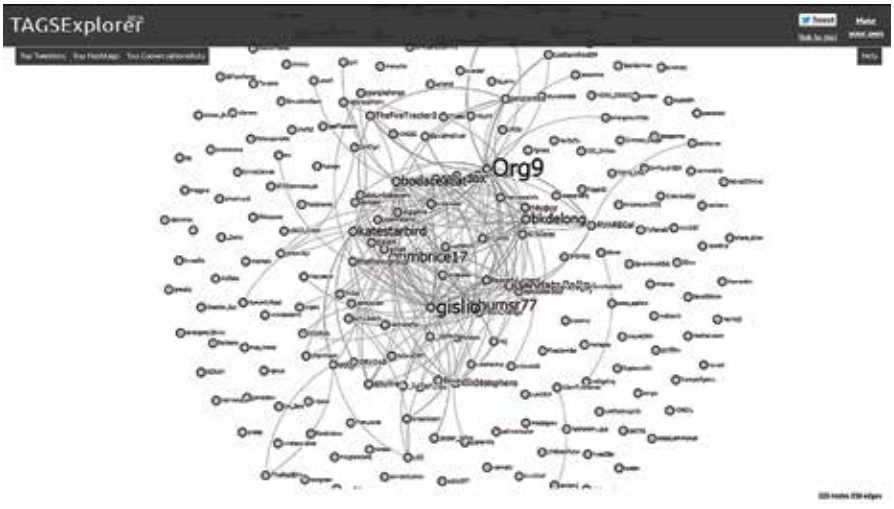
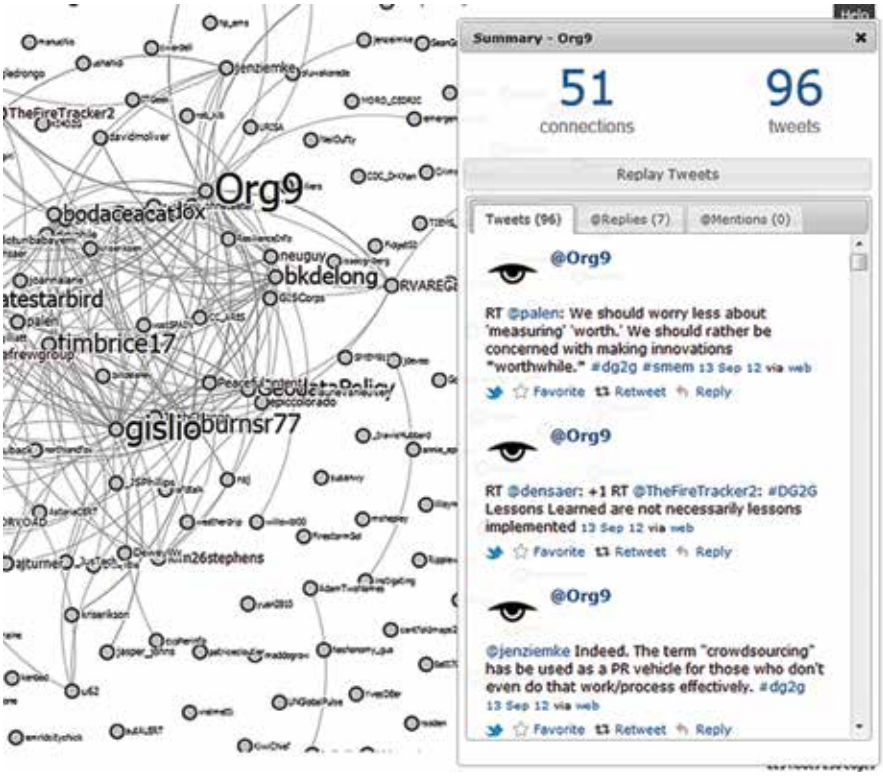


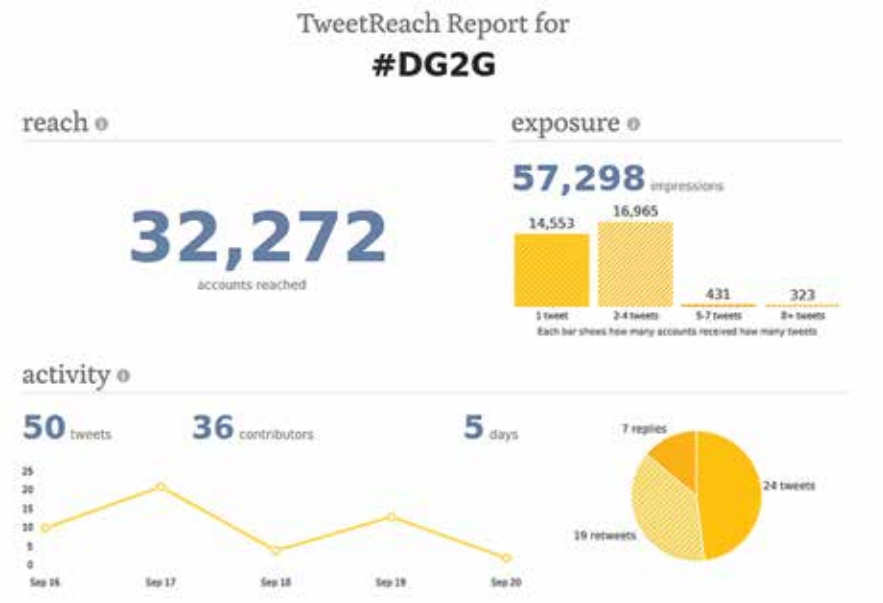
Figure 4. Users' tweets can be seen by clicking on the user in the graph



Exposure via Twitter

A workshop participant also created an interesting analysis on TweetReach. During the first day of the workshop, the #DG2G hashtag was exposed to more than 91,000 Twitter users. Two days after the workshop, the conversation continued with over 32,000 users since the analysis began, even with a mere 50 tweets over 5 days (Figure 5).

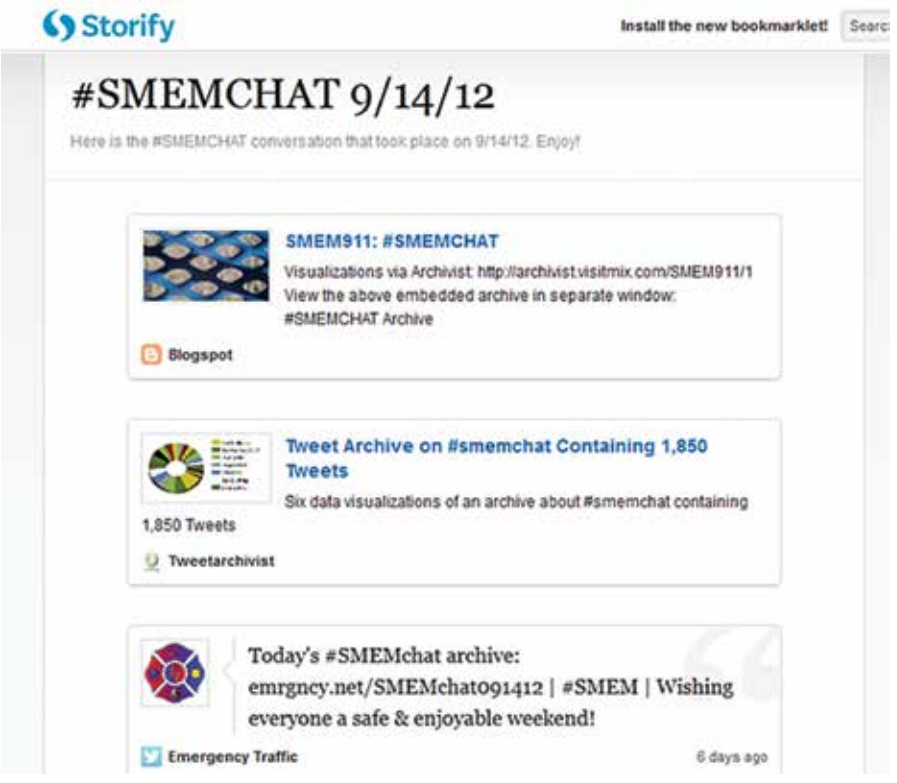
Figure 5. Post-workshop TweetReach report showing exposure through followers of tweeters



Storify Twitter Timelines

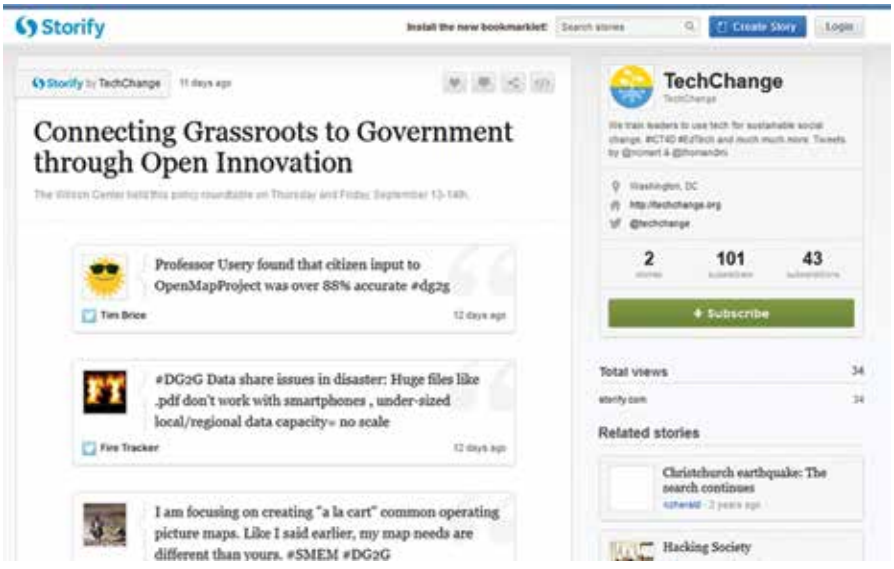
Interestingly, some who participated in a related event, which used the twitter hashtag #smemchat, also used the #DG2G hashtag (Figure 6). This indicates the workshop is gaining exposure in the broader conversations targeted.

Figure 6. Some involved in #smemchat also tweeted the #DG2G hashtag



A second Storify built by TechChange was viewable by the public, particularly by the group's 101 subscribers (Figure 7).

Figure 7. TechChange created a Storify dedicated to the #DG2G hashtag



#DG2G Tweet Database

Finally, one participant proactively collected all the tweets containing the workshop hashtag #DG2G, archived them, and made them available to the public. This will serve as productive material for future analysis and reports. This also included graphics of tweet volume over time (Figure 8) and top tweeters (Figure 9). The live video feed went down in mid-afternoon of the first day, which may account for the fewer tweets the second day.

The link for the tweet database is: https://docs.google.com/spreadsheet/pub?hl=en_GB&key=0Agv4Epc567okdHlNdE5xRzhOODM4Y3diMVh6dUg3aUE&hl=en_GB&gid=36

Figure 8. Tweet Volume Over Time

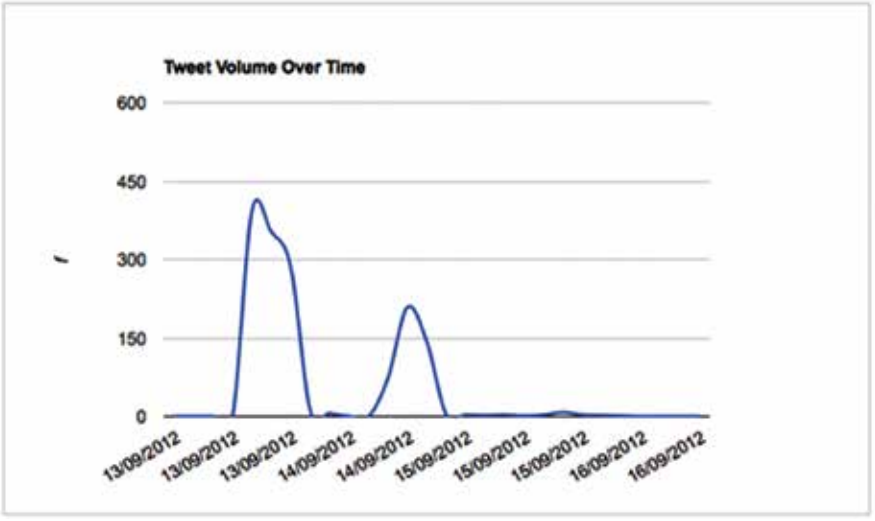
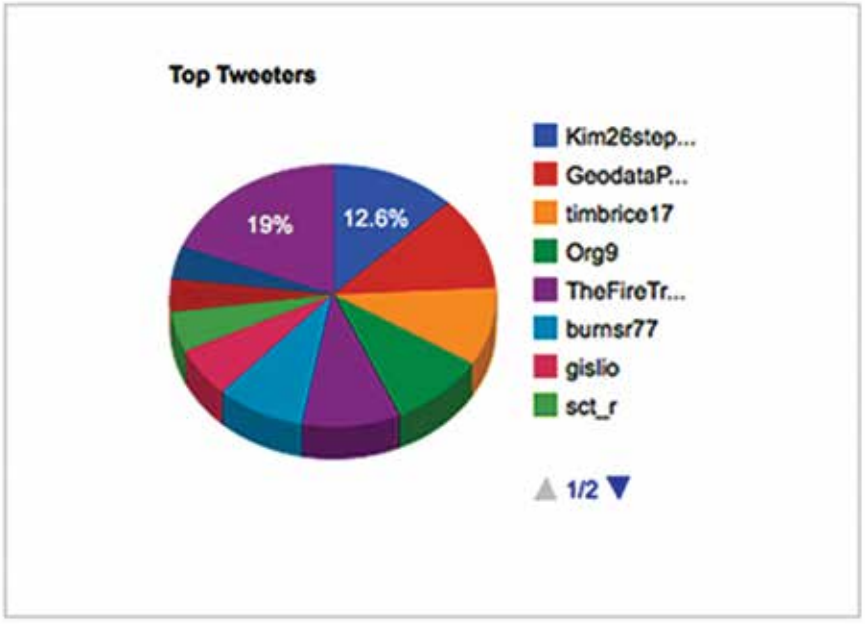


Figure 9 . Top Tweeters using hashtag #DG2G



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The Commons Lab of STIP advances research and policy analysis of emerging technologies and methods—such as social networking, crowdsourcing, and volunteered geographic information—that empower individuals ("citizen sensors") to collectively generate actionable scientific data, to augment and support disaster response and recovery, and to provide input to government decision-making, among many other activities.

http://CommonsLab.WilsonCenter.org

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