g2g 0.90: Connecting Grassroots and Government for Disaster Response

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CONNECTING GRASSROOTS AND GOVERNMENT FOR DISASTER RESPONSE

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The Commons Lab of STIP seeks to advance research and independent policy analysis on emerging technologies that facilitate collaborative, science-based and citizen-driven decision-making, with an emphasis on their social, legal, and ethical implications. The initiative does not advocate for or against specific technological platforms, rather works to ensure that these technologies are developed and used in a way that maximizes benefits while reducing risks and unintended consequences. Our work often focuses on novel governance options at the "edges" where the crowd and social media operate—between formal and informal organizations and proprietary and open-source models of data ownership and access.

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Foreword

This report is a testament to the vision of the Wilson Center and Sloan Foundation to study how to address an emerging problem in disaster response. After Hurricane Katrina, it is no longer acceptable to think of response operations as the domain of governments alone. Most of the actions on the ground are performed by communities. That said, these efforts are often poorly coordinated with themselves and with larger government-led operations. While today's communication technologies—from social media to crisis mapping—have been improving coordination at the citizen-to-citizen level for several years, they are just now beginning to have an effect at the interface of those grassroots efforts and their connection to government. This report studies the interface that future-looking agencies are establishing, and setting out these examples as potential exemplars of change.

Goal of the Report

This report surveys the state of the interface between these two communities: grassroots organizations like the Humanitarian OpenStreetMap Team (HOT) and Standby Volunteer Task Force (SBTF) and US federal agencies. This interface is changing rapidly—Hurricane Sandy catalyzed effort by federal agencies to connect into the whole of community response. As a result, I am writing a dynamic document: a text that is meant to be edited like a wiki entry, rather than consulted as a brick of knowledge. With the Wilson Center, we will build a wiki to edit the core toolkits and policy issue, and drive energy to the development of a comprehensive map via workshops at the Wilson Center and other venues, such as RELIEF/Camp Roberts and TIDES/NDU, and OHI/NetHope, and ICCM.
Report does not claim to be a new version of Disaster Relief 2.0 (the so-called 2.1 version), but rather a 0.1 version of an interface between the grassroots and government around crises. Like most version 0.1 software, it is a framework for further work by many others—hopefully by experts that can expand the thinking from this document and correct errors early in the process. With luck, it will limn out a framework that can shape these efforts, without locking federal agencies into a single approach or constraining them to early legal and policy opinions about how to engage with the grassroots. It is my hope that technologists, legal advocates, and senior policy makers will create a partnership that will explore what can be done when the collective intelligence of the world comes together for disaster response.

John Crowley
Cambridge, Mass. and Newtown, Conn.

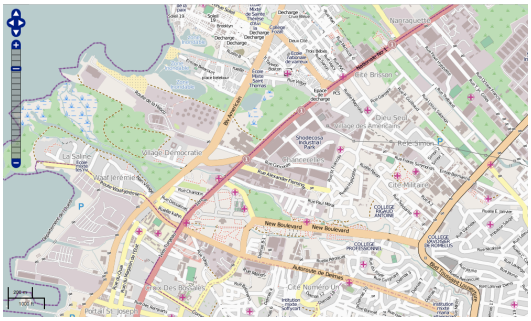
Dedicated to the citizens of
Newtown, Connecticut:

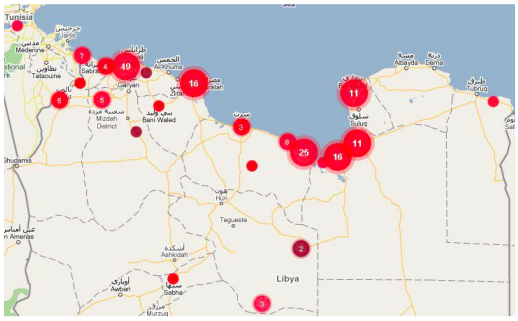
my hometown
whose educators and first responders
taught us a love of community,
introduced us to the joys of public service, and
filled our hearts with the courage to
make great sacrifices to
protect that which is most dear.

Introduction

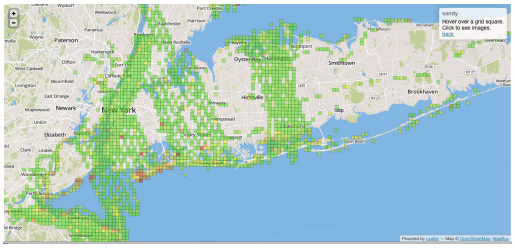
Leaders in disaster response are facing the need to adapt to a new reality. Collective action from the grassroots has changed crisis response operations in ways that few would have predicted even five years ago. The era when citizens listened passively to official announcements made by radio and television has ended. Today, they can exchange information over mobile phones and social media and then mobilize thousands of people to collect, analyze, and act on that information. Sometimes, community-sourced intelligence may be fresher and more accurate than the information given to the responders who arrive to provide aid.

Federal agencies have taken notice of this newfound capacity. Over the past two years, a series of events caused several agencies to explore how to engage these citizen-driven efforts and fashion them into new partners in agency response operations. This work began in Haiti, when—for the first time—a crowdsourced data set became the foundation on which UN and US agencies planned their response operations. Over the three weeks following the 2010 earthquake, 640 volunteer mappers traced high-resolution satellite imagery released by Digital Globe and GeoEye. They made 1.2 million edits to the map in less time that it would have taken an agency to solicit bids from vendors, building a free and open atlas of roads and critical infrastructure that is among the most detailed digital maps in the world. The UN used these data to build its maps, and the US soon followed (albeit with some caveats).





In 2011, the UN Office for the Coordination of Humanitarian Affairs activated a group of 250 volunteers to monitor the media in Libya. They scanned new and traditional media sources to find information about who needed what where as well as what acts of violence happened where. Their work provided OCHA with a window into the emergency before the UN was given the mandate to start work on data aggregation. These reports were available in English



translation via a private web site, and selected reports were made available in summary form via a public web site. In another case from 2012, 6717 volunteers analyzed more than 35,535 photographs of the US eastern seaboard after Hurricane Sandy, completing more than half of that work in the first 48 hours. The analysis jumpstarted FEMA's ability to scope the federal response operation by several *days* over previous methods. In a time of budget cuts amidst increased expectations, this type of surge capacity is hard for federal agencies to ignore.

In reaction to the challenges posed by these operations, several of these emergent grassroots technology initiatives have since formed into stable organizations that now provide services to governments during crises. Some have organized to analyze imagery and build maps. Some have developed modular structures to translate, categorize, and summarize social media and reports sent from the general populace over mobile phones. Yet others have engaged experts from various fields in development and deployment of tools from citizen scientists and technologists to difficult challenges in disaster response. Each has shown great promise for augmenting the capacities of federal agencies during operations at home and abroad.

For all the potential power that would derive from institutionalizing a link to this new form of mutual aid, creating the interface between grassroots and government has raised numerous challenges. After studying efforts to connect the grassroots and government at the Departments of State, Defense, Health and Human Services, Homeland Security, and Interior, the major issues could all be distilled down to two questions. First, federal agency managers have asked about the authority under which government personnel can create a workflow with the grassroots using techniques like crowdsourcing, participatory mapping, and other approaches that build information resources from the bottom up (*i.e.*, socially constructed knowledge). Second, many have asked what controls must be put in place within any such workflow to ensure that the process itself stays within the law and the resulting data can be reliably delivered and trusted.

Based on research funded by the Commons Lab at the Woodrow Wilson International Center for Scholars, the answers to the first question on authority proved to be straightforward. *No law specifically prohibited engagement with grassroots technology organizations during disasters*. Instead, several policies specifically encouraged certain agencies to pursue community-based activities—sometimes phrased as 'whole of community' engagements—that increase national resilience at home and abroad. For example, USAID/OTI actively fosters community-based activities, including participatory mapping. Similarly, FEMA

catalyzes whole-of-community approaches to major disasters under Presidential Policy Directive 8 (PPD-8).

The laws and policies we discovered only governed the second question; that is, *how* agencies should engage with grassroots communities. In specific, these questions broke down into several pragmatic areas that should be asked regardless of whether legal code existed or not. Such questions included: How should agencies establish workflows with volunteers that create no expectation of payment and do not overlap with duties already performed by USG personnel as part of their usual duties (*Anti-Deficiency Act*)? How should these processes control for personally identifiable information (*Privacy Act*) and prevent the disclosure of private information (*Nondisclosure Act*)? How should these processes be designed so as to avoid creating new undue burdens on citizens (*Paperwork Reduction Act*), taking into account the exceptions that disasters can create under the interpretation of this law? And how should agencies ensure that data integrated from outside sources adhere to criteria for quality, objectivity, utility and integrity that citizens expect from government's authoritative data sets (*Information Quality Act*)?

Research indicates that several US federal agencies have found answers to these questions and have developed pilot projects that establish experimental interfaces to grassroots technology organizations. Although each pilot was generated by a unique problem and emerged within the context of the particular agency's interpretation of law and policy, a pattern is beginning to emerge. While the development of this grassroots to government (g2g) interface happened iteratively in each case—without a master plan outlining a series of steps in a waterfall chart, the interface unfolded in what might be described four phases:

1. **Design**: *A process to scope the legal and policy questions that need to answered and defining what needs to be done, why, by whom and how*. This phase established the goals of the pilot, clarified the roles of the federal agency and other partners, built a 'worknet' that included legal and technical advisors, and created the holding environment for exploring the legal, policy, and technology challenges of working with grassroots organizations.

2. **Experimentation**: *a process for an iterative exploration of options that might inform the design, workflow, policy/legal framework, and technologies*. Agencies created a shared laboratory between both sides of the grassroots-to-government interface. This phase gave agencies and partners a space where they tried multiple approaches and failed—sometimes repeatedly but

each time in new ways—in a safe holding environment.

3. **Activation**: *the execution of an initial plan with a pilot activation, with a plan for collecting metrics on the performance of the system*. To learn how a workable approach works in real-world (or simulated real-world) environment, the partners implemented their design and gathered data about the nature of its performance. This phase provided the space for this learning and measurement without expectations of having a fully-operational capability or contractual obligations that force federal program managers to limit the amount of learning that can happen as the work unfolds.

4. **Learning/Evaluation**: *a process for auditing the quality of the data submitted from the crowd and integrating lessons learned from the activation into design tweaks or even a rethink of the process.* After an activation, partners to a pilot discovered parts of their design which needed to be fixed. They also found that they had data to prove the merits of the approach to skeptical audiences and began a process of briefing the proposed design as a proposed policy change.

The *Design-Experiment-Activate-Learn* (DEAL) framework is the lens through which this report will analyze these three cases, with a look towards showing the common questions that emerged when building the grassroots to government interface while also diving into the specific legal, policy, and technology questions that each team had to answer when building their pilots.

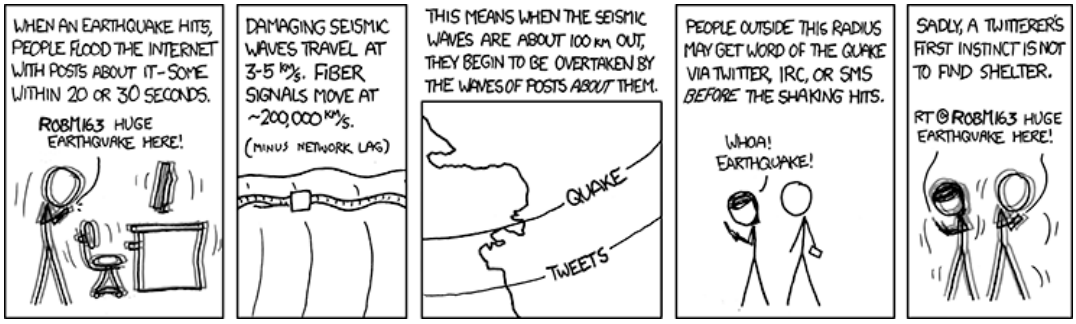
Section 1 begins with a definition of the context: what is crowdsourcing and why is it useful? Why is it so hard to mix crowd-sourced data with authoritative government data? Section 2 explores how these grassroots entities emerged and how they work. It explores the problems with engaging with the crowd. Section 3 explores the DEAL framework by which agencies have successfully answered established an engagement with the crowd.

An online site will provide a space for a growing repository of case studies. It will be available online at the following URL: [http://tbd.wilsoncenter.org].

1: Defining the Context

The increasing interconnectedness of societies is transforming disaster response. Billions of people now have direct access to cellular phones and communications networks. Billions of networked devices are now participating in this ecosystem as automated intelligent agents. Via face-to-face relationships with other community members, untold millions more have indirect access to messages that hop back and forth between our internetworked grid and word-of-mouth communications. With this increase in scale, the cost of sending a message between devices on this network is approaching zero[1].

During recent disasters, this network has been behaving ever more like a central nervous system. Signals from communities have been traversing wide geographic areas, sometimes traveling pathways that are sufficiently rapid as to give early warning to those beyond the immediate impact zone. This happened with the 2011 earthquake in Virginia. Just as the light from an exploding firework precedes the shock of its *boom*, a Twitter wave with memes about the earthquake preceded the buckling of the earth's surface. Citizens in New York and Boston knew that an earthquake was happening seconds *before* they felt any shaking, simply by glancing at surge of messages on this popular social site.[2]



While the earthquake example is easy to understand, this phenomenon of 'citizens as sensors' gets far more complicated once the response operation begins. When thousands of organizations begin to mobilize their personnel, both affected populations and responders clamor to make sense out of data that says *who needs what where* and *who is doing what where* (or has plans to do something there). The combined grassroots and government efforts to make sense of the situation after Hurricane Sandy generated over 20 million tweets, terabytes of satellite and aircraft imagery, and an incalculable number of emails, SMS/text messages, and

[1] That said, the household costs of communication as a percentage of household budgets is a new load on the vulnerable.

[2] XKCD, http://xkcd.com/723/.

documents. For federal agencies, the task of aggregating, filtering, and making sense of the sum of all these information streams has already become overwhelming. As communities begin to participate ever more as partners in a whole of community response operation, the sense-making problem is going to get worse. Far worse.

Study after study is asserting that the stock of human information is expanding at an exponential rate.[3] As Eric Schmidt of Google noted in 2010, we produce as much data in two days as all of human civilization produced from the beginning of written history to 2003.[4] However, this rate is also accelerating. Our societies are now at a point *doubling* rate for this new level of information production is less than 3 years and that rate is increasing.[6] For disaster response agencies, these numbers should ring alarm bells. During disasters, the rate of information flows tend to spike off baseline levels, as families first try to discover the status of loved ones and then switch into coordinating their household-level responses and learning about the disaster. This phenomenon was seen with Japan, Hurricane Sandy, and (during editing of this paper) with the Boston Bombing. The spikes of information flows are getting larger as the baseline rate of information flows increases. Federal agencies are already living in an information superstorm. If our citizens are going gain increased capacity to publish their needs via multiple channels, the usual approach of linearly scaling staff to process information flows will no longer be adaptive. Our capacity to process exponentially increasing information rates (and contextualize new information against stocks that are also growing at exponential rates) must be also be scalable at an exponential rate.

Federal agencies are not ready for either the volume or velocity of this kind of information flow, nor are the humanitarian institutions on the international level. Collecting, processing, and analyzing information requires federal staff to monitor hundreds of channels, many of which are compartmentalized by law, policy, and/or technology. This task is beyond the surge capacities of federal agencies, even those with authorization to activate reserve staff (such as FEMA and State).

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[3] Cf. http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/.

[4] Eric Schmidt, Technonomy 2010 Conference remarks. Cf. http://techcrunch.com/2010/08/04/schmidt-data/.

[6] *Ibid*.. Also see http://whatsthebigdata.com/2012/06/06/a-very-short-history-of-big-data/.

Setting aside traditional methods[7], there have been two innovative approaches to addressing this information processing challenge:

- Teaching computers to make sense of the ways that humans express ideas in crisis (and augmenting human ability to discern patterns); or

- Teaching humans how to work in new organizational designs that enable thousands of individuals to work together to aggregate, process, and analyze large data streams more efficiently.

(A third approach—a hybrid of the two, is now in experimentation but has never been applied to an emergency).

The first approach—*machine intelligence*—uses technologies where algorithms have helped to discern signals from noise. It is this "big data" strategy that has been taken by many large US agencies, such as the Department of Defense and the intelligence community, as well as many academic institutions. Computationally intensive tools ingest millions of short messages from social media and simple text message services and pull out "memes" such as requests for aid or changes to overall perception of a situation (a.k.a., sentiment analysis).[8] This process often uses a "human in the loop" to correct and teach the machine how to discern patterns which are not semantically obvious. An example is the process that several university teams used to collect social media around Hurricane Sandy and pull out patterns of communication between federal agencies and the affected population, dividing those dialogues into memes that provide an understanding of the general sentiment of the conversation.

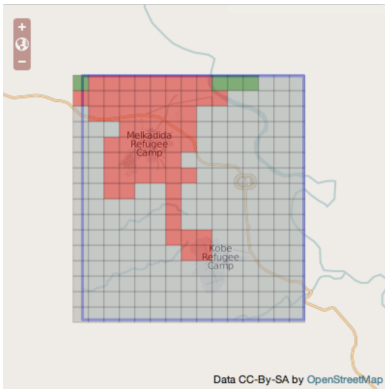
Unfortunately, humans make this approach complicated. Language is contextual: we are apt to retweet messages about people buried under rubble long after the building has been cleared by search and rescue teams, causing a conflict between Big Data analysts who claim that the crowd is certain people are buried there and fielded personnel, who have eye-level proof that all bodies had been recovered from the site the day before. But there is another issue beyond context: the very act

[7] If a traditional approach (such as a SharePoint) portal can withstand exponential rates ofincrease to total information resources in a problem domain while scaling knowledge management staff linearly, it will need to show year over year exponential increases to productivity of its curators, who are often professional knowledge managers. That kind of performance metric appears to be absent in industry. There is too much to know.

[8] Good examples include the social media tools in the American Red Cross Disaster Operation Center as well as the Information Volume and Velocity joint capability technology demonstration from DoD.

of aggregating data about American citizens on a government-managed big data platform—never mind a platform that can correlate their expressions with other conversations (and thereby make sense out of the verb *pitch)*—raises privacy issues that some agencies have not yet found ways to address. Perhaps just as importantly, machine learning delegates none of the work of sensemaking and responsibility for providing mutual aid to our citizens. Instead, it keeps the whole information flow inside government, where it can be hard for citizens to access. As a result, the second approach to solving the information-processing problem has taken on special currency.

This second category—*collective intelligence*—enables hundreds or thousands of volunteers to work together on open platforms to aggregate, process, and analyze large pools of information (e.g., Wikipedia) using a combination of tools and practices. Their methods can be roughly divided into two categories: they either divide a large stock of information into smaller bits that a large number of individuals can analyze (which is the origin of the word "crowdsourcing), or they aggregate a stream of data built by many individuals into larger stocks of information (sometimes as a market or a wiki), or they build some combination of both approaches.[9] A good example of the fusion of these two approaches fused into one engagement is what the OpenStreetMap community did when it mapped refugee camps in East Africa. Approximately 40 individuals checked out a grid square of fresh satellite imagery (dividing the magnitude of the stock of imagery) and then used the OpenStreetMap software to add roads and structures to create a digital map of the camps around Somalia (adding a multitude of small edits together to create a whole picture).[10]



Collective intelligences do not just emerge *ex nihilo*: they occur with an organizational structure that provides coordination, decides on methods and tools, and provides a mechanism for recruiting and mobilizing thousands of individuals. In crisis response, these organizational structures generally take two forms:

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[9] Cf. *The Consolation of Philosophy*, Boethius. This text established the seven liberal arts, including arithmetic, which was then concerned the aggregation of small multitudes into larger structures (induction), and geometry, which was then concerned with ratios and the division of larger concepts into small structures (deduction). This division is one of the earliest codifications of the pursuit of knowledge by the concept of magnitude and multitude—core concepts at the root of the development of natural science in the 12th century and, from there, of the Scientific Revolution.

[10] Cf. disruptivegeo.com's story on OpenStreetMap and Refugee Camps.

communities of volunteers that associate and often incorporate to support their work; and corporate structures that mobilize large user bases to provide aid during crises. Good examples of the former include Crisis Commons, the Humanitarian OpenStreetMap Team, and the Standby Volunteer Task Force. Examples of the latter include Google MapMaker.

During recent disasters, these organizations have mobilized collective intelligences to coordinate and channel the energy of an ever more interconnected society. They are providing *information as aid*, both to responders and the affected population.[11] It is this new capacity to transform diffuse citizen efforts into targeted campaigns to provide information as aid—and the legal and policy challenges that it raises—which catalyzed the generation of this report.

Here is the rub: federal agencies have a much easier time working with corporations that engage in collective intelligence than with the communities that emerge from grassroots processes. Like the agencies, corporations tend to have careful internal processes to vet data before it gets published back into the wild. Agencies also have contracting mechanisms that can be used to ensure data quality and place liabilities onto the corporate structure. That said, corporations have little incentive to work across their ecosystems: Google and Facebook compete as much during an emergency as between events.

During crises, however, the grassroots organizations have significant advantages: they tend to attract individuals with direct relationships with the affected populations. Because these grassroots organizations have methods for mobilizing and training eager volunteers, they can scale and process information at faster rates than most large corporations (with the possible exception of small crowdsourcing companies that fuse the two concepts, such as Idabon and Crowdflower, which have their own models for scaling quickly). For federal agencies who have to scope the magnitude of their response to a sudden onset emergency (usually literally deciding how many zeroes will be assigned to their operations), rough answers on a fast timeline are often better than exact figures that get delivered after the crisis has moved into another stage. Federal agencies are not always optimized for providing rough answers in hours or minutes. As a result, the rise of collective intelligences outside of government provide a method for quickly processing information and mobilizing citizens to provide mutual aid, with caveats added about potential risks of verification of the data.

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[11] One NGO now has a campaign called "Information is Aid." Cf. Internews' work with Communicating with Disaster Affected Communities.

For all the power that these groups have demonstrated with the application of collective intelligence to disaster response, their interface to US federal agencies is still nascent and not generally well characterized. In addition, these groups have experienced their own growing pains, some of which have stemmed from lack of resources during the economic downtown, right at the time that they were scaling their operations.

Federal officials that we interviewed raised a number of questions about how these groups work, what they do and why they do it. They want to know how these groups make decisions and how a federal agency can invest in this capacity within current law and policy. And they wish to know how these groups handle issues that make data aggregation within the federal bureaucracy into a challenge.

The next two chapters provide an initial overview of the answers uncovered from a summer of research. They are inherently incomplete and therefore placed into the public discourse for editing and expansion by the community about which it claims to describe. The following is intended to be initial description in a wiki that will get amended (and probably emended) by experts within each area. We begin with a definition of the grassroots and how they work in Section 2, and then will look at the interface between these groups and federal agencies in Section 3.

2. Defining the Grassroots: Who they are and what they do

During our research, federal officials frequently asked, "what are these volunteer technical communities and why are they trying to provide services during disasters? Why should we trust the data they produce?" This paper limns out preliminary answers to these questions and offers sketches that the actions of these communities and future research will fill out.

The first step towards this end is to abandon a term that has come into common use: "volunteer technical community (VTC)" as well as its variant, "volunteer and technical community (V&TC). Both have been used to describe the grassroots communities that emerged in the crisis mapping space. The VTC moniker was the result of a paper in 2010 after the Haiti crisis, when the movement was inchoate and appeared to be composed of volunteers using technologies inside online communities. Since that time, it is now better understood that all three terms have changed or were inaccurate to begin with.

It is now known that a significant fraction of the participants are not *volunteer*, but are instead being paid by their respective employers to participate in a collective intelligence, as happens with open source software. That said, these individuals participate for a different suite of reasons. Some test their tools and practices in crisis response, which is one of most unforgiving environments in the world for privacy, security, and austere communications and therefore an ideal site for spurring innovation.[12] Others engage to advance efforts at corporate social responsibility or other forms of giving. In addition, many of the leaders of these organizations have migrated from being volunteers to being paid professionals who earn their income running these incorporated grassroots organizations.

Neither are all these individuals *technologists* nor are the grassroots organizations purely *technical* or limited to conducting their work via online/virtual communities. Most participants are, in fact, experts in other fields who happen to be adept at using crisis mapping tools, many of which are simple, familiar tools that are applied with within a set of increasingly standardized practices (such as SMS/text messages and social media). These organizations foster practical approaches that often focus more on relationship building and information analysis and fusion than on software development. Several organizations now send staff directly into affected communities to mentor them on the use of tools and practices for collecting, analyzing, and curating their community's data.

[12] This was the reason Microsoft had a Humanitarian Systems team.

Last, these groups may mobilize *communities*, but they are now (generally) incorporated entities that have a different set of expectations around their behavior, including their governance and reporting requirements. They are more appropriately called *organizations.*

The UN's Office for the Coordination of Humanitarian Affairs (OCHA) has taken up the term *digital humanitarians* to describe this work, because their tools tend to be based on ideas that emerged during the digital revolution. Today, most these organizations work under this moniker and an umbrella called the Digital Humanitarian Network (DHN). That said, 'digital humanitarians' is an imperfect term. Entities like the Humanitarian OpenStreetMap Team are not purely digital and work from the field with affected communities using a mix of handheld- and paper-based tools, not just online. They also are not necessarily as fully subscribed to the application of humanitarian principles of impartiality, neutrality, and independence as traditional actors. These organizations are more focused on the practices of working with a collective intelligence that bridges the affected communities, diasporas, and experts in parts of the world which are willing to provide information as mutual aid.

However imperfect the term may be, digital humanitarian organizations (or DHOs) is used here to reflect current practice.

Defining Digital Humanitarian Organizations

The DHOs studied during our research harness the collective intelligence of a large number of individuals to provide information as a form of aid before, during, and after a crisis. To achieve this end, each DHO applies a mix of social technologies using an evolving set of practices shared by its members, which often take advantage of open source software, open data, and open interfaces. All have adopted or are in the processing of adopting a set of ethical standards in the form of codes of conduct. As a result, our working definition of a DHO is:

A DHO is a grassroots organization that mobilizes a relatively large number of individuals that share a common set of open tools, practices, and ethical standards to create a collective intelligence with the objective of providing information as a form of aid.

An Abbreviated History of DHOs

Most DHOs have evolved from networks of volunteers that collaborated across their respective organizations to solve complex problems during previous emergencies. The first two to form—MapAction and GISCorps—mobilized seasoned geospatial professionals to provide mapping and analytical services to

institutions that were just learning how to leverage GIS tools during operations in the early 2000s. The subsequent evolution of these networks defined the organizational design of subsequent DHOs.

Based on the successes of these first DHOs and parallel work in disciplines such as crime mapping, Patrick Meier and Jen Ziemke convened a group of practitioners, academics, and corporations to explore the concept of crisis mapping. In October 2009, they hosted the first International Conference of Crisis Mappers, which brought together geospatial experts in the United Nations, US federal agencies, and the private and public sectors. This meeting came at a pivotal moment. The relationship and ideas generated by the conversations created a buzz throughout the late fall. When the Haiti earthquake hit on 12 January 2010, these relationships became a game-changing part of the response operation.

When dozens of international agencies were scrambling for imagery and maps of the country, the Crisis Mappers discussion list quickly catalyzed into a *worknet*—a new organizational design that pools key experts across institutional boundaries. This network was the forum by which international responders coordinated their requirements with the volunteer efforts of hundreds of organizations, including Digital Globe, GeoEye, Google, ESRI, US State Department, US Department of Defense's Joint Task Force for Haiti (*JTF Unified Response*), UN OCHA, and myriad open technology communities, including OpenStreetMap and Ushahidi.

Crisis Mappers quickly found itself responding to a string of major emergencies: Chile in February-March 2010, the Deepwater Horizon Oil Spill in April-May 2010, and then the Pakistan floods and Haiti Cholera outbreak. As a result of the intensity and tempo of these activations, DHOs affiliated with Crisis Mappers found that they could not function solely as an *informal* worknet. Individuals had insufficient support from their various organizations to keep self-activating as part of the worknet. Some had overstepped their mandates or job duties, and had projects which had suffered from the time commitment to disaster response. Others had to find a business model to keep working on the development of crisis mapping. During this period, several DHOs began a process of building formal organizational structures that could receive funding, sign contracts, and limit the liabilities of their members.[13]

[13] See WWICS study on the Liabilities of VTCs for a discussion of the liabilities to which VTCs may open their members when they work as associations without incorporation. The surprising legal opinion is that Good Samaritan laws do not protect volunteers engaged in crisis mapping activities; in fact, current law may open them to liabilities in multiple jurisdictions.

Today, the organizational structures of DHOs reflect this evolutionary dynamic. Some are communities that are coordinated by corporations (Google MapMaker) or larger formal associations (GISCorps is under URISA). Others are fully incorporated independent non-profits (HOT, HR, Crisis Commons) or charitable organizations (MapAction). Some remain unincorporated voluntary associations (SBTF). This last class of organizations retain the strongest link to the idea from which they emerged: grassroots networks. While they do retain a great deal of flexibility, they also incur additional risks for their volunteers. As a WWICS study outlined in 2012, the actions of one 'bad apple' within these unincorporated voluntary associations may expose all volunteers in a given effort to tort liabilities (Cf. WWICS VTC liability study).[14]

[begin sidebar]

Conflation of Technologies, Channels, and DHOs

Research revealed an important misunderstanding in many federal agencies: DHOs are often confused with the technologies that they deploy, to the point that some DHOs are *called* by the name of the tools they use instead of their actual organizational names. However, the Standby Volunteer Task Force is not Ushahidi. The Humanitarian OpenStreetMap Team is not OpenStreetMap. These are *four* separate organizations.[15] Large system integrators have shown themselves eager to perpetuate this confusion: it is far easier to sell a silver-bullet technology to the government than it is to build the combination of community, technology, and practices that DHOs have created. However, without the elements of grassroots mobilization of a collective intelligence, the practices by which participants in that collective intelligence coordinate and build a shared understanding, and the ethical frameworks that keep the values of thousands of individuals aligned, technologies are only empty shells. [end sidebar]

Organizational Design

DHOs have four elements that enable them to perform their work:

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[14] NB: An emerging class of DHOs now requires study: the FlashNGO. First seen in Haiti with the Mission 4636 Initiative, a flash NGO emerges to serve a specific purpose during a single response operation, and then disbands. The operation during Hurricane Sandy saw the rise of numerous flash NGOs, so much so that they are now on FEMA's radar as an emerging policy issue. To the best knowledge of this report, creating a workflow with these FlashNGOs remains an ad hoc art form. Given the importance of these FlashNGOs to the delivery of aid during Hurricane Sandy, it may be necessary to perform additional study on this issue in a domestic legal context.

[15] Ushahidi is a US-based 501c3 that supports the development of a software platform for citizen reporting. The OpenStreetMap Foundation (OSMF) is a UK-based charity that supports the development of the software and community behind OpenStreetMap.org.

- *Communities*. They have the reputation and skills to mobilize a community of individuals around particularly approach to building collective intelligence.

- *Technologies*. They use a suite of hardware and software tools to facilitate their work in the field and online.

- *Practices*. They apply tools within a set of shared practices that provide an organizational design for delivering information as aid.

- *Ethics*. They ensure that the participants in a collective intelligence work within an ethical framework that ensures individuals work along a set of shared values.

This paper examines each of these four elements of DHOs so that agency officials understand the basic structure of work, decision making, and values—all of which are essential for building trust and creating an interface with DHOs.

Communities

Mobilizing a collective intelligence requires the use of an organizational design that harnesses low-cost communications to enable coordinated action of hundreds or thousands of individuals.[16] A set of leaders must motivate experts to devote time to their project (leadership), then mobilize them in a work structure that uses their skills appropriately and efficiently (management). When a federal agency establishes an interface to a DHO, it is this leadership and management that they are activating to meet a given end, rather than just the technology. As a result, interviewees emphasized the need to create clear statement of work. This not only establishes clear expectations between organizations, but also gives the leaders of the DHO a clear set of expectations that that they can communicate with their members.

There is a growing number of DHOs, each of which is adopting a special niche in an ecosystem. Each has a different design by which they coordinate their internal activities. The short descriptions of the major players below pull on their own descriptions, in an effort to remain true to their own characterizations of their work.

[16] See Malone, The Future of Work.

Humanity Road (HR) has a mission of "to educate the public before, during and after disasters on how to survive, sustain and reunite with loved ones."[17] HR generally activates in the initial hours after a disaster, providing immediate information triage and categorization for later analysis. HR has also deployed field teams to provide direct aid.

The **Standby Volunteer Task Force** (SBTF) has a mission "to provide live mapping support to humanitarian, human right, and media organizations."[18] It offers a range of services organized by specialty and managed by seasoned volunteer coordinators. It has an activation protocol that usually will deploy after the initial 48 hours of a disaster and last up to 3 weeks into the response operation.

The **Humanitarian OpenStreetMap Team** (HOT) has a mission to coordinate "the creation, production and distribution of free mapping resources to support humanitarian relief efforts in many places around the world." HOT trains communities how to map (community mapping) while also organizing a worldwide community of mappers to trace satellite imagery during emergencies (remote mapping).

GISCorps is one of the oldest DHOs, launched in 2003. It provides "short term volunteer GIS services to underserved communities world wide both in post disaster, humanitarian relief, capacity building," and other forms of service. It is an association of approximately 2600 GIS professionals who donate their expertise to the betterment of underserved communities.

MapAction is one of the oldest DHOs in disaster response, with its first deployment in 2004. It is the only NGO which can deploy teams of GIS experts any where in the world in a matter of hours. It is the official mapping support element of the UN Office for the Coordination of Humanitarian Affairs. It is a UK-based charity.

Crisis Mappers is an "international community of experts, practitioners, policymakers, technologists, researchers, journalists, scholars, hackers and skilled volunteers engaged at the intersection between humanitarian crises, technology, crowd-sourcing, and crisis mapping." Crisis Mappers provided the forum by which many other DHOs, agencies, universities, NGOs, and corporations coordinated the exchange of imagery, maps, and operational data during recent emergencies. It is a network more than a DHO, but a critically important coordinating mechanism.

Several newer DHOs have emerged in the space, including the Public Laboratory for Open Technology and Science (specifically the part of their work that develops remote sensing as a citizen science), DataKind (experts in databases and data manipulation), Geeks without Bounds (experts in convening and incubating

[17] Digital Humanitarians web site, last accessed 8 January 2012.

[18] Ibid.

technology interventions), Translators without Borders (experts in translation), and Statisticians without Borders (experts in the application of statistical analysis to humanitarian problems). They are worth further exploration by US agencies. They are omitted from this report *not* for lack of merit, only for lack of specific case studies around their work with US federal agencies. This is an open opportunity for another researcher to dive more deeply into these communities.

Technologies

There are a growing number of **platforms** that enable crowdsourcing. These are software platforms where organizations that support their development. That said, it needs to be stated emphatically that these organizations support the underlying software, not deployments that use their software for disaster response operations. While the organizations have been known to donate their time for special cases, it has become common practice among large agencies to assume that this is the mission of the organizations. It is not. The platforms in common use include are here divided into four categories: imagery, mapping, data aggregation and processing, and analysis:

Imagery

A growing number of volunteer organizations have access to satellite and aerial imagery. They have also been developing tools that enable them to collect imagery using various aerial and ground-based platforms. Given the challenge of makings sense of so many pixels, groups have also been developing tools to crowdsource that analysis among thousands of volunteers. These tools include MapMill from the Public Laboratory for Open Technology and Science (PLOTS) and OpenAerialMap.

Mapping

The development of maps has traditionally been done by closed groups of surveyors and cartographers. With the advanced in GPS technologies, it is now possible to use standard GPS units (and with less accuracy, even some smart phones) to trace roads and map major points of interest. There are current two platforms which dominate this market: OpenStreetMap and Google MapMaker.

Citizen Reporting

When citizens act as sensors, they generally submit text reports via text message from their cellular phones or tweets via Twitter. There are a growing number of platforms in this area, but the most well known are Ushahidi, FrontlineSMS, and Twitter.

Data Aggregation and Analysis

Pulling data from multiple sources into a common platform for analysis is a fundamental requirement for moving the sensemaking process from a solitary

activity on a desktop to a collective activity on the Internet. Several applications facilitate this type of work: GeoIQ, ArcGIS Online, and Google Crisis Map, Data.gov, Amazon Mechanical Turk, MapStory, Sahaha, Crowdflower, and Idabon.

[begin sidebar]

DHOs are not Social Media

It is critical to separate the *channels* of social media with the *technique* of crowdsourcing, the *platforms* that enable those techniques, the *organizational structures* around DHOs, and the *actions* that they perform, like mapping, citizen reporting, etc.

Social media refers to several of the various *channels* by which citizens are sharing reports from a crisis, including short text messages (Twitter, Facebook), photos (Instagram/Facebook, Flickr), and videos (YouTube, Vimeo), as well as fusions of all three (Facebook). Social media can be bounded or unbounded. Distribution can be limited to a social network that the user has defined, or distribution can be public. In the hands of a skilled organizer, social media can become set of interlinked channels. A quote from an activist in Cairo from the Arab Spring provides insight: "We use **Facebook** to schedule the protests, **Twitter** to coordinate, and **YouTube** to tell the world."[19]

That said, social media represent only a subset of the total channels being used in collective intelligence. Others include wikis, which allow any authorized user to edit a common knowledgebase, or OpenStreetMap and Google MapMaker, which are essentially wikis for maps. In additional, traditional Web 2.0 interactive tools and the emerging set of Web 3.0 (Semantic Web) services like WMS, RDF, and other languages that aim to create an ecosystem of humans and automata interacting on each other's behalf.

[end sidebar]

Practices

Separate from the channels over which information flows, **crowdsourcing** is term more accurately used to describe a set of techniques within the realm of collective intelligence, which uses a network of individuals to perform one or more tasks in an effort to create a collectively shared product. Many of these techniques are detailed in the *Handbook of Collective Intelligence* from the MIT Center for

[19] Cf. Clay Shirky, Foreign Affairs.

Collective Intelligence.[20] The most relevant specific techniques to crisis mapping are:

1. *Crowdsourcing*: dividing larger task into smaller tasks, each of which can be performed by an individual in a relatively short period of time.

2. *Wiki Development*: building collective understanding of a large domain of knowledge through the aggregation and collation of knowledge of many individuals using a wiki.

3. *Markets*: information aggregation of complex problems (like pricing or logistics needs) through the exchange of data between many individuals. Importantly, markets need not set *pricing* in this context or lead to sales of items.

4. *Open Source*: development of a common understanding or code base by the collective action of many minds, as with open-source software.

These techniques then get applied to *actions* performed by communities, which tend to fall into four areas:

1. **Data Collection (***markets and wikis***)**: Citizens and/or their devices act as sensors, submitted data which might range from simple text reports to eye-level photos of a flood taken with a smart phone (and therefore "geotagged" with the location). Example include the USGS *Did You Feel It?* program, where citizens submit information about earthquakes. Another example derives from the Louisiana Bucket Brigade, which partnered with the MIT-affiliated Public Laboratory for Open Technology and Science to take ultra-high resolution aerial photographs of the beaches around the Deepwater Horizon oil spill, documenting not only the initial damage, but taking periodic photographs to show the ongoing issues and absorption of oil into the ecosystem.

2. **Data Aggregation (***crowdsourcing, markets, wikis***):** In many cases, information about a disaster is spread across multiple data sources: Twitter, Facebook, Crowdmap, Google+, Flickr, YouTube, and in several countries, proprietary and/or local web sites that use local (non-Roman) character sets and languages. Mobilizing volunteers to aggregate and categorize these data is a time consuming task that may require special language skills. *Example*: Standby Volunteer Task Force aggregated and categorized social media

[20] Handbook of Collective Intelligence: http://scripts.mit.edu/~cci/HCI/index.php?title=Main_Page. The version on SocialText from 2008 is the version referenced.

reports from Libya on behalf of several UN agencies, giving them visibility into the emerging needs on the ground.

3. **Data Processing (***crowdsourcing***):** Once data has been aggregated, it often needs to be transformed into other formats or languages someone needs to make sense out of it. Sometimes this work is done by the traditional definition of crowdsourcing: an institution breaks a large task into small tasks that can be done by individuals, and citizens perform those tasks, re-aggregating them back into a processed data set. *Example*: the work that Mission 4636 performed on the translation of Haitian Kreyol text messages into English, as well as the work that the Humanitarian OpenStreetMap Team did when it traced satellite imagery and turned those pixels into polygons on the map of Haiti.

4. **Analysis (***wikis, open source***).** Turning processed data into information that can be used to drive decision making often requires analytical skills that extend far beyond the typical volunteer. These functions have included the fusion of datasets that map social media activity over both time and place, showing the progression of a fire line against movement of persons. In addition, this type of analysis might include quality assurance work against the processed data of other volunteers. *Example*: GISCorps deployed experienced geospatial information systems professionals (average 11+ years of experience) to analyze the accuracy of work performed by the Standby Volunteer Task Force in processing the geodata of a USAID dataset.

NB: It should be noted recruiting a network of individuals to participate in a crowdsourcing effort (and channeling them to activities that are appropriate for their skills and interests) is a skill unto itself. Most DHOs have developed this skill to a set of processes and workflows (usually in the form of an activation protocol), but it is not necessarily a competence of all federal agencies.

Ethics

DHOs exist as form of mutual aid. For this reason, they tend to be focused on assisting affected communities, which often takes the form of assisting the organizations that have a formal mandate to respond to the emergency, from local fire departments to federal agencies and international organizations. This focus on using information to save and sustain lives has exposed both opportunities and risks. Humanitarians have long known that family reunification is difficult. While collecting information about refugees can enable them to reunite with separated family members, making that database fully open can expose the vulnerable to further risks, especially in areas where genocide or blood feuds might have

catalyzed a family to take the risk of migrating from one place to another. As DHOs have entered this space, they have brought much more powerful tools than humanitarians have traditionally used while mobilizing a base of volunteers from a wide mix of background, most of which have never been the field. DHO leaders have recruited humanitarians who can provide this ethical mindset at the core of their organizations and build training programs that enable volunteers to understand tat opening information can open risks.

Most DHO today combine specific training with codes of conduct that ensure participants are working with a common set of techniques within a shared set of values. These programs vary widely in their rigor, but generally ensure that anyone who helps build a collective intelligence has basic knowledge of the technology and practices. They also provide online forums where mentors can correct issues as they emerge and answer questions from 'newbies' in real time via chat and asynchronously via online discussion forums.[21] These mentors are sometimes formed into teams, whose role is to review the work of participants, either before data gets released to partners or once the data is in a wiki-like forum, such as the OpenStreetMap database.

Data Quality: Why trust DHO-generated data?

Federal agencies are under legal obligation to provide data to the public which is accurate, reliable, and useful. It must take steps to ensure the integrity of that data, and protect the release of information which may violate the privacy or security of citizens or organizations, violate non-disclosure agreements, or endanger national security. In this context, the release of data to DHOs to gain a surge capacity takes on special controls about the methods by which government data gets into the workflows of DHOs. Likewise, federal agencies need to know that they data they accept from DHOs is accurate, reliable, and useful for government decision making and future release back to the public.

In current practice, it is far easier to mandate these types of controls for the machine learning or Big Data initiatives. Agencies can issue legally-binding contracts for the development of big data tools that can be built around intellectual property agreements that lock the methodologies, code, and often the data into tightly scoped work groups. Teams can be made responsible for harnessing various inputs, performing the processing and analysis, and delivering a complete product that answers either pre-established questions in a workflow or identifies emerging

[21] NB: federal officials often lack access to these real time exchanges because chat is blocked at the federal firewalls. This is a liability for crisis response operations, as federal officials therefore have delays in correcting the actions of DHOs. This generates a second liability, as federal staff need to go offsite to work with DHOs, separating them from internal resources.

threats that need further analysis. As a result, the software and data often remain locked in the system; the method and questions being asked *might* be open (but are often closed).

In contrast, collective intelligence requires a far greater openness around software, data, and methodology. To harness the capacities of a network, large numbers of individuals need to be trusted to view and/or edit subsets of the total data set. In some cases, the release of the *complete* dataset is highly desirable or even mandatory. To have a collective intelligence, an initiative works best when it has open processes, open data, and open source code.

This situation establishes a very different view of the construction of knowledge. In closed systems, such as government, the fear is *being in error*. Making a mistake can be costly, can generate penalties, and sometimes end a career—or a life. In an open, collective intelligence—where knowledge is a social construction, the fear is *burying error*. It is a fear that errors will get hidden in secrecy and that collective efforts will perpetuate or even amplify those errors. This social approach to constructing knowledge is every bit as powerful as the authoritative method: it has generated Wikipedia as well as the major software that drives the Internet (including Linux and Apache).

In the world of DHOs work in disasters, early academic studies indicate a high degree of accuracy in the processed data. OpenStreetMap data is very close to professional cartography.[22] Crowdsourced geotagging of large data sets can be more accurate than automated (big data) processing of the same data.[23] So, the challenge of creating an interface between the grassroots and government is more than a matter of integrating new techniques into federal workflows; it is fundamentally about building *trust* around new methods of generating knowledge in the open. It is also one of the core challenges of building open government.

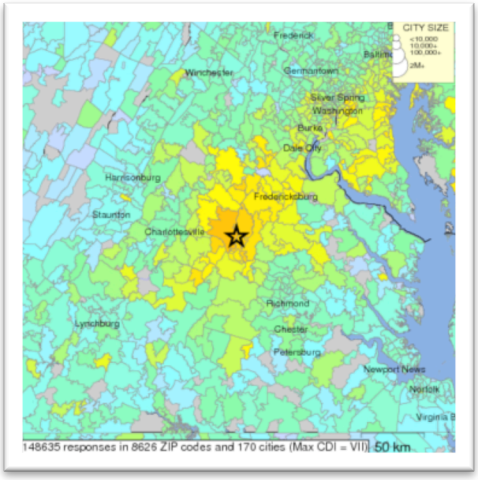
Several federal agencies have been building processes to build this trust. The next chapter explores the framework by which they have been performing this work.

[22] Muki Hackly, UCL.

[23] USAID, *With a little help from the crowd*.

3. Defining the G2G Interface

The pathways can be unclear for federal agencies that wish to harness the capabilities of DHOs for disaster response. Initial pilots have only begun to map out the legal, policy, and technology issues involved with integrating crowdsourced information sources into official, authoritative data sets. That said, parts of the US federal government has been engaged with the collection and verification of data collected from citizens in crisis for much of its existence. Several agencies have deep experience with these processes and began to bring themselves into the age of open government several years ago.



To give just two examples, the USGS established the *Did You Feel It?* service in 1999 to augment the agency's capability to judge the human impact of earthquakes. Millions of citizens submit data not just in the United States, but around the world. In 2010, the CDC implemented the BioSense platform to better enable the community of local, state, and federal public health officials and practitioners to identify emerging disease outbreaks and health threats. The 2.0 version has aggregated a community of practitioners around the analysis of real-time health data, some culled from social media.

While these tools do connect an agency to citizen sensors and wrap a community of trusted experts around those data, creating an interface to grassroots technology organizations like DHOs requires a level of policy review that neither a pure sensor network nor an interagency community of practice have yet needed. Because crises require working with vulnerable populations at home and abroad, both privacy and information quality have warranted special review, and therefore are the focus of the cases in this report.

There are three known cases in the USG that established an interface to grassroots technology networks within the *crisis mapping* community: two specific to disaster, and one with a development focus but obvious applications to crisis response.

1. The US State Department Humanitarian Information Unit's pilot workflow with the Humanitarian OpenStreetMap Team and the National Geospatial-

Intelligence Agency to catalyze remote mapping activities like that seen during the first weeks of the Haiti earthquake operation.

2. An interface that FEMA established with the Civil Air Patrol and the Humanitarian OpenStreetMap Team to provide damage assessment from photographs collected by aircraft after disasters.

3. The process that USAID created with the Standby Volunteer Task Force (SBTF) and GISCorps to 'munge' geographic data on loan guarantees in developing nations.[24]

US State Department/NGA

In late 2010, the US State Department HIU and NGA explored how the US Government could use the commercial satellite imagery that it purchases to catalyze remote mapping activities by entities like the Humanitarian OpenStreetMap Team. This initiative required finding the solution to several legal, policy, and technology challenges:

1. Seeing if and how intellectual property licenses with USG vendors could apply to the creation of derived works by DHOs (called Volunteer Technical Communities (VTCs) during the project).

2. Developing a workflow for requests from DHOs, so that the HIU would not be overwhelmed and so that NGA would not violate its status as a supporting federal agency.

3. Developing software to ensure that those who participate in remote mapping could perform five linked tasks: a) users can consent to the terms of the intellectual property agreement, b) users can checkout a small section of imagery for work, c) users can check their completed work back into the system, d) editors can check/correct initial work of remote mappers, and e) the HIU can ingest the DHO data for inclusion in its analytical products.

The project iteratively uncovered the issues through experiments held under a program called RELIEF (Research and Experimentation for Local and International First-Responders) with the National Defense University and Naval Postgraduate School. This program provided the holding environment where

[24] Data munging is "loosely the process of manually converting or mapping data from one 'raw' form into another format that allows for more convenient consumption of the data with the help of semi-automated tools. " Cf. http://en.wikipedia.org/wiki/Data_wrangling.

lawyers, line managers and analysts, and DHOs co-designed solutions iteratively. By using the quarterly field exploration cycle of RELIEF to gradually peel back layers of a proposed interface, agencies were able to build trust with DHO leaders and build solutions to all three challenges. During its first activation for the famine in the Horn of Africa, 40 mappers traced imagery from 10 refugee camps in Kenya and Ethiopia, creating a dense map with three days of activation. The State Department officially released the process under the moniker Imagery to the Crowd (IttC). A brief can be found at https://hiu.state.gov/ittc/ittc.aspx.

FEMA/CAP

FEMA had a similar problem to the State Department, but could not use satellite imagery to solve it. Within the first few hours of a new emergency, FEMA's leadership needs to make a rapid decision about what federal resources should be deployed. In general, satellite imagery is not available fast enough, especially if there is cloud cover. However, the Civil Air Patrol has 550 aircraft in all 50 states and has developed the ability to photograph crisis-affected areas quickly and from under the clouds. That said, there existed no means of quickly analyzing thousands of images for level of damage. So FEMA and CAP partnered with the Humanitarian OpenStreetMap Team to build a method of crowdsourcing this analysis.

Working through the RELIEF experimentation process, Kate Chapman and Schuyler Erle from HOT developed a basic workflow and modified a piece of open-source software called MapMill. Originally developed by the Public Laboratory for Open Technology and Science to crowdsource the analysis of balloon imagery, MapMill provided a simple interface that FEMA, CAP, and HOT could deploy in a disaster.

During its first activation in Hurricane Sandy, over 6717 volunteers processed 35,535 images in a few days—much of the work being completed in the first 48 hours. These initial damage assessments gave FEMA's leadership a rapid understanding of the areas that were worst affected by the storm and accelerated the deployment of federal assets to those sites.[25]

USAID

A program under USAID's Development Credit Authority provides $200 million loan guarantees to entrepreneurs—with only about $9 million in defaults paid by

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[25] FEMA Deputy Administrator Richard Serino and Federal Coordinating Officer Mike Hall released these video about the MapMill process:
http://www.fema.gov/medialibrary/media_records/10370 and
http://www.fema.gov/medialibrary/media_records/10369.

US funds (more than offset by $10 million in incomes from bank fees). However, the program had only country-level geographic data on the 117,000 borrowers that benefitted from this source of capital; it could not tell where in a country the capital was flowing. As a result, it was not possible to see if guarantees were being concentrated in urban areas, or if adjacent regions in different countries had aligned strategies across USAID missions. The DCA also wanted to release the data to show the impact of its work, which would require releasing data about each individual loan, including the geographic data which USAID missions had collected about these borrowers.

In the spring of 2012, DCA worked with the USAID GeoCenter to attempt to determine how to make best use of this extant geographic data. An analysis of the database showed that about 40K of the records only had the country listed for the borrower's address and could only be mapped at the country level. The remainder had additional data that might enable DCA to map the borrowers at the subcountry (*a.k.a.,* 'Admin1') level or below. Further analysis indicated that the process would take about 15 minutes per record to address—a time commitment of approximately 9 person-years. The process by which USAID addressed the issue combined the big data approach with crowdsourcing.

USAID worked with DoD to develop a process to automate the extraction of geographic data from a single column of data into additional layers of specificity. The set of tools they built used natural language processing (NLP) to match geographic data with NGA's GeoNames dataset. This technique enabled USAID to process an additional 66,917 records, leaving a sizable chunk of the data (about 9600 records) needed to be processed by humans. Because the amount of time necessary to process this many records was still not with any USAID budget of time or resources, the team turned to the Standby Volunteer Task Force and GISCorps to develop a crowdsourced process.

Over the course of 3 months, a team of USAID geographers, lawyers, and manager worked with SBTF and GISCorps to develop a workflow on data.gov, which included adding new data editing tools to this government open data platform with the vendor, Socrata. The plan was to divide about 300 volunteers into shifts over 3 days to process the remaining 9600 records. In practice, 145 volunteers completed the entire queue in just 16 hours. The quality of the resulting data set had "69,038 records at 64 percent accuracy while crowdsourcing processes refined an additional 9,616 records at 85 percent accuracy."[26] USAID had shown that volunteers are willing to cleanse government records at low or no cost.

[26] USAID, p. 23.

G2G Framework

In each of these three cases, government staff engaged in informed risk taking, and as a result, the pathway was built by walking it.[27] Analysis after their work indicates that the main areas of effort centered on determining answers to three groups of questions for each stage of the *Design-Experiment-Activate-Learn* framework:

1. People

From the government and grassroots, who should be part of the discussion to build a solution to the problem? After the solution is built, who need to be authorized to work at the interface of grassroots and government and what are they authorized to do? How does one establish a neutral space between the grassroots and government that can act as an incubator? Who needs to be included in this worknet, and who can build the worknet between grassroots and government?

2. Processes

What processes are authorized for work that is to be done at the intersection of grassroots and government? What laws and policies govern these processes? When is socially-constructed knowledge admissible into authoritative data sets and how should it be sourced and labeled? What policy issues emerge around key parts of the federal contracting interface and requirements that the US government has around the storage and release of data, including privacy and information quality?

3. Protocols

What standards and technologies are in use by the parties to the interface? What open standards are available? How can the platforms be altered so that that any agreed upon *processes* can be used by authorized *persons* using open standards? How does one bound the system and when should it be unbounded or opened

Based on these cases, a set of common issues and approaches is emerging around the connection to the crowd. The following checklist abstracts from the insights of all cases that we researched. The DEAL framework aggregates the experiences of individuals who have worked across the cycle of designing a project, experimenting with one or more prototypes, deploying a pilot, and then evaluating the entire process. Instead of narrating a history, it limns out an approach that an agency might take based on the lessons learned from these initial pilots.

1. Design

This phase of the project convened the appropriate set of minds from the government and grassroots, often with a trusted facilitator. Like any project, the team needed to decide the goal for the project and establish the framework by

[27] Antonio Machado, *Proverbios y Cantares* XXIX.

which the team would operate. In hindsight, several interviewees emphasized that the primary goal of this period turned out to be building trust between the agency and the participating DHOs. To this end, it was imperative to pursue two activities in parallel.

- First, federal staff had to be empowered to go to the events where DHOs work through their tools, practices, and ethics. This helped federal staff learn how to connect with DHOs as well as helped DHOs build trust with US agencies (many individuals are not US nationals).

- Second, once the agency and DHO had built sufficient trust to try working a problem together, the whole team needed to define *who* needed to be involved, *what* the interface between the USG and grassroots was supposed to do, how it would work, and when this interface would be needed (i.e., under what circumstances the DHO would be activated).

People

In each case studied, the first part of the design phase was to build the worknet that crossed all the involved organizations. In some cases, this group may become quite large. Not all those who need to be kept in the loop need to be active in all aspects of the design. It is best to keep the team small so that work can be done, and experts then consulted and informed periodically.

The roster generally included the following types of individuals:

- *Government Champion*: typically a senior leader (such as an SES) who had the authority and legitimacy to take informed risks with staff time. This person had the political clout to protect crowdsourcing initiatives from potential adversaries within the bureaucracy and/or interagency process.

- *Project Manager(s):* 1-2 federal staff and/or contractors who were the action officers on the project (often direct reports of the champion). When these project managers (PMs) did not exist, the process moved far more slowly than when they did; federal staff recommended that someone be named PM in the future. That said, the fastest moving process (USAID's crowdsourcing work with the Development Credit Authority), the PMs did the work on their personal time, which is not ideal either. The recommendation was to keep stable leadership, so that the PMs would be the ones charged with developing the interface and running it through the Learning phase. It may be that they would be the managers of the process in the long term.

- *Legal Advocate(s):* both the champion and project managers encountered areas of policy and law that were never designed for the integration with grassroots technology communities. Interviewees emphasized that at many points in the process, they needed and found a legal advocate who helped them find a way to accomplish what needed to be done within the law, and that this kind of legal help was critical to the success of the project. Some said that it was the most important relationship other than the champion, especially when the advocate and champion worked closely together. It should be mentioned that the opposite of a legal advocate—a lawyer who creates delays and tell innovators what could *not* be done—was among their greatest fears during the unfolding of the project.

- *Technology Advisor(s)*. Individuals who have knowledge of the data standards in use by the agency, along with the information quality criteria and platforms. These were not persons whose jobs were to keep the servers running; these were information strategists who could pull on specific experts for particular technical questions.

- *Subject Matter Experts (SMEs)*. Each agency needed to pull on advice from the operational staff, their pool of vendors and contractors, and academics. While some of these interactions were brief and specific, these individuals were brought into the worknet and kept abreast of progress across the cycle. Examples included remote sensing experts, contracting officers who understood data licensing agreements around the data that DHOs would be processing, and vendors whose government platforms would be involved in the initiative. It should be noted that vendors often looked at the project as a positive opportunity to test the addition of entirely new features to their products.

- *Facilitator(s).* Sometimes the nature of the agency (e.g., NGA) or the nature of the project required an intermediary to assist with parts of the process. This was be the case with design and experimentation, when agencies need an individual who understood how to apply crowdsourcing techniques to the problem and had personal relationships with various DHOs. The facilitator advised the project managers on whom to include in the worknet, while remaining true to the values of inclusiveness fostered within DHOs. For experiments that required the coordination of federal assets and DHO personnel, the facilitator found it helpful to have an assistant who could plan events, schedule meetings, and coordinate logistics.

- *DHO Leadership.* Research indicated that agencies should understand the formal and informal authority structures of DHOs sufficiently well to allow a given DHO to determine who to send to the various phases of the engagement on the project. The agency should also ask that these leaders remain stable throughout the project. In return, the agency should ensure stability in the staff it assigns to the core team. It is important to remember that some organizations are decentralized and cellular, and may have roles that can be occupied by a rotating stock of individuals. It may therefore be important to know when one it inviting a *role* rather than an *individual*. In this case, trust building requires advice from those who work with such organizations (like Occupy).

- *DHO Technical Advisor(s).* Technology platforms on the DHO side can be at the cutting edge of what is possible in the field. Some of these experts are defining the cutting edge. It is wise to include them, both as architects and visionaries. A technologist of this caliber can make seemingly difficult problems disappear with a few hours of hacking (this has occurred at Camp Roberts numerous times). There is a reason why they are often called *alphageeks*. Participation in O'Reilly's FOO Camp is a good indicator, but not the only one.

- *DHO SMEs.* From volunteer coordinators to field staff, DHOs often have a depth of expertise that needs to be engaged in the design of the engagement with a federal agency. Sometimes the issues are not known until they are explored as part of the design process.

Processes

Once the worknet was organized, the team set about obtaining the answers to five major groups of questions that laid the groundwork for the legal, policy, and technology challenges that was confronted in the experimentation phase.

1. *What is the goal of the work?* Those interviewed emphasized that by clarifying goals, they were better able to scope the legal and policy questions and build a project with a specific scope to serve a specific set of audiences or end users. In two of the case studies, the goals iterated: they started in one place and evolved to another. This shift represented important learning as well as the freedom that this type of framework provided to federal agencies to explore a new workflow.

2. *What tools already exist to accomplish this task?* Agencies should conduct an *analysis of alternatives* to ensure that a crowdsourcing project is an appropriate means to the intended goals. As was discovered with the

USAID initiative, crowdsourcing efforts might be best done through the modification of existing channels (like data.gov). Some existing channels have limitations which require investigating a different use and building new extensions on tools managed by DHOs (like the reinterpretation of the NEXTVIEW license in the State/HIU case and the corresponding changes needed in the HOT Tasking Manager to support legal interpretations of the NEXTVIEW license).

3. *What legal issues need to be overcome?* In general the legal issues had to address four laws that apply to all agencies, in addition to the intellectual property requirements of the process and the specific concerns inside their own agency around internal procedures:

   Anti-Deficiency: At USAID, the PMs needed to ensure that crowdsourcing work performed for no cost does not replace the work that is part of the duties of federal staff. Volunteers also needed to know and sign off that their work does imply that the US government is going to lead to paid opportunities. This task was completed in a straightforward way: they had check a box on a web form on data.gov that indicated that they understood they would receive no compensation for their work.

   Privacy/Non-Disclosure. Some data sources with PII or other data that might trigger the Privacy Act require special handling. Sometimes certain fields need to be removed from datasets before they can be handled by a grassroots organization. The legal advisor and project managers from the USG will need to determine when removal of data is necessary, and how the removal of that data will affect both the privacy of the individuals listed in the dataset as well as the efficiency/effectiveness of the intended crowdsourcing initiative.

   Paperwork Reduction Act. While none of the three cases explore the obligations under the Paperwork Reduction Act to measure the burden the collection of information on American persons, there is unlikely to be a disaster that triggers the Paperwork Reduction Act's intent. That said, it is an area of open question, and potentially an area where a clause could be added to the Act. The Office of Management and Budget OIRA is the point of contact within the federal government for exemptions, and may well be the best place for agencies to start on understanding how disasters change the requirements under the PRA.

Information Quality Act. Agencies need to ensure that information that will be released as a result of crowdsourcing will adhere to the agency's standards under the Information Quality Act. In the examples above, the agency conducted an audit or evaluation of the data before releasing them to the public, or established a policy for prioritizing speed and utility over accuracy for the initial phase of a disaster. Establishing basic metrics and data collection procedures (as well as a process for monitoring and evaluation of the project) provided the necessary information to meet requirements under this act.

IP Licensing. The PMs needed to ensure that data released or collected via the interface had appropriate intellectual property rights for the purpose. To link the effort to open government, they focused on making the data as open as possible to as broad a range of entities as can be imagined. This openness proved to be a core value shared with DHOs and was one of the motivating factors for DHOs to partner with federal agencies. It also have agencies a mechanism to claim a success under the open government initiative.

4. *What political concerns need to be addressed?* A discussion of building a process cannot occur without confronting the internal politics at the participating agencies. Discussions with or about DHOs sometimes became quite heated and did not always yield clear answers. It was important for the champion, managers, and facilitator is to keep the group moving ahead, even in the face of uncertainty. Interviewees found that (in the federal context), it was better to enter experimentation with unanswered questions that can be explored by doing the work than to get stuck in a series of conference calls on hypothetical risks. DHOs likewise needed space to develop trust with USG agencies, some of which operate in ways that are quite foreign to their memberships. To this end, experimentation that included the champion and legal advocate proved critical (as will be explored later). In addition, an intangible but important process under any crowdsourcing initiative is the slow process of convincing internal skeptics that this alternative mode of knowledge production can create data that meet government standards for timeliness, quality, objectivity, utility, and integrity. It was important to understand their criticisms and plan for collecting data that would mollify these skeptics or might convince them that DHOs are a valid method of generating authoritative data. NB: one important criticism that was raised is the sustainability of DHOs. The plan for the pilot project needs to include a plan for handing off the work to the

DHOs within a sustainable framework.

Protocols

The open technology used by DHOs tends to be very malleable: it can be shaped to meet the goals of the project, the legal channel in which the project must work, and political realities. However, mapping the way that these tools integrate with federal enterprise systems was an important process to sketch out. The real issues were only discovered during experimentation, but the cases each started the process of mapping exactly how which data would flow each way in the design process. To that end, the cases each two issues: open data and open source technology:

Open Data Standards: Engagement with the grassroots in general means the creation of a public good, which can be used by all to bootstrap efforts at the community level. Government data standards are often controlled by an ecosystem of vendors, who may not have platforms in a place where they can interact with open data standards. Establishing open data standards—especially those from international standard bodies or associations—can be forcing function to establish data and transparency as a public good. Agencies should strongly consider using this lever as part of engagement with the grassroots; it may be a non-negotiable item with many DHOs. Given rumblings around new USG policies on open data standards, the development of criteria for agencies will likely take on additional importance (and urgency) in 2013, especially after the release of the new US Open Data Policy.[28]

Open Technology Platforms: Open source software allows everyone to see the methods by which data is collected, analyzed, and visualized. This sense of opening the methodologies to all is an important aspect of many DHO activities, and should be an important part of the interface between grassroots and government.[29]

Open Workflows. Designing the workflow between multiple organizations entails a great deal of transparency. In the process of tracing the details of how data moves from one place to another, the entire team—legal, technical, policy, and operations—generally brings up issues that others may have only tangential awareness of. The more open the process of developing the workflow, the more likely the design phase will raise issues that can be explored and solved during experimentation.

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[28] Executive Order on the US Open Data Policy:
http://www.whitehouse.gov/blog/2013/05/09/landmark-steps-liberate-open-data.

[29] Cf. *Code* by Larry Lessig

2. Experiment

Experimentation offers an iterative mode of continuing the explorations that are only begun in the design phase. One critical aspect of experimentation during the cases was to expose legal advocates, operational staff, and skeptics to the actual implementation of the idea. In this way, they were able to offer criticisms and insights which could be addressed by technologists and DHOs before the tools ever reach the real world.

A key lesson learned from previous projects was that it is important to fail early and often (within an environment of shared good will). Failure in this context is an opportunity for both sides to discover a stumbling block, misunderstanding, or incompatibility before an activation. It is rare to find this kind of space in a federal bureaucracy, where failure is usually penalized. It is imperative for the champion to establish that the purpose of experimentation is to fail early and often, before an operation forces the activation of a DHO. This is the time where the team discovers, in Edison's famous phrase, 9000 ways to not make a lightbulb.[30]

Experimentation was the time to build trust between individuals, bridging the government and grassroots.

People

In general, the experimentation phase included a small group of innovators who can bridge the various challenges involved in the particular challenge. These tended to include the facilitator, project manager(s), legal advocate, technology advisors from each partner, SMEs, and DHO representatives. For two of the cases, the inclusion of lawyers in field experiments gave the DHOs and government technology advisors the opportunity to take questions out of the hypothetical and demonstrate how specific technologies would be used to solve specific problems. For the legal advocates, this specificity enabled them to use case law and policy against a particular set of problems, which is where their legal training shined. The author personally witnessed lawyers co-designing workflows with technologists from both DHOs and federal agencies, breaking through weeks of hypotheticals in a matter of a few hours.

Processes

Experimentation is an iterative process, not a linear one. The worknet may enter this phase and find that multiple iterations are necessary to work through issues before the project can be activated during an emergency. This learning is a feature, not a bug. It is an opportunity for all parties to explore new ways of working—the

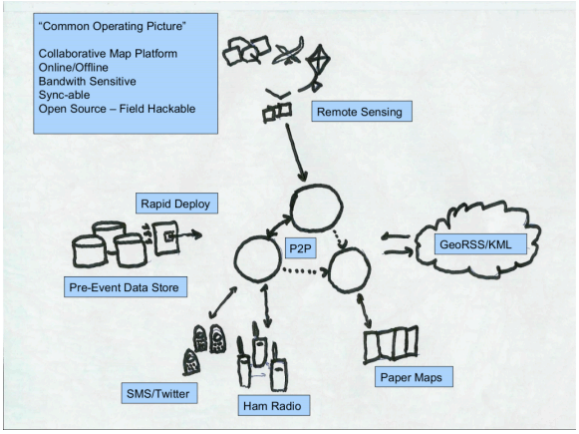
[30] CEO of Google. Larry Page, calls for such a safe space for experimentation in his speech at I/O 2013: http://techcrunch.com/2013/05/15/larry-page-wants-earth-to-have-a-mad-scientist-land/.

core of innovation. The results should be measured not only by the project, but by how many minds are opened to new ways of approaching information sharing challenges.

Minimal, Lightweight Workflows. DHOs are often intensely focused on keeping things simple. They must: they have to work with a wide range of volunteers, sometimes across languages. This simplicity is a design feature for government, as it forces the initiative to focus on the essential instead of trying to build expensive tools that try to cover all possible scenarios. For disasters, simple is fast and resilient. That may not be the design criteria for government applications in other non-emergency contexts, but for the chaos of disasters, lightweight minimal processes at the interface of grassroots and government is essential.

Some experiments can be performed in an office or by working virtually. The experience of interviewees, however, indicated that face-to-face interactions in a safe space (removed from the politics of the agency office) is an effective and worthwhile expense. One issue that emerged in the budget crises of the past two years is a strong desire to measure the effectiveness of experimentation (managers asking, "*what are we getting for our money?*"). The automatic tendency under this question is to impose formal structures on experimentation, so that specific goals are either achieved or the experiment 'fails.' While this approach is understandable, the experience of Camp Roberts/RELIEF experiments points to the effectiveness of semi-structured experimentation, where the design of the work can be altered in mid-stream to meet emerging understandings and failure is a significant finding that provides feedback and enables partners to seek out new pathways.

Experimentation usually created reports about what each side learned during each experimentation event. That said, the most important deliverables tended to be the ideas that worked their way from bar napkins to several types of formal documents.



Statement of Work. By trying out minimally viable examples of how a collective intelligence would use a given set of tools to process data, interviewees showed that they were able to turn their general agreements from the Design phase into specific statements of work. These SOWs, in turn, enabled the DHOs to build their tools to

meet federal requirements. It should be noted that a lesson learned was that this SOW should *not* be a boilerplate document or inflexible contract; it should be a malleable, adaptable statement of expectations that is a co-created document. Its generation is a process by which agencies and DHOs work negotiate their different work styles, make their technologies interoperable, establish data standards, and create metrics and processes by which the project will be evaluated.

Volunteer Management Plan. By co-designing the workflow, the DHOs and agency representatives were able to develop plans to mobilize and motivate volunteers around the project, as well as a plan to coordinate and manage the activation of those volunteers during an activation. The specificity of these plans enabled DHOs to recruit SMEs to lead teams around specific issues raised by the federal government, including data validation, the handling of PII, and licensing of intellectual property.

Protocols

Experimentation will lead to exploration of how specific government and DHOs technologies interact. This is the phase to explore the quirks of making open source, open data, and open methods work together, not activation. This review of protocols should include:

Test Open Data Standards. The specification and testing of open data standards might expose differences in implementation or the need to write adaptors between different open data standards. A good example derives from the OpenStreetMap, Google, and ESRI data models. Each is compliant with open standards, but each has a slightly different way to draw a polygon. As a result, it is necessary to write adaptors to handle polygons as one shifts between an ESRI, Google, and OpenStreetMap description of a place.

Test Flow of data across technology platform: The flow of data is generally easy to describe on a whiteboard. It may all be structured using open standards and have clear pathways between government and grassroots systems. However, it is only by experimentation that the team will discover the file limit placed on a specific server by government IT staff, or discover the costs incurred by trying to transfer data over a satellite terminal to a field team. Technical interoperability is often only achieved by failing repeatedly as teams discover that underlying assumptions about networks and other infrastructure are incorrect.

User Experience Testing. The human factors in a crowdsourcing initiative can make or break the initiative. Given that the user experience (UX) design of government web application tends to be quite poor, this work can have a positive but disruptive effect on federal vendors and staff. That said, the quality of UX design expected by

volunteers tends to be quite high. To keep volunteers engaged, a key motivating factor is to make each task simple and easy to perform; this *requires* good design.

3. Activate

The activation phase gives both agencies and DHOs an opportunity to show what can be done with all previous planning around legal, policy, and technical issues around crowdsourcing. In two of the cases, they activated only when they had tested the tools repeatedly and worked through all major issues. In the case of MapMill, however, the code saw its first use during an actual emergency (Hurricane Sandy). While the workflow around the code worked, and the code remained stable, this was a matter of luck (and credit to PLOTs and HOT developers' skill), not prior planning. Agency risk profiles will generally not allow for this kind of leap of faith. However, given the scale of Sandy and the dire need for imagery analysis, and the fact that internal analysis was going to occur in parallel, the cost-benefit ratio pointed strongly in the direction of using the new tool.

People

An activation will generally include the people who are scoped out by a planned workflow. That said, an innovative pilot will attract attention when it works well. Federal PMs need to ensure that they *include those who are necessary without overburdening the worknet*. Simple and minimal is the best for worknets. It is prudent to keep the list of those involved at the leadership level (not the crowd) to those who are *essential* to the activation phase.

Processes

For most federal agencies, the establishment of a standard operating procedure or new policy around crowdsourcing is a complicated process that engages a wide range of actors, many of whom are not yet ready for this level of commitment to a new form of knowledge creation. As a result, most activations are characterized as "pilots," which have lower standards for getting approval and keeping them alive. To our knowledge, no crowdsourcing initiative has reached the level of becoming a policy. All are still "pilots." As a result, they are still free to innovate during the emergency—a privilege (and opportunity) rarely afforded to enterprise systems.

Choose non-critical missions. For many agencies, engaging a new form of knowledge creation on a mission-critical activity is frightening. It is often best to choose topics, regions, or datasets that allow the worknet to explore and learn without triggering anti-body reactions within the federal bureaucracy. This approach (often called a shadow operation) gives the initiative the chance to prove its worth in a risk management environment that permits the team to make changes on the fly.

Protocols
The technologies and data standards should have been established in the design phase and then honed in the experimentation phase. That said, they must remain malleable in the activation phase. While science does require holding variables constant in order to learn, the mission during an emergency is not to remain loyal to the scientific process; the mission is to preserve lives, health, and property. The worknet needs to remain adaptable and may choose to make evolutions on the protocols to meet unexpected situations or emerging needs. In field discourse, this is sometimes called *Semper Gumby*. If the pilot occurs during an emergency, in no case should the plan for collecting performance metrics get in the way of operations and aid to the affected communities.

4. Learn
Qualitative and quantitative evaluation of the project is important for adapting the design to the actual requirements from one or more activations.

People
The process of evaluating and learning from the activation of a pilot should include not only the worknet from the design, experimentation, and activation phase, but also SMEs who can assist in the evaluation of crowdsourcing projects. Such SMEs are found within the DHO realm as well as academia and commercial crowdsourcing interests. There are growing number of people who specialize in the analysis of DHO operations using a range of methodologies, most of which are mix qualitative research with quantitative analysis of the data that a given project creates during an emergency.

Processes
Open Evaluations. Evaluation and learning should be done in an open forum, so that government and grassroots can learn from each other. There is a tendency to keep internal government reviews under For Official Use Only (FOUO) or Sensitive but Unclassified (SBU) classifications. While this may be necessary to deal with internal arguments over data quality, this approach slows down collective learning. This openness should be scoped into the statement of work with the DHO, so that there is an expectation and framework to draw specific individuals into official internal government reviews. If nondisclosure agreements are required for a given context, those agreements should be in place *before* the work enters the activation phase.

Protocols
There is no data on establishing the open data or open source protocols for learning yet. The expectation in the DHO community is that all learning will be published in an open forum, such as a wiki, where the collective intelligence can

add questions and new layers of meaning to the findings. No government project has used this format yet. That said, it should a core principle of open government to share what partnerships learn, and future work should publish as much of its work as is feasible so that other agencies and DHOs can avoid repeating mistakes, taking unfruitful avenues of experimentation, and replicate results.

Conclusion

"When Thomas Kuhn defined paradigm change in *The Structure of Scientific Revolutions*, he described a state where a traditional framework and several experimental approaches existed in parallel—a period when the explanatory power of the old system wanes while some inchoate new system explores and codifies the methods that are strong enough to begin replacing the old ones." [31]

I wrote those words two years ago, for a conclusion of a World Bank report about the performance of "VTCs" in Haiti. While it is unlikely that DHOs will ever fully replace traditional institutions for disaster response (despite some language of technological determinism that can be found in crowdsourcing), DHOs are going to play a key role in accelerating sense making during emergency operations, especially as information flows scale at the current exponential rate. Building an interface will be a challenge. That said, agencies have already begun to confront the legal, policy, and technology issues that DHOs have raised. This report is but a first step at outlining the framework that is forming. The work is now on the community—the agency champions and DHO leaders—to fill out this initial skeleton.

The key for the successful use of collective intelligence will be generating trust in the knowledge it creates not just inside government, but within the populations that may be affected by future disasters. When FEMA or USAID uses knowledge generated by citizens to make a decision that affects the mission of saving and sustaining life, citizens must trust that the data used to generate a decision was the best available at the time. The process of deciding when to use collective intelligence augment traditional mechanisms of sense making will mediate how this trust is built.

Collective intelligence is a form of leadership: it requires asking our citizens to participate in the response as a whole of nation activity. Despite the many reports of apathy and disengagement, my experience with domestic and international operations has shown that this sense of service is alive and well. That said, we need leaders inside of government to harness collective action to speed our ability to determine at least two questions: who needs what where and who is doing what where. Call it 21st-century bucket brigade: the information brigade.

We wish to emphasize—emphatically—that this document is only a beta version of an interface, perhaps even an alpha version. We wish to encourage those with expertise and experience to fill out the framework, to emend its errors and amend

[31] World Bank Haiti Report, GFDRR, 2010. Get Citation.

its scope. Like patches in an open source software project, edits will be merged into the main body of the work through a process of editing. Not all will make the cut, but the objective is to have a cohesive, relevant, and accurate framework that others can use and build upon—and come to trust.