Crisisonomy

Disaster Intelligence

- Information to Connect and Empower Governments, NGOs, and Citizens -

Ralph S. Brower[1+], David Merrick[2], Robert McDaniel[2]

[1] Askew School of Public Administration and Policy, Florida State University
[2] Emergency Management and Homeland Security Program, Florida State University

Abstract

In this manuscript we present a model of disaster intelligence as an aspirational model for emergency and disaster management in Western contexts. We reinforce this conceptualization with a heuristic for all-hazards disaster communications, in which traditional/local and social media forms of disaster communications are seen as supplements to official disaster communications. It is important, therefore, to enhance our disaster data capabilities by automating the processing of social media disaster data that are not presently being fully exploited. Hilhorst's (2004) social domains heuristic is proposed as a way to represent the competing interests and understanding of disaster science and management, disaster governance, and local participants and vulnerable populations, respectively. We then present a series of empirical incidents of disaster communication failure that illustrate breakdowns among competing perspectives from the three social domains. In conclusion, we offer recommendations for practice and scholarship to advance disaster communication and disaster intelligence capabilities in both Western and developing contexts.

Key words: disaster communications, disaster management social domains, social media disaster data

Ⅰ. Introduction

Western practitioners and scholars have advanced an increasingly coherent body of knowledge and practices for emergency and disaster management. One noteworthy juncture in that development was the creation of the U.S. Federal Emergency Management Agency (FEMA) under President Jimmy Carter in 1979 (FEMA, 2010). The new agency had been directed to create diverse multi-agency and multi-level partnerships and responsibilities; following this directive, FEMA's leaders created a "rational system of management called the Integrated Emergency Management System (IEMS)" (Giuffrida, 1985: 2) that employed what is now the well-known four phase model of emergency management activities (⟨Figure 1⟩).[1)] By the mid-1980s the four phases were common

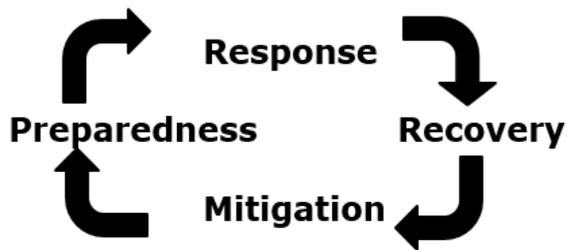[+] Corresponding author: Ralph S. Brower, e-mail. rbrower@fsu.edu

Figure 1. The four phases of emergency management ctivity

parlance in emergency management in American academic and practice communities. In support of this point, it is noteworthy that a special issue of *Public Administration Review* in 1985 contained 22 articles dedicated to emergency and disaster management, and the four phase model is employed broadly throughout those articles.

The historical trajectory may not always have been straight-forward, but the four phase model eventually diffused broadly among disaster professionals throughout most of the world. Evidence for this is found, for example, in projects funded by the World Bank.

Since 1980, the World Bank has approved more than 500 operations related to disaster management . . . . These include post-disaster reconstruction projects, as well as projects with components aimed at preventing and mitigating disaster impacts (World Bank: p. 1, as quoted in Brower & Magno, 2011: p. 43).

In reviewing these World Bank funded projects Brower and Magno (2011) found many dating to the early 1980s that dealt specifically with mitigation and preparedness as well as others intended to enhance more traditional response and recovery activities. They argued that, although the World Bank had only recently assembled this list as a

hindsight acknowledgment of the various projects' relationships to the four phases, the Bank's attention to preparedness and mitigation in these projects demonstrated an early recognition of these four faces of disaster management activity. The four phase model is an important foundational component of the approach to disaster intelligence that we present in this article.

II. Intelligence for Disaster Decision Making in an Ideal World

Among the various models that might be employed to describe the filtering of data and information from the human and physical environment for the purposes of decision making in disaster management, one that is particularly useful is the data-information-knowledge-wisdom hierarchy (DIKW). We will employ the DIKW heuristic in this article as a starting point for thinking about disaster intelligence activities for professionals in disaster management (⟨Figure 2⟩). Jennifer Rowley (2007: 163-164) summarized the model as follows:

The data-information-knowledge-wisdom hierarchy (DIKW) . . . is one of the fundamental, widely recognized and 'taken-for-granted' models in the information and knowledge literatures. . . . The hierarchy is used to contextualize data, information, knowledge, and sometimes wisdom, with respect to one another and to identify and describe the processes involved in the transformation of an entity at a lower level in the hierarchy (e.g. data) to an entity at a higher level in the hierarchy (e.g. information). The implicit assumption is that data can be used

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1) Some United Nations agencies now add a fifth phase, prevention, to recognize, for example, potential interventions into the human activities that contribute to global climate change.
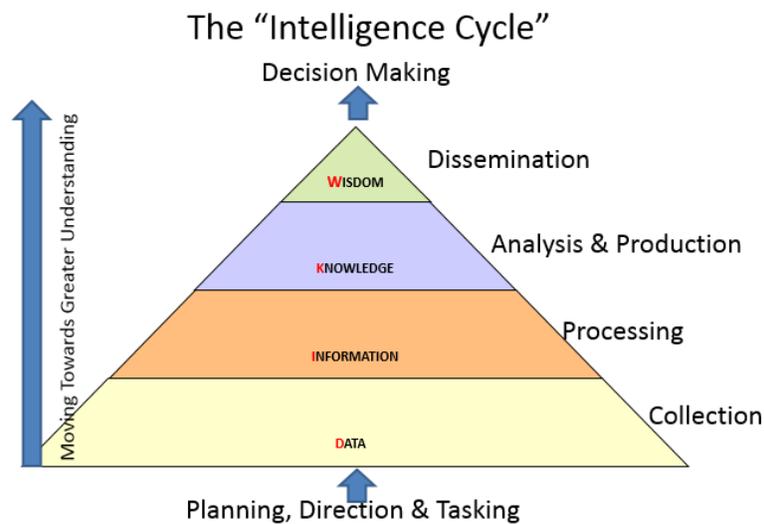
The "Intelligence Cycle"

Figure 2. The DIKW hierarchy

to create information; information can be used to create knowledge, and knowledge can be used to create wisdom.

Russell Ackoff, whose 1989 article is often cited as a foundational framing of the idea, initially crafted the hierarchy to reflect content in the human mind. His model included a fifth element, understanding, but later authors generally dispensed with this element, and subsequent literature has typically applied the model in information systems perspectives (Rowley, 2007).

The following definitions of data, information, knowledge, and wisdom are extracted from his original (1989) article:Data are defined as symbols that represent properties of objects, events and their environment. They are the products of *observation* (emphasis in original), but are of no use until they are in a useable (i.e., relevant) form. The difference between data and information is functional, not structural.

Information is contained in descriptions, answers to questions that begin with such words as who, what, when and how many. Information systems generate, store, retrieve and process data.

Information is inferred from data.

Knowledge is know-how, and is what makes possible the transformation of information into instructions. Knowledge can be obtained either by transmission from another who has it, by instruction, or by extracting it from experience. . . .

Wisdom is the ability to increase effectiveness. Wisdom adds value, which requires the mental function that we call judgement. The ethical and aesthetic values that this implies are inherent to the actor and are unique and personal (Rowley, 2007: 166).

In ⟨Figure 2⟩ the DIKW hierarchy is depicted as an "intelligence cycle," in which decision making is the culmination of movement toward greater understanding. Disaster management data can appear in many forms - on-the-spot reports from lay and professional personnel; observations obtained through technologically-enhanced data gathering such as weather instruments, hydrology equipment, seismology, and so on; and visual images obtained through photography on the ground or in manned and unmanned aircraft or satellite imagery.

Data can be collected in many forms, but individuals who have been trained or who have explicit instructions for filtering data to extract useful and relevant data from irrelevant "noise" are necessary in order to convert data into information. Their activities constitute a "processing" of the data.

Useful knowledge is obtained when disaster experts analyze relevant information and process it into a form that can be used by decision makers. The model presumes that decision makers then dispense wisdom in the form of decisions they take and directives to citizens and implementation instructions to other disaster professionals. We argue below that, for a number of reasons, "wisdom" is an aspirational component of actual decision making. We also propose that the collecting, processing, analyzing, and producing of important disaster information varies substantially across national settings, and we provide illustrations for this variation.

Ⅲ. All-Hazards Disaster Communications in the Real World

One implication of the DIKW hierarchy in the preceding paragraphs is the assumption of an ideal system in which available data necessarily contribute to greater understanding of the disaster situation and to decisions made by "wise" decision makers. One might also surmise that the filtering process implied in the intelligence hierarchy is centered on disaster officials and decision making officials. In the real world of disaster activities, especially in developing countries, many participants in addition to disaster officials are substantively important in the communication of data relating to disasters. These include local participants,

officials charged with governance responsibilities, NGOs and their leaders, and the media, among others.

1. All-Hazards Approach

An important component of disaster management in virtually all contexts is the all-hazards principle. An all-hazards approach considers all potential risks and impacts, both from potential natural and man-made disasters (intentional and unintentional), to ensure that decisions made to mitigate against one type of risk do not increase vulnerability to other risks or other people. An all-hazards approach requires many organizations and people to coordinate their activities and keep each other informed. In ⟨Figure 3⟩ we offer a heuristic for identifying relevant data in a variety of forms and communication flows among three sources of relevant disaster data: disaster officials, local and traditional communications, and social media.

2. Official Communications

As we acknowledged above, the foregoing discussion of the DIKW hierarchy emphasizes the flow of data and information through official
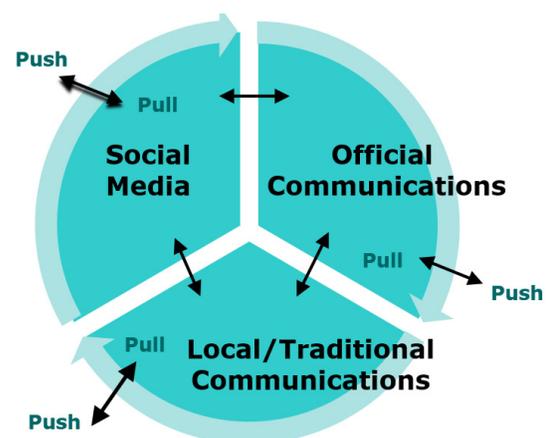

Figure 3. Components of all-hazards disaster communications

Table 1. An illustration of official emergency support functions[3]

Emergency Support Function	Description
1. Transportation	Provide or obtain transportation support.
2. Communication	Provide telecommunications, radio, and satellite support.
3. Public works	Provide support in restoration of critical public services, roads, and utilities.
4. Firefighting	Support detection and suppression of wildland, rural, and urban fires.
5. Information and planning	Collect, analyze, and disseminate critical disaster information to emergency response team members.
6. Mass care	Manage temporary sheltering, mass feeding, and distribution of essential supplies for disaster victims.
7. Resource support	Provide logistical and resource support to other organizations through purchasing, contracting, renting, and leasing supplies.
8. Health and medical	Provide health, medical care, and social service needs.
9. Search and rescue	Locate lost persons and victims trapped in collapsed structures and provide immediate medical care.
10. Environmental protection	Respond to actual or potential hazardous materials discharges and other situations threatening the environment.
11. Food and water	Secure bulk food, water, and ice to mass care sites.
12. Energy	Support response and recovery from shortages and disruptions in supply and delivery of energy resources.
13. Military support	Provide military resources to support logistical, medical, transportation, and security services.
14. Public information	Disseminate disaster-related information to the public.
15. Volunteers and security	Coordinate utilization and distribution of donated goods and services.
16. Law enforcement	Coordinate the mobilization of law enforcement and security resources.
17. Animal protection	Provide rescue, protective care, feeding, and identification of animals separated from their owners.

※Source: Choi & Brower(2006).

communication channels. We can regard official communications as those among agencies, both government and voluntary sector,[2] designated by law or other agreements with specific roles in emergencies and disasters – and with other sources that can inform official disaster activities. In Western settings these agencies or actors are often designated with specific emergency support function designations (ESFs). An all-hazards approach is assumed in these communications.

An illustration of typical emergency support functions is offered in ⟨Table 1⟩. This particular list was drawn from Choi and Brower's (2006) study of emergency management networks in a Florida county in the United States. The official communication channels among government agencies and voluntary sector organizations as they perform the work of individual support functions can become quite

2) We acknowledge that various terms – nonprofit, nongovernmental, third sector, and so on – are used in various literatures and in different countries to refer to such organizations. We refer to these organizations as voluntary organizations, which draws attention to the substantial component of their activities that are voluntary; this implies the uncoerced and uncompensated contributions of time and resources.

3) Florida later added an 18th ESF, entitled Business, Industry and Economic Stabilization.

complex. 〈Figure 4〉 depicts the actual communication channels of one of the ESFs (Resource Support) from the Choi and Brower (2006) study. For any given local government, state or provincial, or national government, we would expect to find channels like these in each ESF, similar communication patterns among the ESFs, as well as similar patterns between ESFs at different levels of government.

〈Figure 3〉 presumes that the flow of data and information among the communication elements implies both "push" and "pull" processes. In push processes actors within the particular element send data and information to others who are presumed to need them. Pull activities are those in which the same actors draw relevant data and information from others who have them. As the figure suggests, it is likely that each element engages in push and pull communications with external actors in addition to those in the three principal elements depicted in the model. We also assume that there may be actors in each element who are capable of processing data into useful information. That is, the processing of data into information is not exclusively the domain of designated disaster officials; there may often be knowledgeable or influential people in the other two elements who convert disaster data into information in various ways.

As suggested earlier, official communications are often reinforced with technologically-produced data (and information) from sources such as aerial photographs, satelslite images, and from scientists employing technologies such as meteorology, seismology, climatology, oceanography, and so on.

3. Local and Traditional Communications

Local and traditional communications related to
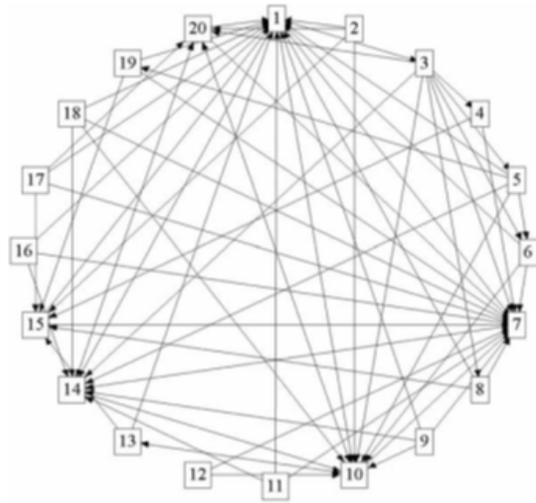
※Source: Choi & Brower(2006).

Figure 4. Illustration of official communication channels in a Florida County ESF

disasters existed long before the professional designation of official disaster and emergency management activities were created. The most basic communication systems were simply word-of-mouth or messengers designated to carry warning to people in other locales, near and far. Other traditional signaling or warning systems in various parts of the world have consisted of such things as drums, horns and bells, and smoke signals.

In addition, lay people in many settings have developed a body of local wisdom such as observing animals as warning signs for impending natural disasters. Hesitant or nervous behavior from horses and other domestic animals were sometimes regarded as signals of impending seismic activities; in hindsight we suggest that the animals were sensitive to preliminary seismic shocks that humans could not detect. Similarly, the first author has been told by locals in slum settlements along the Marikina River east of Metro Manila in the Philippines about how they traditionally listened for squealing among pigs in their pens as a signal

that the river level had risen into preliminary flood stage. This was an especially important indicator during the night that their households needed to prepare to evacuate to higher ground.

In the same Philippine setting the locals organized a community-based organization focused on preparation and planning to avoid the periodic threat of flooding. Among their systems was a system of two-way radios which was employed to spread the word to others about the need to evacuate. One woman who lived near a bridge was given the assignment to watch the water level relative to a gauge on the bridge pilings. When the water level reached 17 meters, she transmitted to those with the other radios to spread the word to evacuate. These individuals subsequently activated a cell phone communication tree so that every household near them received the warning.[4] Later, leaders in this organization (depicted as Buklod Tao both in Brower & Magno, 2011 and Bankoff, 2015) made connections with residents along the Marikina River at higher elevations who began to provide cell phone warnings to them about changes in upriver water levels. These warnings helped give the former group a two-hour headstart in preparing for evacuation whenever flooding threatened. These systems were created with some assistance from another voluntary sector organization,[5] but without direct assistance from local or national government.

In some Western settings emergency management systems often employ the services of Ham radio operators, who can often transmit important information using battery power when other communication systems are inoperable due to power outages. Operators of these traditional local systems were often organized through Ham radio clubs and had well established knowledge of other radio operators among nearby communities.

4. Social Media as Communication Source

In this section we advance the argument that social media outlets may contain useful data that are often left untapped by official emergency and disaster managers. The underlying argument is that local individuals often post photos and field observations in sources such as Twitter, Facebook, and Instagram, and these data greatly extend the reach and view of official channels. These social media sources come from many sets of eyes and ears that extend beyond official information. We must acknowledge, however, that these sources often have serious challenges. The validity of information is not always clear; a lot of time may be required to separate useful information from all the "noise." Official channels can't afford the time to process these data, so it often falls to volunteers – whose work must be coordinated and supervised.

We contend that this sorting of social media data is at present cumbersome, since it must be done manually by trained volunteers, but there are indications that in the near future these procedures may be enhanced technologically so that this processing

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4) We asked why they needed to employ two-way radios when cell phones were available. They answered that people put cell phones on "vibrate" or "silent," whereas the "squawk" of the radio could be counted on to awaken the people who possessed the other radios.

5) The other voluntary organization, Center for Disaster Preparedness (CDP), is also depicted in Brower and Magno (2011). Although headquartered in Metro Manila, CDP operated throughout the Philippines to assist communities and community-based organizations in disaster mitigation and preparedness.

of data can be substantially computer-assisted. We offer preliminary evidence for this argument below.

As to the accuracy of data, a research team from Florida State University traveled to areas along the U.S. Gulf Coast impacted by Hurricane Isaac in 2012 specifically to confirm social media reports about hurricane damage. The researchers drove to the locations of approximately 30 incidents in which damage was reported and GPS coordinates were provided. In 80% of the incidents the researchers were able confirm the reported damage. In all of the cases for which photos had been posted, the information was confirmed. The team could not confirm the remaining 20% of incidents, but neither could they disconfirm them, since they could not rule out that damage had been remedied or changed after being initially reported. The researchers concluded that their study constituted a preliminary proof of concept that social media reports often contain useful data that substantially extend the data available through official disaster management communication channels.

The Office of Emergency Management for the City of New York presented evidence at the 2016 hurricane conference in Florida that further reinforced this proof of concept. They had newly operationalized an automated warning system, and in one recent incident they detected approximately 40 social media photo and video postings about a five-alarm fire within the metropolitan area. These data alerted the Office of Emergency Management to dispatch equipment and personnel even before they received a request for backup from personal communication.

A further indicator of viable automated systems

on the horizon for processing social media data related to emergency management is shown by recent activities at the Red Cross Digital Operations Center in Northern Virginia. Here Red Cross officials are building a system designed by Dell Computers that has been copied from brand management systems used in the private sector to detect positive and negative social media comments that customers have posted about various private company products. Based on these several sources of evidence, we may reasonably conclude that automated systems to exploit social media data may be employed in the near term in disaster management.

IV. Communication Failures and Competing Interpretations

Since information comes from many sources and gets conveyed through a variety of channels, there are many opportunities for communication failure. A non-exhaustive list of these sources of communication failure or distortion includes:

- Failures of information reception: mis-comprehension, inadequate attention, or blocked channels;
- Exaggerated responses to information: contagion, rumors;
- Human cognitive limits that create erroneous information; and
- Competing channels conveying contradictory information or interests.[6]

We assert, moreover, that many of the failures and distortions can be mapped against competing roles or competing sets of actors in disaster

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6) See also Brower, *et. al.*, 2009; Manoj and Baker, 2007; Cole and Fellows. 2008.

activities. In addition, although the communication of data, information, and knowledge ideally should bridge the activities of the four distinct emergency phases, we suggest that such bridging is often the most costly locus of communication breakdown in disaster information systems. We next offer a model that illuminates the competing information activities among distinct social domains of disaster actors, and then provide evidence for several forms of typical communication failure.

1. Competing Social Domains

Dorothea Hilhorst (2004) has offered a social domain heuristic that is useful for the present discussion (⟨Table 2⟩). In this heuristic Hilhorst assumes that three principal clusters of actors construct and define unique representations of the activities of disaster management. She defines social domains as "areas of social life that are organized by reference to a central cluster of values which are recognized as a locus of certain rules, norms and values implying a degree of social commitment" (p. 57). The respective social domains in disaster management in her model are those of "scientists and managers, bureaucrats and politicians, and local producers and vulnerable people" (p. 57).

We note that Hilhorst (2004) illustrates the three domains primarily from activities shown in her own research and that of others in developing countries;

we might thus question the applicability of the three domains to more developed national contexts. Recently, Susan Spice (2017) applied Hilhorst's heuristic in a study of organizational and inter-organizational behavior in the sheltering of special needs populations during the 2004 hurricane season in Florida. She concluded that the heuristic was eminently useful in this context, but that the requirements of inter- organizational coordination appear to soften silo effects across the domains that might apply to some degree in developing nation contexts.

The *science and disaster management domain* is a hazard-focused paradigm, in which the best of contemporary science and technology is directed to controlling the consequences of disasters through expert knowledge. We suggest that the foregoing DIKW hierarchy and the processes of official communication are generally dominated by this domain of values. Hilhorst cautions, however, against assuming that this domain is a unitary and hegemonic paradigm. Rather, as Latour and his associates have shown in their study of life in scientific laboratories (1997; Latour & Woolgar, 1979), the processes by which scientific truths are obtained are much more dependent on social relations and practices within laboratories than on raw scientific discovery. In addition, popular conceptions of scientific and technological management notwithstanding, political rivalries, social networks, career advancement, and

Table 2. Hilhorst's social domain heuristic

Domain	Science and Disaster Management	Disaster Governance	Local Responses
Actors	Scientists and Managers	Bureaucrats and Politicians	Local Producers and Vulnerable People
Paradigm	Hazard-Centered: seeks to control hazards themselves	Mediation-Centered: seeks to mediate risk and reduce vulnerability through policies and governance institutions	Emphasizes the various ways local people cope with emergencies and maximize their capacities and resources

personal characteristics all enter into the ordering of values and priorities within the domain of science and disaster management.

The domain of *disaster governance*, whose principal actors are bureaucrats and politicians, is where:

society's priorities regarding risk and vulnerability are defined. It is the domain where disaster knowledge and management is mediated and altered through political and bureaucratic governance practices and institutions. In a broader sense, the domain of disaster governance is also the domain in which it becomes apparent how disasters affect state-society relations and, vice-versa, how state-society relations affect responses to risk and disaster (Hilhorst, 2004: 59-60).

Although some inconsistencies between science and governance occur in all societies, such ruptures are especially common in developing countries. In these settings we see especially how social inequalities and political relations are reflected – and reinforced -- in the interventions that government leaders impose on local citizens and disaster officials. Gaillard (2011) offers a particularly poignant illustration from 2011 flooding in an area north of Manila in the Philippines. A provincial governor reported to a journalist that "I sent some boats to rescue (some residents) and one councilman even died while trying to rescue them. But the residents still refused to leave, so I have decided to without relief goods from them." The same journalist later praised the governor for "teaching recalcitrant residents lessons in civic and personal responsibility and refusing to abet their stubbornness . . ." (p. 30). Responding to Gaillard's report, Brower, Magno and Dilling observed that "apparently both the official

and the journalist have little understanding about the ways that disasters' consequences are directly related to development capacity, public education, and comprehensive planning that anticipates and mitigates potential hazards" (2014: 303). We offer several additional illustrations below about the ways state-society relations are reinforced in interactions between governance actors and local participants in developing country contexts.

Beyond merely reinforcing inequalities in economic and political relations, these interactions sometimes allow resourceful people to manipulate the situation for personal or political gain. In a news story in the Philippines in 2013, then Vice President Binay was widely reported to have directed the repackaging of foreign relief supplies headed for the quake-stricken island of Bohol into plastic bags blazoned with words announcing that the supplies had been provided by Vice President Binay. Mr Binay had previously announced as a probable candidate for President for the 2016 elections, and both citizens and journalists commented on this blatant politicizing of relief activities.

Hilhorst (2004) suggests that the domain of *local knowledge and coping practices* is "constituted by the manifold ways in which local people cope with emergencies, maximizing their own capacities, resources and social networks" (p. 62). Hilhorst cites Duffield's (1993) work, which argues that no more than 10 percent of survival from disasters can be attributed to the delivery of outside relief. Or, as one research informant in Leyte Province told us in the aftermath of Typhoon Haiyan in the Philippines in 2013, "all that most people say they need are a hammer, a saw, some nails, and some plastic tarpaulin. They can find the other materials

they need to survive in the short term and get back on their feet for the longer term" (Robin Lim, personal communication, August 8, 2014).

In addition to the implications for self-sufficiency in the wake of disasters, we suggest that local knowledge also figures prominently in the ways that local residents respond to the activities of official disaster science and disaster governance. In the story reported by Gaillard (2011) above and similar cases, the reluctance to relocate from disaster-threatened property is often rooted in fear that one's unguarded property will be stolen, or in the desire to sustain what is familiar, such as their children's schools, local employment, and family and neighbor relations (Dilling, *et. al.,* 2014). These typical social anchors figure prominently in the ways that government officials' disaster directives will be received by local participants.

2. Communication Failures Between Domains

We conclude with illustrations of communication failures in both developed (U.S.) and developing contexts (Philippines). Earlier in the manuscript we suggested several typical forms of communication failure in disaster management; *failures of information reception* was among these typical forms. Typhoon Washi which struck the southern Philippines island of Mindanao in 2011 offers a useful illustration. In this instance blocked official channels figure prominently in this account illustrated in Brower, Magno & Dilling's research (2014). In the build-up to this typhoon both American and Philippine meteorologists provided detailed warnings about the strength, likely trajectory, and potential extensive rainfall from this powerful storm, predictions which ultimately proved correct.

Perhaps because powerful typhoons had typically passed further to the north, skeptical local officials failed to convey information provided to them by the Philippine Office of Civil Defense. Significant results included torrential rains in high elevations and heavy flooding downstream in rivers that flowed to the north through the island. This resulted in more than a thousand subsequent drownings downriver near the cities of Cagayan de Oro and Iligan, many of them caught unaware in their homes during the night. One obvious way to bracket this occurrence is as a breakdown between actors in the domain of science and disaster management and those in the domain of disaster governance. Sadly, those in the domain of local participants are ultimately victimized in this breakdown that falls under the control of actors in the other two domains.

We note also that numerous accounts exist of communication failures that occur because of *competing information, intentions, or interests in different channels.* In one U.S. illustration a small group had organized a voluntary structure for filtering social media postings about a tropical storm bearing down on the southern U.S. Atlantic coast. They had begun to gather data from a number of posts that reported storm impacts within their state. On the second day of their activities the leader of the group was contacted by the official public information officer of the state's emergency operations center. The PIO advised that he had received a request from the Governor's office for information from posts that might indicate adverse economic effects on the state's tourism, such as posts from people indicating they were changing their travel plans. The group's leader perceived this

as an inappropriate political interference into efforts that were ostensibly meant to report storm damage and displaced citizens, and he instructed the group to cease operations. As we noted in earlier discussion, disaster governance in Western countries is scarcely immune to particularistic efforts among disaster governance officials to exploit official disaster activities for economic, personal, or political gain.

Another account of competing intentions is drawn from experiences following the 2013 Typhoon Haiyan in the Philippines. As an active member of a local community's Filipino-American association, the first author received group emails announcing plans for a "Balikbayan box party" at the home of a family whose relatives lived in Tacloban, a city directly hit by a large tidal wave that drowned many individuals and displaced thousands of others. The idea for the party was to gather non-perishable food, clothing, and tools, pack them in shipping boxes, and arrange to ship them to affected areas such as Tacloban. Unfortunately, this well-intended effort of local participants flew in the face of "best practice" from the domain of disaster science and management.

Disaster managers usually preach the advantages of sending money to disaster distressed areas rather than food, clothing, and tools. The latter items must be unpacked, temporarily warehoused somewhere near the distressed area, and then repackaged and distributed to individuals who need them. Money, on the other hand, helps to infuse resources into the economy of the distressed country, can be directed to supplies and food items that are specifically needed, and thus minimizes unpacking, warehousing and repacking. The first author

emailed the association's president to encourage his intervening in their well-intended but "misguided" plans. The president of the association did not reply to the email, and the email was not forwarded to the list serve for association members. The party occurred as planned, and subsequent photos suggested that about 14 large boxes had been shipped to Leyte Island, where Tacloban is located.

Eight months after the typhoon, in preparation for a research field trip to Tacloban, the first author interviewed the woman who had organized the Balikbayan box party. She explained that the idea for the party had arisen from the members of a Filipino youth dance group, whose members were eager to do something to help. She explained at length the cultural practices of Filipino community self-help (*Bayanihan* and *Pagtutulungan*) with which the author was already familiar, and she emphasized that this activity had served a social function for the young people and their parents that was nearly as important as the assistance that it provided to those who received the relief supplies. The author timidly raised the question whether she had received any advice to send money rather than supplies. She had, but she reported that there were specific reasons that they had declined to send money.

Prior to the party her parents in Tacloban had reported about the distribution of relief supplies from Western sources. In particular, there had been bags of rice, ostensibly delivered from money donated to the Philippine Red Cross, but because the Red Cross lacked sufficient foot soldiers to deliver the rice themselves, they had enlisted the local political structure to help distribute the food relief. Her parents reported that the Barangay Captain[7] and his followers had played favorites in

distributing the rice, so that some families received three kilograms of rice, others received five, and still others received seven or more. These distinctions appeared to the parents to reflect political loyalties rather than family size or need. In subsequent field research in Tacloban we found confirmation for these reports of inequitable relief distribution. We received similar reports from a "squatter community" in Metro Manila about relief supplies distribution in the wake of flooding in recent years. In this instance the inequitable distribution appeared to be the work of leaders in an ostensibly community-serving community organization.

We suggest that the Tacloban incident in particular illuminates a conspicuous communication failure and system rupture involving actors in all three social domains: disaster managers who recommended monetary donations, disaster governance officials exploiting relief supplies for their own political purposes, and local participants acting on and reinforcing their own social reality that trusted neither disaster managers nor disaster governance. We suspect that such ruptures are commonplace in the disaster communication systems in developing countries, but as the U.S. example shows, Western settings are not entirely immune either.

3. Implications for Disaster Practice, Theory and Research

1) Automated Social Media Processing for Western Contexts

We have argued that the DIKW hierarchy is an aspirational heuristic that fits Western disaster management settings better than those in developing countries. Thus disaster intelligence, the topic of this article, is well suited to emergency and disaster decision making in Western countries. One of the important practice implications from this article is to encourage the development of systems that better integrate other sources of disaster data in addition to those that are conventionally managed in official communication channels. In particular, we offered evidence of proof of concept for greater efforts to tap into social media postings to supplement data that are already available to emergency managers. This recent evidence is reinforced by activities suggesting that technologies are currently under development to produce improved automation for the screening and processing of social media data in emergency management activities.

2) Improving Forms of Communication between Social Domains

The DIKW hierarchy is a much more distant aspiration for developing countries. It might be the argued that the assumption of "Rule of Law" that is taken for granted in most Western contexts in fact creates stability for emergency managers so that there is less volatility from unpredictable decisions from disaster governance officials as well as fewer complex and unanticipated difficulties presented by local participants. It is precisely these aspects of uncertainty – from unpredictable or uninformed disaster governance and local participants and vulnerable populations – that make disaster intelligence such a difficult goal for disaster management in most developing contexts.

We argue, however, that the disaster intelligence heuristic, given a few modifying considerations, has application in developing contexts as well. What

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7) Barangays are neighborhood political units, and the Barangay Captain is the elected head of the Barangay.

is implied, however, is that the heuristic be used as a diagnostic rather than prescriptive tool. That is, we might employ the heuristic to diagnose failures in communication systems. In addition, we suggest that both the All-Hazards Communication heuristic and Dorothea Hilhorst's (2004) social domain framework offer important supplements to the processes of disaster intelligence.

Particularly in developing contexts, it may be especially important to acknowledge and empower traditional communication systems, especially when doing so empowers these participants to take an active bottom-up role in disaster risk reduction in their everyday lives. Social media are no strangers to most developing countries, and so this source of communication may in the future become more actively incorporated into data processing systems for disaster management in these settings.

The social domain framework offers a particularly helpful diagnostic tool, especially for those attempting to produce research and theory for disaster management in developing contexts. As our several presentations of evidence from the Philippines suggest, communication failures in developing contexts may be particularly prevalent in which the actors in competing social domains proceed with substantially different intentions, understandings, and interests. In these instances, the social domain framework becomes a useful diagnostic tool for unraveling these competing perspectives. We caution Western scholars and practitioners, however, that this and other Western frameworks are appropriate for asking probing questions about existing systems, but answers and remedies need to come from locals who are most familiar with existing systems and most affected

by prescriptive changes that may be introduced to those systems.

3) Communication Failures Between the Phases

A final area of inquiry is beyond the scope of the present article; specifically, we suggest that many of the most significant intelligence and communication failures in emergency and disaster management systems are between the disaster phases. That is, they arise from failure to follow through from experiences in response, for example, to anticipate mitigation or preparedness efforts that might have improved response capabilities. Or they arise in the failure during response and recovery to assess the effects, beneficial and detrimental, from earlier mitigation and preparedness activities. Brower, *et. al.* (2009) identified a number of systemic reasons why opportunities for these types of organizational and inter-organizational learning often fail. We conclude with the suggestion that, as researchers undertake further explorations of the activities of disaster intelligence, that they couple these activities with efforts to explore further the failures of organizational and inter-organizational learning across the phases of emergency management activity. In so doing, it is imperative that they actively engage practitioners as consultants and as participants in suitable simulations.

Acknowledgement

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Profiles   **Ralph S. Brower :** He is Professor of Public Administration and Policy and Director of the Center for Civic and Nonprofit Leadership at Florida State University. He is the immediate past Editor-in-Chief of the International Review of Public Administration. His research and teaching focus on organizational theory, nonprofit and NGO management, and qualitative research methods. His work has appeared in numerous public administration, nonprofit management, and disaster management journals(rbrower@fsu.edu).

David Merrick : He is Director of the Emergency Management and Homeland Security Program at Florida State University(dmerrick@cdrp.net).

Robert McDaniel : He is Senior Fellow with the Emergency Management and Homeland Security Program at Florida State University(rmcdaniel@cdrp.net).