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BACKGROUND PAPER

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THEMATIC SUMMARY REPORT

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Executive Summary

Post-disaster decision-making is characterized by uncertainty. These difficulties are greatly compounded in the presence of limited or inconsistent information. Governments' and other stakeholders' capacities to exchange information and conduct post-event reviews are growing rapidly yet remain far from their potential. The components of success do exist, but perhaps the greatest obstacle is a shortage of research and discussion on the topic. Confusion still remains about what information sharing entails. There exist great differences in how countries interpret their own progress in this area.

Core Indicator 4 of the Hyogo Framework for Action (HFA) Priority for Action 5 (PFA5/CI4) seeks to evaluate the degree to which nations establish disaster information exchange procedures, and whether or not they undertake post-event reviews. Progress towards this objective is assessed in the HFA Monitor using a single question: "*Has an agreed method and procedure been adopted to assess damage, loss and needs when disasters occur?"* However, the scope of information sharing extends far beyond the task of post-disaster damage and loss assessment. In fact, few aspects of disaster management are as broad and all-encompassing as that of information sharing.

Significant technological and organizational advancement in the management of data, information, and knowledge has occurred since the 2005 signing of the HFA. These changes have corresponded to a rapid rise in social media use and the increase in prevalence of institutes, platforms, and other organizations created to enable the capture, processing, and sharing of information. The shift towards modernity has altered the way disaster risk management and disaster risk reduction are performed, strengthening the mainstays of global DRR and disaster management capacity building efforts in the process.

Despite challenges, governments have taken steps to increase their information sharing capacities. The Post-2015 Framework for Disaster Risk Reduction presents an opportunity to make broad-sweeping changes to how governments are further encouraged to manage disaster information during the response and recovery phases, and how they approach post-event reviews. This report contains guidance on eight recommendations and associated implementation actions through which the Post-2015 Framework for Disaster Risk Reduction may improve national and regional capabilities, including:

1. Assess information needs and sharing capabilities
2. Establish standards and protocols
3. Develop Systems and Invest in infrastructure
4. Work with the mass and social media
5. Build Partnerships
6. Establish Legal, Statutory, and Regulatory Frameworks
7. Engage Citizens
8. Establish SOPs for post-event reviews
9. Make information Available to DRR Efforts

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Introduction

Audience, Purpose, and Objectives

The intended audience of this report includes the GAR 2015 Lead Author and all associated Co-Authors. Ultimately, the material contained herein is intended for public dissemination to all sectors and practitioners involved in DRR including international organizations, national and local government agencies, nongovernmental organizations, the private sector, and academia.

The purpose of this report is to inform the 2015 Global Assessment Report (GAR15) on Hyogo Framework for Action (HFA) Priority for Action (PFA) 5 / Core Indicator (CI) 4, namely that:

> *Procedures are in place to exchange relevant information during disasters and to undertake post-event reviews.*

PFA5/CI4 is also referenced as one of two components under *Research Area 13* of GAR15.

The objectives of this report are:

1. To define information sharing and lesson learning in the disaster management context;
2. To highlight and document the progress made, successes achieved, and challenges encountered to date in line with PFA5/CI4; and
3. To provide recommendations for enhancement of this indicator in the Post-2015 Framework for Disaster Risk Reduction.

Methodology

This report was developed through the review and analysis of the following resources:

- Prevailing research and documentation on the collection and sharing of post-disaster needs assessment information;
- Prevailing research and documentation on the collection and dissemination of post-disaster lessons learned for recovery and DRR;
- Case studies detailing actual practices and methods of individual, intra-organizational, and inter-organizational disaster-related information exchange;
- HFA Assessment Reports detailing the following assessment periods: 2007-2009, 2009-2011, and 2011-2013; and
- Input papers (8) authored specifically to inform this project (see Appendix 1).

Scope

The author examined the following in his analysis:

- Information sharing requirements;
- Advancements and improvements in information sharing practices and technologies;
- Information sharing successes, challenges, and gaps encountered in practice and noted in literature;
- The nature of information sharing that occurs among and between national and local governments, nongovernmental organizations, intergovernmental organizations, and other relevant stakeholders;
- The role of media (including social media) in information sharing;

- Capacity building efforts to support information sharing;
- The role of legislation and mandates in enhancing or expanding information sharing; and
- Impacts of the HFA on disaster-related information sharing.

Background

> *"Responding to a disaster, either natural or human induced, is a complex process in terms of the number of actors, information systems and the interactions between actors and information systems. During the response phase, multiple autonomous agencies form a response network and need to share information at strategic, tactical and operational echelons. As a disaster evolves, the state and configuration of multiple elements in the response network changes rapidly, indicating a high level of dynamics in information demand and supply. The process of information sharing and coordination is further hampered by time pressure, event uncertainty, and information need unpredictability. The physical distance between the tactical and strategic echelons, as well as the differing time spans for decisions, poses additional challenges for designing systems for information sharing and coordination. In other words, complexity, dynamics and uncertainty are contingency factors influencing information sharing and coordination in the multi-agency response network."*
>
> (Bharosa, Appelman, van Zalen, and Zuurmond, 2009)

> "*Information is the reduction of uncertainty."*
>
> (Shannon and Weaver, 1948)

Core Indicator 4 of the Hyogo Framework for Action (HFA) Priority for Action 5[1] (PFA5/CI4) seeks to evaluate the degree to which nations establish disaster information exchange procedures, and whether or not they undertake post-event reviews.

Progress towards this objective is assessed in the HFA Monitor using a single question: "*Has an agreed method and procedure been adopted to assess damage, loss and needs when disasters occur?"* Verification is achieved by means of four sub-indicators, namely that:

1. Damage and loss assessment methodologies and capacities are available;
2. Post disaster needs assessment methodologies exist;
3. Post disaster needs assessment methodologies include guidance on gender aspects; and
4. Human resources (to support the assessment process) have been identified and trained.

However, the scope of information sharing extends far beyond the task of post-disaster damage and loss assessment. In fact, few aspects of disaster management are as broad and all-encompassing as that of information sharing. It is certainly arguable that not a single emergency management function could take place without information being shared. Every situation report, every press statement, every extended offer of assistance, every updated

[1] Priority for Action 5: *Strengthen disaster preparedness for effective response at all levels.*

map, and every plea for help involves the capture, processing, and communication of information.

Thus, to fully understand what measures of success are sought through the vehicle of this indicator, and the degree to which progress has been made towards those measures in the nine years that have intervened since the signing of the HFA, one must first define several key concepts and explore how and why information is shared in the disaster management context.

Information, Data, and Knowledge Defined

Information is shared every time individuals, organizations, or entities interact. That it occurs, however, should not suggest that such sharing is intrinsically effective or even helpful. To the contrary, most exchanges – especially those that occur in crisis, emergency, or disaster situations - are conducted in the absence of any systematic protocols, robust data collection or validation system, accessible and relevant institutional knowledge, or established information management system. Historically, information sharing in the disaster management context has been extremely inefficient and, to a degree, only marginally helpful.

Despite its prevalence in colloquial language, there exists no commonly-accepted definition for the term information. In fact, very little academic research exists at all on the topics of disaster information and disaster information sharing practices. According to information scientists, who study the acquisition, supply, and distribution of information within organizations, information is a *representation of a message that is processed into something of value in order to be applied in practice* (Pipes, 2006). There is a clear distinction between information and the data upon which information is drawn, and the two terms cannot be used interchangeably. Data is characterized as unprocessed numbers, figures, facts, or images and rarely provides a tangible benefit on its own. It is through the application of knowledge that data is processed into useful information in order to support decision-making processes (Johnson, 2014).

Knowledge is requisite to the generation of information as without it, data remains unprocessed and therefore without value. Groups, organizations, and systems amass institutional knowledge in their staff or members through a mix of capacity building, first-hand experience, and knowledge transfer. The knowledge of institutions or individuals falls into three distinct categories, which include (Allen, 2012):

- **Tacit Knowledge** – Gained through personal experience and therefore lost with the loss of the person who possesses it; cannot be written down and is hard to communicate.
- **Explicit Knowledge** – Can be easily transmitted to others by articulating, codifying, and storing it into various media; can be written down and is accessible.
- **Implicit Knowledge** - Is not written down yet is not dependant on personal experience or individual context; is more procedural and can simply be implied.

Information and knowledge are both managed by organizations, whether deliberately or not. Disaster management and disaster risk reduction are both supported and limited by the information and knowledge that is managed in and by its practitioners, and these functions together form the core of PFA5/CI4. These functions are defined follows (UNISDR, 2013; Davenport, 1994):

- **Information Management (IM)** - The collection, processing, organization, storage and dissemination of information for a specific purpose.

- **Knowledge Management (KM)** - Leveraging people, resources, processes and information in order to achieve a strategic objective.

The quality and effectiveness of ex-post and ex-ante disaster risk management efforts are determined in large part by the involved stakeholders' abilities to acquire, utilize, and distribute or redistribute relevant and accurate information. This is by no means a simple task. Disaster information falls among the disaster management practitioners most valuable assets, yet its acquisition remains one of the most difficult and resource intensive tasks (Paul, Thomas, and Adam, 2006.)

With the right information in hand, warning, coordination (intra- and interagency), targeted response planning, short- and long-term recovery planning, and even post-event disaster risk reduction all become possible (Oloruntoba, 2005). Conversely, a lack of information or worse, inaccurate information, only complicates the emergency management effort and hinders the decision making process (Puras and Iglesias, 2009). Information failures have even been singled out as the root cause of governmental emergency response failure (Sobel and Leeson, 2007).

Disaster Assessment Data Requirements

Like all types of information, disaster information is drawn from data. Data sets relevant to the disaster response and recovery contexts include both pre-existing and newly acquired collections. Examples of these might include:

- Pre-existing
    - Population and social demographics
    - Land use patterns and surveys
    - Infrastructure master plans, blueprints, and inventories
    - Geologic and hydrologic surveys
    - Local, national, and regional maps (e.g., topographic, political, physical, climate, etc.)
    - Historical hazard impact maps and consequence data
    - Emergency management resource inventories (e.g., responders, equipment, vehicles, supplies, commodities, facilities)
- Newly-acquired or requested
    - Seismic event shake maps
    - Flood gauge readings
    - Meteorological data
    - Damage reports
    - Casualty counts
    - Commodities

In the lead-up to and the aftermath of a disaster, new data sets are generated using assessments. Stakeholders tasked with incident management and/or coordination must know with relative confidence at any given time (and with regular updates) what is happening, where it is happening, what is needed, what is required to address those needs, and what resources are available. The difficulty and complexity of providing such information increase with the size and scope of the disaster.

Disaster assessment efforts can be grouped into two general categories, defined by the type of data they seek (Coppola, 2011):

1. **Situation assessments** (also called damage assessments, loss assessments, or damage and loss assessments (DaLAs), seek to determine what has happened as a result of the hazard. Situation assessments can help determine the geographic scope

of the disaster, and how it has affected people and structures. They are, in essence, measures of a hazard's consequences. Collected data might include:

a. Area affected by the disaster (location and size—can be plotted onto a base map or described in words)
b. Number of people affected by the disaster
c. Number of injured (morbidity) and killed (mortality)
d. Types of injuries and illnesses
e. Description of the characteristics and condition of the affected
f. Description of the medical, health, nutritional, water, and sanitation situation
g. Ongoing or emerging hazards and hazard effects
h. Damage to infrastructure and critical facilities
i. Damage to residences and commercial structures
j. Damage to the agricultural and food distribution systems
k. Damage to the economic and social status of the affected area
l. Vulnerability of the affected population to ongoing disaster effects or to expected related or unrelated hazards
m. Current response effort in progress

2. **Needs assessments** (also called Post Disaster Needs Assessments, or PDNAs), which involve gathering data on the services, resources, and other assistance that will be required to address the disaster and save and sustain lives. Disaster managers may use a range of methods to conduct this assessment, which could include:

a. Gathering of internal information (entails gathering and reporting all information known by staff or affiliates)
b. Visual inspection (involves using various methods of observation, including satellite imagery, aerial flyovers, and drive or walkthrough surveying)
c. Sample surveys (information gathered by interviewing representative segments of the affected population)
d. Sentinel surveillance (certain disaster characteristics or "early warning signs," which tend to be indicative of larger problems, are monitored and reported when found)
e. Detailed critical sector assessments by specialist (experts in various sectors, such as transportation, energy, health, or water supply, make targeted surveys of the infrastructure component for which they are specially trained)
f. Ongoing interviews (people are designated to gather information on an ongoing basis to support updating the assessments)
g. Interviewing of informants (members of the affected population who are identified as being able to provide useful information regarding the situation and needs are contacted on a regular basis to report any findings they may have)
h. Partnerships (information sharing partnerships are established between the various organizations, nongovernmental or otherwise, operating throughout the impacted area)

The reliability, relevance, and timeliness of assessment data is of paramount importance. It is said that "while good assessment [data] does not guarantee a good response, poor assessment [data] almost certainly guarantees a bad one." (UNOCHA, 2006). Assessment data is drawn from a great many different stakeholders, each with a unique operational bias, assumptions, area of concern, capabilities, and limitations. Through HFA PFA5/CI4 nations have been encouraged to establish methodologies and capabilities that address damages, loss, and post-disaster needs. Moreover, these methodologies should address gender and be conducted by individuals trained to perform them (UNISDR, 2013b).

Disaster assessments may be initiated by and organized at any jurisdictional level (local to national), and may be coordinated with nongovernmental and private sector partners as well as with the general public to an increasing degree. The basic requirements of an effective disaster assessment include (but are not limited to):

- Dedicated financial resources
- Ample trained staff
- Coordination and communication mechanisms
- Appropriate equipment and supplies (e.g., imagery and monitoring devices, communication equipment, data storage and management hardware, etc.)
- Data standards, collection protocols and tools (e.g., checklists), and assessment objectives (e.g., Search and Rescue, Shelter, Health and Medical, Water and Sanitation, Food and Nutrition, Economics and Livelihoods, Displacement, Logistics, Transportation, Power and Energy, Agriculture, Commodities, and Capabilities)
- Validation methods

Many countries reporting through the HFA Monitor describe having developed and instituted standard assessment mechanisms. The UN Economic Commission for Latin America and the Caribbean (UN-ECLAC) Damage and Loss Assessment (DaLA) and UN/World Bank/European Commission-developed Post Disaster Needs Assessment (PDNA) methodologies serve as the basis for most, though a handful of respondents have developed unique methods to meet their own needs and structures. Examples of these include:

- **United States**
  National-government support to disaster impacted states is determined in part by the Preliminary Damage Assessment (PDA), conducted by the US Federal Emergency Management Agency (FEMA). The PDA looks specifically at:

  - Number of residences destroyed, damaged, and affected
  - Percentage of impacted residences that are insured
  - Percentage of impacted households that are low Income
  - Percentage of households with elderly residents
  - Description of the major community-level impacts (e.g., Roads, Bridges, Schools, Energy Sector)
  - Estimated financial cost of damages
  - Per-capita impact (by dollar) at the local and regional levels

  Individual agencies also conduct specialized assessments specific to their missions and areas of operations. For instance, the US Department of Interior operates the *Natural Resource Damage Assessment and Restoration (NRDAR) Program* to assess damages to and promote restoration specifically as they relate to natural resources and the environment.
- **Granada**
  The Granada *National Disaster Management Plan* authorizes the conduct of damage, loss, and needs assessment through establishment of the Damage Assessment and Needs Analysis (DANA) Committee (one of thirteen national disaster committees). This committee is comprised of representatives from the budgeting agency, various relevant sectors, and the private sector. The private sector is charged with coordination of the DANA process, maintenance of related databases, training of officials involved in the assessment, and communication of required information to national and external stakeholders within expected timelines. To strengthen the analysis process, several sectors have begun to maintain baseline data during non-disaster periods (e.g., livelihoods and agriculture). The program has

experienced some constraints and challenges, such as a lack of assessment methodology standards, outdated baseline data, legal limits to data and information sharing, and incentives to misreport baseline or assessment data (e.g., as related to compensation for crops that are damaged in the disaster event). However, capacity currently exists in all sectors to conduct the assessments, and the country is seeking to train more officials and shore up data and standards deficiencies by 2015 (HFA Monitor 2011-2013).

- **Bangladesh**
  The Bangladesh Department of Disaster Management (DDM) is currently in the process of establishing a unique nationwide Damage-Loss and Needs Assessment (DNA) within the DDM Damage-Loss and Needs Assessment (DNA) cell. In order to develop this assessment capability, DDM is providing training on standard assessment practices to ensure that data collection process and the data that is collected are of uniform format regardless of where the event takes place. The assessment program, including the training that is provided, extends down to the *Upazila* (sub-district) level (DDM, 2012).

Assessment is most effective when coordination exists between coordinating authorities and other nongovernmental stakeholders operating in the disaster area. This often includes participants that are not typically associated with response but nonetheless have a unique connection with or view into the affected population (e.g., religious organizations, social services organizations, or business associations). Collaborative efforts help to establish a more complete inventory of available capabilities, resources, and assets. When compared to response and recovery requirements, the comprehensive inventory gives a much more accurate impression of outstanding gaps than when governmental resources are considered in isolation.

Information Sharing Systems

Modern disaster management is exemplified by the existence of procedures, mechanisms, structures, and systems that enable or enhance inter- and intra-organizational information exchange. Information collected, processed, and distributed begets knowledge, which subsequently enables deeper data analysis and breeds the creation of new information. Abdul Rahman, Dahan, and Saman (2013) state that, "inter-organizational information and knowledge sharing or government information sharing is important, because no single organization can have all the resources to run its activities without the inputs from other organizations."

Information sharing occurs at multiple levels, each characterized by a distinct set of opportunities and challenges. These levels include:

- **Sharing at the individual level:** Individuals have traditionally served as information recipients in the information sharing relationship with disaster management stakeholders. At the individual level they do share freely within their own social networks which has a collective effect across populations even if limited for the individual. The rise of social media has significantly changed the nature of this relationship, with significant amounts of data and information now being broadcast and otherwise shared by individuals. Individuals, however, are limited in their ability to process or validate the information they are receiving, and often propagate incorrect or inaccurate information.
- **Sharing at the organizational level (also called "intra-organizational sharing"):** Governmental and nongovernmental disaster management organizations acquire, process, utilize, and share information within their internal networks. For governments this typically involves the sharing of information between different agencies at the same level (e.g., local to local sharing) and between different levels

(e.g., national and local government agencies). Sharing can be upward (from staff to leadership), horizontal (peer-to-peer), or downward (from leadership to staff) (McLean, 2014). Bharosa, et al. (2009) describe the difficulties that can arise in organizational information sharing during extreme events due to differences in cultures and organizational structures. See Box 1.

BOX 1: Intra- and Inter-Organizational Information Sharing in Brazil

The Government of Brazil notes a high degree of communicability between all government levels in Disaster Risk Management efforts. A study performed by Otoni de Araújo et al. (2014) found that State and Federal agencies made themselves very accessible to each other. During disaster events, local departments reported that the National Civil Defense Secretariat (SEDEC) is immediately present, with one study participant stating that, "*Our physical contact is much more with the state. But every time we get in contact, with the federal agency by telephone and e-mail we get a response, it is not a distant agency. For example, in the rainy season complete facilities are offered. They are accessible*. *It is essential to have efficient mechanisms and processes that allow communication between the various actors involved, facilitating the mobilization of human material and financial resources to disaster response.*"

Communication channels are established between the different government levels through face-to-face meetings and by developing joint strategies that enable more efficient information transmission. Workshops were listed as one mechanism through which this occurs. One measure that these agencies are currently pursuing to improve the communication process is an increase in mapping and standardization of data. The goal is to establish a database capable of facilitating the dissemination of data and information to the various stakeholders involved. This database must be updated regularly, thus requiring technology that enables each municipality to monitor risk and events and contribute as necessary. Participants felt that such a system would prevent cases of overlapping efforts and/or gaps in response, and enable greater cooperation with NGO response, recovery, and DRR stakeholders.

END BOX

- **Sharing at the inter-organizational level:** Whether at the community, country, or international level, a coordinated exchange of disaster information must occur between each of the different disaster management stakeholders for effective response and recovery to occur. Each organization involved both utilizes and contributes to the greater body of information framing the event. The existence of a central coordinating body through which inter-organizational information sharing flows is assumed in large-scale disasters. However, less-visible secondary inter-organizational dependencies can contribute to response failures such as occurred during the 9/11 attacks in New York City when warnings of imminent building collapse were unable to reach disparate response agencies (Kean and Hamilton 2004). (See Box 2)

BOX 2: Inter-Organizational Information Sharing – The FEMA Whole Community Concept

In 2011, the US Federal Emergency Management Agency issued a directive to local government to promote an inclusive concept for emergency management entitled "Whole Commnity". FEMA defined the whole community to be, "a means by which residents, emergency management practitioners, organizational and community leaders, and government officials can collectively understand and assess the needs of their respective communities and determine the best ways to organize and strengthen their assets, capacities, and interests."

The effort is seeking to change the way disater management organizations operate such that a greater partnership with all community stakeholders is possible. The Whole Community approach seeks to expand response and recovery capacity of all sectors and challenges disaster management organizations to learn how to work with diverse groups and organizations that make up their community. The identified benefits of applying this philosophy include:

- A more informed, shared understanding of community risks, needs, and capabilities;
- An increase in resources through the empowerment of community members; and,
- More resilient communities.

The process of building relationships between stakeholders and learning more about the community's complexity and interdependencies reveals otherwise hidden resources and identifies vulnerability sources. In times of disaster, these relationships servie as an infrastructure upon which immediate and effective information sharing can occur, and allow the diverse community of stakeholders to works more like a single organized unit. (FEMA, 2011)

Information is considered *static* (unchanging, such as the location of buildings that were impacted by a flood event) or *dynamic* (constantly changing, such as the number of people requiring shelter). Most information relevant to the response and recovery operation becomes outdated or "stale" after a brief period, thereby requiring regular updates to ensure a continued high degree of accuracy. Oftentimes governments will assign line agencies with responsibility for tracking and reporting on information relevant to their mission and scope. Pathirage, Seneviratne, Amaratunga, and Haigh (2014) identify eight categories into which disaster knowledge may be classified. These factors are common to disaster types and exist across each of the four emergency management phases (mitigation, preparedness, response, and recovery). They include:

- Technological
- Social
- Environmental
- Legal
- Economical
- Operational/Managerial
- Institutional
- Political

Information and knowledge transfer occurs in both *formal* (performed according to a defined schedule or procedure) and *informal* (performed outside of an established system or structure) transactions. Transactions range in complexity from very simple (e.g., two individuals speaking to each other in person) to highly complex (through an integrated web-based system that supports the operations of multiple stakeholder types in multiple countries on multiple response and/or recovery topics). As complexity increases, so do the requirements of the interaction (see Box 3). Information sharing requirements include:

- **Existence of the information:** Nations and regions must ensure that the data collection mechanisms and the knowledge-base to translate that data into information both exist. The development of academic, national, and regional research institutes and institutions drives this capability.
- **Quality of the information:** The value of information is determined as much by its breadth as it is by its quality. Bharosa, et al (2009) state that information must be correct, up to date, and consistent or the quality of humanitarian operations will suffer and/or the safety and security of relief workers and victims will be at stake. Lee,

Strong, Kahn, and Wang (2002) have isolated several measures to help assess information quality, including: accuracy; amount (appropriateness of quantity); believability; completeness; consistency; interoperability (format); objectivity; relevancy; security; timeliness; and understandability.

- **Awareness of the source:** In order for the supply and demand of information to exist, generators and requesters/consumers of information must be aware of each other's' capabilities and requirements. Information and the data upon which it is generated is drawn from many traditional and nontraditional sources, as determined by the information sought.
- **Relationships between stakeholders** – It has been argued that "the strengthening of networks among disaster experts across sectors and between regions is needed" (Kaklauskas, Amaratunga, and Haigh, 2009) and that "linkages among all agencies working on disaster management need to be strengthened in order to derive best practices and coping mechanism" (Mohanty, Panda, Karelia, and Issar, 2006.) Pathirage, Seneviratne, Amaratunga, and Haigh write that disaster management organizations and institutions must be closely linked together in order to enhance the information sharing and management of the knowledge the generate. They describe how a network of such institutions creates a common platform and enables its stakeholders and people to capture, organise, share and reuse the knowledge generated.
- **Trust and commitment between stakeholders:** The importance of trust in information sharing relationships cannot be understated. Ahmad Dahlan, et al (2013) state that information sharing networks and collaborations "can only be successful if these wide ranges of participants display the same commitment to share their information, knowledge, and expertise." Turf issues, distrust between public and NGO sectors, proprietary inclinations, and fear that information will be used for other-than-humanitarian uses all weaken the effectiveness of the working relationship.
- **Information coordination and sharing protocols and methodologies:** Data and information reporting and sharing mechanisms are quickly overwhelmed if coordination and sharing protocols and methodologies are not established and followed. Information should meet verification (quality) standards, and be submitted according to accepted terms. For instance, situation reporting protocols might stipulate that the report include the date and time the report was issued, the geographic area the report pertains to, specific categories of damage, need, or activity, contact information, among others.
- **Information Sharing System Quality:** Bharosa, Appelman, van Zalen, and Zuurmond (2009) describe factors that contribute to information sharing and/or management System Quality (SQ). These factors, which address both the human and technical components of the system, include: accessibility, reliability, availability, flexibility, interoperability, ease of use, efficiency, and response time. This includes the ability of the system to accommodate information requests, to host information, and to distribute it. There are hardware and software requirements, operational requirements including electricity and user training, as well as a common language between users.
- **Institutional capacity to manage information sharing relationships and networks, and to verify and update information as required** (Professional institutions need to carry out training programmes and disaster management courses to enhance capacity and disseminate knowledge on disaster risk management initiatives. For example it is found that the pre-construction phase is considered as the most critical phase for integrating disaster risk management into the construction; hence, designers, civil engineers, structural engineers, specialist contractors, engineering consultants and developers should be actively involved (Bosher et al., 2007). Further it is identified that the stakeholders involved in the preliminary phase should consider what materials to use, where to build and what to build. It is

emphasized that there is a need to develop accreditation schemes and training programmes relating to disaster management efforts)

- **Legal, statutory, and regulatory frameworks to permit and/or foster information sharing** (Christchurch case study) This includes ensuring the information management is addressed in agreements, plans (contingency, response, recovery, Disaster Risk Reduction (DRR), etc), and policies.

BOX 3: The Complexity of Information Sharing Systems

Blame for the widespread failure of advance notification by governments of countries impacted by the December 26, 2004 Indian Ocean Tsunami is much more complex than a simple lack of sensors. In fact, many sensors were in place, and awareness of the earthquake's 9.0 magnitude and high tsunami likelihood began just minutes after it struck. For locations in close proximity to earthquake's epicenter, seismic shaking was perceptible but waves actually struck within minutes – much sooner than is required to launch an international alert. But for many of the areas farther outside the shaking zone these physical clues did not exist and there was more time to allow for warning.

Several countries had seismic detection and tsunami forecasting systems in place, including the United States, China, Russia, and Japan. A number of international organizations did as well, including the International Monitoring System of the Comprehensive Nuclear Test-Ban Treaty Organization and the European Space Agency. Unfortunately, few of the impacted countries had this capacity, and recognition was therefore possible only through information exchange. Availability of data was the first failure.

The second problem stems from the fact that even those countries that maintain sensing capabilities did not have in place standard mechanisms through which information could be quickly and efficiently packaged and communicated to the international community. Notification efforts were ad-hoc, and questions about the source, reliability, and responsibility of the information persisted.

Thirdly, there were few if any pre-existing relationships between governments to facilitate the sharing of warnings, and virtually no information sharing protocols. Those countries that did receive notifications by the Pacific Tsunami Warning System did so by telephone - and only after the US Geological Survey requested that the US Department of State identify appropriate contacts and share the information as they were able.

And lastly, there were no mechanisms in place in those countries that did receive warnings that would allow rapid and effective message transmission to the at-risk communities. Any such measures would have to had been in place prior to the event, and have included communications systems, local protocols for receiving and acting on the information transmitted, and knowledge among citizens about how to react to the warnings. (Chossudovsky, 2005; Knight, 2005; Lloyds, 2010; and Revkin, 2005). **END BOX**

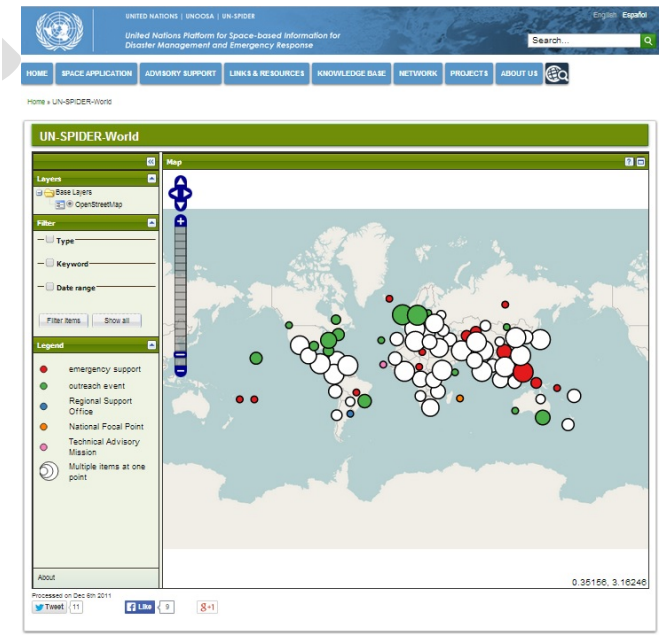
Information centers and knowledge platforms have been established at the national, regional, and global levels to facilitate information sharing. Relevance in the disaster response and recovery context is difficult due to the highly-dynamic nature of disaster events. However, many national governments and several intergovernmental organizations have succeeded in establishing information hubs that serve a multitude of stakeholders.

Information sharing centers and platforms differ significantly in their mandate and operations. For instance, several focus on a specific hazard or on a unique technology, and mainly provide pre-event warnings and analysis of disaster impact zones. Examples include:

- **The Pacific Tsunami Warning Center (PTWC)**: An office of the US Government that gathers and distributes real-time data and information on tsunami threats to most

countries around the Pacific Rim, to the small island nations in the Pacific, to the nations bordering the South China Sea, and to countries bordering the Caribbean Sea.

- **Euro-Mediterranean Seismology Centre (EMSC)**: The EMSC is an international, non-governmental, and non-profit association that collects real time data provided by 65 seismological networks in the Euro-Med region. Data are provided either by email or via QWIDS (Quake Watch Information Distribution System). The collected data are automatically archived in a database, made available via an automatic email system (called a data request manager, or AutoDRM), and displayed on the EMSC web site. Data are automatically merged to produce automatic locations which are sent to several seismological institutes in order to perform more in-depth analysis about the event (e.g., displacement information). For potentially destructive earthquakes, the EMSC operates an Earthquake Notification Service in which email, Short Message Service (SMS), and fax notifications are disseminated to registered end-users within approximately 20 to 30 minutes of the earthquake. Real time information services are purely automatic and deal with all events reported by the data contributors, while the Earthquake Notification Service is manual. There are currently more than 8,400 registered.
- **The European Center for Disease Prevention and Control (ECDC)**: The ECDC is an EU agency established in 2005 to strengthen Europe's defenses against infectious diseases. ECDC staff work to identify, assess, and communicate current and emerging threats to human health posed by infectious diseases. Efforts are performed in close partnership with national public health agencies and organizations throughout Europe. The Center pools information from 28 EU Member States in order to develop authoritative scientific opinions about the risks posed by current and emerging infectious diseases. Fifty-two communicable diseases and conditions are tracked using The European Surveillance System (TESSy). Disease Networks in the EU countries report data to ECDC on a regular basis. ECDC staff analyze and interpret this data and disseminate the resulting information using specific surveillance reports (on the various communicable diseases) and through a number of standardized tables and charts that available directly from the TESSy website. ECDC supports the EU Member States in these efforts by developing tools and guidelines to assist in evaluating preparedness levels, identifying potential gaps and vulnerabilities, and strengthening their capacities where needed.
- **UN Platform for Space-based Information for Disaster Management & Emergency Response (UN-SPIDER)**: UN-SPIDER was created in 2006 to "ensure that all countries and international and regional organizations have access to and develop the capacity to use all types of space-based information to support the full Disaster Management cycle" (UN-SPIDER, 2014). The program provides monitoring services and disaster information to National Disaster Management Offices (NDMOs) through web-based facilities, and acts as an information hub between the disaster management, risk management, and space communities.



- **International Office for Migration (IOM) Internal Displacement Monitoring Centre (IDMC)**: See Box 4

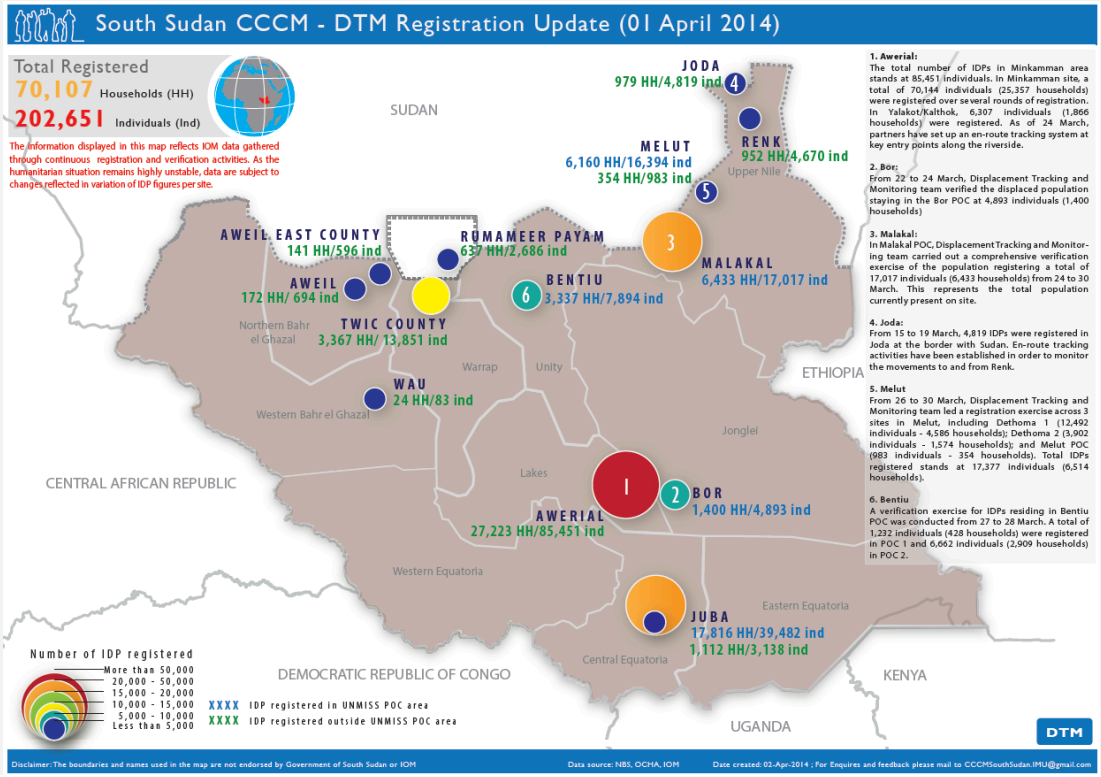
BOX 4: The International Office for Migration (IOM) Internal Displacement Monitoring Center (IDMC)

To address the challenge of monitoring population movements in crisis situations, IOM developed the Displacement Tracking Matrix (DTM). DTM consists of a suite of tools that capture, process and disseminate information in order to increase understanding of the evolving needs of displaced persons, both on-site and en-route. DTM was first used during the 2004 Iraq response but has since been deployed in over 20 countries.

The DTM uses a modular approach to make it adaptable to response and recovery in disaster and conflict settings. It has been gradually refined through use and is now a standard response and recovery resource for government agencies and international and NGO stakeholders. It also supports preparedness activities by allowing the identification of areas at high-risk for displacement, populations with specific needs, and capacity gaps of institutions and communities. It informs the contingency planning process and enables prepositioning of resources in line with key population needs.

Knowing where people are, what they have access to and what they need allows agencies to:

1) Monitor and improve the delivery of emergency assistance in order to enhance the living conditions of disaster-affected people in the short term and reduce long-term negative impacts;
2) Understand the full cost of disasters;
3) Better plan for reconstruction and recovery;
4) Prevent the influx of populations from translating into increased levels of risk for destination communities; and
5) Evaluate progress and success of pre- and post-disaster efforts.



Understanding who needs to move and who has the capacity to do so in the face of a given hazard exposes underlying patterns of vulnerability and resilience and allows humanitarian agencies to design better preparedness plans and apply more accurate risk reduction measures. Population flows in disasters tend to be fragmented and inorganic. As such, the DTM tracks movements that are:

1) **Directed towards any destination**
2) **Covering any distance**
3) **Lasting any amount of time**
4) **Presenting any composition**

DTMs evolved from simple databases to complex information management systems that capture, process and disseminate complex information on location, needs and capacities of disaster-affected people. Each is based on a series of iterative assessments that provide accurate, up-to-date snapshots of existing vulnerabilities and a clear understanding of their evolution. They are composed of four main elements, which are adapted to the local context and phase of an emergency, including:

- **Displacement and mobility**: to regularly track cross-sectorial needs and population movements to target assistance in locations of displacement;
- **Community**: to track needs and movements in locations of origin and destination, including for host communities, or possible relocation sites to support sustainable solutions for displacement;
- **Flow monitoring**: to track movements of displaced populations at key transit points when locations of origin are not accessible and displacement is gradual;
- **Registration**: to provide individual level information used by site managers for beneficiary selection and programming.

The data is collected using all available means, ranging from analogical and digital field questionnaires to unmanned aerial vehicles surveys, and is constantly innovated to reflect technological evolution. DTM data is often collected in collaboration with local partners (from governmental and non-governmental institutions) and validated and consolidated through the system's methodology.

DTM databases are relevant to all response and recovery stakeholders, and are thus made public and distributed through the CCCM website and other avenues in order to allow wide access. It contains a number of different informational products, such as spreadsheets, reports, and maps, that allow users to use the information in a manner that best meets their own organization's needs.

As part of the DTM in-country implementation in natural disaster response operations, local governmental and non-governmental partners are trained in the use of the methodology, including collection, validation and distribution of data. The ownership of the displacement monitoring process is progressively transferred and adequate technological support is provided. This empowers local personnel for future implementations of the DTM, even though guaranteeing a national reach to these capacity-building initiatives has proved challenging.
(Source: Lorenzon, 2014.)
END BOX

Several information centers and platforms focus on the capture and distribution of post-disaster assessments for the purpose of institutional learning and capacity development. These institutions are not able to nor do they attempt to maintain the time-sensitive

information valuable to an effective response operation. They are, however, integral to information sharing at national, regional, and global levels. Examples include:

- **International Recovery Platform (IRP)**: IRP was conceived at the World Conference on Disaster Reduction (WCDR) in Kobe, Japan (January 2005) as a thematic platform of the UN Office for Disaster Reduction (UNISDR). Its key role is to identify recovery gaps and constraints experienced in the post-disaster recovery period, and to serve as a catalyst for the development of tools, resources, and capacity for resilient recovery. IRP aims to be an international source of information and knowledge on good recovery practice. In addition to generating original recovery situation reports, guidance documents, and after-action/lessons-learned studies, IRP facilitates capacity building through global forums, regional trainings, and other collaborative efforts.
- **Disaster Inventory System (DesInventar):** In 1994, a group of researchers, academicians, and institutional stakeholders linked to the Network of Social Studies for the Prevention of Disasters in Latin America (LA RED) began developing a common conceptual and methodological framework to gather information about the occurrence of daily small and medium-sized disasters. This group conceptualized a system of information acquisition, consultation and display drawn from pre-existing data, newspaper sources and institutional reports in various Latin American countries. The result was development of the Disaster Inventory System (DesInventar), which tracks disaster information from the local vantage (town or equivalent), and facilitates communication and information exchange between actors, institutions, sectors, provincial and national governments.

There is another category of disaster information sharing centers that amass and repost disaster information, such as situation reports and press releases generated by a variety of external sources. Examples include:

- **Reliefweb**: Reliefweb is a specialized digital information service managed by the UN Office for the Coordination of Humanitarian Affairs (UNOCHA). The organization's mission is to **provide reliable disaster and crisis updates and analysis to humanitarian organizations in order to allow them to** make informed decisions and plan effective assistance. Information products are provided on a continuous basis on a global scale. The organization's three functions are: 1) To collect updates and analysis from over 4,000 sources worldwide; 2) Deliver relevant content to a global audience, including country and disaster reports, maps, info-graphics, and more; 3) Enable better decisions by providing information products and services.
- **Pacific Disaster Net**: PDN is considered a "Virtual Centre of Excellence" of disaster risk management for the Pacific Region. It is a web-based database of information for stakeholders. It was created to support planning and decision making and to provide country-level information for distribution within the region. Information included in the portal comes from national governments, regional and global intergovernmental organizations, and NGOs relating to: Governance; Risk Assessment; Early Warning and Monitoring; Disaster Risk Management; and Training and Tools. Information from the portal can be viewed, downloaded, sent by email and exported into other formats.
- **ASEAN Disaster Information Network (ADInet):** The ADInet was created to provide hazard monitoring and disaster information exchange between the various national disaster management organizations in ASEAN. Exchange is conducted through web-based facilities. The ADInet portal and database system consolidates information on active and past disasters in the region. It is intended for the ASEAN Member States but is publically accessible.

Several countries have instituted national-level capacities to enable the pooling and sharing of information among national government offices, between the national and local levels, and/or between governmental and nongovernmental entities. Several examples, as reported in the HFA Monitor, include:

- **New Zealand**: The New Zealand National Emergency Management Information System (EMIS) was commissioned to link emergency management agencies at all government levels (national, regional, and local) together. EMIS provides a robust and consistent approach to the collection, collation and sharing of information across the ongoing response. The system is centrally hosted from within the National Crisis Management Centre (NCMC) and replicated at a secondary site in Auckland. Standard procedures have been instituted at the national, regional and local emergency operations centers and by other agencies to guide the collation of a range of disaster impact data across all relevant sectors. There now exists a consistent approach to reporting information including impact assessments, situation reports, and action plans (though one major challenge encountered in implementation is that differences do exist in the collation and assessment approaches between agencies and at different levels of response.) All events and exercises involve debriefs, and in the case of larger events, independent reviews, in order to ensure that lessons are captured. (HFA Monitor 2011-2013)
- **Germany:** The German Federal Office of Civil Protection and Disaster Assistance (BBK) manages the *German Emergency Planning Information System* (deNIS IIplus). The system centralizes disaster and risk information in the pre-disaster risk reduction phase (including hazard, vulnerability, and risk information) and post-disaster response and recovery phases. deNIS IIplus was created to provide responders with real-time information about disaster events, as well as geological data, the location of critical infrastructure and at-risk facilities, and resources for emergency assistance. The system is structured on a web-based GIS system that includes three modules: situation management (interactive situation map); information management (dispatching of instructions and announcements); and resource management (management of all reactionary resources). The system supports review and feedback processes, and can be adapted for specific conditions (e.g., radioactivity, weather data, and water levels). During the demobilization phase, the system event log is used to generate a lessons-learned review. The program has encountered challenges related to the integration of the system into some regions where crisis management systems are already implemented. However, efforts have been initiated to initiate special information exchange interfaces as is practical. Problems have also arisen relative to the post event reviews on account of the fact that there are no legal or regulatory requirements to conduct them. (HFA Monitor 2011-2013)
- **Somoa:** Samoa utilizes an inter-organizational mechanism rather than a technological solution to share disaster information. The Disaster Advisory Committee, together with its sub-committees, has instituted training to ensure that members are familiar with the procedures for conducting initial damage assessments, with each agency maintaining a dedicated response plan. The National Disaster Management Plan dictates when and how post-event briefings are held. Information is communicated via the recently-upgraded Emergency Communications Network which utilizes radio communication. Multiple users are able to talk concurrently, and dedicated frequencies limit interference. Radio is also less susceptible to communication infrastructure failures. The National Emergency Operations Center (NEOC) is currently implementing an Information and Data Management System which will be used to record hazard event information and enable access to all relevant stakeholders. Challenges related to data collection have been identified, on account of a reluctance on the part of some agencies to relinquish 'ownership' of certain data. Additionally, it has already been recognized that the Information Management and Reporting System will require a significant

amount of staff training, dedicated personnel support, and ongoing maintenance of baseline data if it is to be effective. Consideration is being given to the development of a common format for data sets to ensure interoperability and ease of use. (HFA Monitor 2011-2013)

- **Australia:** The Pilot Impacts Portal is a component of the Australian Natural Disasters Impacts Framework Project, which is a national initiative to better understand the economic, social, and environmental impacts of disasters on communities. The Pilot Impacts Portal was created to improve the availability of relevant data to support: 1) Informed discussion and decision making by governments and communities; and 2) Policy development, planning and accountability for the emergency management sector. The Portal offers a web-accessible interface that provides a single point of access to data that allows users to determine the economic, social, and environmental impacts of disasters. It identifies the elements that contribute to the consequences and defines the relationships between them. It can be used across any temporal or geographic scale. It's goal is to "deliver the *right* information to the *right* people in the *right* format in the *right* place at the *right* time." Portal users include emergency management personnel, Federal, state and local government agencies, and community groups. It integrates data managed by these various stakeholders using the Google Map interface, thereby allowing users to access disaster event information by geographic region. It provides street map, terrain and satellite imagery backdrops for Australia, each overlaid with further geographic data. Similar efforts are being developed at the state and territory levels (Power, Robinson, Cameron, Nicolopoulos, 2012).

Information sharing networks are not limited to governmental and intergovernmental organizations. Examples of disaster information sharing hubs and partnerships maintained by the NGO sector include:

- **The Asian Disaster Reduction and Response Network (ADRRN)**: The goal of ADRRN is "to promote coordination, information sharing and collaboration among NGOs and other stakeholders for effective and efficient disaster reduction and response in the Asia-Pacific region. The network provides a mechanism for members to share reliable information and to facilitate capacity building. (ADRRN, 2014).
- **The Virtual Disaster Viewer (VDV)**: The Virtual Disaster Viewer is a web-based geospatial disaster information platform designed by a consortium of private and nonprofit sector organizations in the aftermath of the Wenchuan, China earthquake. The VDV provides distributed remote (satellite imagery) and field-based damage assessment information to a global audience, and has been used for pre-deployment purposes as well as for field operations (Bevington, Adams, Verrucci, Amyx, Huyck, and Eguchi, 2009.)
- **The Disaster Management Information System (DMIS)**: The International Federation of Red Cross and Red Crescent Societies (IFRC) maintains the Disaster Management Information System (DMIS) to improve the decision-making process and to enhance the speed and efficiency of operations. DMIS is a web-based tool accessible only to Red Cross and Red Crescent staff working in National Societies, delegations, and the Geneva headquarters. It allows staff access to real time information on disasters, internal and external resources, and other tools and databases.

Formal Information Sharing Agreements

Information exchange occurs more smoothly and systematically when involved stakeholders establish agreements that define roles, responsibilities, and expectations. Trust between parties is always prerequisite given the nature of the request. Commitments may be free-

standing or elaborated as a part of more comprehensive mutual aid compacts, and can exist at the local, national, regional, or global levels. Examples include:

- **The European and Mediterranean Major Hazards Agreement**: This agreement promotes closer cooperation among member states on the prevention of and response to natural and technological disasters. The agreement dictates how countries will participate in and coordinate region-wide policy making and scientific and technical efforts, including development of early warning systems and other research centers. One of the three tasks assigned to a special body of representatives from each country is *"to exchange and share information on relevant events which have occurred in the participating countries"* (EUR-OPA, 2014).
- **The Association of South East Asian Nations (ASEAN) Agreement on Disaster Management and Emergency Response (AADMER):** The ASEAN Agreement on Disaster Management and Emergency Response (AADMER) is "a proactive regional framework for cooperation, coordination, technical assistance, and resource mobilisation in all aspects of disaster management." The AADMER work program asks three questions in regards to the development of a region-wide knowledge management system – namely: "1) What kinds of knowledge and information are needed; 2) How can these be generated; 3) What are the sources; 4) What is the best modality for enabling sharing and exchange; and 5) How can we ensure that these would reach the end-users, and in a timely manner?" This document provides great insight into the planning that took place in order to establish a system that effectively meets needs. It states that, "On the matter of disasters, there are two main sets of relevant knowledge and information. One is on disaster response. This involves the accurate forecasting and rapid dissemination of information at the onset of disaster – especially for those to be affected as well as the early responders. The other set is on the more strategic disaster risk reduction. This comprises lessons from past disasters, disaster patterns in the region, available material, human, and institutional resources, new technologies, community-based knowledge and ways of coping, and other related themes such as climate change, poverty, and human conflict. There are numerous resource and data centres within and outside the region. The aim for creating the online knowledge centre is not be to the dominant site that would supersede or supplant the others, but simply to build ASEAN's own disaster data hub: containing relevant knowledge and reliable and up-to-date information and at the same time interconnecting other sites and facilitating continuous exchanges." (ASEAN, 2010).
- **The South Asian Association for Regional Cooperation (SAARC) Agreement on Rapid Response to Natural Disasters:** The Agreement on Rapid Response to Natural Disasters establishes cooperative mechanisms between the SAARC Member States, thereby allowing them to provide humanitarian assistance in a timely and coordinated manner. Signatories to this agreement are obligated to perform the following (in addition to other tasks): 1) Cooperate in developing and implementing measures to reduce disaster losses including identification of disaster risk, development of monitoring, assessment and early warning systems, standby arrangements for disaster relief and emergency response, exchange of information and the provision of mutual assistance; 2) Immediately respond to a disaster occurring within their territory. When the said disaster is likely to cause possible impacts on other Member States, respond promptly to a request for relevant information sought by a Member State or States that are or may be affected by such disasters, with a view to minimising the consequences; and 3) Share technical know-how and information on the best practices and lessons learnt in reducing disaster losses." (SAARC. 2011).
- **The France, Australia, and New Zealand (FRANZ) Agreement**: The FRANZ Agreement was created to facilitate international emergency and disaster

management operations in the South Pacific region. In particular, signatories are committed to exchanging information to ensure the best use of assets and other resources for relief operations. Subsequent ad-hoc agreements with other donor countries have formed around the FRANZ Agreement.

- **The Agreement Between the Government of the United States of America and the Government of the United Mexican States on Emergency Management Cooperation in Cases of Natural Disasters and Accidents**: The 2011 agreement signed between the United States and Mexico establishes partnership requirements for disasters, including a working group that is responsible for (among other things): 1) Exchange of information, experts and technicians; 2) Exchange of information on techniques for evacuation of persons under emergency conditions; and 3) Exchange of information on techniques to ensure an adequate supply of resources necessary to meet emergency situations.

Information Sharing Role of the Mass and Social Media

The news media play a significant role in disaster management both before and after disasters occur (see Box 5). The media are well recognized for the invaluable service they have consistently provided during disasters' initial critical moments when emergency response efforts are mobilized. In such instances, the media transmit warning messages and alerts and provide instruction on where to evacuate, where to seek medical care and shelter, and where to go for more specific information (Mileti, 1999). Jim Willis (1997) writes, "there may be no other area of journalism [than risk communication] where the Fourth Estate has such an awesome responsibility." Furman (2002) contends that the media ability to educate people during these times is in many cases more likely to save lives than many other components of emergency response, adding that "people will die if they don't get good information." The emergency response community has embraced the media for their capability in response, recognizing that they will be the primary, if not the only means for informing large masses of potential victims (McCormick Tribune Foundation, 2002).

BOX 5: Mass Media Disaster Roles
The putative DRR-relevant roles of mass media have been classified into four categories: 1) neutral (information providing); 2) negative (watchdog/whistleblower/blame assignment); 3) positive (recognition/credit giving); and 4) problem identification/agenda-setting (related to risk identification, emergency management, and disaster recovery). Mass media have an active role to play in early warning systems and are essential partners to help educate communities, highlight the particular needs of vulnerable groups and to channel DRR messages to different audiences. The ability of the mass media to share information to the public enhances the disaster risk management capacity of communities by increasing citizen engagement. Mass media's role in building social cohesion and constructing narratives has made it an important element to post-disaster social change (Miles and Morse, 2007; Olson, et al, 2010; Hibino and Shaw, 2014). **END BOX**

This positive view of the media as a successful risk communicator comes not without contention. Many social scientists feel that the media, for various reasons, are ineffective at informing the public about the risks they face. Winston (1985) feels that it is the "built-in, organizational, competitive and institutional biases" that prevent the media from informing citizens about hazards. These biases are coupled with procedural standards that can also make effective communication of risk difficult. For instance, Singer and Endreny (1993) report that the media inform about "events rather than issues, about immediate consequences rather than long-term considerations, about harms rather than risks," and Wenham (1994) describes how the media "tell how bad things are, while [Disaster management agencies] make things better." Burkhart (1991) feels that it is a deficiency of knowledge about hazards and disaster management among journalists that makes them unable to effectively communicate due to both a lack of understanding of the most basic

concepts, and their inability to act as a "surrogate for the layman, to absorb and transform technical information to a public that is often even less well prepared to grasp technical information and concepts." There are other similar reasons identified by research efforts that sought to explain media risk communication deficiencies, including restrictions of time and space that prevent adequate knowledge transfer (Willis, 1997) and the media's insistence on taking control of the selection and presentation of message format that leads to a decrease in message effectiveness (Burkhart, 1991).

There is another subgroup of studies that found the news media to be largely ineffective as a risk communicator, but assign less blame to them for such problems. Raphael (1986) turns the focus of the blame onto the public, stating that "citizens often display a magical belief in goodness and protection and a sense of generalized risk, which may explain why people pay less attention to preparedness information provided by the media outside of the context of an emergency". Jerry Hauer from the New York City Office of Emergency Management feels that it is the tendency of the emergency management community to exclude the media from training and drills due to fear that the media will leak operational plans to terrorists, and the fear that they will cause mass public panic, that has prevented the media from being able to be effectively inform the public (McCormick Tribune Foundation, 2002). This position is supported by Burkhart (1991) who states, "Media are often limited by the nature of the information they receive," and Bremer (2002), who states, "Terrorism presents a major dilemma to political leaders in terms of how to get enough attention without bringing too much attention to the problem."

There is a third party of research that claims that while the news media are in fact ineffective at educating the public, they still play a vital role in risk communication. McCallum, Hammond, and Morris (1990) state that, "Regardless of reservations about their ability to play the role effectively, the media do carry considerable information about certain hazards and risks to most people." This view of the media as informer is fairly widespread. Willis (1997) states that, while the media too often avoid contributing to the solution to the problems, they are effective at raising attention to issues and communicating degrees of urgency. Mullis (1998) further promotes this argument, stating that the media are effective at initiating preparedness activities. Burkhart (1991) found that, while media warnings were too imprecise to be effective, they "were able to get people talking to other people about the danger mentioned in media warnings." Cohen (1963) succinctly characterized this phenomenon in writing that "the press may not be successful much of the time in telling its readers what to think, but it is stunningly successful in telling them what to think about."

The rise of seemingly-limitless media coverage of events worldwide (referred to as both the "*24-hour news cycle*" and "*the CNN Effect*") decreased the delay of notification of major disaster events while simultaneously increasing the reach of disaster information to a global audience (Cate, 2002; Hansen and Folkenfilk, 2005). However, traditional mass media outlets, inclusive of print, radio, and television, are unable to meet all of the information sharing and communication needs that arise during disaster response and recovery. And while the Internet and mobile communication technologies do open many new opportunities for coordination among affected communities, governments, and other stakeholders, they clearly do not meet stringent information sharing requirements (see Box 6).

That being said, the media are both consumers and producers of information and therefore a key stakeholder in the relationship that must be actively engaged. Media organizations have unique access and utilize unique methods that help to both acquire data and information that other emergency management organizations might not otherwise have, and can provide a voice or method of transmission that is highly advanced – especially with regards to communicating with the public and releasing critical warnings and other instructions.

BOX 6: Traditional Media versus Modern Media

Because radio is a resilient communication medium, all of the coastal municipalities in Iwate, Miyagi, and Fukushima prefectures of Japan were equipped with a disaster radio system following the 1960 Chilean tsunami. In the 2011 Great East Japan Earthquake and Tsunami, communication cables and mobile phone base stations were disrupted or destroyed, and power outages were widespread. In many places, the only means of communication was battery-operated radio, which was credited with saving the lives of many people who received radio-broadcast evacuation announcements. In Miyagi Prefecture, off-air activities of community radio stations (e.g., organizing forums) have helped in the post-tsunami recovery process to keep the disaster-affected population informed and to ensure that community engagement is maintained (Ichiguchi, 2011; Ideta, 2012; Ideta et al., 2012).
END BOX

The mass media provide tremendous information sharing capacity in all disaster phases, not just response and recovery. Media organizations that attended the Fifth Asian Ministerial Conference on Disaster Risk Reduction (DRR) in Yogyakarta, Indonesia in October 2012 declared that they (the media) should take DRR as a serious threat to development and as such commit to "provide balanced, accurate, timely coverage of disaster risks before, during, and after disasters; prioritize the dissemination of accurate information on natural hazards and disaster risk reduction and dedicate more time and space to report on the causes of disasters and what can be done to prevent disasters; and network with media peers and journalist associations to convey the message of the Declaration in order to strengthen the resilience of communities" (Statement of Media, 2012). The media recognize the increasing importance of DRR issues in current affairs and the power of communications in building the resilience of people. The media also acknowledge the role that they can play in informing and educating people including the most vulnerable groups of society about the disaster risks they are facing and are willing to work closer with national and local DRR partners to keep their audiences informed and save more lives and protect more assets against disasters.

Like the mass media, social media has enabled vast quantities of information to be shared easily across myriad audiences. Social media use in post-disaster settings has increased significantly in recent years, and common applications like Twitter and Facebook are addressing many disaster data collection needs. Correctly used, social media platforms have enabled an acceleration of critical damage and needs assessments even in local and remote communities. Wikis, online community forums, blogs, and e-government portals on disaster recovery have enabled instant feedback loops, thereby increasing the participation of citizens in the recovery process.

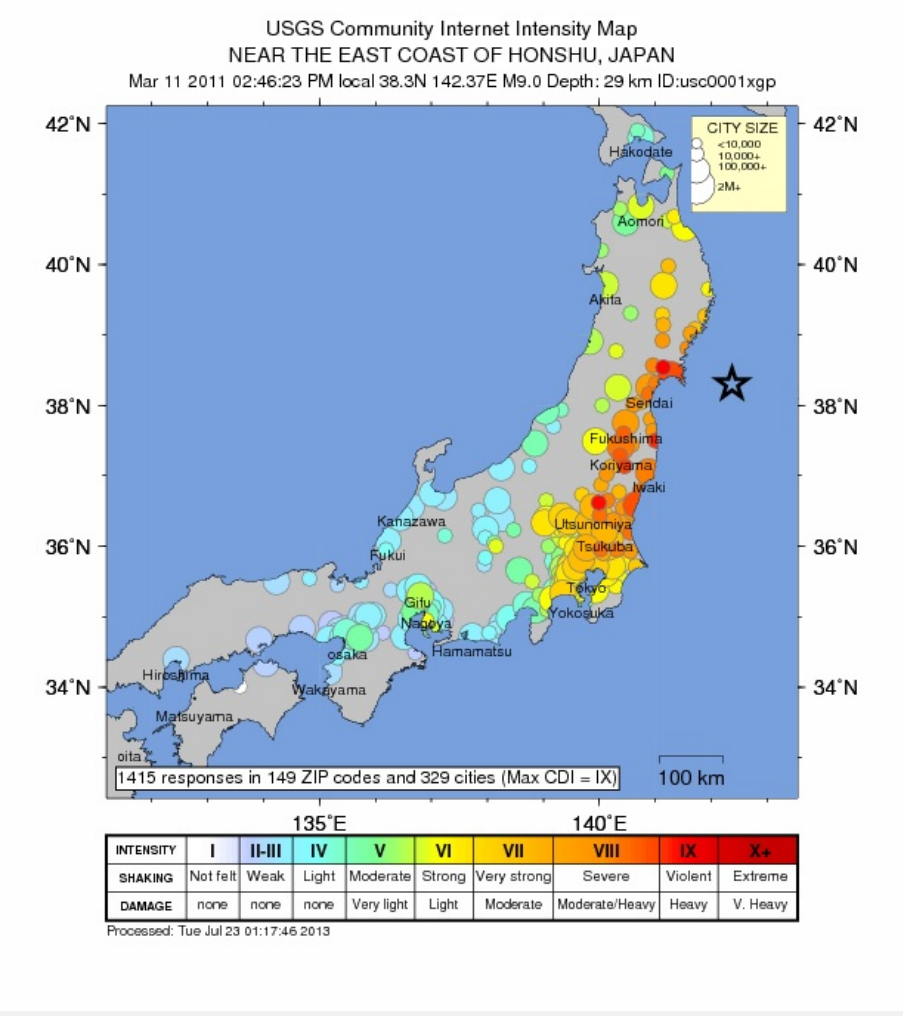
In a survey conducted by Peary (2012) after the 2011 East Japan Earthquake and Tsunami, respondents in the Tohoku region said that they relied upon social media primarily in obtaining disaster-related information, followed by the Internet, word of mouth, and TV. Social media can serve as an effective means of communication for governments to reach individuals and communities (Goldfine, 2011).

Social media has likewise played an important role in increasing the collection of information and serving as a tool for response and recovery collaboration (Gundecha and Liu, 2012). Individuals have a unique perspective of their immediate surroundings and within their own social circles, and are able to report through social media outlets in a manner that is searchable by traditional disaster risk management stakeholders. This practice is called crowdsourcing, and has been used to generate data, information, ideas, funding, and other resources that are critical in response and recovery periods. Examples of crowd-sourced platforms include OpenStreetMap and Ushahidi (See Box 7).

BOX 7: Crowdsourcing - US Geological Survey "Did You Feel It" Application

The United States Geological Survey (USGS) utilizes a crowdsourcing system for measuring earthquake intensity that provides incredibly-rapid and highly-accurate assessments almost anywhere in the world. This web-based program, called “Did You Feel It?”, can provide responders with information about which specific areas experienced the most shaking and therefore the most potential damage – even in areas with few or no technical instruments. This information provides an almost immediate post-earthquake response tool and helps improve the methods by which future earthquake losses are estimated.

Within minutes of an earthquake anywhere in the world, the USGS reports seismic readings on the Did You Feel It? website. Upon feeling tremors, citizens can log onto this site and select the event matching their location that they just felt. A survey is presented that asks them their specific location (often their postal code) and questions that help to provide a Modified Mercalli Intensity (MMI) such as "Did the earthquake wake you up?" or "Did objects fall off shelves?" Within minutes, a map with micro-zoned intensity begins to take shape. This map, called a Community Internet Intensity Map (CIIM), shows where and how strongly an earthquake has been felt.



Surveys of earthquake intensity are vital because many different factors determine how each specific location is impacted (e.g., earthquake type, rupture direction, local geography, soil conditions, and type and age of buildings). Shake maps therefore cannot simply estimate outcomes based on the distance from an earthquake’s epicenter – they appear like patchworks of high and low intensities felt. Such maps traditionally required months to complete using in-person questionnaires, phone surveys, and mail-surveys. Using crowdsourcing, CIIM's begin to take shape almost instantly, but are no less accurate than

the traditional methods. The CIIM summarizes responses and provides MMI intensity numbers to each postal code for which a questionnaire is completed. The intensity values gain accuracy as more and more respondents log answers into the postal code. Areas for which data have been received are color-coded according to the intensity scale while unreported areas are shown as gray. There is no time limit to reporting so users can even contribute to earthquakes they experienced months or even years in the past.

A CIIM's value comes, in part, from the fact that it communicates actual observed descriptions of damage rather than inferences of damage such as those based on instrument readings. Data points are much more numerous than instrument readings and thus the data points provide a more dense sampling. Additionally, their use significantly reduces the human resources required to conduct rapid assessments of earthquake intensity given that individuals self-report. They also provide users with a sense of community involvement in the response, which has been shown to have psychosocial benefits. And finally, simply by accessing the website they have initiated a mechanism of two-way information sharing between responders and victims that can be utilized in the response and recovery period to follow.

The CIIMs also support disaster risk reduction. In regions with few earthquakes and, hence, few seismic instruments, which includes most of the world, large numbers of intensity observations for a small to moderate event can indicate which areas will be more prone to shaking in the less frequent larger earthquakes.
(Wald, Wald, Dewey, Quitoriano, and Adams, 2001)
END BOX

Social media has also been successfully used to provide citizens with an alternative and timely source of recovery information, and allows users to stay informed when conditions change. It has enabled the recruitment of volunteers, the organization of disaster donations, and ongoing communication about the status of disaster impacts and relief services (e.g., the status of ongoing repair of power transmission lines or the location of mass-care commodity distribution sites).

The following examples describe how social media has been tapped to exchange information during recent disaster events:

- **Damage and needs assessment mapping in Haiti**: Historically, mapping required the skills of trained professionals. After the 2010 Haiti Earthquake, relatively untrained volunteers, NGOs, and citizens were together able to create maps that proved to be of critical value to the recovery (Zook et al., 2010). The Haiti experience provided a counterexample to the concern in both academia and industry about the accuracy, validity, and reliability of volunteered geographic information (VGI). The resulting maps were heavily used by numerous agencies and NGOs on the ground. (http://bit.ly/1lp8Zav; http://haiti.openstreetmap.nl)
- **Disaster Information following the Joplin (USA) Tornado**: The Joplin Tornado Info (JTI) Facebook page is a volunteer-led effort that uses social media to connect members of the public with needed resources. JTI provided a centralized hub for the public to ask for help, offer aid, and understand the ongoing response and recovery needs at any given time. The page served as a clearing house for information, aided communication, and "connected the dots" between needs and resources (Williams et al., 2012). It encouraged dialogue in the community. Similar pages have been set up in the aftermath of subsequent events with the same positive impact. This event highlighted a positive outcome of the proliferation of smart phones, which may be the only means of information access when electricity and other mass media are cut off. (https://www.facebook.com/joplintornadoinfo)

- **Disaster mapping and information following the Great East Japan Earthquake**: All311 was launched immediately after the 2011 East Japan Earthquake and Tsunami (Saito, 2013). The site was built and hosted by the National Research Institute for Earth Science and Disaster Prevention (NIED), and provides a one-stop shop for information on ongoing activities (top-down and bottom-up) in the recovery process. Sinsai.info was launched just four hours after the after the 2011 East Japan Earthquake and Tsunami, using the Ushahidi platform. Open Street Map volunteers were mobilized to create topographical maps of the region with annotations in English and Japanese. Online platforms were created to host and distribute spatial data useful for response and recovery (Saito, 2013). Twitter and other social media outlets were also heavily used in the aftermath of this event. Mobile data networks were among the only reliable means of two-way information sharing among the public due to the loss of power and damage to so much of the communications infrastructure. Web-enabled phones and smartphones provided access, and these social media sites became a source of comfort and in some cases a lifesaving tool (Kaigo, 2012). Although there were concerns about falsified or unverified information, the simplicity of using Twitter and the function for users to 'follow' a reliable account user made this a valuable resource in the immediate response stage. (http://all311.ecom-plat.jp; http://www.sinsai.info)
- **Damage assessment in the US Gulf Oil Spill Crisis**: The 2010 Gulf Oil Spill threatened local economies and the environment (McClendon and Robinson, 2012). The Louisiana Bucket Brigade used the Ushahidi map platform to raise awareness of the ongoing ecological disaster and to document the extent of damage. The information collected has continued to be useful as long-term recovery efforts progress. (http://oilspill.labucketbrigade.org/main#)
- **Twitter notifications in the Queensland (Australia) Floods**: In the first six days of the floods, twitter users sent more than 35,000 tweets using the hashtag #qldfloods. By midday on the second day of the floods, over 1,100 tweets were being sent each hour. The Queensland Police Service utilized this hashtag to communicate with the public, and was the most visible voice in the ongoing information feed. Messages were able to be easily reposted into other platforms, including Facebook, on government websites, and in the mass media. The most common uses for this account included sharing of information, discussion and reaction, media sharing, requests for help, fundraising, and sharing of direct experience (Liddy, 2013). (https://twitter.com/search?q=%23qldfloods&src=typd); http://bit.ly/Qk6SYN)

The harnessing of social media for disaster response and recovery information sharing should be pursued given significant opportunities to enhance information sharing in disaster response and recovery. However, this pursuit should be conducted in conjunction with other traditional methods given limitations and notable shortcomings to its use that must be recognized and addressed (Fernandez and Shaw, 2014). For instance, information broadcast via social media is un-moderated, unverified, and rarely attributable to a reputable or even identifiable source. Its use can and has caused confusion when incorrect or intentionally-misleading information has been spread. Because it is unfiltered, the amount of information can become overwhelming and users may find it difficult to cull through the chatter to find anything of value. And finally, it is also self-selecting in that only those with the means to access the required technology can contribute or receive information.

Legal, Regulatory, and Procedural Frameworks for Information Sharing

Information sharing mechanisms are often restricted by laws and regulations, or by the absence of such laws. Privacy and non-disclosure laws, for instance, have barred certain organizations and institutions from sharing information for risk civil or legal penalties (Pedroso et. al., 2014). Conversely, the absence of guiding laws, regulations, or procedural

frameworks has led to ad hoc information transfer. This occurred following the 2011 Great East Japan Earthquake (GEJE) when ad hoc efforts to provide the public with response and recovery information ultimately led to psychological stress, confusion, and unfair treatment (Kaneko, 2012). Experience from this event also revealed how limited legal procedures to guide public participation and information access can drastically stifle integration of DRR in recovery and reconstruction (Kaneko et al, 2014).

Several countries have passed or are developing legal and regulatory frameworks that provide authority and structure to information sharing mechanisms during crises. Keneko et al. (2014) found that the establishment of procedural frameworks for sharing information with the disaster-affected communities and for cooperating with such communities in undertaking post-disaster planning activities for DRR is implied in PFA5/C14. They further state that PFA5/C14 should not be interpreted as merely encouraging intra-governmental preparedness for control of information and post-event decision-making.

The following examples illustrate how national legal frameworks can support or guide information exchange:

- **New Zealand**: Following the Christchurch Earthquake (2011), privacy and non-disclosure issues created bottlenecks to the sharing of critical data. Critical infrastructure systems were severely impacted, but providers were unable to access data on the seismic demand, the surface and subsurface conditions, and damages to structures because of confidentiality issues. Maps reporting the land damage to residential areas commissioned by the Earthquake Commission (EQC) was withheld because it would have breached confidentiality about damages to individual residential properties, and information on damage to the underground water and sewage network was also held closely. Providers had no choice but to use less accurate and/or alternate sources of data. In the aftermath of the event, positive changes occurred almost immediately, with both public and private organizations more willing and able to make their information available with less restrictive conditions. Policies like the New Zealand Government Open Access and Licensing framework (NZGOAL) set out a series of open licensing and open access principles. Finally, new technology was successfully used to provide new and easier ways to deliver geospatial information. (Pedroso, et al., 2010.)
- **Brazil:** Many efforts have been undertaken by civil defense authorities in Brazil's Espirito Santo State and in the municipality of Vila Velha to create legal framworks to enhance information sharing. Brazil recently formulated and implemented the National Civil Protection and Defense Policy (PNPDEC - law 12.608/2012) to address HFA recommendations and in recognition of the January 2011 disaster in Rio de Janeiro state. A DRR campaign launched by the Ministry of National Integration (MIN) and the National Civil Defense Secretariat (SEDEC), and participated in by civil society, placed DRR responsibilities at the municipal level. This project was entitled "Constructing Resilient Cities: My City is Preparing." Dialog has been promoted between the agencies as recommended in part because a high degree of harmony exists between the National Center for Natural Disaster Monitoring and Warning (CEMADEN) and the National Center for Risk and Disaster Management (CENAD). There exists technological infrastructure to support its functions of monitoring alerts and communicating them to the municipalities. Communication between national, state and municipal government is guided by Complementary State Law 694/2013, in terms of: 1) coordination and promotion related to the implementation of joint actions between the state and municipal levels; and 2) the presentation of information and support to the National Secretary for Civil Defense and Protection concerning the occurrence of disasters and other civil defense activities. In Vila Velha, Law 5265/2012 and the Municipal Contingency Plan (MCP) have helped to establish communications. The MCP addresses hazards and

hazardous land use practices by low income populations and marginalized people. Communication between the national, state and municipal levels is also addressed in the MCP, which makes references to several other relevant laws, including the PNPDEC and to Complementary State Law 694/2013 (Otini de Araújo, 2014).

- **Japan:** The 1981 Kobe City Ordinance on District Plans and Town-Planning Councils added unique provisions (articles 4 through 8) to encourage broadly ranging civic participation in town-planning. These extended the mandate given by the national Law on Urban Planning which had merely allowed local governments to elaborate procedures for the involvement of stakeholders in district plans. In Kobe, this ordinance played an important role in the 1995 earthquake recovery effort as it enabled civic participation in the post-disaster urban planning. Other municipalities subsequently enacted ordinances for participatory disaster-recovery that promoted information sharing with the public. The 2006 Katsushika Ward Ordinance in Tokyo on the Promotion of Town-Planning by way of Civic Participation is a product of an active campaign by the Tokyo Metropolitan Government to establish "pre-disaster recovery planning under the community cooperation." The framework established by the 2000 Tokyo Ordinance on Disaster Response and the 2003 Tokyo Manual on the Disaster Recovery enabled such action.

Capturing and Applying Lessons

Post-disaster evaluations enable institutional learning and likewise improve the conduct of future response and recovery efforts. These reviews also ensure disaster risk reduction measures are adequately informed during the reconstruction phase and in the course of ongoing development. A formal process for capturing and sharing lessons is necessary to prevent experiential knowledge from remaining in the individual or institutional domain, or as tacit knowledge that cannot be shared. In fact, a lack of effective knowledge sharing has been identified as one of the reasons that disaster management organizations continue to struggle with response and recovery operational success (Pathirage, et al, 2014).

Unfortunately, many organisations have faced difficulty in capturing, retaining and/or re-using knowledge gained through disaster management operations (Koria, 2009). Lessons are ignored or quickly forgotten soon after response or recovery operations end and new responsibilities take precedence. As philosopher George Santayana said in his quote "Those who cannot remember the past are condemned to repeat it," many emergency management organizations repeat the same problems and mistakes from disaster to disaster in the absence of evaluation mechanisms.

Dufty (2014) explains that, "[e]valuation arguably is society's most fundamental discipline. It is oriented to assessing and helping to improve all aspects of society including emergency management. It is a critical element of personal, societal and organizational learning." Dufty identifies five types of formal post-event emergency management evaluations:

- **Government inquiries and reviews**: Formal investigations conducted to determine facts, typically conducted following significant events and led by government-appointed senior personnel; they are oftentimes guided by terms of reference and seek to address a recognized problem or shortfall with recommendations for action.
- **After-action reviews (AARs) and operational briefs**: Held soon after response or recovery operations have ceased in order to capture what was planned, what worked well, what did not work well, and what opportunities exist for improvement.
- **Community meetings/debriefs**: Typically ad-hoc meetings that provide an opportunity for citizens to discuss an event, examine the quality of the emergency

services provided, and identify ways to improve community preparedness, response and recovery in the future.

- **Community surveys and other social research**: Independently-facilitated and systemic effort to identify and report on various factors surrounding a disaster event including causes, public perceptions, and local emergency management capacity, among others; research is conducted by social scientists and may include surveys and/or focus groups; participants may include residents, businesses, special interest groups, or potentially vulnerable groups, for example.
- **Independent evaluations**: Post-event evaluations typically commissioned by the emergency services yet conducted by private consultancies or academic institutions in order to maximize the likelihood of objective feedback.

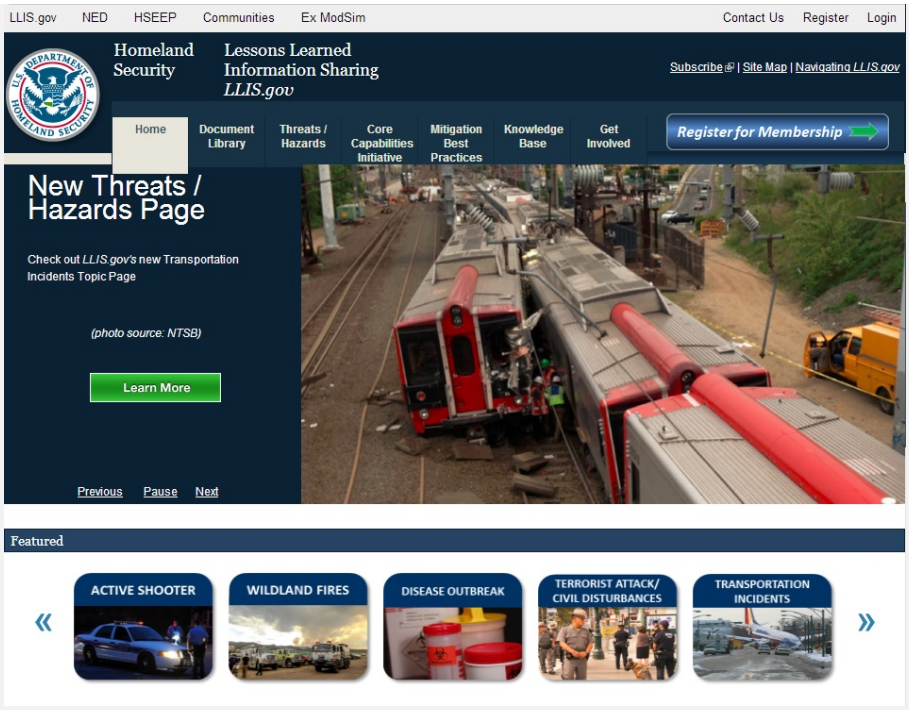
The media play a strong role in the evaluation process in that they document the event and its response and recovery, as well as seek the opinions of a wide variety of experts, citizens, and other community stakeholders impacted. Media evaluations, however, are often overly critical, based on perceived public expectations, and must rely upon incomplete evidence (Dufty, 2014).

Knowledge and information management systems are critical to the lessons learning process in that they make the storage, indexing, and sharing of such information possible. While dedicated information portals are not always necessary, they do exist and provide a central repository for all assessment and review materials for stakeholders. The US Department of Homeland Security (DHS) Lessons Learned Information Sharing System (LLIS) is an example of this type of portal (See Box 8).

BOX 8: Lessons Learned Information Sharing System (LLIS)

The US Government developed the Lessons Learned Information Sharing System (LLIS – http://www.llis.gov) in 2004 to provide a "one-stop resource for the most current homeland security and emergency management-related information." The system operates as an online library that contains peer-rated documents that cover all hazards, all disciplines, and all levels of government, nongovernmental organizations, and the private sector. The purpose of the program is to ensure that responders and emergency managers from all disciplines are able to benefit from the lessons learned and the best practices identified through disaster experience, exercise and drills, and research. The system contains over 20,000 searchable documents that include:

- Full plans, templates, after-action reports, articles, guidelines, best practices, and other documents;
- Short summaries that highlight best practices or innovative ideas submitted by members that could provide lessons to other jurisdictions or organizations;
- Open source documents or content developed by users of the system;
- Subscription-only email updates covering a number of specific topics, postings, categories, events, or channels; and
- Region-specific content, updates, and events.



Though almost 2,000 documents are available to the public, the majority of documents are accessible only through an account. The provision of accounts increases the level of trust among information providers and enables the responder community to better understand who they are exchanging information with. It includes a member directory to improve peer-to-peer discussions, enables forum-based discussions on broad reaching topics, and provides a secure method of document sharing when needed.

END BOX

Section 1: The Impact of the HFA: achievements

Significant technological and organizational advancement in the management of data, information, and knowledge has occurred since the 2005 signing of the HFA. These changes have corresponded to a rapid rise in social media use and the increase in prevalence of institutes, platforms, and other organizations created to enable the capture, processing, and sharing of information. The shift towards modernity has altered the way disaster risk management and disaster risk reduction are performed, strengthening the mainstays of global DRR and disaster management capacity building efforts in the process.

Understandably, the crafters of the HFA monitor could never have predicted such an explosive scale of expansion. Just ten years ago, far fewer academic reports and practical resources existed - and many of the foundational technologies behind today's sharing platforms were experimental at best (and even then, far out of reach for most). Alfred Gilman's (World Food Program (WFP)) words from a 2011 report on information sharing practices characterize this rapid evolution:

> *"If you look at the expectations 10 years ago in Afghanistan and what a typical humanitarian responder now is expecting in terms of services, it has dramatically increased, both in terms of the number of systems but also the types and quality of information and the bandwidth expectations"*
> (Harvard Humanitarian Initiative, 2011).

Today, information is instantly shared across collaborative global platforms. Lessons learned and best practices captured are distributed not only within countries but also within regions and throughout the world. Post-disaster assessments are centralized on web-based platforms, supported by multiple stakeholders and facilitated through the use of tablets, smartphones, and other handheld devices. Audio and video communications with satellite-based data-sharing capabilities connect every possible location, and citizens have come to produce data at levels equal to or exceeding how much they consume.

The HFA Monitor assessment instruments, the first of which was developed in the first years following the signing of the HFA, lack the tools to enable an accurate or useful assessment of the scope and progress of reporting countries' information sharing activities. In the first reporting period, no specific means of verification were provided, leaving respondents to individually interpret the meaning of the phrase "exchange of relevant information." In the second round of reporting, when four means of verification were provided, consideration became limited in scope to a single aspect of information – the damage and needs assessment. This change had the unintended consequence of limiting respondents' interpretations of the indicator and likewise the scope of their considerations. By the third reporting period, many respondents appear to have taken a broader approach to their own assessment despite that verification remained limited to the same four items. Nonetheless, there exist great differences in how the respondents interpreted the task as indicated in their descriptions. From a temporal perspective, this prevents significant difficulty in establishing a sweeping assessment of progress.

As presently written, the HFA Monitor reporting template guides nations to focus primarily on the post-disaster needs assessment process in the assessment of PFA5/CI4. Respondents are asked the following guiding question to frame their thinking on the topic:

> *"Has an agreed method and procedure been adopted to assess damage, loss and needs when disasters occur?"*

Furthermore, verification of this question is to be achieved by providing yes/no responses to the following four indicators:

1. *Damage and loss assessment methodologies and capacities are available;*
2. *Post disaster need assessment methodologies exist;*
3. *Post disaster needs assessment methodologies include guidance on gender aspects; and*
4. *Human resources (to support the assessment process) have been identified and trained.*

As with all core indicators in the HFA Monitor template, assessors are asked to expand upon their answers by providing a narrative description of progress towards meeting PFA5/CI4 and to detail the context of their efforts and the constraints encountered.

The exchange of relevant information and the conduct of post-event reviews together encompass a broad category of functions that extend far beyond the narrow scope detailed in these verification means. This fact is not lost on participants in the national assessment process, and the manner in which respondents interpreted these questions and responded differs greatly. While many answered these posed questions directly thus focusing only on the assessment process and their relative capabilities, others did consider the core indicator's broader language and provided expanded answers that addressed many other information-related activities. But even among those broadly interpreting the questions, their scope of answers differ considerably given no standard means of verification exist to guide them (e.g., whether or not they have a national-level information sharing portal, whether or not they have statutory or legal instruments to facilitate information sharing, whether or not mechanisms to capture and share lessons learned exists, or whether mechanisms were in place to facilitate information sharing between governmental and nongovernmental disaster management stakeholders, among others).

By reporting year, there were 60 submissions in 2009, 103 submissions in 2011, and 98 submissions in 2013. A total of 141 unique countries reported their progress in meeting PFA4/CI4 in at least 1 of the 3 reporting periods. Of these, 86 reported in at least two of these years which allows for an assessment of progress from one reporting period to the next. A statistical analysis of the national government responses to the answers provided in the HFA Progress Reports from 2009, 2011, and 2013 sheds some light on the state of information sharing, and indicates that greater recognition of the scope of this indicator is occurring.

Overall, the progress reports indicate that steady improvements in information sharing are occurring and the capture of lessons learned has increased. The average of self-assigned ratings in this indicator rose from 3.45 (of 5) in 2009 to 3.54 in 2013. However, the 2011 average rating in this indicator was 3.37, which represented a drop in overall achievement from the first to the second reporting period. Examination of how countries reporting in multiple reporting periods (either 2 or 3 periods) offers a possible explanation for this interim drop. Countries reporting multiple times indicated either:

1. A constant increase (e.g., 2 to 3);
2. A constant decrease (e.g., 5 to 4);
3. A constant level of progress (4 then 4); or
4. A reversal in progress (4, then 3, and then 4).

Interestingly, of the 86 countries that reported in at least 2 of the 3 reporting periods, 48 remained constant, 24 showed an increase in capabilities, and 12 showed a decrease in capabilities. Two countries showed a reversal in progress, in both cases a decrease from 2009 to 2011 followed by an increase from 2011 to 2013.

The author suggests that the drop in overall ratings from 2009 to 2011, followed by an increase in ratings from 2011 to 2013, is the result of the change in manner in which the indicator was assessed that occurred in the middle reporting period (with the introduction of the assessment-focused verification means). Detailed descriptions provided in the first period of performance, when interpretations were not guided by such verification means, addressed the broader scope of information exchange and lessons-learning. When the verification means were introduced in 2009, the descriptions of progress provided focused much more on damage and needs assessment capabilities and in many cases addressed no other aspects of information exchange. However, by the 2011-2013 reporting period, many more respondents chose to expand their view of this indicator to again include more aspects of the information sharing and lessons-learning functions as described in the introduction to this paper.

The 98 countries reporting in the 2013 reporting period showed varied yet positive levels of achievement in relation to the leading question and the four indicators listed in the HFA Monitor Template. For the leading question, "*Has an agreed method and procedure been adopted to assess damage, loss and needs when disasters occur?*" 86 of 98 respondents answered yes (88 percent). The four indicators, and the total number of countries answering "Yes" to each, include:

- Damage and loss assessment methodologies and capacities available (72, or 73%)
- Post disaster need assessment methodologies (68, or 69%)
- Post-disaster needs assessment methodologies include guidance on gender aspects (37, or 38%)
- Identified and trained human resources (76, or 76%)

While it is difficult to assess the broader implications of this indicator across all countries, it is possible to provide some clarity on the progress occurring by commenting on individual cases reported by both developing and industrialized nations. These cases highlight the range of information measures being taken, and shed light on differences in understanding that exist per this indicator. For instance:

- **Mauritius** - Communication to the general public is performed by the Mauritius Meteorological Society, the Mauritius Broadcasting Corporation, private radios, the Mauritius Police Force, the Internet, and call centers. During and after disaster events, statistics are gathered and reports produced by the Central Statistics Office.
- **Rwanda** - The Rwanda Ministry of Disaster Management and Refugee Affairs (MIDMAR) planned to have a new Disaster Management Communication System in place by November 2012. The system provides warning and provides a platform to collect relevant needs assessment data. This has included the distribution of phones to each administrative Sector, Smartphones and Modems to each District, and installation of a server at MIDMAR. Future efforts include distribution of more phones to the sectors and laptops to each District. Phones are used to send SMS alerts to MIDMAR and other stakeholders and to initiate rapid needs assessment. District and Sector Disaster Management Committees will be trained as end-users of the system. 7 District Disaster Management Officers have already been deployed and 24 more will be deployed at the second phase of the project.
- **United States** - The U.S. National Institute of Standards and Technology (NIST) has established a Disaster and Failure Studies repository for disaster and failure events to identify common vulnerabilities to which hazard mitigation strategies and technologies can be developed to reduce risk. As part of this program, NIST post-disaster studies provide a unique environment to help determine the causes of failure

and valuable data that will help design professionals to improve the resiliency of infrastructure and materials and to update codes and standards.

- **Japan** - The Cabinet Office of Japan has developed databases to track lessons learned gained from experience responding to large-scale disasters. Materials include incident analyses, official reports, general publications, magazines and papers. Materials are compiled for the purpose of being utilized in future hazard events and disasters. Following the Great East Japan Earthquake, an expert committee which was set up in Central Disaster Management Council to capture lessons learned and to verify and prepare relevant reports. The Central Disaster Management Council has established a committee for technical investigation for collecting lessons learned from past disasters that have occurred since the 17th century in order to secure these for current and future generations.
- **China** - The Government of China has developed early-warning and information sharing mechanisms in conjunction with several ministries including the Ministry of Civil Affairs, the Ministry of Land and Resources, the Ministry of Water Resources, the Ministry of Agriculture, the National Bureau of Statistics, the State Forestry Administration, the China Earthquake Administration, the State Oceanic Administration, and others. A disaster information database has been created, which has enabled a national public service platform for geographic information, which in turn has supported regional and local governments in their decision-making processes (for both disaster risk reduction and emergency response). The National Commission for Disaster Reduction and the Ministry of Civil Affairs have built a 24-hour disaster monitoring mechanism that provides information on new and ongoing disaster events. Disaster management departments have built information sharing networks with insurance companies, reinsurance companies and insurance regulators. In August 2012, to improve disaster relief decision making, the Guiding Opinions on Strengthening Natural Disaster Relief Evaluation were issued to offer new strategies for the evaluation of response and recovery efforts.
- **Malaysia** – Following disasters, after-action reporting is conducted by the District and State Disaster Management Committees. Agencies that participated in the response and recovery participate in the review process, which identifies the root causes of the disaster, characterizes damages and losses, and captures lessons learned and best practices. A final report is submitted to the National Security Council, and outcomes are shared in seminars and as a component of training.
- **Lao PDR** – The National Disaster Management Office maintains a Disaster Assessment Committee responsible for collection of both pre- and post-disaster data in partnership with other ministries and DRR/DRM partners. Assessment methodologies and coordination mechanisms are developed but are being refined in part through a joint project between the Ministry of Planning and Investment (MPI) and the Asian Disaster Preparedness Center (ADPC). The project aims to:
    - Develop a national assessment methodology and strengthen the assessment capacity of the Lao Government
    - Strengthen information sharing between the Government of Laos, the UN, and other IGOs.

  An Emergency Task Force disseminates information within the NDMO vertical structure from the National level to the Provincial, District, and local governments. To address some weaknesses with coordination and horizontal information exchange with external stakeholders, the Government of Lao PDR is adapting the National Disaster Management Plan to include the establishment of a Disaster Response Coordination Centre operational upon disaster onset.
- **Norway** – Norway has developed a new Emergency Network in the East-Central part of the country that enables information sharing. This system has been tested and shown to be effective. In the summer of 2012, the Parliament approved an extension of this network to cover the remainder of the mainland. Once completed, it will

enable more effective communication between the police, the fire service and medical personnel, thereby supporting quicker assistance to the public in the event of a disaster.

- **United Kingdom** – Information sharing in disasters is guided by the UK Government Department for Communities and Local Government, Resilience and Emergency Division (DCLG/RED). The national Concept of Operations (CONOPs) guides information sharing between the local and national levels, and between local governments (cross-boundary). RED is capable of setting up a response coordinating group (RES-CG) in a high-impact or wide-area incident. Local partners tap into this group through the multi-agency emergency coordination plans they maintain. These plans also stipulate post-event reviews. RED reviews Emergency Response Plan (ERP) procedures and makes changes as required after each significant event and exercise – including overseas events.
- **Switzerland** – Switzerland maintains two expert platforms that provide disaster information exchange between Federal, Cantonal and communal task forces. These include: 1) The Joint Information Platform for Natural Hazards (GIN); and 2) The Electronic Situation Display (ESD) of the National Emergency Operation Center. The Federal Office of Meteorology and Climatology (MeteoSwiss), the Federal Office for the Environment (FOEN), the WSL Institute for Snow and Avalanche Research (SLF), and the Seismological Service provide current measurement and monitoring data, forecasts, models and bulletins regarding storms, floods, avalanches and earthquakes to the GIN, whereas local and regional authorities can report the situation and potential damages to the ELD.
- **Italy** – Information on hazards and disasters is perpetually maintained by Italy's National Civil Protection according to the European standards and procedures. It is circulated through an operational network that reaches all levels from National to local. There also exists a National Warning System for which data is gathered and circulated. Emergency communication procedures and systems have been established to facilitate communication and information resilience and availability. In 2002, a national emergency frequency was established together with a "national radio network" which link the National Civil Protection Department, the National Fire Brigade, and the regional civil protection authorities. This network was extended in 2007 through the use of satellite systems. To address emergency public information, the National Civil Protection Department entered into agreements with TLC providers and major Television and radio broadcasting companies to set up a "National Public Utility Programme" and a "National Circuit for Public Information". Post-disaster reviews are carried out by the National Civil Protection Department as soon as the immediate response operations have ceased.
- **Sweden** – The Sweden Civil Contingencies Agency (MSB) is responsible for national-level information management and coordination during disasters, and for ensuring that local government is informed. County Administrative Boards maintain a similar role at the county level, while the municipal government is tasked with local information management. When disasters occur, MSB conducts cooperative conferences to enable coordination between the different stakeholders and to keep them informed of developments. MSB is tasked with expanding, developing and supporting the digital communication system, RAKEL, which is used by the emergency services, civil protection, public safety and security, emergency medical services, and healthcare. RAKEL provides greater coverage than commercial systems, and enhanced methods and platforms for interaction. Together with forty other organizations, MSB has produced national guidelines for cooperation through the use of RAKEL.
- **Australia** - The Government of Australia has established a 24-hour, 7-days-per-week all-hazards Crisis Coordination Centre that provides a central point of coordination and management. The Centre provides whole-of-government information,

coordination and decision support to the Australian Government Crisis Committee and other committees and agencies during crises. The Centre has proven effective in ensuring broad situational awareness and maintaining ongoing monitoring of events. Federal Government agencies maintain procedures to provide warnings, information and support to States during disasters. This support includes mapping and weather support for major bushfire events, flood events, and other natural hazards. Procedures are also in place at both the federal and state level for conducting post-disaster reviews. The Federal Government conducts post-event reviews of its response to disaster events, and contributes information to State governments conducting similar reviews. A nationally-consistent approach to lessons and knowledge management is currently under development. It is expected that this will support cross-jurisdictional and agency planning at the strategic, operational and tactical levels. The private sector, including critical infrastructure, is involved in the lessons sharing process.

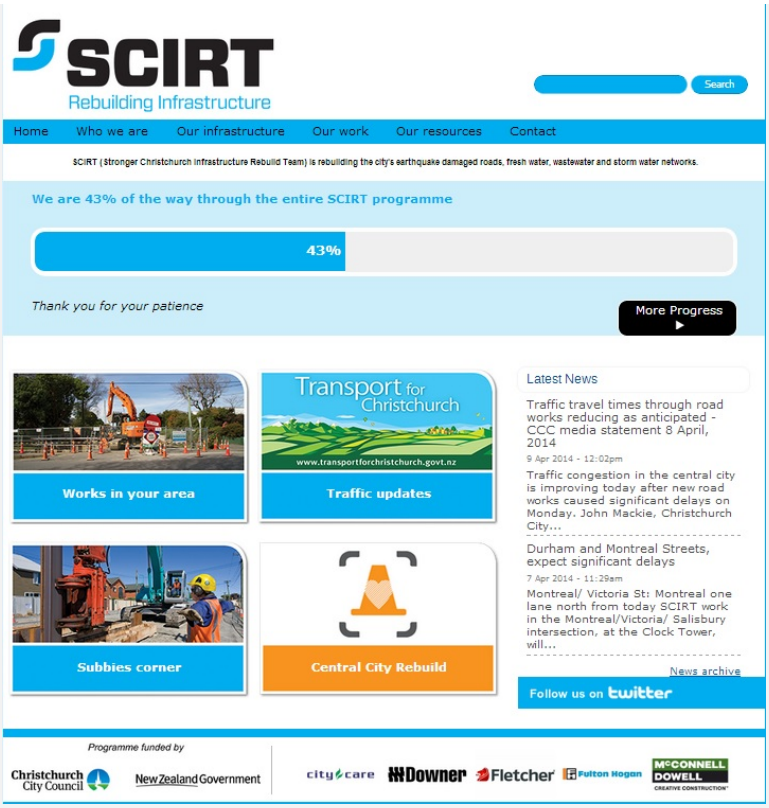
- **Cook Islands** – The Cook Islands Response Executive, established in the event of a disaster, is the main mechanism for information exchanging during declared events. This body operates as the nerve center of the National Emergency Operations Centre providing analyses of all information received from Initial Damage Assessments and authorization of actions by response agencies and line ministries. The Response Executive is typically involved in response and recovery planning meetings. As required, more substantial damage assessments are conducted by an UNDAC team through a Government request for assistance.
- **Marshall Islands** - The Republic of the Marshall Islands (RMI) Chief Secretary's Office is the designated focal point for disaster response and coordination. Communication of disaster warnings and response information to the public is generally made through the 24-hour V7AB radio network responsible for broadcasting such information. The National Weather Service (NWS) plays a primary role in disasters, and maintains five early warning systems called "chatty beetles" that to assist with information communication – especially in more remote locations where communication options are limited. The Ministry of Health (MoH) has recently improved communications between Majuro and the Outer Islands by purchasing and distributing radios that connect all of the nation's 54 dispensaries. The RMI Emergency Response Plan details communication channels, roles, and responsibilities. This plan gives the Central Control Group responsibility for conducting Initial Damage and Needs Assessments, which are typically assisted by the US Agency for International Development (USAID). The Marshall Islands Conservation Society (MICS) and the College of the Marshall Islands (CMI) also have the capacity to contribute to disaster needs assessments as needed. The Asia Foundation supports assessment capacity by conducting training sessions and workshops on Initial Damage Assessment .
- **New Zealand** - National, regional and local emergency operations centers maintain standard procedures for the collation and sharing of a range of disaster impact data. The Ministry of Civil Defence and Emergency Management (CDEM) guides the consistency of reporting instruments like impact assessments, situation reports, and action plans. A National Emergency Management Information System (EMIS) has been commissioned to link all government levels from local to national during nationwide response. This network, which provides a more robust and consistent approach to the collection, collation and sharing of information, is centrally hosted by the National Crisis Management Centre (NCMC) in Wellington and replicated at a secondary site in Auckland. New Zealand conducts after-action reporting following all events and exercises. Larger events where additional consideration is necessary, such as the Canterbury earthquakes, can also result in independent reviews (see Box 9).

- **Palau** - The NDRM Framework provides clear guidance on roles and responsibilities and procedures for information exchange during and after disasters. For example NEMO is charged with the responsibility of ensuring that post-disaster response reviews and debriefings take place and that experience gained and lessons learned are used to strengthen future preparedness, response and recovery procedures. Given its multi-agency representation, the NEC is a key institutional mechanism to enable the exchange of information between relevant agencies. The NDRM Framework proposes that Initial Damage Assessments (IDAs) and Comprehensive Damage Reports (CDRs) be used as the standardized methodology for damage reporting by all agencies.
- **Samoa** - The Disaster Advisory Committee and its sub-committees are the primary mechanism for exchanging information. Training has been provided to members who are now familiar with the procedures for conducting initial damage assessment and response, and each key response agency has its own response plan. The recently-upgraded Emergency Communications Network provides a robust means of radio communication that response agencies may use to achieve country-wide coverage. It allows multiple users to talk concurrently, and uses a dedicated frequency free from interference. The National Emergency Operations Center (NEOC) is designing and implementing an Information and Data Management System that will be used to record hazard event information, and can be accessed by all relevant agencies. The National Disaster Management Plan explains when and how post-event briefings are conducted.

BOX 9: Information Sharing Following the 2011 Christchurch Earthquake

The Stronger Christchurch Infrastructure Rebuild Team (SCIRT) is an alliance of governmental and privately-owned organizations established in September 2011 to rebuild the city's damaged street-level civic horizontal infrastructure (including water, wastewater, and storm water networks and roads). The SCIRT team built a centralized spatial database for the city's horizontal infrastructure, including planning, cadastral, topographic, and environmental data. The Geographic Information system (GIS) can connect to web services like a "Planning and Community Toolset" and with partner rebuild agencies like the Canterbury Earthquake Recovery Authority (CERA) and Christchurch City Council (CCC). It serves as a powerful online tool for planning, assessing and coordinating various activities across the city. In addition SCIRT has embarked on a "Learning Legacy" project with the goal of sharing the data, reports and stories that encompass the various research projects underway.

Aiming to inform organizations and the wider community about how Christchurch is changing and how residents, organizations and businesses can plan for such changes, the Canterbury Earthquake Recovery Authority (CERA) established an online map viewer application called the "Planning and Community Toolset". This viewer provides users information about: 1) land zone status and technical categories; 2) building demolition status; 3) status-quo aerial imagery of the city, and pre-September 2010 earthquake aerial shots; 4) transport and zoning across greater Christchurch; and 5) information on schools, community centers, halls, council facilities, libraries, pools and parks. Information is provided by a variety of sources and is updated regularly.



Land Information New Zealand (LINZ) has also taken significant steps to support recovery planning and operations by providing up to date and easily accessible information. LINZ coordinated the repair of Canterbury's positioning and survey control infrastructure, which is required for the design and repair of essential services and the conduct of natural hazard assessments. It also helps to re-establish property boundaries. LINZ implemented a program that consists of eight interrelated projects, namely:

1. 3D Cities: An interactive 3D computer model that records buildings lost in earthquakes, and supports planning for new structures, places and activity flows – both of which help in the community consultation process.
2. Canterbury Maps: An online portal that enables users to access maps showing data on air, water, land transport, council services and recreation options.
3. Forward Works Spatial Co-ordination: A program that provides government agencies and contractors current information on the locations of underground utility networks (e.g., water, gas, sewage, telecom) in order to help plan and coordinate activities.
4. Open Data and Application Program Interface (API) Support: Efforts to develop smart phone apps for citizens to access useful information services on the move.
5. Property Data Management Framework: A system that allows sharing of reliable data about land titles, parcel dimensions, rating units, buildings, addresses and owners.
6. Utilities Data Access: Provisions that enable efficient data sharing about public utilities across Canterbury recovery agencies.
7. Geospatial Data Discovery: A program to accelerate online accessibility of location-based information by public agencies, businesses and community groups.
8. GIS Interoperability: Efforts to establish systems that enable technical experts to exchange datasets and coordinate quality standards across a variety of different static structural and dynamic geospatial design, engineering and construction modeling programs.

(Source: Pedroso, et al., 2014)
END BOX

Section 2: **Remaining Challenges and Gaps**

> *Information sharing problems remain one of the most significant obstacles to effective emergency management and inter-agency crisis management today, and often leads to multiple failures including inappropriate allocations of first responder resources, counter-productive ordering of sequential relief processes, and delayed evacuations, which often result in crisis escalation and even higher numbers of causalities*
> (Bharosa, Lee, and Janssen, 2009).

Post-disaster decision-making is characterized by uncertainty. These difficulties are greatly compounded in the presence of limited or inconsistent information. Governments' and other stakeholders' capacities to exchange information and conduct post-event reviews are growing rapidly yet remain far from their potential. The components of success do exist, but perhaps the greatest obstacle is a shortage of research and discussion on the topic. Pipes (2006) writes that "the study of disaster information flow has been virtually ignored by [information science] researchers, despite its importance in emergency management and society." Confusion still remains about what information sharing entails. In fact, the great differences in how countries responding to the HFA Monitor interpret their own progress serves as proof that more must be done to formalize the practice and formulate concrete definitions. Until that happens, assessment of institutional capacity, and efforts to expand upon such capacities, remain far from ideal.

A number of more specific challenges have confounded countries in their efforts to attain information exchange capacities they can report in the HFA Monitor to be *"Comprehensive achievement with sustained commitment and capacities at all levels"* (Level 5).

Challenge 1: Institutionalization

The first of these pertains to the ability of organizations or institutions to incorporate internal and external information sharing practices into regular operations. Abdul Rahman (2013) identifies four factors that influence the success of information sharing practices, and examination of PFA5/CI4 responses indicates a prevalence of these factors in the successful systems (where higher levels of achievement have been reported - see Section 1). These four factors include:

- **Political Leadership Support:** *Existence of an organization that is committed to implementing and overseeing government information sharing initiatives at the higher or national level.*
- **Interagency Collaboration**: *Collaboration relies heavily on the building of trust and incentives for participation.*
- **Individual Agency Capacity**: *Capacity includes the motivation of leadership to participate, the financial resources to support sharing activities, the existence of equipment (hardware and software) that enables sharing and use, operational processes to guide information collection, processing, use, and sharing, and the skills of relevant staff.*
- **Agency Benefits**: *Agencies and individuals will only share information if they believe that the recipient will use it in a positive manner (one that is not 'opportunistic'.) The information sharing relationship works best when it provides benefits for both the agency sharing and the agency receiving.*

Challenge 2: Data Standards and Information Coordination Structures

A widespread lack of common data standards and information coordination structures presents a second challenge to improvement of the practices described in this report. Common data standards are a pre-requisite of system interoperability. Otoni de Aroújo (2014) found that the development of data standardization measures improves information sharing and coordination practices even where effective communication. Application of standards enables coordinated inter- and intra-agency mapping and data storage and exchange, and by extension more broad-reaching dissemination. Capabilities are further expanded when nongovernmental stakeholders are encouraged to apply the common standards to their own data and information management capabilities in exchange for participation in a data sharing network.

Otoni de Aroújo (2014) also found that the existence of standards increases interoperability of information management systems and strengthens governmental and NGO relationships – both of which in turn reduce the overlapping of actions as was noted in the experience of the Government of Brazil (see Page 8).Standards can be developed to address a number of factors, including (but not limited to) data formats, operational platforms, data and information entry SOPs, validation protocols, access criteria, and guidelines to maintain accuracy during disaster operations as conditions evolve. Stakeholders should be supported in their efforts to coordinate hardware, software, and other technological drivers.

Weaknesses in data collection and sharing standards persist in most countries, and disparate information sharing networks and disconnects between existing databases containing related information continue to pose response and recovery planning problems. These issues plague even countries reporting highly-advanced systems - and in some instances are even more problematic given such countries are likely to maintain multiple independent systems operating concurrently on related issues (e.g., the Ministry of Housing and the Census Bureau collecting similar information on households).

During assessment and response, stakeholders scramble to assemble data from different sources, and problems related to compatibility, geographic coverage, and timeliness of access together reduce their operational effectiveness (see Box 10).

There are diminishing returns with too much rigidity in standardization, however, when working in an all hazard, multi-stakeholder spectrum. The International Organization on Migration (IOM), for instance, found that data collection mechanisms should be adaptable to the specifics of any particular crisis context and of the information needs of different stakeholders. IOM also found that stakeholders should each promote inclusive methodologies to engage and work with other relevant partners by establishing clear responsibilities and setting up appropriate collaboration procedures (Guadagno, 2014).

BOX 10: Data Obstacles Following the 2011 Christchurch Earthquake

The lack of a central housing data hub in Canterbury posed several problems in the aftermath of the Christchurch earthquake, specifically with regards to establishing a common operating picture about the supply and demand for temporary housing. In this event, a large number of agencies, including the Christchurch City Council (CCC), the Interagency Housing Group, the Canterbury Earthquake Temporary Accommodation Service (CETAS), the Canterbury Earthquake Recovery Authority (CERA), the Department of Building and Housing (DBH), and Statistics NZ, each sought to establish a clear understanding on housing needs and population dynamics in order to support their own operations. However, data on temporary housing needs were never proactively collected. Information was therefore based on inference, and drawn from multiple disparate databases such as international travel and migration data, information collected by local authorities during annual consultations, residential building consents, electoral enrolments, school registrations, prison rosters, military rosters, tax information, and other sources. Obtaining and sharing data between the different agencies and amongst decision makers,

stakeholders, and researchers became a hurdle to effective collaboration throughout the temporary housing decision-making process. For instance, Statistics NZ were unable to share the data they held due to ethical issues and commercial sensitivity. Some of the protected information that had been obtained from utility providers, such as mobile phone and electricity usage, could have given an indication of population movements following the event. Statistics NZ was unable to obtain insurance data, which could have allowed recovery planners to better understanding the level of housing damage and to better predict the number of people who needed to permanently or temporarily relocate. Finally, Opus Central Laboratories had purchased NZ Post data to track mail redirections and gauge migration patterns of the Canterbury population post-earthquake, and while they were able to share general reports based on this data, permission from NZ Post was required to share any data itself. (Pedroso, et al., 2014) **END BOX**

Kaklauskas (2009) and Mohanty (2006) both found that stronger linkages between disaster experts from all agencies, across all sectors, and between all regions is needed. Closely knitting stakeholder relationships creates a synergistic platform that enables stakeholders to collectively capture, organise, share information such that the knowledge gained by each is greater than would have existed operating in isolation. Mass and social media outlets are an important partner yet they present a greater challenge in this regard. The existence of a government- or industry-driven coordination structure that allows media networks to more effective contribute can provide a better alternative to the typically ad-hoc networks and poorly-understood responsibilities these organizations often adhere to in disaster settings (Fernandez and Shaw, 2014). Especially in the case of crowdsourcing efforts, the establishment of protocols and standards that guide volunteer-based open-source platforms is becoming increasingly important (Saito, 2013).

Challenge 3: Understanding Information requirements

Measurement of disaster information requirements presents a third challenge. Organizations need targets to guide their capacity-building efforts, and these are established according to recognized needs (see Box 11). Unfortunately, such needs are poorly understood, even in the aftermath of disasters. In emergency management, a disaster is a situation where response capacity is insufficient to meet response needs. *Information disasters* and *internal communication disasters* are related to this concept.

BOX 11: Data Sharing in a Humanitarian Organization – The Experience of MSF
In 2012, the medical humanitarian organization Médecins Sans Frontiéres (MSF) decided to adopt a data sharing policy for routinely collected clinical and research data. The MSF policy builds on the principles of ethical, equitable, and efficient data sharing to include aspects relevant for an international humanitarian organization, in particular concerning highly sensitive data (non-maleficence), benefit sharing (social benefit), and intellectual property (open access). There are aspirations to create a truly open dataset, but the initial aim is to enable data sharing via a managed access procedure so that security, legal, and ethical concerns can be addressed.

The MSF data policy, which can be found at http://bit.ly/1n4v5ge, addresses the following:

- Eligibility for Access
- Application for Access
- Processing Applications
- Conditions of Access
- Data Handling Fees
- Withdrawal of Consent
- Governance Processes
- Procedure for the Inclusion of Routinely Collected Data or Human Samples

- Procedure for the Inclusion of Data or Human Samples Collected for Research

Source: Karunakara, 2013.
END BOX

McLean (2014) explains that an *internal communication disaster* occurs when inadequate communication competencies become surpassed by needs. Two major factors must exist for a breakdown in disaster communications and information sharing to happen. These include:

1. There is an inability to obtain critical and needed information; and
2. There is an inability to obtain sufficient information quality to support decision-making.

McLean found that many of the Small Island Developing States were at risk for internal communication disasters due to the great geographic distances between them, the range of languages spoken, the prevalence of poverty, and institutional capacities related to brain-drain and a small 'economy-of-scale'. However, risk of this breakdown also exists in developed countries, such as occurred in the aftermath of the GEJE. An official investigation of the 2011 Fukushima Nuclear Accident found that not only was there a disruption of the usual lines of command by the Executive Branch of the Government, there also existed cultural and relationship dynamics that served as barriers to competent communication and information exchange. The report noted that there existed a significant culture of deference and obedience by Tokyo Electric Power Company (TEPCO) management to government authorities, and "[r]ather than make strong decisions and clearly communicating them to the government, TEPCO insinuated what it thought the government wanted and therefore failed to convey the reality on the ground" (Fukushima Nuclear Accident Independent Investigation Commission, 2012).

Pipes (2006) describes how even those systems capable of managing the information sharing needs are still at risk of experiencing an "information disaster," wherein these systems are themselves negatively impacted or destroyed by the event to the point where information is lost and/or information exchange becomes impeded. Pipes writes that, "Hazards — in the form of terrorism, vandalism, heating/air conditioning failure, user error, computer viruses, hackers, power failures, cyber-terrorism, information warfare, cultural power struggles, or even careless or impulsive law-making / enforcement — all threaten the security and effectiveness of information." As such, when agencies and organizations design and institute information systems that meet their needs as assessed, it is critical that they consider options to mitigate the loss of information and the mechanisms by which that information is obtained, processed, and/or shared. Pipes writes:

> *Teams within EM organizations may struggle for long periods—or be forced to decide quickly how best to approach disasters. During these times of decision-making, the members of a team participate, either consciously or unconsciously, in creating and modifying information flow. Productive information flow is vital to ensure that EM teams reach sensible decisions. Sensible decisions aid in the prevention and mitigation of disasters.*
> (Pipes, 2006)

Professional institutions need to carry out training programmes and disaster management courses to enhance capacity and disseminate knowledge on disaster risk management initiatives. For example it is found that the pre-construction phase is considered as the most critical phase for integrating disaster risk management into the construction; hence, designers, civil engineers, structural engineers, specialist contractors, engineering consultants and developers should be actively involved (Bosher et al., 2007).

Challenge 4: Intra- and Inter-organizational Trust

Historically, governments have not been generous with disaster data or information. Even within the broad institution of government itself, individual agencies suffer from compartmentalization and operational 'stove-piping' that stifles coordination between information management structures. Guarding of turf and protection of policy control have impeded trust and prevented effective information sharing during non-disaster times. When disasters occur under these conditions, it is very difficult to quickly establish inter-agency collaboration, if it can be established at all. In fact, a lack of inter-agency trust and cooperation is considered a cause of the US Government's botched response to Hurricane Katrina (see Box 12).

BOX 12: Institutional Sharing Challenges in Hurricane Katrina
The following excerpt is drawn from the US Government Post-Katrina Lessons Learned report describing information sharing difficulties at all government levels:

> *There are significant institutional and intergovernmental challenges to information and resource sharing as well as operational cooperation. These barriers stem from a multitude of factors—different cultures, lack of communication between departments and agencies, and varying procedures and working patterns among departments and agencies. Equally problematic, there is uneven coordination in pre-incident planning among State and local governments. For example, our States and territories developed fifty-six unique homeland security strategies, as have fifty high-threat, high-density urban areas. Although each State and territory certainly confronts unique challenges, without coordination this planning approach makes the identification of common or national solutions difficult. Furthermore, our current approach to response planning does not sufficiently acknowledge how adjoining communities and regions can and do support each other. For example, there is wide disparity in emergency response capabilities across the country's many local jurisdictions. Yet we currently lack the means to assess and track what these disparities are and, consequently, how we must plan to account for them in a crisis.*

The report later addresses these issues in stating the following:

> *Over the long term, our professional development and education programs must break down interagency barriers to build a unified team across the Federal government. Just as the Department of Defense succeeded in building a joint leadership cadre, so the rest of the Federal government must make familiarity with other departments and agencies a requirement for career advancement. Where practicable, interagency and intergovernmental assignments for Federal personnel must build trust and familiarity among diverse homeland security professionals. These assignments will break down organizational stovepipes, advancing the exchange of ideas and practices. At a minimum, we should build joint training and educational institutions for our senior managers in homeland security-related departments and agencies.*

Source: Townsend, 2006.
End Box

Sharing between government and the nongovernmental sectors and with the public is even more difficult on account of institutional distrust. Tom Davis, Chairman of the US Committee on Government Reform, stated in a 2006 testimony on how to improve information sharing for disaster response that, "[g]overnment is faced with the difficult task of transforming from a "need-to-know" information sharing environment to a "need-to-share [environment]" (US

House of Representatives, 2006). The response to the Fukushima nuclear disaster was severely hampered by problems associated with trust – between government, the private sector, the media, and even academia. An advisor to the Prime Minister described the situation early in the disaster as follows, "There were delays. First of all, we weren't getting accurate information from [the Tokyo Electric Power Company (TEPCO)]," adding that the Prime Minister's distrust of TEPCO and of bureaucrats "interfered" with the overall response Onishi and Fackler (2011).

Solutions are needed that enable the building of trust prior to disasters so that critical information can be shared among the wider humanitarian network of responders. In the aftermath of the September 11th attacks, the United States Government began setting up "Fusion Centers" around the country to establish trust and guidelines for information sharing between the national and state governments and the private sector. But simply building a center will not completely solve the problem, as the response to Katrina just years later showed. A culture of trust and collaboration must exist where all response and recovery stakeholders see each other as partners and understand the value in providing the information they hold. Likewise, an accepted mechanism to guide the use of such information must exist and be followed by all participants such that the trusting relationship may be fostered.

Challenge 5: Availability and Use of Technology

The need for cost effective and proactive technologies to support communication and information sharing was highlighted in a recent study (Pathirage et al., 2014). The Kashmir Earthquake revealed the importance of information sharing efficiency and speed after it was found that many victims had died before the government had realized the event's scale and initiated relief operations. Technological advancements, including the storage of data and information, the presentation of information in useable formats, and the wide geographic access to it, have provided solutions to these challenges. But the skills necessary to use such technologies are equally important given that users cannot benefit from them without the required competencies and knowledge.

In the building of information sharing capacity, decision-makers must understand the need for and availability of technologies as well as the limits and weaknesses of them. Training programs that address the needs of all associated stakeholders must be widely accessible, and the political institutions and bureaucratic structures that exist should not stand in the way of the implementation of these technologies. Parthirage et al (2014) found that the effective use of technology to create networks among communities and across networks between policy makers and communities is an area that is lacking and that needs further improvement.

The Harvard Humanitarian Initiative (2011) describes the need for the disaster risk management community to understand and adapt to the rapidly increasing rate at which technology has contributed to information sharing networks, especially with regards to interpersonal communication and the use of social media to communicate. Describing the use of such methods following the 2010 Haiti Earthquake, the authors of *Disaster Relief 2.0* write:

> *"For the first time, members of the community affected by the disaster issued pleas for help using social media and widely available mobile technologies. Around the world, thousands of ordinary citizens mobilized to aggregate, translate, and plot these pleas on maps and to organize technical efforts to support the disaster response. In one case, hundreds of geospatial information systems experts used fresh satellite imagery to rebuild missing maps of Haiti and plot a picture of the changed reality on the ground. This*

> *work—done through OpenStreetMap—became an essential element of the response, providing much of the street-level mapping data that was used for logistics and camp management. The international humanitarian system was not tooled to handle these two new information fire hoses—one from the disaster-affected community and one from a mobilized swarm of global volunteers."*
> (Harvard Humanitarian Initiative, 2011).

Technology comes not without risk, however. The International Federation of Red Cross / Red Crescent Societies identified a number of issues that currently limit the effectiveness of technology, including (IFRC, 2013):

- The cost of implementing technology solutions
- A lack of trust in technologies by users
- Digital literacy
- Technology acceptance by government and humanitarian organizations
- Reaching affected communities
- The simplicity of solutions
- Incentives for participation in technology-based community solutions
- Demographic representation of the communities participating in solutions

Quarantelli (1997) poses a number of questions that together serve as warning about what could happen to disaster information flows with too much reliance on technology:

1. If [technology] provides all persons possible with [access] to disasters, will they be helpful or, as untrained professionals, become additional hazards preventing the trained professionals from doing their jobs?
2. Will the new [technology] provide too many choices for technology? Or too much information? Or be so dynamic that information is outdated the second it is transferred?
3. Will the hackers and cyber-terrorists be as updated as the legitimate providers?
4. Will messages lose the richness only found in face-to-face communication?
5. Will the addition of Web-like platforms impede typically hierarchical information flow?
6. Will fad-like methods for dealing with disasters spread across the Internet before they can be tested?
7. Will safety and ergonomic guidelines be realized before possibly hazardous [technology] is implemented?
8. Will the increase of [technology], and its computer representations, increase the likelihood of even more computer-system related disasters?

Reliance on technology clearly presents new risks when the systems or structures upon which those technologies rely, such as the energy or communications sectors, break down (Lindsey, 2011). Together, all of these potential problems mandate greater consideration of systems that combine both traditional (e.g., paper-based) and technological information sharing mechanisms in order to increase resilience.

Challenge 6: Focus on Social Networks

Oftentimes the discussion of information exchange becomes too focused on how technology can enhance the practice at the expense of social and relational innovations. Leaders can greatly enhance information sharing within their organizations by fostering the domains of intelligence-self-awareness, social awareness, self-management, and relationship management (Goleman, 2011). In fact, resilient communities are those which have strong leaders, the ability to engage their citizens, utilize resources wisely, and foster the social

supports of the populace (Norris, Pfefferbaum, and Pffefferbaum, 2008). Multiple researchers have tied resilience to social connectedness, thus confirming the importance of inter- and intra-organizational information sharing and the inclusion of the public before, during and after disasters. The importance of connectivity cannot be understated in the context of information sharing capabilities. Among the SIDS, which face particularly severe connectivity challenges, several nations have initiated or joined "mutual communities" in order to support each other and affect change within political, economic and scientific spheres. The Alliance of Small Island States (AOSIS) is an example. For sound decision-making, leadership must have the necessary information. For necessary information to be available there must be a barrier free environment for honest reporting. Many private-sector industries, including those in the aviation and medical sectors, have realized that preventing high stakes errors requires brutal honesty and intensive surveillance. Disaster communication and information sharing within governmental organizations should be no different.

Social strength also promotes information sharing at the individual level. Although reconstruction tends to focus on physical capital such as bridges, buildings and other infrastructure, there have been arguments for a stronger focus on social capital building, most notably in the aftermath of the Great East Japan earthquake. Social capital refers to "the resources available to individuals through their social networks" (Lin, 2008) and encompasses trust and the norm of reciprocity. The overall aim of resilient social capital for post-disaster recovery is to show that "even highly damaged communities with low income and little aid benefit from denser social networks and tighter bonds with relatives, neighbors and extra-local acquaintances" (Aldrich, 2012). The benefits of a resilient social capital include more lives saved through community evacuation, self-organized civilian firefighting corps, community-driven relief distribution etc. (Aldrich, 2011). Collaborative Aid Networks (CANs) highlighted the benefits of the existing collaboration networks. For instance, Evangelical churches' social service work in the Dominican Republic and in Haiti had fostered significant dialogue prior to the Haiti Earthquake. These dialogues enabled citizens to better understand each other's needs both before and after the earthquake struck. Caritas Dominican Republic drew from their long history of working with citizens in Haiti to establish a public information sharing structure that ultimately became the foundation of their assistance (Pedroso, et al., 2014). Resilience is established in the quiet periods between disasters, and the development of social capital is an important part of this process. Social capital in the local community, and the relationships and networks established between government, the private sector, and the other stakeholders that participate in response and recovery, prove invaluable to the information sharing process. Such networks are much more difficult to develop once an event has begun.

Challenge 7: Information Bias and Distortion

Information sharing mechanisms, and the individual end users of the information provided, must each remain cognizant of data distortions and bias. Distortions can be intentional or unintentional, and result from a range of factors that include political and economic interests, cultural misunderstandings, language barriers, the existence of social caste systems, or simply a lack of knowledge about the affected people and area. As is true with all aspects of response and recovery, knowledge about these biases must often exist in order for correction of any data distortion to occur. Checchi and Roberts (2005) describe how data bias often occurs when sampling must be used, which is a common practice in disaster assessment methodologies (given that rapid assessments cannot consider every case individually). Their research looks at reporting on disaster mortality, and describes the following sources of bias:

- **Household selection bias** (When a sample of households is drawn from the population, bias can occur if the sample is not random or if certain types of households are systematically omitted)
- **Household size reporting bias** (Victims or others intentionally misrepresent the size of their household for the purpose of influencing the amount of relief they receive)
- **Event recall bias** (When assessments are conducted long after the event has occurred, individuals may have trouble remembering specific damages and may even grossly under- or overestimate them.
- **Event reporting bias** (Respondents may under or over report damages in order to hide something, such as the case of a household with strong ties to an armed group under-reporting violent deaths of family members belonging to that group.)
- **Survival bias** (Post-disaster assessments can only interview households where at least one member survives. The households where all members have died cannot be interviewed and therefore impacts may be underestimated.

Information generated or transmitted by social media is at greater risk for distortion or bias given that there are fewer mechanisms for validation. Social media information sharing has also been used to deliberately spread incorrect or malicious information, and this has hindered response efforts. A report generated by the U.S. Congressional Research Service found that, "outdated, inaccurate or false information has been disseminated via social media forums during disasters, [and in] some cases, the location of the hazard or threat was inaccurately reported, or, in the case of the Japanese tsunami, some requests for help were retweeted repeatedly even after victims are rescued." Intentionally misleading information spread by individuals or organizations through social media can "confuse, disrupt, or otherwise thwart response efforts." (Lindsey, 2011).

Challenge 8: Understanding the Limits of Information Sharing

Disaster management stakeholders must always keep in mind that knowledge management systems are only able to provide decision support, not solve the problem itself. It is the training and experience of the leaders and the responders, as well as the relationships that exist between the various stakeholders, that determines the course of action that is taken (and whether or not it was the right course to take). Knowledge on disaster management strategies, together with good practices and lessons learned, can undoubtedly support this effort through well-informed mitigation measures and preparedness planning. Practitioners in disaster management should improve their skills and increase their level of knowledge, which requires investments in systems, databases and network structures so as to build a culture of learning from previous lessons and the adoption of best practices.

Knowledge on disaster management strategies remains fragmented, emphasising a perceived gap in information coordination and sharing. The knowledge and experiences of disaster practitioners remain in individual or institutional domains. While abundant knowledge about risk and vulnerability to hazards exists, its access and utilization at the community, national, regional and international levels, to empower or protect, is yet to reach its full potential.

Section 3: Recommendations for policy change in the Post-2015 Framework for DRR

Governments and regions have taken significant steps to increase their capacity to exchange relevant information during disaster response and recovery, and to take post-event reviews for the purpose of capturing and sharing lessons. However, there is very little common guidance in this through which they are able to set common capacity goals or objectives. The HFA does identify information sharing as an indicator of effective emergency management systems and structures, but the assessment focus of the HFA Monitor guidance template causes confusion.

Information sharing has long been central to the conduct of effective disaster management response and recovery operations. However, the availability of new technologies, recognition of legal framework requirements, opportunities for public/private partnerships, and many other factors as described in this report will each continue to grow at the brisk pace observed during the past decade. Many disaster management stakeholders will have a difficult time sorting through these changes, while others may not even have the capacity to properly exploit them to their own benefit.

The Post-2015 Framework for Disaster Risk Reduction presents an opportunity to make broad-sweeping changes to how governments are encouraged to manage disaster information during the response and recovery phases, and how they approach post-event reviews. Listed below are eight recommendations and associated implementation actions.

Recommendation 1: Assess information needs and sharing capabilities

- Identify and analyze disaster information stakeholders
    - Disaster data and information needs (users)
    - Disaster data and information to offer (producers)
    - Information sharing capabilities
    - Damage, loss, and needs assessment capabilities
- Identify, assess, and support pre-existing data
- Identify hardware and software requirements
- Assess risk and vulnerabilities of information sharing systems and procedures
- Stress and exercise capabilities and elicit feedback
- Assess levels of readiness

Recommendation 2: Establish standards and protocols

- Establish forward-looking interoperability and compatibility standards
- Establish accessibility standards, including languages
- Establish data and information security standards
- Define standard definitions for key terminology
- Institute quality control and data verification protocols
- Establish and maintain transparent information sharing practices
- Ensure systems account for culture, gender, functional needs, and other special factors

Recommendation 3: Develop Systems and Invest in infrastructure

- Develop assessment methodologies that match data requirements
- Identify leaders and build support for information sharing initiatives
- Identify and secure multiple (governmental and nongovernmental) funding sources
- Establish a national lead-agency to oversee information sharing efforts
- Acquire computer, server, network, Communication, and other hardware, including radio and video-conferencing systems

- Develop appropriate data and information management software
- Establish web-based interfaces with GIS tracking and display capabilities
- Establish redundant systems
- Develop human resources and provide adequate training

Recommendation 3: Work with the mass and social media

- Promote the use of social media (e.g., Twitter, Facebook) by all relevant stakeholders
- Identify and/or establish crowd-sourced assessment and information sharing platforms
- Form media partnerships and institute formal information sharing procedures with media contacts
- Develop crisis communication media strategies to effectively engage the media during disaster response and recovery

Recommendation 4: Build Partnerships

- Engage reliable data and information sources
- Identify information categories and assign lead organizations to plan / coordinate
- Form inter- and intra-governmental information sharing working groups
- Engage the private and nonprofit sectors
- Engage external information sharing networks and platforms
- Establish pre-disaster credentialing systems for information sharing mechanisms
- Establish trust-building mechanisms to increase sharing between local and national government
- Identify and address duplication and data gaps

Recommendation 5: Establish Legal, Statutory, and Regulatory Frameworks

- Establish formal information sharing agreements (regional, national, and inter-disciplinary)
- Develop legal and regulatory frameworks that provide authority and structure to information sharing mechanisms during disasters
- Assess and amend privacy and disclosure laws to ensure they do not conflict with disaster information flows

Recommendation 6: Engage Citizens

- Assess social information networks and identify preferred information channels
- Allow for and encourage two-way information sharing with the public
- Enable public access to disaster information (as appropriate)
- Identify and address information sharing and communication coverage gaps
- Apply indigenous culture where possible

Recommendation 7: Establish SOPs for post-event reviews

- Promote the transfer of tacit knowledge
- Establish standard after-action reporting requirements
- Conduct independent reviews for larger incidents
- Ensure lessons are documented and distributed using a web-based portal
- Engage the public, the private sector, and other nongovernmental stakeholders in the post-event review process
- Engage the media in the evaluation process
- Support Information Sharing Research Efforts

Recommendation 8: Make information Available to DRR Efforts

- Make disaster damage, loss, needs, and other related information open and available before recovery begins
- Update and distribute hazard maps
- Ensure communication and engagement addresses awareness about disaster risk, vulnerability, and DRR
- Expand the information sharing network accordingly to meet the needs of all recovery stakeholders across all sectors
- Engage the academic and scientific communities

Appendix 1: List of Thematic Reports

Fernandez, Glenn and Rajib Shaw. 2014. The Role of Mass Media in Disaster Recovery. Graduate School of Global Environmental Studies. Kyoto University. Japan.

Ferreira Pedroso, Frederico, Joel Teo, Erica Seville, Sonia Giovanazzi, and John Vargo. 2014. Post-Disaster Challenges and Opportunities: Lessons from the 2011 Christchurch Earthquake and Greate Eastern Japan Earthquake and Tsunami. University of Kyoto.

Kaneko, Yuka, Toshihisa Toyoda, Akihiko Hokugo, Katsumi Matsuoka, Takayuki Ii, Yuichi Honjyo, Taqwaddin Husin, Teuk Alvisyahrin, Li Weihai, Gu Linsheng, Kanongnij Sribuaiam, Chodnarin Koedsom, Ebinezer Florano, and Joe Mar S. Parez. 2014. Impacts of the HFA on the Procedural Basis of Human-Centered Recovery. Kobe University. Kobe.

Khenniche, Hakim, Thomas Van Can, Jonathan Suk, Svetla Tsolova, Josep Jansa, and Massimo Ciotti. 2014. European Centre for Disaster Prevention and Control: Public Health Emergency (Monitoring and evaluation of responses to cross-border public health events caused by infectious diseases in Europe). European Centre for Disease Prevention and Control.

Lorenzon, Guadagno. 2014. Tracking post-disaster population displacement to improve risk reduction, emergency management and recovery. International Organization for Migration.

McLean, Andrew J. 2014. Intra-Organizational Risk Communication Issues (With Focus on Small Island Developing States). University of North Dakota. School of Medicine and Health Sciences.

Otoni de Araújo, Raquel, Teresa da Silva Rosa, Maria da Penha Smarzaro Siqueira, Márcio Reis, and Camila Réboli, Arthur Aguiar. 2014. Communicability Between The National, State, and Municiapl Governments in the integration of the principles of the Hyogo Framework for Action to Reduce Risks and Disasters. Center for Socio-Environmental and Urban Studies/NEUS. University of Vila Velha. Espírito Santo.

Pathirage, Chaminda, Krisanthi Seneviratne, Dilanthi Amaratunga, and Richard Haigh. 2014. Knowledge Factors and Associated Challenges for Successful Disaster Knowledge Sharing. Centre for Disaster Resilience. University of Salford.

Appendix 2: List of Acronyms

HFA	Hyogo Framework for Action
PFA	Priority for Action (HFA)
CI	Core Indicator (HFA)
IM	Information Management
KM	Knowledge Management
DaLA	Damage and Loss Assessment
PDNA	Post-Disaster Needs Assessment
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNISDR	United Nations Office for Disaster Risk Reduction
UN-ECLAC	United Nations Economic Commission for Latin America and the Caribbean
PDA	Preliminary Damage Assessment
FEMA	Federal Emergency Management Agency (USA)
UN	United Nations
NRDAR	Natural Resource Damage Assessment and Restoration Program (USA)
DDM	Department of Disaster Management (Bangladesh)
DNA	Damage-Loss and Needs Assessment (Bangladesh)
SEDEC	National Civil Defense Secretariat (Brazil)
SQ	System Quality
DRR	Disaster Risk Reduction
PTWC	Pacific Tsunami Warning Center
EMSC	Euro-Mediterranean Seismology Centre
QWIDS	Quake Watch information Distribution System (EU)
SMS	Short Message Service
TESSy	The European Surveillance System
UN-SPIDER	UN Platform for Space-Based Information for Disaster Management & Emergency Response
IOM	International Office for Migration
IDMC	Internal Displacement Monitoring Center
NDMO	National Disaster Management Office
DTM	Displacement Tracking Matrix (IOM)
IRP	International Recovery Platform
WCDR	World Conference on Disaster Reduction
DesInventar	Disaster Inventory System
LA RED	Network of Social Studies for the Prevention of Disasters in Latin America
ASEAN	Association of South East Asian Nations
ADInet	ASEAN Disaster Information Network
EMIS	Emergency Management Information System (New Zealand)
NCMC	National Crisis Management Centre (New Zealand)
BBK	Federal Office of Civil Protection and Disaster Assistance (Germany)
deNIS	Emergency Planning Information System (Germany)
GIS	Geographic Information System
NEOC	National Emergency Operations Center (Samoa)
ADRRN	Asian Disaster Reduction and Response Network
NGO	Non-Governmental Organization
VDV	Virtual Disaster Viewer (China)
DMIS	Disaster Management Information System (IFRC)
IFRC	International Federation of Red Cross and Red Crescent Societies
EUR-OPA	European Union
AADMER	ASEAN Agreement on Disaster Management and Emergency Response
SAARC	South Asian Association for Regional Cooperation
FRANZ	France, Australia, and New Zealand Agreement
USGS	United States Geological Survey
MMI	Modified Mercalli Intensity Scale
CIIM	Community Internet Intensity Map (USGS)
VGI	Volunteered Geographic Information
JTI	Joplin Tornado Info (USA)
NIED	National Research Institute for Earth Science and Disaster Prevention (JAPAN)
GEJE	Great East Japan Earthquake

EQC	Earthquake Commission (New Zealand)
NZGOAL	New Zealand Government Open Access and Licensing Framework
PNPDEC	National Civil Protection and Defense Policy (Brazil)
MIN	Ministry of National Integration (Brazil)
SEDEC	National Civil Defense Secretariat (SEDEC)
MCP	Municipal Contingency Plan (Brazil)
AAR	After-Action Review
LLIS	Lessons Learned Information System
DHS	Department of Homeland Security (USA)
WFP	World Food Program
MIDMAR	Ministry of Disaster Management and Refugee Affairs (Rwanda)
NIST	National Institute of Standards and Technology (NIST)
MPI	Ministry of Planning and Investment (Lao PDR)
ADPC	Asian Disaster Preparedness Center
IGO	Intergovernmental Organization
DCLG/RED	Department for Communities and Local Government/Resilience and Emergencies Division (UK)
ERP	Emergency Response Plan
RES-CG	Response Coordinating Group (UK)
GIN	Joint Information Platform for Natural Hazards (Switzerland)
ESD	Electronic Situation Display (Switzerland)
MateoSwiss	Federal Office of Meteorology and Climatology (Switzerland)
SLF	Institute for Snow and Avalanche Research (Switzerland)
FOEN	Federal Office for the Environment (Switzerland)
MSB	Civil Contingencies Agency (Sweden)
UNDAC	UN Disaster Assessment and Coordination Team
RMI	Republic of the Marshall Islands
NWS	National Weather Service (NWS)
USAID	US Agency for International Development
MICS	Marshall Islands Conservation Society
CMI	College of the Marshall Islands
CDEM	Ministry of Civil Defense and Emergency Management (New Zealand)
EMIS	Emergency Management Information System (New Zealand)
NCMC	National Crisis Management Centre (New Zealand)
NEMO	National Emergency Management Office (Palau)
NEC	National Emergency Committee (Palau)
IDA	Initial Damage Assessment (Palau)
CDR	Comprehensive Damage Report (Palau)
NEOC	National Emergency Operations Center (Samoa)
SCIRT	Stronger Christchurch Infrastructure Rebuild Team
CERA	Canterbury Earthquake Recovery Authority
CCA	Christchurch City Council
LINZ	Land Information New Zealand
API	Application Program Interface
SOP	Standard Operating Procedure
CETAS	Canterbury Earthquake Temporary Accommodation Service
DBH	Department of Building and Housing (New Zealand)
TEPCO	Tokyo Electric Power Company
EM	Emergency Management
DRM	Disaster Risk Management
DM	Disaster Management
SIDS	Small Island Developing States
CAN	Collaborative Aid Network
AOSIS	Alliance of Small Island States

Appendix 3: References

Ahmad Dahlan, Abdul Rahman, Hayati Mohd Dahan, and Md Yazid Mohd Saman. 2013. The Government Information Sharing (GIS) in Natural Disaster Management and Risk Reduction. 5th International Conference on Information and Communication Technology for the Muslim World.

Aldrich, D. P. 2011. The power of people: social capital's role in recovery from the 1995 Kobe earthquake. Natural Hazards, 56(3), 595-611.

Aldrich, D. P. 2012. Building Resilience: Social Capital in Post-disaster Recovery (p. 232). Chicago and London: The University of Chicago Press.

Allen, April. 2012. Tacit, Explicit, Implicit, Whatever. Let's Call the Whole Thing Off. Knowledge Bird. http://bit.ly/1nDFmUC

Asian Disaster Reduction & Response Network (ADRRN). 2014. About ADRRN. ADRRN Website. http://www.adrrn.net/about.html

Association of South East Asian Nations (ASEAN). 2010. ASEAN Agreement on Disaster Management and Emergency Response: Work Programme for 2010-2015.

Bevington, John, Beverly Adams, Enrica Verrucci, Paul Amyx, Charles Huyck, and Ronald Eguchi. 2009. Distributed Information Sharing for Disaster Response and Recovery. DHS Workshop on Emergency Management.

Bharosa, Nitesh, JinKyu Lee, and Marijn Janssen. 2009. Challenges and Obstacles in Sharing and Coordinating Information During Multi-Agency Disaster Response: Propositions from Field Exercises. Inf Syst Front (2010) 12:49-65.

Bharosa, Nitesh, Jaco Appelman, Bart van Zalen, and Arre Zuurmond. 2009. Identifying and Confirming Information and System Quality Requirements for Multi-Agency Disaster Management. Proceedings of the 6th International ISCRAM Conference. Gothenburg, Sweden. J. Landgren and S. Jul, eds.

Bremer, Ambassador L. Paul Bremer III. 2002. "The Terrorist Threat." In *Terrorism: Informing the Public*. Nancy Ethiel (ed.). Chicago. McCormick Tribune Foundation.

Burkhart, Ford N. 1991. *Media, Emergency Warnings, and Citizen Response.* Boulder. Westview Press.

Cate, Fred. 2002. "CNN Effect" Not Clear-Cut. Humanitarian Affairs Review. Global Policy Forum. http://bit.ly/OXZfGy

Checchi, Francesco, and Les Roberts. 2005. Interpreting and Using Mortality Data in Humanitarian Emergencies. Humanitarian Practice Network. N.52. September. http://bit.ly/1h3VP0N

Chossudovsky, Michael. 2013. Nine Years Ago, December 26, 2004: Indian Ocean Tsunami – Why Did the Information Not Get Out? Global Research. http://bit.ly/1o4nKl5

Cohen, Bernard C. 1963. *The Press and Foreign Policy*. Princeton. Princeton University Press.

Coppola, Damon P. 2011. Introduction to International Disaster Management. Butterworth Heinemann. Burlington.

Davenport, Thomas H. (1994), Saving IT's Soul: Human Centered Information Management. Harvard Business Review, March-April, 72 (2)pp. 119-131. Duhon, Bryant (1998), It's All in our Heads. Inform, September, 12 (8).

Department of Disaster Management (DDM - Bangladesh). 2012. Damage-Loss and Needs Assessment. DDM Website. http://www.ddm.gov.bd/ecrrp.php.

Dufty, Neil. 2014. Evaluating Emergency Management After an Event: Gaps and Suggestions. Australian Emergency Management Institute. Australian Journal of Emergency Management. V.29. No.1.

EUR-OPA. 2014. EUR-OPA Major Hazards Agreement: A Tool for International Cooperation. EUR-OPA Website. http://bit.ly/1j9e4Rv

Federal Emergency Management Agency (FEMA)(US). 2011. A Whole Community Approach to Emergency Management: Principles, Themes, and Pathways for Action. FDOC 104-008-1. Washington, DC. http://1.usa.gov/1i1rZX5

Fukushima Nuclear Accident Independent Investigation Commission. 2012. Fukushima Nuclear Accident Independent Investigation Commission Executive Summary. Published by The National Diet of Japan. Tokyo, Japan.

Furman, Matt. 2002. “Good Information Saves Lives.” In *Terrorism: Informing the Public*. Nancy Ethiel (ed.). Chicago. McCormick Tribune Foundation.

Gundecha, P. and H. Liu. 2012. Mining Social Media: A Brief Introduction. http://www.public.asu.edu/~pgundech/book_chapter/smm.pdf.

Goldfine, E. 2011. *Best Practices: The Use of Social Media Throughout Emergency and Disaster Relief*. Washington, D.C., USA: American University (unpublished Master’s thesis).

Goleman, D. 2011. Leadership: The Power of Emotional Intelligence (Selected Writings). Northampton, MA, US. More Than Sound LLC.

Hansen, Liane, and David Folkenfilk. 2005. The Power of the 24-Hour News Cycle. National Public Radio. May 29. http://n.pr/1l7st0K

Harvard Humanitarian Initiative. 2011. Disaster Relief 2.0: The Future of Information Sharing in Humanitarian Emergencies. Washington, D.C. and Berkshire, UK: UN Foundation & Vodafone Foundation Technology Partnership.

Hibino, J. and R. Shaw. 2014. Role of Community Radio in Post Disaster Recovery: Comparative Analysis of Japan and Indonesia. In: Disaster Recovery: Used and Misused Development Opportunity. Shaw, R. (Ed.). Tokyo, Japan: Springer.

House of Representatives (US). 2006. The Need to Know: Information Sharing Lessons for Disaster Response. Hearing Before the Committee on Government Reform. March 30.

IFRC. 2013. Technologies and the Effectiveness of Humanitarian Action. World Disasters Report. Chapter 4.

Kaigo, M. 2012. Social media usage during disasters and social capital: Twitter and the Great East Japan Earthquake. Keio Communication Review, 34, 19-35.

Kaneko, Y. 2012. Livelihood Support for the Early Recovery in the Great East Japan Earthquake and Tsunami— Lessons for Developing Countries. Journal of International Cooperation Studies. Kobe University. Vol.20, No.2, p.79-109.

Kean, T. H., & L. H. Hamilton. 2004. The 9/11 Report. New York: St. Martin's Press.

Ichiguchi, T. 2011. Robust and Usable Media for Communication in a Disaster. Quarterly Review, Vol. 4, Issue 41: 44–55.

Ideta, A. 2012. *Role of FM Radio in Post-Tsunami Recovery Process in Natori, Miyagi Prefecture*. Kyoto, Japan: Kyoto University (unpublished Master's thesis).

Ideta, A., R. Shaw, and Y. Takeuchi. 2012. Post Disaster Communication and Role of FM Radio: Case of Natori. In: *East Japan Earthquake and Tsunami: Evacuation, Communication, Education, and Volunteerism*. Shaw, R. and Y. Takeuchi (Eds.). Singapore: Research Publishing.

International Recovery Platform. 2013. Recommendation for Recovery and Reconstruction in Post-2015 Global Framework for DRR (HFA2). Summary of Consultations. Kobe.

Johnson, Matthew. 2014. *The Many Differences Between Data and Information.* Udemy. February 13. http://bit.ly/OFInow

Karunakara, Unni. 2013. Data Sharing in a Humanitarian Organization: The Experience of Médecins Sans Frontiéres. PLOS Medicine. V.10. N12. http://bit.ly/1qiHorb.

Knight, Will. 2005. Tsunami Warning System is not Simply Sensors. New Scientist. January 4. http://bit.ly/1o4nKl5

Koria, M. 2009. Managing for Innovation in Large and Complex Recovery Programmes: Tsunami Lessons from Sri Lanka. International Journal of Project Management, 27(pp. 123-130.

Lee, Yang W., Diane M. Strong, Beverly K. Kahn, and Richard Y. Wang. 2002. AIMQ: A Methodology for Information Quality Assessment. Elsevier Science. Information & Management. V40. Pp. 133-146.

Liddy, Matthew. 2013. How Twitter Covered the Queensland Floods. ABC News Australia. April 26. http://ab.co/1g4UCQL.

Lindsey, Bruce. 2011. Social Media and Disasters: Current Uses, Future Options, and Policy Considerations. Congressional Research Service. September 6. Report R41987.

Lloyds. 2010. Lessons Learned: The Development of Tsunami Early Warning Systems. Lloyds News. January 13. http://bit.ly/1j9ek38

McCallum, D. B., S. L. Hammond, and L. Morris. 1990. *Public Knowledge of Chemical Risks in Six Communities*. Washington, D.C. Georgetown University Medical Center, Institute for Health Policy Analysis.

McClendon, S. and A. Robinson. 2012. Leveraging Geospatially-Oriented Social Media Communications in Disaster Response. http://iscramlive.org/ISCRAM2012/proceedings/136.pdf.

McCormick Tribune Foundation. 2002. “Terrorism: Informing the Public.” Cantigny Conference Series. Nancy Ethiel (ed.). Chicago. McCormick Tribune Foundation.

McLean, Andrew. J. 2014. Intra-Organizational Risk Communication Issues (With Focus on Small Island Developing States). University of North Dakota School of Medicine and Health Sciences.

Miles, B. and S. Morse. 2007. The Role of News Media in Natural Disaster Risk and Recovery. *Ecological Economics*, Vol. 63, Issue 2–3: 365–373.

Mileti, Dennis S. 1999. *Disasters by Design.* Washington, D.C. Joseph Henry Press.

Mullis, John-Paul. 1998. “Persuasive Communication Issues in Disaster Management”. *Australian Journal of Emergency Management*. Autumn 1998. Pp. 51-58.

Norris FH, Stevens S, Pfefferbaum B, Wyche K, Pfefferbaum R. 2008. Community Resilience as a Metaphor, Theory, Set of Capacities, and Strategy for Disaster Readiness. *American Journal of Community Psychology.* 41, pp. 127-150. New York, NY, US. Springer.

Oloruntoba, R. 2005. A Wave of Destruction and the Waves of Relief: Issues, Challenges and Strategies. Disaster Prevention and Management, 14(4), pp. 506-521.

Olson, R.S., J.P. Prieto, and G. Hoberman. 2010. Disaster Risk Reduction, Public Accountability, and the Role of the Media: Concepts, Cases, and Conclusions. http://bit.ly/1gFWcOT.

Onishi, Norimitsu, and Martin Fackler. 2011. In Nuclear Crisis, Crippling Mistrust. The New York Times. June 12. http://nyti.ms/1qeJg4g

Pathirage, Chaminda, Kristsanthi Seneviratne, Dilanthi Amaratunga, and Richard Haigh. 2014. Knowledge Factors and Associated Challenges for Successful Disaster Knowledge Sharing. Centre for Disaster Resilience. University of Salford.

Paul, M., Thomas, N. & Adam, S. 2006. After the Tsunami: Lessons from Reconstruction. McKinsey Quarterly, (1), 94-105.

Peary, B. 2012. *The Role of Social Media in the 2011 East Japan Earthquake and Tsunami and Its Potential Future Application*. Kyoto, Japan: Kyoto University (unpublished Master’s thesis).

Pipes, Tisha Slagle. 2006. Information Disasters and Disaster Information: Where Information Science Meets Emergency Management. University of North Texas. Denton.

Power, Robert, Bella Robinson, Mark Cameron, and Nick Nicolopoulos. 2012. The Pilot Impacts Portal: Experience in Building an Emergency Management Information Sharing Tool. Emergency Management Australia.

Puras, J. C., and C.A. Iglesias. 2009. Disasters2.0. Application of Web2.0 Technologies in Emergency Situations. *6th International ISCRAM Conference,* Gothenburg, Sweden.

Quarantelli, E.L. (1997). Problematical aspects of the information\ communication revolution for disaster planning and research: Ten non-technical issues and questions. Disaster Prevention and Management, 6(2), 94.

Raphael, B. 1986. *When Disaster Strikes: How Individuals and Communities Cope with Catastrophes.* New York. Basic Books.

Revkin, Andrew. 2005. With No Alert System, Indian Ocean Nations Were Vulnerable. New York Times. December 27. http://nyti.ms/1jR2lFT

Saito, K. 2013. Risk and Damage Information Management. The World Bank. http://bit.ly/1fB21LN.

Shannon, C. and W. Weaver. 1948. *The mathematical theory of communication*. Chicago: University of Illinois Press.

Singer, Eleanor, and Phyllis M. Endreny. 1993. *Reporting on Risk: How the Mass Media Portray Accidents, Diseases, Disasters, and Other Hazards.* New York. Russell Sage Foundation.

Sobel, R. S. & Leeson, P. T. 2007. The Use of Knowledge in Natural Disaster Relief Mangement. The Independent Review, XI(4), pp. 519-532.

South Asian Association for Regional Cooperation (SAARC). 2011. SAARC Agreement on Rapid Response to Natural Disasters. May 25. Male.

Sleter, Greg. 2014. High-Tech Buoy System Tracks Galveston Bay Oil Spill. Emergency Management Magazine. March 28. http://bit.ly/1mKzFD3.

Townsend, Frances Fragos. 2006. The Federal Response to Hurricane Katrina: Lessons Learned. The White House. http://1.usa.gov/1h8V4ml.

UNISDR. 2013. Information and Knowledge Management for Disaster Risk Reduction (IKM4DRR) Framework and Scorecard. Global Platform for Disaster Risk Reduction. Geneva.

UNISDR. 2013b. HFA Monitor Template: HFA monitoring and review through a multi-stakeholder engagement process 2013-2015. http://bit.ly/1er1hIo

UNOCHA. 2006. Disaster Assessment. UN Disaster Assessment and Coordination (UNDAC). http://bit.ly/1g5HpvO

UNOCHA/ROAP. n/d. Disaster Response in Asia and the Pacific: A Guide to International Tools and Services. http://bit.ly/1htncfH

UN-SPIDER. 2014. About UN-SPIDER. UN-SPIDER Website. http://www.un-spider.org/about-us/

Wald, David, Lisa Wald, James Dewey, Vince Quitoriano, and Elisabeth Adams. 2001. Earthquake Hazards Program. http://pubs.usgs.gov/fs/fs030-01/.

Wenham, Brian. 1994. “The Media and Disasters: Building a Better Understanding.” In *International Disaster Communications: Harnessing the Power of Communications to Avert Disasters and Save Lives.* Washington, D.C The Annenberg Washington Program.

Williams, R., G. Williams, and D. Burton. 2012. The Use of Social Media for Disaster Recovery. http://bit.ly/1i0b3QQ.

Willis, Jim. 1997. *Reporting on Risks: The Practice and Ethics of Health and Safety Communication.* Westport. Praeger.

Winston, J. A. 1985. “Science and the media: The Boundaries of Truth.” *Health Affairs*. v6. Pp.5-23.

Zook, M., M. Graham, T. Shelton, and S. Gorman. 2010. Volunteered Geographic Information and Crowdsourcing Disaster Relief: A Case Study of the Haitian Earthquake. *World Medical & Health Policy*, Vol. 2, Issue 2: 7–33.