2013

World Disasters Report
Focus on technology and the future of humanitarian action

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International Federation
of Red Cross and Red Crescent Societies

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Focus on technology and the future of humanitarian action

Technology and humanitarian action

In 2012, fewer people were reported to have died or been affected as a result of disasters than any other year during the previous decade, according to figures presented in this report. While these numbers are positive news, they also reflect the absence of major events like the 2004 Indian Ocean tsunami, Cyclone Nargis in Myanmar in 2008 or the 2010 Haiti earthquake.

We have learned from these major disasters. At the same time we must continue to improve and innovate to make disaster preparedness, mitigation, response and recovery more effective and accountable. With these objectives in mind, this year's *World Disasters Report* focuses on the rapid spread of technologies, especially information and communication technologies, which is changing humanitarian action and humanitarians, too.

The changes are most evident in highly technological environments, such as megacities, or when disasters affect critical infrastructures, resulting in secondary technological disasters, such as nuclear power plant accidents. But technology also enables affected communities to quickly transform themselves into first responders, send requests and messages, provide critical information, match assistance needs with providers or support rapid damage assessments. This is also the case in rural areas around the world, which are increasingly connected and have access to information and communication resources that are unprecedented. Local communities are now becoming more fully engaged in humanitarian action than ever. Finally it is also true on the web, where individuals are mobilizing in the aftermath of disasters to provide assistance to affected communities and humanitarian actors.

The International Red Cross and Red Crescent Movement, like many other organizations, explores the potential of new technology in its operations, for example as a new source of information and early warning, for training and continued education of its volunteers, to connect and involve communities at risk and to raise awareness and funds.

The development of a more technology-oriented approach to humanitarian action is essential – and inescapable – to take advantage of the opportunities to improve, for example, information gathering, analysis, coordination, action or fund-raising. This report presents impressive examples where technologies already contribute to humanitarian action, often with the result of putting affected communities at the centre of humanitarian action as engaged participants and not merely as witnesses or recipients of aid.

In Syria, for example, digital data collection tools were adapted and are now used to serve as a commodity tracking system, monitoring the distribution of supplies as they are transported and delivered by local partner organizations in areas that remain inaccessible to international humanitarian agencies. The system improves efficiency and accountability and helps deliver life-saving supplies.

In the Philippines, the government used social media to help prepare for Typhoon Pablo. It created information pages accessible from mobile phones to help locate disaster shelters and other assistance. It also created and promoted the use of a Twitter hashtag for the storm, #PabloPH. Tweets from the population were later mapped to provide the United Nations Office for the Coordination of Humanitarian Affairs with early damage assessment information.

Technology is also central to improving early warning systems, whether it is the World Food Programme relying on mobile phone-based short text messages (SMS) to monitor food prices at market, or the United Nations Educational, Scientific and Cultural Organization improving drought monitoring and forecast systems for sub-Saharan Africa.

However, as new applications of technologies become more prevalent among humanitarians, the risks, limitations and failures of technology also become more apparent. In this respect, the *World Disasters Report* presents a balanced perspective between optimism and caution and highlights the need for guiding principles and more rigorous testing and evaluation of solutions that are largely emerging from non-humanitarian actors.

Some of the key challenges result from unequal access to technologies among both affected populations and humanitarians. Impressive worldwide or even regional statistics on mobile phone use, for example (6.8 billion subscribers in 2013 and double-digit growth), mask important inter- and intra-state disparities. Those least likely to have access to technology – the poor, the uneducated, women – are also the most vulnerable to disasters. Similarly, local organizations and even governments in poor countries, which are most likely to be the first responders when disaster strikes, are also least likely to be able to take advantage of technologies. For organizations, access is not only limited by financial or human resources, but it can also result from restrictions on access to information, like satellite imagery for example. This potentially impacts the balance of power between actors, or access to funds. Another structural limitation is the limited and/or expensive communication bandwidth which requires improved public–private partnerships so that mobile phone network operators and internet providers ensure minimum services.

Despite these challenges, the responsible use of technology in humanitarian action offers concrete ways to make assistance more effective and accountable, and to reduce vulnerability and strengthen resilience. Distance learning and online education are good examples of technology supporting these goals. The Red Cross Red Crescent has been active in this area for many years. Regrettably, however, most technological innovations still need to be tested and scaled up to demonstrate their usability and benefits for humanitarians. What matters is not technology, but how we use it. Affected communities, on the other hand, are already rapidly adopting social media and other technologies. This is a trend that is unlikely to change and that humanitarians must embrace – even support – by recognizing access to communication and information as a basic need and priority alongside search and rescue, protection, health, food, water or shelter. The 2005 *World Disasters Report* acknowledged this nearly ten years ago. It is even more true today.

Bekele Geleta
Secretary General

Chapter 1

Chapter 1

Humanitarian technology

Humanitarian action is evolving rapidly in response to new applications of technologies. Innovations appear almost daily in almost every aspect of humanitarian action, from robots being deployed for search and rescue or demining, to remote surgeries or improvement in vaccine transportation and conservation, water purification or sanitation. Considering the wide range of innovations, the focus of this *World Disasters Report* had to be narrowed to what is rapidly becoming a major field of humanitarian practice: humanitarian information and communication technologies (HICT).

This 2013 *World Disasters Report* explores the challenges and opportunities in the ways in which technologies, especially information and communication technologies (ICT), can assist international and national actors, governments, civil society organizations and communities at risk more effectively to prevent, mitigate and prepare for the impact of a disaster and, in its aftermath, respond, recover and rebuild lives and livelihoods. This set of actions is broadly used to define the term humanitarian action, with the goal to "save lives, alleviate suffering and maintain and protect human dignity during and in the aftermath of emergencies" (Global Humanitarian Assistance, undated).

This first chapter of the report introduces key concepts and issues in humanitarian technology. Chapter 2 focuses on how information and communication technologies such as mobile phones (also called cell phones) and social media are creating new ways for disaster-affected communities to organize, coordinate and respond to their own problems, and enabling people-centred humanitarian action. Chapter 3 goes further to discuss not just how technologies help put communities at the centre of humanitarian action, but how the large amount of information generated by these communities through social media or other means can be used by outside humanitarian actors to determine and better respond to communities' needs. Volunteer communities, the chapter author argues, offer invaluable opportunities to gather and analyse these crisis data from all sources and present them in usable format. While Chapter 2 and 3 focus specifically on the 'people' dimension of humanitarian action, Chapter 4 brings a more general discussion and overview of HICT which helps understand the variety of potential benefits and challenges that are rapidly emerging.

Together, Chapters 2, 3 and 4 provide a comprehensive discussion of the existing and potential contribution of ICT to improving humanitarian action. The authors acknowledge challenges and limitations, which are the starting point of the following chapters. Chapter 5 provides an overview of key challenges, including for example unequal access to technologies, the diminishing direct interaction

Humanitarian technologies are the tools and infrastructure necessary to help disaster-prone communities to better prevent, mitigate and prepare for disasters and, in their wake, respond, recover and rebuild more effectively. © Benoit Matsha-Carpentier between aid workers and communities at risk, or the emergence of new actors who are not necessarily grounded in humanitarian principles. This last point leads to Chapter 6, which focuses on the challenges that humanitarian technologies are raising for traditional principles and ethical guidelines. Finally, the last chapter examines key criteria and factors that must be examined to understand the contribution of technology to humanitarian action, arguing for the need for a more systematic evaluation approach rather than the collection of anecdotal evidence that prevails today.

Word cloud of the *World Disasters Report 2013*, generated using http://tagxedo.com

Connecting communities at risk

New ICT tools for humanitarian action are proposed with the potential to detect needs earlier and predict crises better, enable greater scale, speed and efficiency of response and assistance delivery, enhance the specificity of resource transfers to match needs of communities at risk, and increase accountability and transparency. Technologies offer new sources of information and early warning, and new platforms for training or raising awareness and funds (OCHA, UN Foundation and Vodafone Foundation, 2011).

Tools that foster data gathering and communication with affected communities are very rapidly expanding. These include:

- **Crowdsourcing**, which is the process of "obtaining needed services, ideas, or content (e.g. data) by soliciting contributions from a large group of people, and especially from an online community, rather than from traditional employees or suppliers" (Merriam-Webster).
- **Big data, or big data analytics**, which are the range of tools and methodologies that use advanced computing techniques to leverage largely passively generated

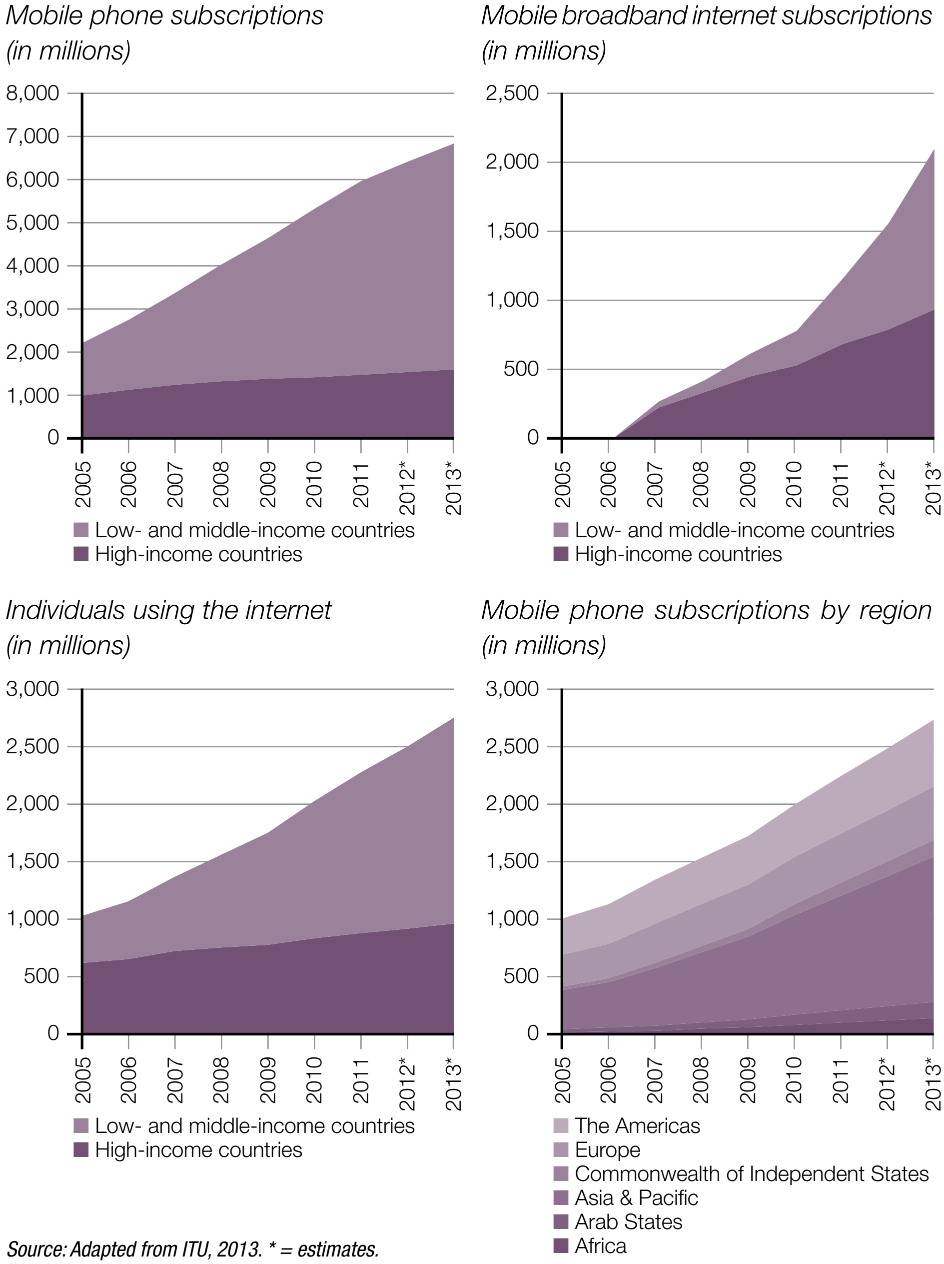
data, for example those resulting from the use of mobile phones or social networks, and the active collection of observed data by satellites for example to gain insights for decision-making purposes (Letouzé, Meier and Vinck, 2013).

- **Crisis mapping**, which "leverages mobile & web-based applications, participatory maps & crowdsourced event data, aerial & satellite imagery, geospatial platforms, advanced visualization, live simulation, and computational & statistical models to power effective early warning for rapid response to complex humanitarian emergencies" (Crisis Mappers).
- **Digital data collection**, which is the process of replacing traditional assessments conducted with pens and papers by data collection by humanitarian actors and, where possible, affected populations, supported by widely available and usable digital devices such as smartphones. This results in substantial gains in terms of speed and quality of the data.

At the same time, communication among affected communities, and between communities and outside actors, is easier than before, enabling them to organize, coordinate and respond to their own problems. There are now more than 6 billion mobile phone subscriptions and over 2 billion mobile broadband internet subscriptions (see Figure 1.1). In the five years between 2008 and 2013, low- and middle-income countries have roughly doubled the number of mobile phone subscriptions, adding an extra 2.5 billion. There are now almost twice as many mobile broadband as fixed broadband subscriptions, with mobile broadband being the fastest-growing information and communication technology. Improved communication and information for communities at risk also reflect improved connectivity to the World Wide Web and the emergence of social media. In some 25 years, the web has become a standard communication mode, reaching 2.7 billion people. Social networking is also increasingly popular. Twitter has more than 500 million users generating 400 million messages (tweets) a day.

These numbers mask important disparities between and within countries – an issue discussed further in this chapter and elsewhere in the report. Nevertheless, this unprecedented level of connectivity provides avenues for more systematic two-way communications, for example transparent feedback through social media or SMS-based systems, as well as fast and real-time life-saving messaging. The result is progress towards both more resilient communities and people-centred humanitarian action, in which people and their communities are not merely recipients, but engaged participants. Communities are, for example, alerted faster of, and better prepared for, impending cyclones or tsunami, and they are able to hold humanitarians accountable for their actions.

FIGURE 1.1 Mobile phone and internet subscriptions, 2005–2013



*Source: Adapted from ITU, 2013. * = estimates.*

The implications of the widespread use of mobile phone technology are significant beyond communication among or with communities at risk. Mobile phones are now routinely used for cash transfers and banking or market services (e.g., prices of goods) or even health-care services. Mobile phones are, of course, routinely used by humanitarians. During the 2008 Sichuan earthquake in China, professionals used their mobile phones to report on the equipment shortages that they encountered and mobile phones were also used to coordinate the rescue and relief efforts (Zhou et al., 2012). More recently, during the Rana Plaza garment factory fire in Bangladesh in April 2013, mobile phone data and SIM cards were used to identify the deceased. Tweets were used to generate assessment maps and facilitate the location of people during Typhoon Pablo (also called Typhoon Bopha) in the Philippines in 2012 or to map cases during the 2010 Haitian cholera epidemic.

The rise of humanitarian technology is also the result of technology fusion or "the integration of information network, mobile technology hardware and applications, and social media and mapping platforms into a readily available single mobile device such as a laptop, a mobile smartphone, or a tablet with access to unlimited amount of data from multiple sources and in multiple formats (big data)" (Pham and Vinck, 2012). In addition, a generation ago it would have taken tremendous work to manage to reach a crisis and try something new. In a networked world, however, opportunities to find partners, resources or opportunities for implementation are easier. This results in a lower barrier of entry for new actors to become involved in humanitarian action and for technology to be tested directly in the field.

BOX 1.1 What technologists and humanitarians can achieve together

One of the most important contributions that digital technology can make to humanitarian operations is to ensure that the voices of people affected by disasters and complex emergencies are heard.

Disaster-affected people are not 'victims' but a significant force of first responders. They need to be empowered and engaged as part of the overall aid effort. Their recovery, their future and their lives and livelihoods are at stake.

The 8.7 earthquake that struck off the coast of the Indonesian island of Sumatra on 11 April 2012 brought a sense of foreboding that the region might see a repeat of the 2004 Indian Ocean tsunami. The tsunami never materialized, but it was clear that this time, communities were better prepared. One of the reasons is that new advances in technology, such as oceanographic radar systems, provided forewarning of tsunami activity relayed via satellite to Indian Ocean meteorological centres. In addition, mobile phones have proliferated in the region, making it easier to transmit fast and clear life-saving data.

This highlights the increased importance of standardization to ensure interoperability of technologies across borders, as well as the harmonization of telecommunication policies and regulations. Cooperation between public and private sectors can be ramped up. This will ensure a more effective use of emergency response technologies at the international level.

However, all the information in the world is useless if it cannot be acted upon. A number of organizations and academic institutions are attempting the difficult task of converting scientific data, such as specialized meteorological data, into actionable and credible information that can be quickly transmitted to – and understood by – vulnerable communities. Technologists and data experts can provide major impetus to this critical area to get data to those who need it most before disaster strikes.

Over the past 20 years, the 'mobile miracle' has brought the benefits of ICTs within reach of nearly everyone and today there are 6.8 billion mobile phone subscriptions worldwide (ITU, 2013).

There are also now some 2.7 billion internet users (ITU, 2013), but that still leaves 60 per cent of the world's people with no access to the internet. Narrowing this 'digital divide' by making broadband internet access available to all is crucial if people everywhere are to take advantage of the economic and social benefits that connectivity makes possible.

The UN Broadband Commission for Digital Development, a public–private partnership, is currently championing high-speed connectivity and through it, access to a set of transformative technologies.

In Rwanda, for example, the government recognizes that broadband is the oxygen of an effective digital economy. Young entrepreneurs, women and men, are working in the digital tech sector with a focus on digital inclusion, citizen empowerment and creation of local content. It is a model that could – and should – be replicated across the world.

Mobile technologies, particularly mobile phones, are now considered an essential tool for public health workers. They are used successfully to gather, collate and transmit data by front-line health workers. Patients are using apps to monitor their diabetes or heart conditions. Health ministries are running effective awareness campaigns on issues such as the effects of alcohol, smoking and other lifestyle-related contributors to the growing epidemic of non-communicable diseases.

In places like Nigeria, the Red Cross is using SMS technology to provide fast and cheap real-time data, strengthening the national health system and greatly improving community engagement and the ability to prevent and treat illnesses.

The technology sector can work with humanitarian partners to help them scale up and apply lessons learned, based on evidence and best practice, to other parts of the world. This is the thrust of a new mHealth initiative launched in 2012 by ITU and the World Health Organization (WHO, 2012).

Mobile phones are also a tool that can significantly contribute to achieving real gender empowerment. Women make up 40 per cent of the global workforce yet relatively few work in the technology sector. Mobile education programmes for technology skills designed for women can address the future labour gap in the tech sector and strike a blow for real equality and economic empowerment.

As people in low- and middle-income countries use digital technologies for more than just mobile money or emergency SMS, the humanitarian world will have to prepare for communities that have a greater voice than they have ever had before, communities that will lead, innovate, disrupt and replace the outdated North-South aid model. The technology sector can provide support to humanitarians to adapt to and navigate through the new, digital reality.

In anticipation of this certainty, aid agencies and their private sector partners need to work with communities and treat communication as a right to be exercised by people in need. They must drive and facilitate this, and create a new paradigm where humanitarians collaborate and innovate together with those who are in need of humanitarian assistance.

Article 19 of the Universal Declaration of Human Rights (UN, 1948) enshrines the right to communicate across all frontiers using any media. By advocating for people's right to access critical communication infrastructure, aid agencies have the opportunity to ensure realization of this right.

The aid model as it is known today is already being disrupted. Decisions and initiatives will take place in Rwanda or Nigeria not in Geneva or New York. The role of international aid workers and their technology partners will be to follow and support the local effort, to facilitate or stimulate local innovation, to connect disparate communities who can learn from each other.

Aid agencies also need to reflect on if and when the private sector is better placed to lead emergency response or development projects, especially relating to humanitarian technology. Private sector organizations are often on the ground when aid agencies are not, they are often at the heart of the community and they often have easier access to much-needed funds and resources. This would change the partnership dynamic whereby aid agencies are supporting the private sector rather than the other way around. While this would require a shift in thinking, it would arguably also represent much added value for prospective private sector partners.

At the end of the day, there is maybe nothing more powerful that technologists and humanitarians can achieve together than enabling people to tell their own stories, advocate in their own interests and design their own solutions. ■

(r)Evolution

The combination of connectivity, technology fusion and new actors is sometimes called a revolution for humanitarian action (Bernard, 2011). This may be overstating the role of technology and ignores the deeper and long-term reflection about humanitarian action that led, for example, to the humanitarian reform process that began in 2005 and the more recent transformative agenda (IASC, 2012). The evolution of technology has been constant, from the first internet (ARPANET, 1969), first desktop computer (Apple I, 1976) and the first cellular phone (1979), and arguably today's innovations are less significant than these milestones. Similarly, the evolution of humanitarian action has been constant and significant over the years and will continue in the years to come. Through this evolution, humanitarians have adopted and adapted technologies that showed significant advantages for their work. The significant shifts for humanitarian action will, therefore, be the result of a convergence between objectives of more efficient and effective action and the resources needed to achieve this goal, including technology and new actors, rather than the result of technology alone.

What this convergence will look like is open to debate. Humanitarian technology enthusiasts tend to be very upbeat about their subjects, suggesting that technology may be simpler and more straightforward to use and deploy than it actually is, and downplaying the significance of the risks. They may also overstate the effects and impact on the ground. Sceptics, on the other hand, focus on the worries, concerns and downsides without acknowledging the contribution that technology is already making to humanitarian action.

Humanitarian technology

Humanitarian technology refers to the use and new applications of technology to support efforts at improving access to and quality of prevention, mitigation, preparedness, response, recovery and rebuilding efforts. While much has been learned from a range of pilot projects and field implementation, the practice of humanitarian technology remains first and foremost defined by its potential contribution rather than by an actual integration in standard practices. This is rapidly changing – for example, the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) is increasingly activating networks of volunteers to crowdsource the collection and analysis of crisis data (see Chapter 3). Similarly, many humanitarian organizations have worked with digital data collection tools. But these efforts remain predominantly the result of individuals' engagement within these organizations, with no or little systematic and standardized implementation procedures so far. This too is changing. NetHope, for example, is a collaboration of 39 international humanitarian organizations established to foster collaboration and innovation, and leverage the full potential of ICT.

Nevertheless, the absence of more widespread adoption of technology reflects in part a lack of systematic evaluation and diffusion efforts, but also the fact that humanitarian technological innovations are emerging largely outside of traditional humanitarian actors. These actors may be communities at risk or affected by disaster that are confronted with specific challenges, creating opportunities for innovations. This is, for example, the case of Ushahidi, a civil society response to the 2008 post-electoral violence in Kenya to enable messages from multiple sources, including SMS, e-mail, Twitter and the web, containing geographic references, to be mapped and serve as a source of information. More recently, it is the case of applications for mobile phones designed to match assistance from volunteers with those in need.

Efforts in other fields of practice that have similar but distinct needs may also be a source of humanitarian technological innovation. A good example is digital data collection which has largely emerged from the health and social sciences, but has direct applicability for humanitarian data collection. Other examples include social media and education platforms whose original goals are not to serve humanitarian purposes, but which are especially well suited to enhance humanitarian action.

The involvement of communities at risk, 'new' humanitarians who are emerging around specific technological innovations, or networks of digital volunteers is one of the new features of a 'technology-enabled' humanitarian world. As such, humanitarian technology brings together actors that have a long tradition of humanitarian action and principles, but may not be regular users of new technologies, and a new, fast-growing number of 'tech-savvy' actors who may have an intimate and personal experience of disaster, but lack understanding of humanitarian action and principles.

This is the source of both opportunities and challenges, and the result is an ever-growing list of potential tools for humanitarian actions. Building a comprehensive list of these tools would be impossible and, almost by definition, rapidly outdated. Nevertheless, Table 1.1 provides a useful illustration of the range of possibilities that are either already realities or close to being implemented in the field.

TABLE 1.1 Examples of technological innovations for use in humanitarian actions

Humanitarian action phases	Selected action	Selected technological innovations
Mitigation	Early warning	Big data analytics for early warning, including social media, satellite imagery, etc.
		Advances in computing
		Text messages and social media warning systems
		Open data, access through social media
Preparedness	Planning and training	Resource databases and social networks
		Online distance learning platforms and discussion platforms, mail lists
		Mobile platforms
		Social media campaigns
Response and recovery	Situational awareness and needs analysis	Big data analytics
		Information sharing platform
		Mobile and digital data collection
		Satellite imagery, aerial photography, unmanned aerial vehicles
		Crowdsourcing information
		Micro-tasking
		Secure data transmission and encryption
		Long range data transmission
	Resource management and accountability	Resource mobilization through social media
		Mobile cash transfers
		Commodity and resource tracking through mobile phones
		SMS-based feedback from affected people receiving aid
		Resource management platforms
		Matching needs and volunteers through social media
	Search and rescue	Reunification through social media
		Search and identification through 'digital signature' (e.g., mobile phone SIM card)

While this table is far from an exhaustive listing of humanitarian technology, it suggests that technological innovations are improving disaster management in all of its phases (mitigation, preparedness, response and recovery) and have the potential for even greater positive impact. This includes advanced computing and the use of big data in early warning systems, enabling greater understanding of risks, better monitoring and earlier warning, and improved awareness-building among communities. Technology plays a positive role in both humanitarian response and post-disaster recovery, including through improved understanding of the situation and needs of the affected community, better coordination of humanitarian response efforts and mobilization of financial support, and greater involvement of affected communities. Technological innovations also contribute to greater preparedness, for example through widespread access to training material or planning for resource mobilization through social networks and flexible resources databases. But a majority of applications of humanitarian technology appears to focus on response and recovery. Unfortunately, this trend reflects the decades-long lack of focus on preparedness in humanitarian action and the need to develop humanitarian technologies that are specific to engaging communities in preparing for disaster rather than responding to it. Possibly the only exception is the rapid emergence and adoption of people-centred early warning systems, or fourth-generation early warning and response, which are more bottom–up and decentralized than traditional hierarchical and top–down approaches, and take advantage of ICT (Meier, 2009).

BOX 1.2 Mobile data collection and joint data analysis: a Pakistan case study

From Syrian refugees in Lebanon to Somalis in Nairobi, Kenya, the increase of emergency displacement towards urban and peri-urban areas has been a topic of discussion among humanitarians for more than a decade. Displaced populations in urban areas are often referred to as hidden, as they are difficult to locate and even more difficult to assist. Gaining access to accurate numbers and reliable information on the needs of urban internally displaced people (IDPs) and refugees is more complex than profiling similar populations in camp settings.

Displaced populations often flee to urban areas instead of camps due to a perception of increased economic and social opportunities. However, data from Pakistan suggest that, although some urban IDPs succeed at rebuilding their lives in the city, many more find themselves in abject poverty, more vulnerable to food insecurity and with fewer economic opportunities than those who sought refuge in displacement camps. While it cannot be assumed that this pattern is consistent across all contexts, this finding highlights the humanitarian community's awareness that stronger tools are needed to identify, assess and assist the urban displaced. Some interventions such as food and health assistance have succeeded in urban displacement contexts because of strong communication and outreach to displaced populations. Nevertheless, serious concerns remain over accessing populations considered the most vulnerable, including those who cannot travel to distribution points due to distance or disability, and those who need specialized assistance, such as survivors of gender-based violence or unaccompanied children. Humanitarian actors need stronger tools not only to identify and assess, but also to target appropriate assistance to the most vulnerable.

The IDP Vulnerability Assessment and Profiling (IVAP) project in Pakistan made use of technology to begin addressing some of these concerns. IVAP began as a pilot project in 2010 and is currently in its third year of assessing and profiling conflict IDPs from Pakistan's Federally Administered Tribal Areas. When IVAP was developed, the humanitarian community was facing a large protracted displacement crisis with diminishing resources to assist. The government of Pakistan and aid groups generally agreed that no one knew how many IDPs were living outside of camps, what their most pressing needs were or who were the most vulnerable among them. This made the prioritization of scarce humanitarian resources extremely difficult.

As a result, 14 humanitarian organizations joined together to design and launch the IVAP project. With the assistance of the humanitarian clusters, these organizations developed a multi-sector profiling questionnaire. A team of assessors was then trained on the questionnaire and the use of smartphones for data collection, and sent to every urban, peri-urban and rural area where IDPs were expected to be living to conduct a door-to-door snowball survey. Data from the smartphones were then uploaded to an online database specifically designed for automated data cleaning and analysis.

This online database, accessible to the entire humanitarian community, hosts the full profiling data of more than 400,000 conflict IDPs living outside displacement camps, most of whom reside in urban or peri-urban locations. The database allows humanitarian actors to identify the greatest needs, such as cash and food assistance or child protection, and also to target more accurately families and individuals who need help most. The most vulnerable are identified through either self-reported vulnerabilities (such as chronic illness) or more complex analyses of household food and income security. The profiles of individual IDP families are updated via a 'call-back and revisit' system to ensure that the database remains as relevant and accurate as possible over time.

Systems like IVAP provide a multitude of benefits in addressing urban displacement crises. IVAP removed the guesswork in planning for the size, locations and needs of urban IDPs in Pakistan. The inclusion of phone, address and local community informant information made it possible to locate urban IDPs for both assistance and future profiling, making them less 'hidden'. In addition, the profiling data have been used to understand various vulnerability profiles among the population and understand how to maximize the impact of limited humanitarian resources by targeting assistance to those most vulnerable to specific threats.

While the concept of profiling and databases is not new to the humanitarian community, the innovative element of IVAP is the scale, quality and depth of data made possible through the use of technology. By using smartphones, surveyors were able to profile an average of 10 to 15 families a day in urban locations. Paper was not used, so surveys could not be lost and no data entry was required. Phones were programmed with specific rules for each question (i.e., age must be between 0 and 105 years) and automated skip patterns were used to ensure that relevant questions were asked to the appropriate people and that all required questions were answered. The database was set up to check for duplications automatically (when the same IDP had been interviewed more than once) and to auto-analyse the data for complex vulnerability criteria, such as female-headed households with more than four children living in a specific slum. Having this single database allowed organizations to have a shared understanding of needs.

The possibilities for similar profiling systems are almost endless, such as IDP or refugee registration, joint agency assistance tracking by family or individual, or information sharing with displaced populations via mass SMS systems utilizing the database. Additionally, an IVAP-like system does not need to be owned or run by one organization, but can be used across humanitarian actors. Each actor can borrow the configured smartphones, use their own staff to profile families in the locations where they are working and then send the data back to the shared database.

Pakistan provides a useful example of humanitarian agencies working together not simply to improve small, one-time surveys with mobile data collection, but to harness the power of technology to solve large and complex information concerns in emergencies. ■

People-centred humanitarian action

Disaster-affected communities have always been the first responders in emergencies. New technologies are greatly increasing their capacity for self-help. The increased availability of ICT around the world, such as the prevalence of mobile phones and widespread internet access, are creating new ways for affected communities to organize, coordinate and respond to their own problems and for outside humanitarian actors to determine and respond to communities' needs. For communities, this means enhanced abilities to participate in humanitarian action, mobilize resources, coordinate with humanitarian actors and other stakeholders, self-organize community-based actions and monitor humanitarian actors, making them more accountable. It also enables non-humanitarian actors to become involved, lowering the barriers of entry for anyone to participate, even if remotely, in humanitarian action. Ultimately, and arguably, technology can "empower individuals and communities threatened by hazards to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life, damage to property and the environment, and loss of livelihoods" (UNISDR, 2006), one of the fundamental principles of community-based early warning. More broadly, technology enables people-centred humanitarian action.

The Sphere Project, established by a group of non-governmental organizations and the Red Cross Red Crescent Movement to improve the quality of their actions during disaster response and to be held accountable for them, has defined a number of minimum standards and core process standards (Sphere, 2011). The first of Sphere's core standards is concerned with people-centred humanitarian response, i.e., that people's capacity and strategies to survive with dignity are integral to the design and approach of humanitarian response. The key actions to realize this standard are shown in Table 1.2.

Populations also produce (voluntarily or not) massive volumes of data, in various formats, through the use of mobile phones, e-mail and social media. These data are typically not easily accessible in organized modes, but can be used to rapidly generate information that is useful for humanitarian action. Google has a unit devoted to information access in disaster settings (Google Crisis Response). It created, for example, the Google Person Finder in response to the 2010 Haiti earthquake. In 2012, the processing of thousands of Twitter messages that included images and videos of damages from Typhoon Pablo in the Philippines enabled the rapid creation of damage assessment maps. The increasing prevalence of mobile phones has also, for example,

TABLE 1.2 Sphere standard for people-centred humanitarian response

1	Support local capacity by identifying community groups and social networks at the earliest opportunity and build on community-based and self-help initiatives.
2	Establish systematic and transparent mechanisms through which people affected by disaster or conflict can provide regular feedback and influence programmes.
3	Ensure a balanced representation of vulnerable people in discussions with the disaster-affected population.
4	Provide information to the affected population about the humanitarian agency, its project(s) and people's entitlements in an accessible format and language.
5	Provide the affected population with access to safe and appropriate spaces for community meetings and information-sharing at the earliest opportunity.
6	Enable people to lodge complaints about the programme easily and safely and establish transparent, timely procedures for response and remedial actions.
7	Wherever feasible, use local labour, environmentally sustainable materials and socially responsible businesses to benefit the local economy and promote recovery.
8	Design projects, wherever possible, to accommodate and respect helpful cultural, spiritual and traditional practices regarded as important by local people.
9	Progressively increase disaster-affected people's decision-making power and ownership of programmes during the course of a response.

Source: Sphere, 2011.

engendered a new trend towards mobile money transfer which has been used for donations, transfers from diaspora members for relief in their home communities and the provision of humanitarian assistance. Mobile technology is increasingly a vector for recipients of humanitarian aid to give feedback to the providing agency, communicate their needs and express their views. In Aceh, Indonesia, for example, an SMS-based system enabled communities to comment on access to and the quality of the work being carried out by humanitarians.

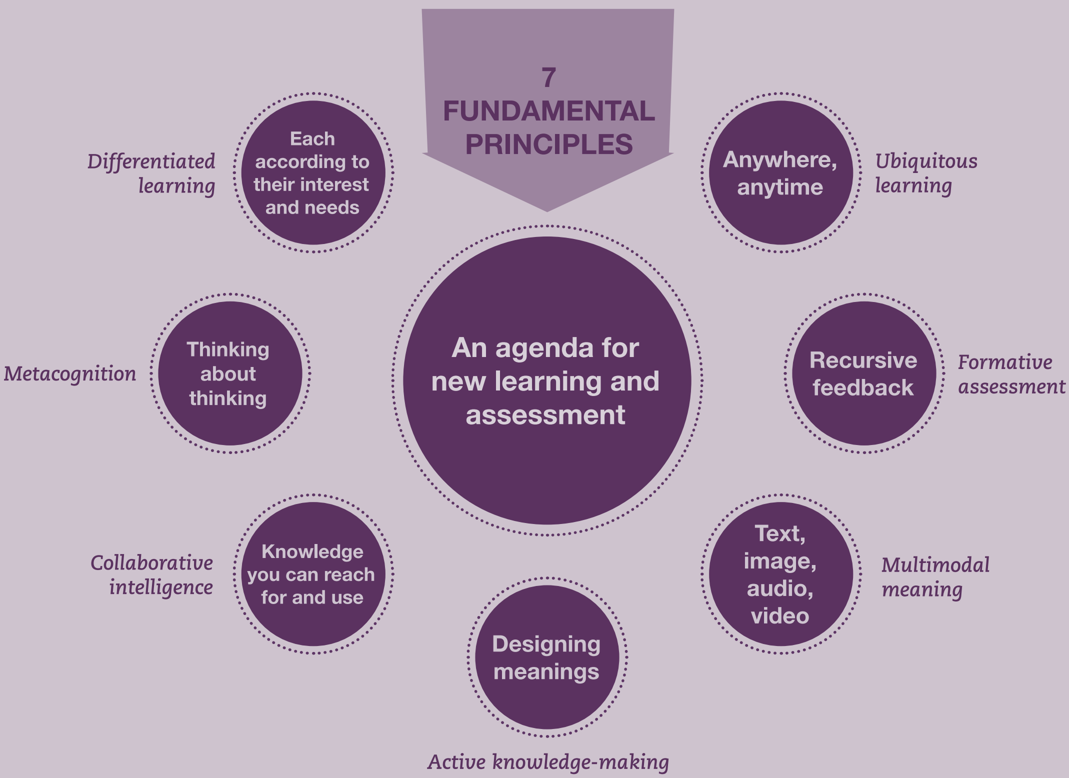
The humanitarian aid community has yet to take full advantage of new opportunities to listen to and engage with communities and gain a more accurate understanding of their needs. It is also ill-equipped to analyse the flood of data from communities at risk and turn it into actionable information. In response, a global network of 'digital humanitarians' has emerged – volunteers who offer their services in response to crisis to gather and analyse crisis data from all sources and present it in usable format. Digital volunteers formed the Standby Volunteer Task Force and later, under the auspices of OCHA, the Digital Humanitarian Network has been called upon a number of times by OCHA and other humanitarian response agencies, with positive results reported in terms of improving data accessibility.

Humanitarian organizations themselves have begun to adopt new technologies, methodologies and policies to manage the enormous volume of data now available to them in crisis situations. For both volunteers and organizations, however, challenges remain in terms of advance preparedness for disasters and the capacity to process such large volumes of information. Advanced computing solutions can help respond to these challenges – they include human-driven processes, such as crowdsourcing and micro-tasking, and machine-driven methods such as data mining and machine learning which go beyond the processing capabilities of humans.

BOX 1.3 The significance of technology for humanitarian education

Since the rise of the internet in the early 1990s, the most obvious benefit offered by educational technology has been its potential ubiquity or the ability to learn anywhere, anytime. In development contexts, sceptics have asserted that the 'digital divide' restricts this benefit to the privileged few, as only 40 per cent of the world's population is online. But such analysis neglects the rapid pace of change in extending mobile (and mobile, 3G-based broadband networks) access in low- and middle-income countries.

FIGURE 1 Principles of online learning



Source: Cope and Kalantzis, 2012.

In many nations, the majority of web users use only mobile phones; the countries with the highest rates include Egypt (70 per cent) and India (59 per cent). In Africa, 85 per cent of the mobile-only web users access the internet with a 'feature phone', a device offering some but not all of the features of a smartphone. In high-income nations, a large minority of mobile web users are mobile-only, including the United States (25 per cent). Where, in many low- and middle-income nations, the mobile-only tend to be aged under 25, in high-income countries, particularly the United States, many mobile-only users are older people and many come from lower-income households (ITU, 2013). These statistics imply that for educational technology to be deployed effectively in the contexts of low-, middle- and high-income countries, a mobile-first strategy building on open, low-cost standards and tools is needed.

Education researchers Bill Cope and Mary Kalantzis (2012) have described the ways in which technology transforms the economy of effort in education, enabling us to afford (both literally and figuratively) not only to make learning available anywhere, anytime, but also to provide learners with formative assessment and recursive feedback as they work. In this economy of 'new learning' (see figure), learners use technology actively to construct knowledge, designing meanings using multiple media at their disposal. By working together collaboratively, every learner is also a peer and teacher contributing to collective knowledge and intelligence that can be used to further thinking and action as well as encouraging 'metacognition' (thinking about thinking). Unlike education in the industrial age, which levelled 'one-size-fits-all' assumptions, new learning can afford to differentiate based on pre-existing knowledge, competencies and skills.

In a new learning system, learners create together, giving each other feedback (and even feedback on feedback), sharing their inspirations and discoveries. Within their knowledge communities, they are connected and can work at their own pace, according to their own interests and capabilities. They are inspired to create through embedding sound, image and video within their texts for digital storytelling, situation reports, operational plans and more. This collaborative, flexible, motivating, participatory and supportive approach is not simply a nicer, kinder and gentler form of learning. Its pedagogical patterns closely emulate the core competencies of 21st century humanitarian workers, who are expected to be able to manage complex, overlapping knowledge flows, to work in networked configurations (rather than command-and-control structures) and to use participatory methodologies to partner with affected populations. If the ways humanitarians teach and learn do not explicitly develop these competencies, then formal education efforts will become increasingly ineffective. The amazing economy of effort afforded by educational technology is the only sustainable way to transform learning systems to meet the challenges of today's volatile, uncertain, complex and ambiguous world. ■

BOX 1.4 Putting first-aid advice in the hands of thousands

Having first-aid skills saves lives and learning first aid can increase individual and community resilience (White and McNulty, 2011) – so how do you put these skills in a population's hands?

The British Red Cross faced the problem of how to increase resilience across the United Kingdom by enabling more people to have the confidence and willingness to use first aid. They embarked on a strategy of making first-aid learning material simple, straightforward, easy to learn, adaptable, relevant to everyone and available through multiple access points. They developed 'Everyday First Aid', an approach to first-aid learning that met these challenges while conforming to the latest evidence-based clinical science. In addition to first-aid courses, different methods were used to disseminate the skills including web-based resources, campaigns, press, social media and the development of a smartphone app.

Developed with everyday people in mind, the presentation of first-aid content was a reversal to the traditional method of teaching first aid, with the new approach engaging the learner directly with the intended change, or outcome, for the ill or injured person. This avoids the complicated mechanics, diagnoses and technicalities which can distract people from learning the principal aim of any first-aid act: to preserve life, promote recovery and prevent worsening of the condition. Reduced complexity might also assist the first-aid helper in an emergency, enabling them to adapt to their circumstances and recall the most important part of the skill they need.

Of course, simplifying the material is only part of the story. The rapid development of smartphone mobile technology provided the means to make first-aid content more available to potential helpers by literally putting the information at people's fingertips.

Analysis of mobile technology trends shows an explosion in its use, with the UK mobile market totalling some 84 million subscribers by the end of 2012 (Paterson and Lane, 2010). By 2016, 65 per cent of the UK population will access this technology via smartphones (*eMarketer,* 2013) and, of the 8.06 million app users in the UK in 2010, some 76 per cent accessed via a smartphone (Paterson and Lane, 2010). In the case of first aid, the mobility of smartphones provides a dual opportunity: smartphones offer the possibility to provide rapid emergency advice when it is needed and also permit people to browse and learn from content at their own leisure.

In developing their app, the British Red Cross decided that it should be more than functional – it needed to be a compelling market leader, of excellent educational quality, free, easy to navigate and offer wider emergency preparedness advice. Interaction was also important, with different tabs allowing users to decide what to focus on. The 'learn' section is predominantly video-led since research shows that viewing video demonstrations, even without practising them, enables people to perform some skills more effectively than untrained individuals could (Eisenburger and Safar, 1999). The 'emergency' section, a defining feature of the app, gives emergency support tools in simple, straightforward steps, such as calling emergency services, and timing devices for managing burns and resuscitation. Finally, the 'test' section tests skills through quizzes.

Since its launch in December 2011, the first-aid app has won two industry awards, the first for best app in the Digital Communications Awards (Europe) (Quadriga, 2012) and the second for best use of digital media in the CorpComms Awards (Dunne, 2012). While these awards are satisfying, it is the feedback from people who use the app that shows its real contribution to reducing vulnerability.

One person wrote via the 'tell us your story' function: "This app is great. I am a fast response paramedic in London and I was called to a category one [life-threatening] call at a school; there was a student with this app that used it to revive the patient. If this app was not out there then there would be one less person in the world."

Billed as building 'real-world' resilience via a digital model, the app has certainly succeeded in its aim to put first-aid advice, literally, in the hands of thousands of people. The target of 30,000 downloads was shattered within nine days of its launch and the current total number of downloads is more than 500,000.

Analysis shows the app is primarily used to learn first aid before an emergency, using the 'learn' or the equally popular 'test' tab. To a lesser extent, people also access the app during emergencies.

Interestingly, feedback also shows that the app is referred to after someone has helped in an emergency, to reassure themselves that they have conducted first aid appropriately.

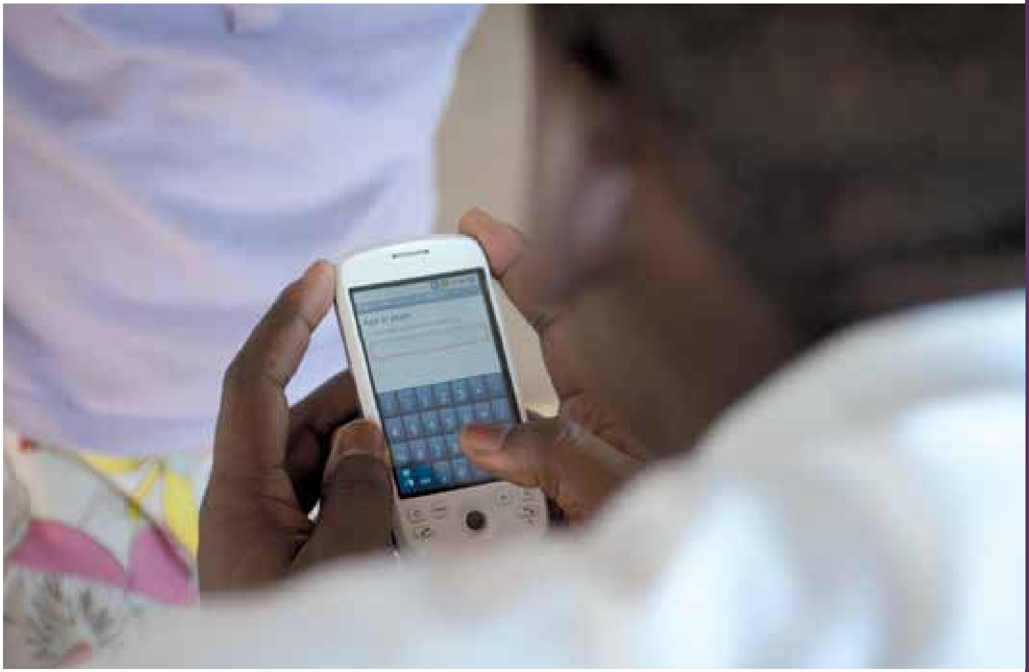
That users have gone on to learn and access more is clearly evident. Visits to the first-aid web site increased in the first month after its launch, with users looking at more content and for longer, and mobile sign-ups to first-aid courses increased by 47 per cent compared to before the app's launch. This all implies that users are motivated to learn more and use their knowledge, suggesting an increase in their ability to prepare for and withstand a crisis situation.

The success of the first-aid app has resulted in several important developments.

The British Red Cross has launched a baby and child first-aid app and work is under way to develop an app focusing solely on the UK's chief disaster threat: flooding.

Internationally, the Everyday First Aid approach has had wide acclaim from across the Red Cross Red Crescent Movement, bringing simplicity while retaining scientific accuracy. The American Red Cross have licensed the app from the British Red Cross and gone on to develop a suite of additional apps to cover a range of emergencies.

Since the British and American Red Cross released the app, many other National Societies have asked to use it. Unfortunately, development costs make the creation of a high-quality app difficult, if not impossible, for many National Societies. However, in order to make simple first-aid skills available at a global level, the British Red Cross has worked with the IFRC's Global Disaster Preparedness Center on the concept of a 'universal app' that would enable every Red Cross Red Crescent society to launch an app in their country, at a lower cost than it would take to create one from scratch. The opportunity brought by mobile technology has the potential to put life-saving skills in the hands of millions. ■



All over the world, adults and children, like this Haitian boy, can take advantage of the possibility technology gives them to access the information they need at the press of a button. © Moira Henessey

Challenges and limitations

Not so connected

Technological innovations are and will continue to transform humanitarian operations in many positive directions. Yet they bring with them inherent risks that often go unaddressed amid the excitement of new technical possibilities and limitations on the full effectiveness of technology for humanitarian purposes. Technology is often assumed to improve not only the efficiency but also the accountability and transparency of humanitarian aid. However, this is not necessarily the case if access to technology is unequal, if aid workers no longer interact directly with the population and if new actors are not necessarily grounded in humanitarian principles. More importantly perhaps, significant portions of populations at risk, especially marginalized or vulnerable groups, may not be regular users of new technologies. This may make them harder to reach while they are, typically, the most vulnerable.

Indeed, as impressive as the number may seem – 6.8 billion mobile phone subscriptions and more than 2 billion mobile broadband internet subscriptions (ITU, 2013) – the on-the-ground reality is more often than not one of information poverty, limited mobile phone coverage and little or no access to internet for both humanitarians and communities at risk. There is no doubt that the prevalence of mobile phones is rapidly growing, but the numbers include inactive connections and multiple connections per user, so that the real number of mobile users worldwide was estimated at 3.2 billion in 2012 (Wireless Intelligence, 2012) – or less than half the 6.8 billion mobile subscriptions. Furthermore, while the proportion of mobile phone subscriptions is rapidly growing, it is not the same for all technological indicators. For example, the proportion of computer ownership in 2011 was only 23 per cent in low- and middle-income countries, compared to 72 per cent in high-income countries (ITU, 2013). Looking at countries' income levels, World Bank data show an even starker picture: while mobile subscriptions reached 114 per cent of the population in high-income countries in 2011 (owing to multiple subscriptions per individual) and 86 per cent in middle-income countries, that proportion was only 42 per cent in low-income countries (World Bank, 2013). According to the same data, only 6 per cent of the population in low-income countries used the internet in 2011, compared to 27 per cent in middle-income countries and 76 per cent in high-income countries.

Disaggregated data on access to technology are unfortunately not widely available. One study showed differences in access to mobile phone, internet or e-mail usage between men and women (Gillwald, Milek and Stork, 2010; see Figure 1.2). The study showed gender inequalities across gender, income and urban/rural divides. Education levels are also likely to play an important role. The cost of communications was identified as a major challenge, especially among women who are more likely to do unpaid work or generally earn less than their male counterparts.

FIGURE 1.2 ICT access by gender in 2008

	Own mobile phone		Use internet		E-mail address	
	Total	Women	Total	Women	Total	Women
Benin	30%	21%	9%	5%	8%	5%
Botswana	60%	59%	6%	4%	5%	4%
Burkina Faso	27%	25%	4%	6%	3%	5%
Cameroon	37%	40%	13%	13%	11%	11%
Côte d'Ivoire	42%	40%	7%	4%	4%	3%
Ethiopia	3%	3%	1%	0%	0%	0%
Ghana	60%	58%	6%	3%	5%	3%
Kenya	52%	49%	15%	12%	13%	10%
Mozambique	26%	33%	1%	1%	1%	1%
Namibia	49%	46%	9%	7%	6%	5%
Nigeria	77%	71%	13%	8%	10%	7%
Rwanda	10%	8%	2%	2%	2%	2%
Senegal	40%	27%	10%	7%	7%	3%
South Africa	62%	65%	15%	11%	13%	10%
Tanzania	22%	18%	2%	2%	2%	2%
Uganda	21%	13%	2%	1%	2%	1%
Zambia	46%	37%	3%	2%	3%	2%

Source: Gillwald, Milek and Stork, 2010.

More detailed studies suggest, for example, that women are more likely to depend on friends and families as their source of information compared to men. In selected areas of the Central African Republic, including the capital Bangui, 47 per cent of women depended on friends and neighbours for information, compared to 30 per cent of men. Differences across income were even more important, with 66 per cent of the poorest 20 per cent of the population depending on friends and family for information, compared to just 6 per cent among the richest 20 per cent (Vinck and Pham, 2010). Recent ITU figures suggest that 16 per cent fewer women than men use the internet in low- and middle-income countries, compared to a 2 per cent gender gap in high-income countries (ITU, 2013).

These differences may not be surprising, but they have important implications for an increasingly technological humanitarian world, namely the potential for digital exclusion of those most vulnerable to disasters. Access to information and technology for at-risk communities must be recognized as a basic need and priority alongside protection, health, food, water or shelter. At the same time, while the appropriate tools must be made available to communities, it must also be acknowledged that new technology may not always effectively replace more traditional means to reach the largest possible audience. However, even traditional means like radio fail to bridge the 'last mile' and reach the 'information poor'. So there must be a conscious and active effort to address unequal access, rather than looking for a one-size-fits-all communication tool.

Digital exclusion, biases and privacy

One of the consequences of unequal access to technology is potential biases in data generated by or about communities at risk. This is a separate issue from data accuracy, for which progress is rapidly being made for the verification of crowdsourced data, for example. Rather, the issue is about the validity of the overall picture obtained by many HICT efforts.

Somalia Speaks, for example, was set up by Al-Jazeera in 2011 to use mobile phone text messages to ask Somalis how they were affected by conflict and received more than 3,000 replies from Somalis. Presented as enabling the voice of people in one of the most inaccessible and conflict-ridden areas of the world to be heard, the number of replies was impressive given that, in 2010, the International Telecommunication Union (ITU) estimated at 648,000 the number of mobile phones in Somalia, giving a mobile penetration rate of just 7 per cent (ITU, 2013). Other estimates, however, put the percentage for mobile phone subscription at 39 per cent (Infoasaid). Just one-third of the population is literate (one-quarter for women). In this context, those able and willing to contribute to Somalia Speaks cannot be considered as representative of the majority of the population. The potential for such data to be further biased along structural inequalities is also important.

One common response of humanitarian technology supporters is that all data have inherent potential biases and that crowdsourced data are very cheap to acquire, unlike more structured population surveys. In fact one report even states that "new information sources are no less representative or reliable than more traditional sources, which are also imperfect in crisis settings" (OCHA, 2013). It is also argued that humanitarian decision-making often relies on anecdotal evidence so that even biased data may be better than no data at all. "Even when good data is available, it is not always used to inform decisions. There are a number of reasons for this, including data not being available in the right format, not widely dispersed, not easily accessible by users, not being transmitted through training and poor information management. Also, data may arrive too late to be able to influence decision-making in real time operations or may not be valued by actors who are more focused on immediate action" (DfID, 2012; Meier, 2013).

However, there has been tremendous progress towards more rigorous evidence-based humanitarian decision-making, with standardization of methods and assessments, indicators and measurements, among others. These trends must continue and a status quo in terms of data quality is not acceptable. What is needed is a more in-depth analysis of what community-generated data can accurately achieve, where, when and under what conditions. For example, crisis mapping in highly connected environments like New York or Japan have very different risks of biases compared to similar applications in remote areas of the Central African Republic, where access to technology may reflect and reinforce structural inequalities. Simply because some data exist does not necessarily mean that they should be used to support decisions. What is needed is for humanitarians not only to become aware of new sources of data, but also to be more educated about their limitations.

There are other forms of exclusions, too. Humanitarian organizations are confronted with the high initial financial cost and human resources requirements (e.g., skills) of many technology solutions, making them prohibitive for many local actors. Vulnerable populations are confronted with the same limitations, which may hinder their ability to access benefits or services. Any solution offered must be simple enough for easy adoption by users including in places where levels of literacy and digital literacy are low. Communities may also mistrust technological solutions due to fears of fraud or security breaches. Incentives can help ensure uptake of technology-based solutions but should be appropriate to the users' level of involvement.

BOX 1.5 World map of UNESCO's points of interest

Within the framework of its post-conflict and post-disaster platform, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has designed and developed a project regarding the use of ICTs in disaster risk reduction.

Vulnerable communities suffer repeatedly from disasters for a number of reasons, including the lack of mitigating actions and informed decisions. Risk information is often not available at the local level where it is much needed to better understand these vulnerabilities, raise public awareness and effectively manage risks.

To date, no comprehensive, openly licensed map of educational, cultural or scientifically relevant installations (such as schools, water wells, sanitation, libraries, etc.) exists. Information, when available, is often superficial and limited to geo-coordinates. The availability of community-prioritized data, particularly on a large scale, from the field is undoubtedly a substantial asset in preparedness, planning and response in post-conflict and post-disaster contexts.

The 'World map of UNESCO's points of interests' project aims to create a free, open and web-based world map through citizen's participation (crowdsourcing) with the objective of strengthening both the resilience of local communities and the response of UNESCO and global organizations to post-conflict and post-disaster situations through an openly licensed GIS data infrastructure. The project focuses on developing assessment tools and mapping relevant sites or data in the targeted areas by using locally available ICT infrastructures, including mobile connections, internet, tablets, TV and radio.

Furthermore, the project seeks to harness the potential of mapping in different UNESCO domains, through adequate capacity building, targeting especially adolescent girls and boys from low- and middle-income countries, through crowdsourcing.

This project builds on OpenStreetMap.org, a collaborative and openly licensed mapping initiative which has been successfully used in several post-conflict and post-disaster situations (e.g., OCHA, Haiti, Japan and Pakistan) and in citizen mapping initiatives (e.g., MapKibera in Nairobi, Kenya).

In collaboration with the stakeholders (e.g., youth, students, teachers and decision-makers), the project aims at developing UNESCO-relevant metadata templates in local languages, to make geospatial data effective in different post-conflict and post-disaster situations.

Five pilot projects began to be implemented in three regions in 2013: Kenya and Namibia (Africa), India and Indonesia (Asia) and El Salvador (Latin America).

In Namibia, community participation was key in achieving the Water Supply and Sanitation Policy's objectives in 2008. The UNESCO project – run in consultation with the UNESCO national commission and the Ministry of Rural Affairs – therefore focuses on developing a solid data collecting system through participatory mapping in order to obtain a clear and transparent picture of the sanitation situation in schools and to promote community engagement in decision-making processes concerning water management.

In Kenya, the project aims at building a network of communities sensitive to disaster risk reduction to improve local knowledge of disaster risk and information management. Activities focus on Nairobi's disaster-prone areas, such as Mathare. In addition, the project seeks to develop and implement a participatory grass-roots community art and advocacy activity on disaster risk reduction. Social interaction and income-generating schemes are incorporated through this process to produce a tangible cultural heritage (moveable educational, cultural and learning materials).

In Indonesia, the project focuses on the lack of community-level information as a key issue for effective flood management. The project proposes using participatory points of interest mapping to create maps that represent land and resource use patterns, hazards, community values and perceptions, to gather information on traditional knowledge and practices, to collect data for assessments or monitoring, to present alternative scenarios and to empower and educate stakeholders, raising collective disaster risk awareness.

In India the main objective of the project is the empowerment of marginalized communities to represent themselves spatially through open visual maps and monitor public community infrastructure. Visual maps of public infrastructure can support citizens and communities in post-crisis and post-disaster relief efforts, for example reporting on how basic infrastructure in schools and/or degraded buildings create unhealthy and unsafe environments which are not conducive to learning. Improving the current understanding of available facilities in a visual format through OpenStreetMap can also improve girls' access to educational facilities and reduce the number of school dropouts, therefore contributing to gender equality and girls' empowerment.

In El Salvador, the project integrates UNESCO's activities to protect school facilities from disasters, as these facilities may help save children's lives and can be used as shelters in post-disaster situations. The concept extends to meet the broader goal of disaster risk management in reducing the impact of disasters. In partnership with the University of El Salvador and the Ministry of Education, the project seeks to reinforce the existing geospatial inventory of schools developed by the ministry with a larger, community-implemented school safety assessment and to develop a data collection system, including mapping tools and relevant training material. The school safety assessment will give local authorities and the community an overview of the state of local schools and provide decision-making tools for the authorities in order to develop detailed school technical assessments (which may require professional inputs) and to decide on retrofitting and reallocating schools at very high risk.

Based on the results of these local initiatives, a report on the use of open crowdsourced mapping for disaster preparedness and risk reduction will be produced at the conclusion of the project at the end of 2013. ■

Other challenges

The *World Disasters Report* offers detailed discussion of many challenges in humanitarian technology which, left unaddressed, could temper the enthusiasm for such new technologies. Greater information sharing and more data collection bring risks of information misuse and compromised data security and privacy. Concerns over data protection and the security of information sources (e.g., individuals) are legitimate, but the actual risk may vary and needs to be carefully analysed in relation to benefits. For example, paper-based collection of protection data may be riskier than the use of digital methods to collect the same information, even if communication is not encrypted.

Two-way communication may also raise expectations and frustration if bottom–up communication is left unanswered. While new technologies can lead to humanitarian crisis, caused by drone- or cyber-attacks, for example, excessive focus on these risks can obscure other genuine and pressing concerns. Increased dependency on technology may also create new vulnerabilities as post-disaster environments are highly prone to failure of technological infrastructures. This may affect not only the population, but humanitarian actors as well. Interventions can become overly reliant on information technology which in turn relies on a highly vulnerable information infrastructure. Furthermore, that information infrastructure is increasingly in the hands of private actors who have no duty to provide minimum services for humanitarian reasons. Ad hoc public–private partnerships have been established, for example to facilitate the distribution of text messages, but there are no national or international requirements to do so.

Technology has also multiplied the use of narratives of suffering to draw attention to humanitarian crisis, without equivalent focus on the ethics and practical security risks of publicizing victims' images and stories.

The emergence and professionalization of new humanitarian actors and the changing role of the populations at risk themselves are beneficial and should be encouraged. However, they also raise urgent questions about the risks, responsibilities and ethical challenges of humanitarian work. Humanitarian values are cultivated within organizations in order to ensure that aid is delivered according to certain fundamental principles. These principles should not be diminished in more decentralized systems where communities and outsiders play as great a role as professional humanitarians. Something is fundamentally wrong when technologies are tested in real-time disasters with the participation of an uninformed population. In this context, the level and extent of data extraction are unprecedented, with few clear guidelines on how actors should behave. Several of the emerging actors are already advancing in this reflection but more work is needed on the ethics and principles of humanitarian technology, for example to avoid the duplication of activities and build the reach, credibility and comprehensiveness that these actors can achieve.

BOX 1.6 Globally coordinated meteorological and climate networks and technology

During the period from 1980 to 2007, about 90 per cent of disasters were caused by recurrent events such as droughts, windstorms, tropical cyclones, storm surges, floods, landslides and extreme temperatures, or by forest fires, health epidemics and insect infestations, which are linked to meteorological and hydrological conditions (CRED, 2013). According to the Intergovernmental Panel on Climate Change's Fourth Assessment Report, the frequency and intensity of weather-, climate-water-related hazards are increasing as a result of climate change (IPCC, 2007).

The emergence of new technology and scientific knowledge provides opportunities to increase the lead times of predictions of weather-, climate- and water-related hazards. Seasonal climate outlooks help governments predict – and manage – excessive or deficient rainfall. Historical data have traditionally been used for analysis of hazard patterns. But this is no longer sufficient, because hazard characteristics are changing as a result of climate change and more severe events could happen more frequently in the future. Weather and climate services are therefore needed to inform long-term investments and strategic planning on, for instance, coastal zone management, development of new building codes and the retrofitting of infrastructure to withstand more frequent and severe hazards (see Figure 1).

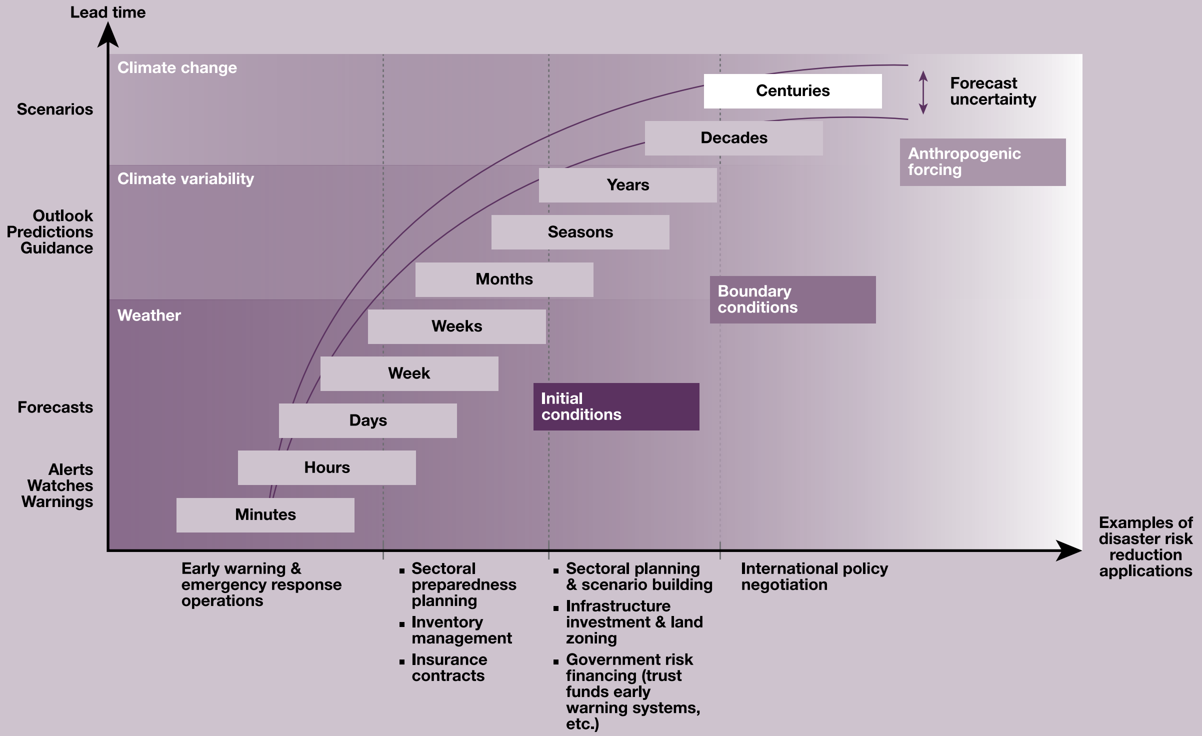
Scientific and technological advances increase the availability and accuracy of user-friendly climate services to help countries and communities, especially the most vulnerable, adapt and build resilience to the impacts of climate variability and climate change. The Global Framework for Climate Services, which brings together governments, the World Meteorological Organization (WMO) and partners, is taking advantage of these new opportunities to serve as a joint platform between providers and users of climate services, and targets disaster risk reduction as one of its top priorities, along with food security, water resource management and health.

WMO coordinates a global network of the national meteorological and hydrological services (NMHSs) of its 191 members with more than 50,000 weather reports and several thousand charts and digital products, which are disseminated every day through the system. The network is comprised of three interlinked operational components:

- *WMO Global Integrated Observing System*, which collects data from 17 satellites, hundreds of ocean buoys, thousands of aircrafts and ships and nearly 10,000 land-based stations

- *WMO Global Telecommunication System (GTS)* is a dedicated network of surface and satellite-based telecommunication links and centres operated 24/7, which connects all NMHSs for the collection and distribution of all meteorological and related data, forecasts and alerts, including tsunami- and seismic-related information and warnings. The GTS is being expanded through WMO Information Systems to exchange all weather-, climate- and water-related information including to users outside the meteorological community
- *Global Data Processing and Forecasting System*, a network of nearly 50 global and regional specialized meteorological centres that provides analysis, bulletins and related information to the NMHSs.

FIGURE 1 Seamless hydro-meteorological and climate services for various risk management and risk reduction applications



Source: Adapted from WMO, 2011.

Building on this network, WMO is working with its members to strengthen and establish new regional climate centres and regional drought management centres. WMO also has an emergency response activities programme, established in 1986, to assist NMHSs, governments and international organizations to respond effectively to environmental emergencies with large-scale dispersion of air-borne hazardous substances. The programme focuses on nuclear facility accidents, but also provides support in emergency response to smoke dispersion from large fires, atmospheric transport of volcanic ash, chemical releases from industrial accidents and sand and dust storms. The WMO operational network of meteorological centres provides specialized atmospheric dispersion-modelling that plays a crucial role in assessing and predicting the spread of air- and water-borne hazardous substances. WMO's system of eight regional specialized meteorological centres supplies highly specialized computer-based simulations of the atmosphere that predict the long-range movement of air-borne radioactivity to support environmental emergency response, when needed. This response system was activated after the Japan earthquake in March 2011.

As these examples show, building on strategic partnerships facilitated through WMO's Disaster Risk Reduction Programme with the international humanitarian community, new technologies are being leveraged to provide meteorological and climate services for improved humanitarian planning, preparedness and response operations. ■

Conclusion

> "Consider today's online world. The Usenet, a worldwide bulletin board, allows anyone to post messages across the nation. Your word gets out, leapfrogging editors and publishers. Every voice can be heard cheaply and instantly. The result? Every voice is heard. The cacophony more closely resembles citizens band radio, complete with handles, harassment, and anonymous threats. When most everyone shouts, few listen. How about electronic publishing? Try reading a book on disc. At best, it's an unpleasant chore: the myopic glow of a clunky computer replaces the friendly pages of a book. And you can't tote that laptop to the beach. Yet Nicholas Negroponte, director of the MIT Media Lab, predicts that we'll soon buy books and newspapers straight over the Internet. Uh, sure" (Stoll, 1995).

Predicting what today's innovations, including humanitarian innovations, will bring tomorrow is impossible. Do they deserve support because of their demonstrated or potential effect on humanitarian action, or should they be dismissed because of the inherent risks and challenges they raise for communities and humanitarian actors? As always, the answer is somewhere in between. Technology is already bringing valuable contributions in key areas of humanitarian action, as a support for learning or by facilitating citizen participation, empowerment and resilience. The adoption of such technologies is part of a natural evolution for humanitarian action. However, this adoption must be cautious, based on rigorous evaluation, and mindful of emerging challenges, such as the risks of technological failure, digital divides and biases, and threats to humanitarian and ethical principles. Humanitarians must work with governments, the private sector and technology communities to ensure that humanitarian technologies are used to predict crises better, mobilize communities at risk and improve response without compromising humanitarian principles.

Ultimately, new humanitarian technologies are just tools towards better humanitarian action. Humanitarian agencies must fully commit and invest in developing the tools, policies and strategies to communicate better with disaster-affected communities and enable their participation and ownership of humanitarian action. Advances in technology should be used to develop extensive and reliable feedback loops between humanitarian actors and the individuals they are serving, but there must also be the commitment and capacity to use this feedback to improve programming.

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Chapter 2

Chapter 2

Technology and community-centred humanitarian action

Technology is changing how humanitarian disasters are prepared for, responded to and recovered from. More importantly, it is changing how local communities, who inevitably are the first responders, react and improve their actions. Both the directly affected populations and the institutions that pledge to support them are finding new ways to connect, enabling them to better attempt to prevent catastrophes, save lives and rebuild communities.

Despite living in Chicago, more than 9,700 kilometres (6,000 miles) from his native Syria, Zaher Sahloul, a medical doctor, has been busy the last two years helping to treat patients in his war-torn country of origin. He has made six trips on medical missions to refugee camps in Jordan and Turkey and to camps for displaced people inside Syria. In the United States, he has used social media to organize medical supplies and donations worth more than US$ 5 million from the Syrian diaspora in the United States. He has also filmed and uploaded tutorial videos (SAMS, 2012) in Arabic to YouTube that give physicians inside Syria advice on how to treat external bleeding, clean wounds and sew injuries common to warfare. And he has been using a computerized barcode system to track medical supplies and ensure they arrive safely at their intended locations inside Syria (Sahloul, personal communication, 2013).

Regardless of the regular phone and internet blackouts and non-secure communication channels in Syria (Reuters, 2013), Sahloul has been able to communicate with medical personnel on the ground. This has been made possible thanks to internet system engineers like Salah Mamdouh (name changed to preserve real identity), who works with an international non-governmental organization (NGO) that preferred not to be named to preserve their identity. Mamdouh, a Syrian who was forced to flee the country, has helped to establish encryption tools and virtual private network (VPN) accounts, to create secure ways for Syrians inside the country to communicate via the internet (Mamdouh, personal communication, 2013).

Mamdouh says Syrians who manage to get online head to YouTube to share footage of the humanitarian disaster they are witnessing. They also flock to Skype to communicate with family members and to get information and requests to the humanitarian community. Having open channels for Skype calls has allowed Sahloul to connect with hospitals and doctors, some of them former classmates from medical school in Damascus. His organization, Syrian American Medical Society, has collaborated with both local organizations inside Syria and international humanitarian agencies, like the International Rescue Committee and the

This refugee from Darfur listens to Radio Sila in a Chadian camp. Internews, a media NGO, trained local journalists and built radio stations for people displaced from Darfur and host communities. Radio is effective in getting social action messages to a population that is largely illiterate.
© Meridith Kohut/Internews

International Committee of the Red Cross, to coordinate aid and make sure the right kind of assistance is reaching refugee camps and into Syria.

Enabling Syrians to use YouTube, Skype and other online tools has been a useful way for people inside Syria to organize, coordinate and respond to their own problems, and for outside actors, particularly when humanitarian access has been so limited, to try to ascertain need and organize and provide humanitarian assistance.

Your mobile, your life

The collapse of the Rana Plaza garment factory in Dhaka, Bangladesh on 24 April 2013, is another testament to the use of information and communication technologies – in this instance, mobile phones – as a tool for post-disaster recovery. While searching through the rubble of the Rana Plaza, looking for survivors after the building collapsed, civilian rescuer Saydia Gulrukh noticed that many individuals had died clutching identity cards and mobile phones (Gulrukh, personal communication, 2013).

Gulrukh says this response can be tied to another factory disaster in November 2012, where a fire tore through the Tazreen garment factory, also in Dhaka, killing more than 100 people. Government estimates of the missing were low, in part because many families had no records of their loved ones to help identify them. This made it difficult for them to claim bodies and prove that they qualified for benefits.

Gulrukh, a trained anthropologist who heads a small organization called Activist Anthropologist, was also doing research as she helped with the initial recovery at the Rana Plaza building. She wanted to try and get an independent count of the dead, communicate with their families and establish how many people were still missing. Gulrukh did this by accessing SIM cards of the deceased, putting them into a second phone and calling a number from the address book, eventually connecting with someone who could confirm the identity of the person. Activist Anthropologist is trying to hold the government of Bangladesh, in particular the Ministry of Labour and Employment, and the Bangladeshi Garment Manufacturers and Exporters Association (BGMEA) more accountable through a parallel investigation. By connecting with families of those affected or missing, the organization aims to force the government to publish more accurate numbers for missing workers and, as a result, offer proper compensation amounts for their families.

Imogen Wall, the coordinator for communications with affected communities at the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), would not be surprised by the creative use of Skype in Syria's war zone or that of mobile phones in response to the Bangladesh factory disaster.

"These tools are amplifying the capacity of disaster survivors to find resources and to find what they need to get them out of whatever situation they're in," says Wall. "Whether that's being able to call a family member to dig them out or rescue them in a boat in a flood, or the capacity to connect immediately to someone overseas who might be able to send money, or family reunification, or being able to just pull a community together to respond really fast" (Wall, personal communication, 2013).

Are we listening enough?

New technologies – mobile phones, SMS, crisis mapping and social media – increase the capacity for affected communities, diaspora groups and ordinary citizens to access, produce, share and disseminate useful and actionable information and also demand accountability outside the traditional humanitarian circuit (Wall and Chéry, 2011).

Humanitarian actors have begun to adopt some of these tools more systematically in their work, relying on input from affected populations. Yet the question remains: are we listening enough (Quintanilla, 2013)? And, even more critically, what happens to those who fall through the cracks of the digital and age divide? Since the earthquake that shook Japan in March 2011, concerns have been expressed about those individuals who live beyond that last mile of existing communication infrastructure, who nevertheless can experience the full range of consequences of a disaster (Internews, 2013).

There has been important progress, including the birth of the Communicating with Disaster Affected Communities (CDAC) Network, a group of organizations established in 2009 to promote more effective engagement with communities affected by crisis, and the Infosaid project which ran from 2010 to 2012 and aimed to improve information exchange in crisis situations, by making more accurate and timely information available to both humanitarian responders and crisis-affected populations. Yet the humanitarian community has yet to fully realize that communication is one of the most powerful forms of aid and that humanitarian responses are often still undermined precisely because people's information needs are considered a low priority.

BOX 2.1 *Voix des Kivus*: crowdseeding event data in eastern DRC

In 2009, New York's Columbia University launched a pilot project called *Voix des Kivus* in the war-torn province of South Kivu in the Democratic Republic of the Congo (DRC). The project sought to examine how mobile phone technology could be used to gather representative data about conflict events in real time.

Data collection projects based on mobile phone technology have become very popular, and often use a 'crowdsourcing' approach in which anyone with the interest and ability can send an SMS message to a central platform. The *Voix des Kivus* project chose to use 'crowdseeding', i.e., it selected villages through random sampling and identified specific reporters in each village. These were given mobile phones, credit and training, and were invited to contribute to the system. This approach has three benefits for data quality. First, people can participate that otherwise would not, particularly in areas such as the DRC, where the crowd may be small: many live in hard-to-access villages and lack a mobile phone or the funds to send an SMS. Second, by selecting a random sample, the information received is representative of a wider population. Finally, there is reduced scope for faking reports. A crowdseeding system builds a relationship with the reporters, increases incentives to report truthfully and offers the opportunity to verify reports.

The project operated in 18 villages. After villagers agreed to participate, three reporters were selected: the chief of the village, the head of the women's association and one reporter elected by the community. Reporters were trained and provided with a phone and a codesheet that listed possible events. Reporters automatically received a weekly phone credit that they could freely use and were reimbursed for the number of messages sent, but did not receive private benefits for sending messages. Sending messages to the system was, therefore, both free and voluntary. The reporters served as representatives of their villages and could relay information on public events witnessed by others. There was 100 per cent consent (0 per cent non-response) at both the village and the reporter levels.

On the receiving side, a standard mobile phone linked to a laptop comprises the necessary equipment. With freely available software (FrontlineSMS, R and LaTeX), messages received were automatically filtered, coded for content, cleaned to remove duplication and merged into a database. Translations of non-coded text messages (generally from Swahili) were undertaken manually.

Uptake was enthusiastic. In 18 months the reporters sent more than 4,000 pre-coded messages about public events and some 1,000 text messages. Moreover, individual rates of sending showed no signs of abating. The data generated were rich, including regular reports of conflict events (abductions, looting, shootings, sexual violence, etc.) and non-conflict events (crop failures, flooding, etc.). Qualitative verification and cross-validation between reporters suggest that the data are of good quality. The system was demonstrably cheap and workable.

Much of the data received, such as information on violence perpetrated by different actors, was sensitive in nature and this had implications for data dissemination and project scale.

In contrast to a crowdsourcing system, where information is received from an unidentified, anonymous public, a crowdseeding system makes use of identifiable users. This characteristic had three implications. First, to ensure that subjects were not harmed, *Voix des Kivus* did not make all the event data public and more sensitive data were only shared with trusted actors in a position to respond. In practice, data were disseminated through a weekly bulletin in two versions – a non-sensitive version shared broadly and posted on the web, and a sensitive version shared with development and relief organizations in the region. Second, although collective participation in a system like *Voix des Kivus* has the potential for disparate villages to engage with each other more directly and coordinate on concerted action, the project's concern with the protection of participants prevented this type of networking since participating villages remained mutually anonymous. Finally, *Voix des Kivus* only worked on a small scale. If brought to scale, more people – among others, violent groups – would be more likely to hear about the project which might create risks for reporters.

Experience with *Voix des Kivus* shows the feasibility of implementing a crowdseeding system to collect high-quality representative data in real time. However, while proof of concept for the data collection strategy exists, there is no proof of concept that the data collected are actionable. In the 18 months of operation, the project is not aware of any instances in which developmental or humanitarian agencies responded to incidents or issues raised by the reporters. It is possible that the weak reaction was because of the project's small scale. *Voix des Kivus* operated in only 18 villages and the researchers did not want to scale up for security reasons. These problems might be mitigated if the project were implemented by an NGO that can respond and is able to take responsibility for risks to reporters. ■

Mobile information

There are currently 6.8 billion mobile phone subscriptions in the world, according to the International Telecommunication Union (ITU, 2013). That's almost one mobile phone subscription per person, a milestone that should be reached by 2014. Mobile phone penetration rates are more than 100 per cent in high-income countries and around 89 per cent in low- and middle-income countries, as even the most impoverished and isolated citizens now find ways to obtain mobile phones and pay for basic coverage.

This proliferation of mobile phones has enabled aid providers to connect with a volume of affected populations and at a speed that was unimaginable ten years ago. In Sierra Leone, where 60 to 70 per cent of the 6 million residents are connected via mobile phone, the IFRC has launched the Trilogy Emergency Relief Application (TERA) project in collaboration with local telecom providers. TERA allows the Sierra Leone Red Cross Society and IFRC to target specific cell towers around the country, sending humanitarian information via SMS to communities in crisis, allowing the agency to connect instantly with affected communities about floods, wildfires and disease outbreaks.

The IFRC's beneficiary communications delegate Sharon Reader helped introduce the TERA project with the Sierra Leone Red Cross Society: "We can SMS up to 36,000 people per hour to tell them that there's a fire happening in this community or this town, where it's happening, so they can avoid it and not get stuck in the middle of it" (Reader, personal communication, 2013).

The Sierra Leone Red Cross is looking to use TERA for prevention outreach too, by sending a series of daily text messages with information about disease prevention and disaster preparedness. For example, as the rainy season approaches and the risk of malaria increases, TERA could be used to introduce the topic to SMS recipients, explain how to prevent it, what the symptoms are and what to do if they become ill.

In the Philippines, with a population of 94 million, there are already more mobile phone subscriptions than people, driving a culture of connectivity in this nation of islands where Facebook and Twitter, most commonly accessed by phones, have become part of everyday life. In December 2012 the government of the Philippines turned to social media to help prepare for the oncoming Typhoon Bopha (also called Typhoon Pablo). Before the category 5 storm – the most severe – descended with 258 kph (160 mph) winds, flooding and mudslides, officials began alerting citizens via television, internet and radio; and they created a special Twitter hashtag for the storm, #PabloPH, and a mobile-friendly disaster information page that helped people locate disaster shelters and other assistance (Tech in Asia, 2012).

OCHA's Imogen Wall was in the Philippines as part of the humanitarian response to Typhoon Bopha. She says that the reason the tech approach to assisting citizens in the storm was successful was that it was homegrown and made use of communication channels that were already widely used in the country. "Technology is just making visible to us what would have happened anyway," she says. "Communities talk to each other, connect to each other and try to leverage resources to get themselves out of the situation they face. That has always been the case, but when people do it electronically – like in the Philippines where they posted messages on Twitter saying 'Stuck here. Help.' – that makes it visible to us" (Wall, personal communication, 2013).

New media/old media

In October 2012, Hurricane Sandy hit the eastern seaboard of the United States with a ferocity for which few were prepared, including governments, businesses, utility companies, aid agencies, transport authorities and residents. Hundreds of thousands of people lost access to basic resources for weeks. Some residents in the hardest-hit areas, such as Staten Island, Brooklyn and the New Jersey shoreline, lost everything.

In Brooklyn's Red Hook neighbourhood, a small enclave that sits on the Atlantic Ocean and includes that borough's largest social housing community, residents were taken unawares. Tide waters rose up and flooded the neighbourhood, filling not only basements, but first floors of buildings. Thousands of people lost power, heat and water, and the main local food outlets were inoperable or completely destroyed.

For weeks, debris littered the streets of Red Hook, while inhabitants queued for food aid and the US federal government and aid agencies set up offices in trailers to help those in need. And this was in New York City, one of the most resource-rich places in the world.

Ulyses Bermudez, aged 57, did not evacuate his apartment when the mayor of New York, Michael Bloomberg, gave warning of the potential damage a day before Sandy hit. It is the only home he has ever known, and he rarely leaves his tight-knit neighbourhood. Bermudez spent the first week after the hurricane in the dark, as ocean waters had flooded the basement of his building, wrecking its electrical system. Afraid that his apartment might get looted if he left it, Bermudez stayed put, lit candles and listened to his battery-powered radio, waiting for news of the arrival of assistance in Red Hook. Bermudez felt isolated. He had a mobile phone, but not a smartphone, no computer and no electricity for a television. His only source of local news was simply talking to the other residents who stayed behind and messages taped by volunteers to the doors of his building with phone numbers to call for various forms of aid. While Bermudez sat in his apartment listening to the radio, the impact of the storm was being documented and identified on the internet, and a substantial relief response was being organized online. One Red Hook community organization was even developing a crisis map for the neighbourhood. But Ulyses Bermudez was clearly never going to access any kind of aid that relied on him being online (Bermudez, personal communication, 2012).

In the wake of the disaster that hit Japan in March 2011, similar scenarios were commonplace. Japan is a media- and information-rich, digitally enabled society, but the regions worst hit by the tsunami – Iwate, Miyagi and Fukushima – were predominantly fishing and rural areas with declining populations, 30 per cent of whom were over 60 years old. Many of the inhabitants were, like Bermudez in Brooklyn's Red Hook, unaccustomed to accessing information online, unfamiliar with social media networks and, therefore, unaware of the relief resources available to them.

Knowing what information people need, what channels people use and – very importantly – trust, and how they communicate within their own communities and with the outside world is the first step to providing aid more effectively.

Kyla Reid is the head of disaster response for the GSMA, a mobile phone industry association that brings together more than 800 of the world's mobile providers. Reid specializes in ensuring mobile networks are available as essential tools in the wake of crises. She is well aware that technology is not always a saviour, or even an available tool, in a disaster situation. "You can prepare the networks as much as you want," she says, "but if you get a 100-year storm or a really severe earthquake, there are going to be interruptions – service interruptions and other kinds of problems. And often, it's actually congestion on the networks of people calling in and calling out than actual damage to the infrastructure" (Reid, personal communication, 2013).

In addition, communities and responders must also remain acutely aware of the likelihood of a technology blackout and are often obliged to come up with strategies to work around the absence of information and communication. In October 2012, in the Brooklyn neighbourhood of Rockaways – hard hit by Hurricane Sandy – Elizabeth Knafo worked as part of Occupy Sandy, a relief effort organized out of funds and networks left over from the resistance movement Occupy Wall Street. While many 'occupiers' were busy making sure affected residents were dry, safe and had basic necessities, Knafo and a small group of other responders went out with notepads and pens and began to do field research. Knafo says there was no consistent information available to the affected communities and, with mobile phones and internet down, people were, literally, in the dark. So she and her colleagues began to organize the information that seemed most essential and in demand from locals, and they created a bulletin dedicated to what storm-affected communities needed to know. "It seemed obvious that, in a place that had no electricity and no phones, the little information that was out there was not going to be acceptable. We just wanted to get as much of that info as we could and print it onto paper. We also wanted to create a little more coherence," she says (Knafo, personal communication, 2013).

The *Sandy Relief Bulletin* was born and included information about recovery, shelter, food, transportation, clean-up, emergency benefits and more. Some 50,000 copies were printed, using funds supplied from the Occupy movements own Occuprint printing collective, and were distributed in Rockaways, Red Hook and Staten Island, some of New York's hardest-hit areas. The bulletins were deposited at aid distribution hubs and made available along with other assistance. A second bulletin was printed a week later and included a map of recovery centres and aid agency outposts. It also published information about disaster unemployment insurance and advice on how to stay warm as temperatures dropped.

Knafo and her colleagues received e-mails from the US Federal Emergency Management Agency and the American Red Cross, inquiring if the group planned to print more copies. She says many of the more essential recovery agencies and the city and federal governments had their forms and deadlines for assistance available only online, where many could not access them due to lack of electricity or internet access.

Knafo's experience in New York is corroborated by that of Hiroyuki Takeuchi, editor of the *Hibi Shimbun*, a local newspaper in the Ishinomaki area of Japan. Immediately after the tsunami in 2011, with his newspaper's offices flooded, no power and the printer broken, Takeuchi sent his six reporters to gather information from the city hall and affected areas, which they reached on foot. The day after the earthquake, reporters handwrote headlines on a giant piece of paper. "People were so hungry for information we could barely stick the paper on the wall at relief sites. If there is no information after a disaster people become even more stressed and anxious. Old media works best in emergencies," he says.

According to Keiichi Saito, a community radio station manager in Tome, Japan, who got back on the air immediately after the disaster by relocating his broadcasts to the hill where his antenna was located: "People act more calmly with a radio. With visual information, people may panic more easily. Also, a radio is good because it is portable and even old people know how to use it." In the first few days after the disaster, Saito's broadcasts helped people get the information they needed about the scale of the destruction, basic resources like food and water, and updates on the local electrical grid.

Japanese citizens outside the impact zones were able to use all kinds of different media to search for loved ones, including the popular Google Person Finder. But Saito says being connected online was a luxury for those who were safe and sound. "The internet is useful for people outside of the disaster area, but inside the area, the power and network are often cut, so it's not useful right after the disaster, when we really need information. In addition, too much information can lead to confusion" (Saito, personal communication, 2013).

In addition to advances in technology, it is necessary to continue to use and support more traditional methods of information and communication, such as community radio stations. Their crucial role is under-acknowledged, however, and funding for them is very limited.

BOX 2.2 Communications, technology and crowdsourcing during the 2011 Japanese earthquake

As a leader in both disaster preparedness and advanced technology, Japan's civil society used everyday tools in unique ways to communicate and share information in the wake of the March 2011 earthquake and ensuing tsunami and nuclear accident. Examples of such platforms include Twitter and Sinsai.info.

Some of the worst-affected areas were without power or access to phones and internet for weeks, but in other areas internet services remained accessible even where mobile phone networks were down. Japan is the third-largest user of Twitter after the United States and Brazil, and Twitter use rose from an average of 3,000 inter-country messages per minute to 11,000 on the day of the earthquake (Kondo, 2011). These tweets included urgent pleas for assistance, which were organized by a hashtag spontaneously created by a Japanese user and re-tweeted across Japan; those who saw the messages contacted rescue centres. Others tweeted assistance requests directly to top officials including the US ambassador to Japan and the deputy governor of Tokyo, and quickly got their attention (Appelby, 2013; Sternberg, 2011). Twitter is by nature public, so even if the officials themselves did not notice the tweets initially, others around them could bring them to their attention. Before the age of Twitter, it would have been almost impossible for the average citizen to mobilize critical resources so quickly through top officials with just a few taps on a smartphone.

Sinsai.info is the Japanese version of Ushahidi, an open-source crowdsourcing platform that was originally created to document and map eyewitness reports of violence after the 2007 Kenyan presidential election. It was also used after the 2010 Haiti earthquake where survivors texted requests for assistance, which were in turn translated, organized and mapped by a team of volunteers in Boston (Heinzelman and Waters, 2010). Sinsai.info was launched four hours after the earthquake, and volunteers manually geo-tagged and mapped more than 12,000 reports mostly from Twitter feeds using OpenStreetMap and satellite imagery provided by the Japan Aerospace Exploration Agency, categorizing them into types of resources such as evacuation shelters, open food stores, gas (petrol) stations and mobile phone charging centres (Katoh, 2011; Inoue and Seki, 2011). It also mapped requests for assistance from survivors stranded at nursing homes and hospitals.

In a crisis, individuals need to be able to navigate quickly through information and access what is relevant for them. For the end user, whether a survivor searching for evacuation shelters or a responder searching to rescue people stranded in flooded buildings, information must be organized in such a way that it is intuitive to navigate and offers actionable data. Sinsai.info's effort to map reports made it easy for users to visualize quickly what was happening where, thus enhancing situational awareness. While Sinsai.info may not have been used as often by those hardest hit by the disaster, possibly due to issues including limited internet access, lower digital literacy in a more elderly population and low familiarity with the system (Appelby, 2013), there is great potential for these tools to be used in the future to conduct needs assessments rapidly and map locations of passable roads and evacuation centres and hospitals with their updated needs.

On the other hand, whether the user actually makes decisions based on the visualized information depends on a number of factors, including familiarity and level of trust in the system. In terms of disaster-affected populations in Tohoku, the most frequently used communication tool on the day of the earthquake was radio (68 per cent), while 38 per cent reported using non-smartphone mobile phones, 20 per cent used internet on personal computers, and only 6 per cent used smartphones (Information Support, 2011). Internet use increased to 55 per cent within the first week, but usage of smartphones remained at 7 per cent and none of the survivors interviewed by a field research team was aware of the Sinsai.info crisis map (Appelby, 2013). In the worst-affected areas, 26 per cent of the population is aged over 65 (Statistic Bureau, 2012) – a vulnerable, elderly population with, probably, low levels of digital literacy. Radios offered real-time local information that affected decision-making. In Haiti, SMS texts were used to send information and the Ushahidi team could contact the sender to verify information. In Japan, however, texting is not commonly used, so Sinsai.info mapped tweets, many of which were not directly from people in the worst-affected areas, but were secondary or tertiary information from people who had heard from the Tohoku survivors (Asakawa, 2011). Thus, the information was not necessarily real time, and there was no system to confirm the accuracy of the information.

Sinsai.info's effectiveness cannot be measured based on its impact on operational decisions, as it was intended not to transmit information, but to select and organize it (Katoh, 2011). However, it is still important to consider its role and implications. As was the case after the Haiti earthquake, it is difficult to measure the actual impact of crowdsourced mapping. For Sinsai.info, more than 500,000 users accessed the site, and there were reports of individuals responding to requests for assistance by connecting them with the Japanese Self Defense Forces (Inoue and Seki, 2011). However, no direct line of communication existed between those running Sinsai.info and assistance teams. By comparison, the Ushahidi team had established relationships with responders before the Haiti earthquake (OCHA, UN Foundation and Vodaphone Foundation, 2011), and there was a system of flagging urgent medical needs and communicating those needs through a direct line of communication with the US marines (Heinzelman and Waters, 2010).

Crowdsourced mapping can be a powerful tool to guide decision-making in humanitarian assistance. In setting up such a platform, it is important to consider carefully its role, purposes and strategic partnerships with different stakeholders before the disaster strikes. While low-tech tools such as radios remain an important lifeline in disasters, in the future, they need to be combined with newer technology, including crowdsourced mapping, to improve disaster response. It is also essential to establish a link between volunteer technical communities, local and national emergency management agencies and disaster responders. ■

Giving and supporting differently

An estimated US$ 43 million was donated by people in the United States via SMS to help with relief in the aftermath of Haiti's 2010 earthquake. According to *Real Time Charitable Giving*, a Pew Internet Project and Knight Foundation report (Smith, 2012), most of these donations were made through mobile phones, with a majority of donors using that method for the first time. Since then, around half of those original donors donated again in the wake of the 2011 Japan earthquake and tsunami. People in the United Kingdom have also been donating millions of pounds to disaster relief in places like Somalia and Syria through mobile and online networks.

But mobile giving is not only a Western innovation for disaster response. In fact, it has caught on equally fast, if not faster, in low- and middle-income countries. Pointing to the Haiti earthquake, the GSMA's Reid says mobile money transfers also flowed from diaspora communities who could give directly to friends and relatives.

She also says local communities in low- and middle-income countries have found mobile money transfer a way to support people in their country of origin. "I think that there is a reality more important than allowing people to connect with responders, but now it is allowing people to connect within their own communities before any outside help arrives" (Reid, personal communication, 2013).

During the 2011 famine in East Africa, a coalition of Kenyan government, civil society groups and businesses set up and promoted a mobile transfer initiative to help farmers in the north of the country. Asking for the equivalent of 10 US cents from donors, they were able to raise hundreds of thousands of dollars in relief (BBC, 2011). A similar initiative was launched in Turkey, where 100,000 SMS messages were sent in a campaign to raise funds for Somalis affected by famine (World Bulletin, 2011).

Indeed, Kenya has become a world leader in the use of technology as a development tool, including through the widespread use of mobile money transfer. "More than 16 million adults in the country utilize M-PESA and majority are in the rural areas," says Nicholas Wasunna, a mobile money expert in a leading telecommunications company in Kenya. Wasunna says it is not just people buying essentials and sharing money with friends and family. He says users in rural areas, specifically women, have also found mobile money to be a community development tool, "let's get together and raise some funds to dig a borehole in our community, or let's build a school, or let's build a dispensary or hospital, or let's put some money together to buy some fertilizer for our produce, or medicine for our families or livestock. Within those communities you'll find groupings of 5, or 50, or 100 women, collecting money using different means and mobile money has provided a useful avenue for such collections" (Wasunna, personal communication, 2013). Electronic cash transfer is also a rapidly growing tool for humanitarian action, including payment of vouchers for food or shelter.

Increasingly, partnerships are being formed by relief organizations and local Kenyan telecoms to distribute aid more efficiently. The World Food Programme (WFP) is currently partnering with M-PESA to make sure drought-affected populations in northern Kenya are getting the food they need (WFP, 2012). Around 16,000 participating families were given a mobile phone, a SIM card and set up with M-PESA accounts as part of a three-month pilot programme. They receive about 3,000 Kenyan shillings a month (about US$ 35) to buy groceries at local markets. Sara Belfrage, WFP programme officer, says there was some concern that handing over money, instead of food, might backfire. "Of course you can never be sure, but if you target right and reach food insecure people, their first need is to buy food. Women make up an 80 per cent majority of the beneficiaries. We also monitor the projects and those reports show that they are spending the majority of the money on the food" (Belfrage, personal communication, 2013).

BOX 2.3 The use of new technologies for cash transfer programming

In recent years, advances in new technology in low-income countries are leading to a growing interest in how they can best serve humanitarian responses (Smith et al., 2011). The world now has more mobile-connected devices (mostly phones) than it has people and mobile penetration in Africa is about 70 per cent, reaching 735 million subscribers in 2012, up from 4 million in 1998 (OCHA, 2013). Technology is considered to have the potential to detect needs earlier, enable greater scale and speed of responses, enhance specificity of resource transfers to match needs and increase accountability while reducing opportunities for corruption and diversion.

The humanitarian sector has also experienced rapid uptake in the use of cash transfer programming (CTP) as a tool for humanitarian response. From 2007 to 2010, humanitarian aid spending on CTP increased from US$ 1.8 million (0.7 per cent) to US$ 52 million (25.9 per cent) (Global Humanitarian Assistance, 2012). This has, in part, been enabled by the advances, availability and adoption of appropriate technology, even in the most remote and insecure areas. The use of electronic transfers for CTP has increased significantly in the humanitarian sector and is becoming increasingly recognized as an effective intervention in emergency contexts. The World Food Programme, for example, in 2012 delivered 50 per cent of the US$ 340 million of cash assistance it provided by electronic means.

CTP is an area where innovative ideas – including those involving new technologies – can have huge impact. The Cash Learning Partnership (CaLP), a consortium of Oxfam GB, the British Red Cross, Save the Children, the Norwegian Refugee Council and Action Against Hunger/ACF International, aims to improve the quality of emergency cash transfer and voucher programming across the humanitarian sector by raising awareness of CTP as an appropriate and effective mechanism for emergency response, building capacity in the use of cash and vouchers, gathering evidence through research and encouraging learning and knowledge-sharing among humanitarian actors. CaLP is at the forefront of efforts to improve guidance, provide tools and build capacity in the use of new technologies that support quality programming.

In 2011, CaLP commissioned and released a research report, *New Technologies in Cash Transfer Programming and Humanitarian Assistance* (Smith et al., 2011). Research was undertaken to explore preconditions for the use of technological mechanisms identified, user-friendliness of the technology for the recipient and the agency, issues concerning accountability and potential for wider impacts. Three types of technology currently being used in aid programming – electronic payment systems, use of mobile phones and digital data-gathering tools – were examined. The report outlines suggested actions to move towards more systematic adoption of effective and accountable technological solutions in humanitarian aid and concludes by making recommendations for humanitarian actors in differing technological environments.

There is now growing recognition that electronic payment (e-payment) systems have the potential to provide more efficient and reliable delivery for cash payments. Almost 50 per cent of social transfer programmes launched globally in the past decade (mostly in middle-income countries) use electronic payments (NAO, 2011). Manual payment arrangements are assumed to be inherently prone to inefficiency and risk, particularly in isolated rural areas, to divert staff from core responsibilities and to impose hidden costs. This change is partly driven by a desire to realize cost savings. An analysis to estimate the aggregate benefits that would accrue to the Indian government if it connected all poor households to an e-payment system found that automating all government payment flows could save up to US$ 22.4 billion per year, or 8 per cent of total flows. Inefficiencies were found to be based on leakages (75–80 per cent of total losses), transaction costs (15–20 per cent of total losses) and administrative and overhead costs (5–10 per cent of total losses) (Lochan et al., 2010).

The report's three main conclusions are that where mobile connectivity is already established in an area and technological solutions exist, agencies and donors should develop standard approaches to support systematic adoption of new technology in programmes to improve efficiency and effectiveness of aid provision. In areas where emergencies are chronic or recurrent, there should be a push to develop new financing models to meet costs of investment and for preparedness frameworks between donors, agencies and solutions' providers. When an area with limited infrastructure or technology is hit by a sudden-onset disaster, it is not the right time to start implementing new ways of working or try out new technology. However, the humanitarian community operating in these contexts should stay abreast of developments and seek to advance the development of such solutions and of network connectivity where possible.

In a context where technology is evolving rapidly, practitioners need to better understand what options are available, and when and how to access and utilize them. Underlying this is the need to ensure continued accountability – to both donors and affected populations – and to enable more systematic adoption of effective and accountable technological solutions in humanitarian aid. ■

The 'exciting' (and unstoppable) world of two-way communication

The WFP office in Kenya, having given mobile phones to 16,000 families in drought-stricken northern Kenya, knew they had a captive audience. And they wanted to do more with the mobiles than just initiate their normal aid mechanism of providing assistance. They saw an opportunity for local community empowerment and capacity building, and for WFP, the potential for greater transparency and greater accountability.

Using a WFP mobile accountability pilot project in Pakistan as a model, Belfrage helped develop a feedback and comment hotline for Kenyan families already receiving the money transfers. Little by little, people began to call: "Complaints come in about delays in cash, questions about when people would receive cash, or technical issues. We had a few cases related to fraud and corruption that we also managed to solve" (Belfrage, personal communication, 2013).

All calls to the WFP feedback service go to a central hub in Kenya's capital, Nairobi, and once the problems and solutions are determined, WFP forwards the cases to regional partners who can then respond in person.

Pakistan-based WFP programme assistant Syeda Zahra manages the original pilot feedback project. Zahra cites a cash-for-work programme where Pakistani villagers did not receive payments promised for the road and bridge work they were doing. They contacted the WFP office through the feedback hotline and WFP was able to fix both the immediate payment problem and the longer-term problem of monitoring their local partner better (Zahra, personal communication, 2013).

This idea that humanitarian agencies are opening up to two-way communication channels with affected people is 'exciting' to many. Will Rogers, IFRC's global coordinator for beneficiary communications, says as local communities continue to connect more, they also begin to assert themselves more with aid agencies. He says with access to mobile phones and the internet, affected people are already demanding more transparency and accountability (Rogers, personal communication, 2013).

"The days of silent, passive recipients of aid are over," wrote Information and Communication Technologies for Development (ICT4D) expert Wayan Vota in May 2013. "In the future, probably even before 2018, communications in aid will be more from those in the middle of the crisis situation out to the world than any of us in development can imagine. What I can imagine is a future where those in a crisis tell us what they need and want- and don't – and are loud and forceful enough in their communications that they drive the development process, not us." Vota's vision echoes that of Toby Porter, Save the Children's emergencies director, who said in 2007 what today does not seem such an unachievable dream: "In the humanitarian operation of the future, beneficiaries of emergency aid will use technology to tell us what they need – cash, food or education – find out from us what to expect, and track its arrival, just as we track an order from Amazon.com now."

International aid consultant Paul Currion says that while positive, this transition to hearing more from local communities may pose problems for humanitarian agencies. "Because more and more people have access to information, the same information we do, they can ask, now hold on, why did you decide to do that instead of that?" he says. "Now that criticism is good, it should open and increase our accountability, but I do believe we are just not prepared for it. We're not looking

In Sri Lanka, a boy in an IDP camp looks at posters promoting *Lifeline*, a service run by media NGO Internews. *Lifeline*'s radio programmes and free newspaper carried news and information for IDPs and ensured their voices were heard.
© Jacobo Quintanilla/Internews

at how to improve decision-making processes and accountability both upwards and downward in response to new pressures" (Curion, personal communication, 2013).

The American Red Cross released a survey in 2010 that showed respondents increasingly considered social media, e-mail and web sites as potential alternatives to dialling 911 (the emergency phone number in the United States) in an emergency (PR Newswire, 2010). Of those surveyed, 74 per cent said if they posted a call for help on Facebook or Twitter, they expected a professional response within an hour.

BOX 2.4 Technology, communications and services during disaster

Social engagement has brought about a fundamental shift in the way people engage with each other and with organizations. It has also changed the way the American Red Cross does business: the Red Cross has committed to making social engagement part of its operational DNA, impacting outreach to the public, engagement with disaster-affected communities and operational decision-making processes.

One example is the American Red Cross Digital Operations Center (DigiDOC), which opened in March 2012. Funded by Dell computers, DigiDOC synthesizes 'big data' social conversations into situational awareness and, often, anticipatory awareness. It allows social media posts from the disaster-affected area to be tracked and integrated into response decision-making. While DigiDOC is often staffed by the social engagement team, trained digital volunteers work remotely to engage with affected people, providing information, real-time tips, resources, comfort and confidence via social media tools. By routing requests for assistance received through social media to the disaster relief operation on the ground, the centre has opened up an easy-to-use channel for affected populations to communicate directly with the American Red Cross. Their input can be used by decision-makers in real time to determine the best course of action.

When Hurricane Sandy (although it was no longer technically a hurricane, but a superstorm when it made landfall) hit the north-eastern coast of the United States in October 2012, DigiDOC's team had already been at work for hours, sharing storm safety tips and providing support to those waiting for the storm to make landfall. For six weeks, 31 digital volunteers, along with American Red Cross staff, tagged and categorized more than 10,000 social media posts, responding to 2,386 of them. In total, more than 2 million posts were tracked. The team responded to hundreds of additional posts on the American Red Cross Facebook page and message box. Online conversations informed national headquarters teams about specific needs on the ground, resulting in adjustments in service delivery plans where needed. The team also pushed out information on service locations to help community members find the services they needed. In areas where the American Red Cross's physical reach was limited, the DigiDOC team helped facilitate neighbour-to-neighbour conversations and direct people to local resources, empowering communities to help each other and themselves.

The American Red Cross has also used technology to engage with people through a suite of preparedness apps. Beginning with the First Aid app, which was adapted from the British Red

Cross, the American Red Cross released apps for hurricanes, earthquakes, tornadoes and wildfires that have helped put critical information into the public's hands before, during and after emergencies or disasters. Available on both Apple and Android platforms, the apps have been downloaded nearly 3 million times in less than a year, and most have received a 4- or 4.5-star (out of 5) rating for usefulness, content, user experience and ability to save lives.

Before and during Hurricane Sandy, users of the Hurricane app read preparedness information, tracked the storm's direction, checked American Red Cross shelter locations and shared early warning messages via social media. Immediately after the storm made landfall, app users could search for open shelters and let loved ones know that they were safe. The American Red Cross later added recovery information to the app, including locations of American Red Cross vehicles carrying food and water, locations of government-run disaster recovery centres and open gas (petrol) stations. The ability to update and add content in direct response to users' specific needs was a key component of the Hurricane app platform, and distinguished it from others.

Screenshots from the American Red Cross Hurricane app.
© American Red Cross

To expand the utility of similar tools, the Global Disaster Preparedness Center, established by the American Red Cross and the IFRC, is piloting a platform to allow Red Cross Red Crescent societies to localize apps, with translation, content changes, image swapping and branding. This 'universal app approach' will provide access to existing apps to other National Societies that are interested in accessing the technology for their own use, providing efficient and cost-effective access to app development. This will be of interest to countries with large urban centres and a high penetration of mobile subscriptions, but these apps can also provide life-saving information for millions of people in hard-to-reach places.

The American Red Cross is also developing a cash grant system for use in international emergency relief operations. Using mobile banking, this system will provide individuals with increased decision-making power and flexibility by providing cash grants in place of relief items. Although many people in low- and middle-income countries may not have traditional bank accounts, a growing proportion does have mobile phones. Mobile banking allows individuals to send and receive funds securely, pay for goods and services, and withdraw cash using technology that they already own and use.

In 2013, the American Red Cross is piloting the use of mobile phones for cash transfers in East Africa in partnership with the IFRC and regional National Societies. This builds on previous programming in Haiti that began in 2010, when the Red Cross used SMS texts and remittance companies to deliver cash grants to thousands of earthquake survivors. Using a unique PIN number sent by SMS and government-issued identification, affected people collected cash grants directly from remittance companies. American Red Cross staff also used mobile devices to monitor the programme, which allowed for real-time aggregation and reporting of monitoring information.

Through social media and mobile devices, the American Red Cross's response to Hurricane Sandy had a virtual presence to support its presence on the ground. This kept individuals informed and provided critical data that helped inform relief operations. While volunteers provided traditional disaster response services, apps and digital volunteers provided information to affected populations at a speed and reach unimaginable before social media and mobile devices became ubiquitous. Internationally, the American Red Cross is also using the power of mobile devices, particularly phones, by making important information and aid itself, in the form of cash, available to disaster-affected people at the touch of a finger. ■

The IFRC's Will Rogers says this kind of expectation is precarious, especially when considering almost everyone now has access to a mobile phone. If an organization solicits requests too openly, it also risks creating expectations that it cannot fulfil.

Tools to the people: DIY

Graphic designer and developer Samia Kallidis says modern humanitarian disasters are a reminder that governments and aid agencies cannot determine or cover every need, especially when the volume is so great. "For many little things, individuals can have the tools and power to do or get help for themselves" (Kallidis, personal communication, 2013). She says in a lot of ways, local citizens, connecting with local businesses and resources, can get some of the important recovery work done. After Hurricane Sandy hit, the New York-based Kallidis began spending time in local disaster zones, talking to residents, volunteers, local organizations and aid managers. What she saw was an amazing desire and energy from communities themselves to become problem-solvers, but a lack of organization and streamlined process to put people and skills to good use.

From this experience Kallidis created a mobile application called Jointly, which helps connect people affected by disaster directly with volunteers who can help. The start screen invites users to 'get help' or 'give help'. Moving forward through the application, people can select the specific help they need or skill they have, and then put a call out to get connected. "It will not solve every problem, but it gives people tools so they are able to start doing small things that really make the biggest difference in the recovery process. Even connecting people strengthens the community, being able to use resources more efficiently," she says.

Kallidis's theory behind Jointly is that communities are capable of dealing with many facets of disasters. Her app simply organizes the talents and needs available in a geographic area and mobilizes them. It also begins to build a community before disaster strikes, which enables the community to communicate, organize and get things done quicker after the event.

Consultant Paul Currion says it is increasingly clear that communities are better equipped to communicate and share important information with each other. "In the last five years, humanitarian organizations have become less important, particularly in politicized emergencies" (Currion, personal communication, 2013). Whether it is sending information, remittances, clothes, building materials or food, diasporas and local citizens, aided by technology, are increasingly creating a do-it-yourself approach, in some ways competing with humanitarian agencies.

When tornadoes devastated parts of Oklahoma in May 2013, groups of citizens from New York City areas damaged by Hurricane Sandy jumped in trucks to transport donations and relief materials to the affected areas. Currion says that enthusiasm to 'pitch in' is a positive trend in many ways. And although he does not foresee the humanitarian sector becoming totally obsolete, he does worry that a diminished professional humanitarian presence is problematic in other ways. "I think the humanitarian sector is not a delivery mechanism for humanitarian assistance, it's a delivery mechanism for humanitarian values. But, if our role of deliverers of humanitarian assistance is put by the wayside, becomes less important and we become less relevant, then we can no longer deliver humanitarian values. So we face this problem: at the same time [as] people are able to help themselves more, the basis of humanitarianism as we understand it, as a principled approach to helping people, could itself become eroded" (Currion, personal communication, 2013).

But this debate about who will provide humanitarian assistance in the future has more than two potential scenarios. Messages of resilience and empowerment – and information as a form of assistance – are often best delivered by individuals who have connections to both local communities and humanitarian agencies.

In the summer of 2008, as Sri Lanka's decades-long civil war became more heated, Ramanan Santhirasegaramoorthy's voice became more and more crucial. He was the chief editor and host of a daily radio programme, *Lifeline*, that broadcast news and information for people displaced by war about their situation, where to find basic resources, how to stay safe and how to connect with humanitarian and government agencies that could help them. Internews, an international media development NGO, trained Santhirasegaramoorthy and his newsroom on humanitarian principles, how to cover disasters, how to liaise professionally with government officials, military and humanitarian organizations and how to connect and interact with listeners in need. When the war ended, Santhirasegaramoorthy, like many other Sri Lankans, decided to leave the country, settling in Toronto, Canada, home to one of the largest Sri Lankan Tamil diaspora populations in the world.

A year ago, Santhirasegaramoorthy began broadcasting again, on a new Toronto-based Tamil language station, Vannakam FM. In addition to providing music and entertainment, he started some programming reminiscent of the *Lifeline* show that got people through the war.

His new call-in programme tackles resettlement issues: how to adjust to life in Canada and how to deal with the stress of living and working in a Western society.

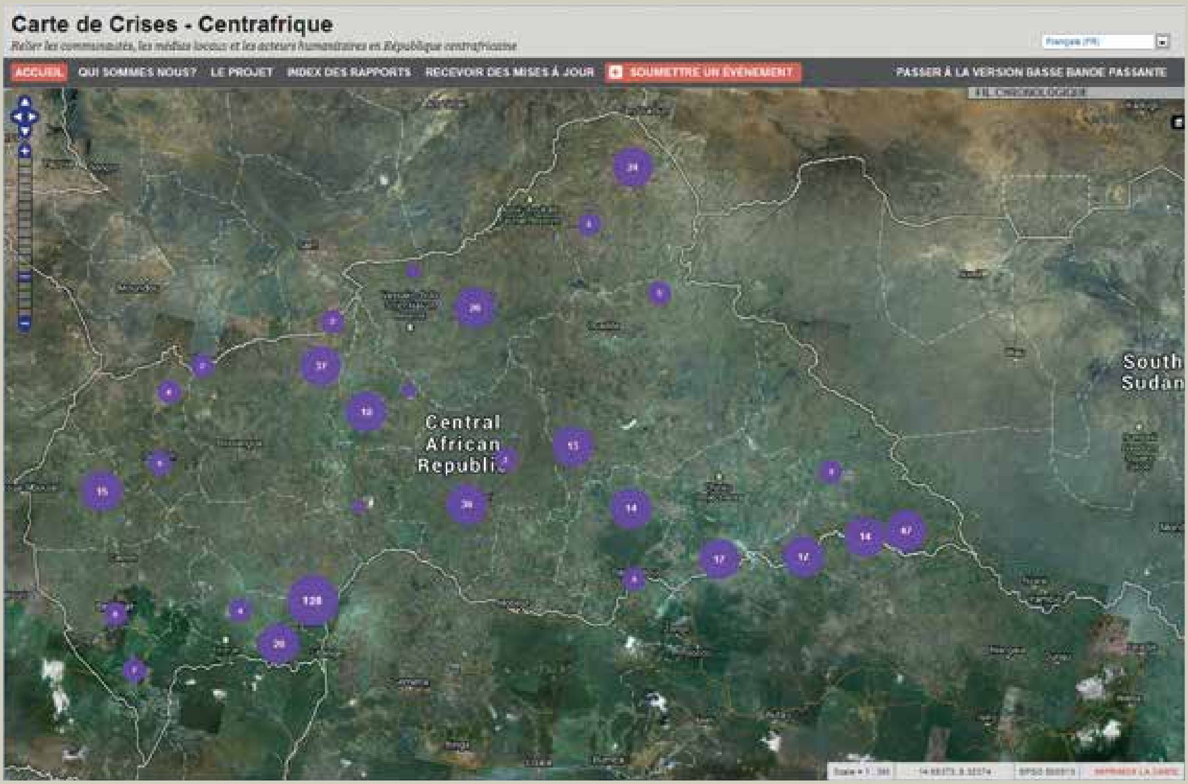
BOX 2.5 Combining local radio, SMS and crisis mapping

The Central African Republic is one of the United Nations' 34 least developed countries and faces endemic crises, corruption and inexistent infrastructure. In 2012, Internews and its local partner, the Association of Journalists for Human Rights, launched a crisis map in partnership with Ushahidi (a non-profit software company) and OCHA to gather real-time, first-hand information from populations across the country through an enclosed network of trusted local media organizations and community correspondents.

While half of the humanitarians interviewed at the end of the project consulted the map on a regular basis, all reported improvement in their relations with media, leading to increased contacts and collaboration. Journalists reported improvement in information collection and sharing.

Humanitarians, however, played a mainly passive role. They consulted the reports and maps, but contributed little. Of 346 messages featured on the humanitarian map between February and August 2012, only two were issued by humanitarian organizations. The information from the map and reports did not directly influence decisions or actions. This is partly due to their reliance on their own information networks and to mistrust of media and crowdsourced data on the grounds of validity and risks.

The journalists' contribution to the humanitarian map also varied greatly. Half of the radios involved in the project did not send any messages. The lack of training in handling the system, and more generally in journalism, were major issues. However, 4 of the 11 radios involved in the programme received more than 100 SMS a month from their listeners between May and July 2012. These messages, once verified and vetted, were sent on to the crisis map.



A crisis map of the Central African Republic was created based on information gathered by a network of local media organizations and community correspondents.
© Internews

The problems encountered in achieving the project's goal of improved communications with affected communities had less to do with technology than with the relations between actors and capacity development. Changing behaviours and ways of thinking and doing are, however, always difficult.

The Internews project, entitled 'Integrating local media and ICTs (information and communication technologies) into humanitarian response in Central African Republic', and its crisis map of the country, were cited as good examples of improving information for and communication with affected populations in an innovative way in the *State of the Humanitarian System 2012* report published by the Active Learning Network for Accountability and Performance. ■

Santhirasegaramoorthy says he has been getting calls from listeners telling him they used to listen to his programmes in Sri Lanka and that it's comforting them to hear his voice in their new home, giving them information of the same quality that they can use to help themselves in their new homes (Santhirasegaramoorthy, personal communication, 2013).

Conclusions

To understand the local information 'ecosytem', responders need to determine what technologies and platforms might be useful before, during and after disasters. They must listen to and understand the local environment. The answer may well include local radio, community mobilizers, SMS or crisis mapping. Responders will also need to foster coherent communication with local communities in need, by linking up with the people affected by the crisis, local media, government, business and civic groups, and by listening to how people on the ground are communicating with each other. Does the local community radio station have a loyal base? Or is the small newspaper considered a more reliable information source? Who are the local mobile phone providers? Are they already working on ways to get messaging out? If not, what can be done to help restore different communication networks?

This reaffirms Paul Currion's advice that the humanitarian sector needs to keep an eye on what is effective in terms of technology and communication, not just what is new. In other words, what matters is communication, while the choice of tools is secondary. New media may not always be more appropriate. It is also important to avoid using technologies in post-emergency settings in ways that exacerbate inequalities and create divisions based on levels of technology and access to information.

This further points to the need to 'keeping it simple'. Communicating via radio, print and even word of mouth remains highly efficient. Getting the message out in a disaster should use all available means. OCHA's Imogen Wall says that, ultimately, introducing new technologies without listening first to local communities, especially after an emergency has already occurred, can complicate matters. "In the first days and weeks, if you actually want to talk to people, it is most effective to default to old-fashioned, simple, straight-forward low-tech stuff (Wall, personal communication, 2013).

The greatest implication of opening up new and more accessible methods of communication and opportunities to inform affected people is that humanitarian agencies will be more scrutinized. IFRC's Will Rogers says that while the aid sector might open up to two-way conversations, agencies also need to be prepared when the questions, and complaints, come in (Rogers, personal communication, 2013). At the same time, there is a risk of raising expectations and possibly frustrations among affected populations.

This type of communication will require effective collaboration and coordination among humanitarian agencies, media development organizations and technology groups, and with local governments. It must also take into consideration more effective partnerships with the private sector. GSMA's Kyla Reid says that it is time for these kinds of private–public partnerships to become more common, between humanitarian actors, governments and technology and telecom businesses. "I think it's in everyone's interest, especially [that] of the private sector, to have those partnerships developed before a disaster occurs because nobody in the immediate aftermath wants to be dealing with MOUs [memoranda of understanding] and figuring out the right people to talk to in different agencies. That kind of preparedness and professionalization make those relationships more sustainable and more predictable when disasters do happen" (Reid, personal communication, 2013).

In this sense, it is important to note the role played by the CDAC Network, a ground-breaking cross-sector initiative between aid agencies, UN organizations, the Red Cross Red Crescent Movement and media development organizations, that recognizes information and two-way communication as key humanitarian deliverables.

Ultimately, the best way to create empowerment and resilience within disaster-affected communities is by investing in developing the capacity of community members to be the responders and organizers of their own relief. When Port-au-Prince, Haiti was hit by the 2010 earthquake, one of the most effective responses was by a radio DJ, Carel Pedre, who realized his station's signal was still working, got on the air and, within days, had improvised an internationally accessed family reunification system, using the radio, Facebook, Twitter and a small staff to locate loved ones around Haiti (Wall, personal communication, 2013). Pedre was sharing information gathered from the humanitarian sector and was the ideal messenger, because he was a local voice, with a built-in audience and community trust.

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Chapter

3

Strengthening humanitarian information: the role of technology

When disaster strikes, access to information is as important as access to food and water. This link between information, disaster response and aid was formally recognized in the *World Disasters Report 2005* (IFRC, 2005). Since then, the vast volume of crisis information generated and consumed during emergencies is increasingly digital and user-generated. Indeed, affected populations are increasingly able to source, share and generate a vast amount of real-time information, which is transforming the humanitarian information landscape. Humanitarian organizations are also adopting geospatial and mobile technologies such as smartphones for rapid digital data collection, allowing them to rapidly collect structured and geo-referenced data in multiple formats, such as text, image, video and voice. And so, while humanitarian organizations typically faced a vacuum of information following sudden-onset disasters with limited situational awareness that could only be filled by humanitarians on the ground or via established news organizations, one of the major challenges today is the colossal volume of big data produced by affected communities themselves.

That said, disaster-affected populations are not simply passive producers of big data during disasters. Empirical research has clearly shown that local communities save the most lives following a disaster (Gilbert, 1998). In fact, "no more than 10% of survival in emergencies can be attributed to external sources of relief aid" (Bankoff, Frerks and Hilhorst, 2004). By definition, disaster-affected communities are, and always have been, the real first responders. Moreover, disaster-affected populations have always self-organized in times of crisis regardless of external intervention. Humanitarian professionals, after all, cannot be everywhere at the same time; but the 'crowd' is always there.

Self-organization in a digital world affords many new opportunities that were unfeasible in the analogue age. Disaster-affected populations today have greater access to information and many of their information needs during a crisis can increasingly be met and responded to locally thanks to mobile technologies. Local media continue to play a critical role during crises – they are culturally aware and can disseminate accurate, life-saving information more widely. Together with local media, the expanded access to user-generated information afforded by mobile phones and social media can facilitate self-organization and time-critical mutual aid, which in turn builds resilience. Indeed, as noted in the *Haiti Humanitarian Assistance Evaluation*, "Resilience is the capacity of the affected community

Information available both before and after disasters is increasingly digital and user-generated. Mobile technologies are used to send early warnings, such as this earthquake alert sent to a mobile phone in Japan, and allow affected populations to create and share localized, real-time information.
© Lori Appleby/ Internews

to self-organize […]" (Tulane University, 2012). This capacity is in part reliant on available information. But an overflow of information and data can be as paralysing as the absence of it when it comes to mobilizing response both locally and internationally.

Access to information that is relevant and manageable is thus critical for effective humanitarian assistance and as a critical lifeline for local self-help operations. In fact, information is just as important as access to food, water or shelter, for without information, who would know where the nearest shelter is, or whether the water is safe to drink? This highlights the imperative of prioritizing two-way communication with disaster-affected communities. The major consequences of the information revolution are the rise of self-help actions directed by and for disaster-affected communities, and the unparalleled volume of real-time crisis information generated following a disaster.

Big crisis data

Almost 250 million people were affected by disasters in 2010 alone (OCHA, 2013a). Since then, the number of new mobile phone subscriptions has increased by well over 1 billion. As a result, disaster-affected communities today are increasingly likely to be 'digital communities' as well – that is, both generators and consumers of digital information. More than 100 countries now have more mobile phone subscriptions than they have people. In addition, more than 70 per cent of Africa's total population already subscribes to a mobile phone service; while one in four individuals in low- and middle-income countries already use the internet, a figure set to double within the next 20 months (OCHA, 2013a).

In early 2012, Filipinos, for example, sent an average of 2 billion text messages (SMS) every day and more than 92 per cent of Filipinos who are online have used Facebook (OCHA, 2013a). When disaster strikes, many of these SMS and Facebook posts relay critical crisis information. Indeed, recent data-driven research on social media use during disasters has shown that user-generated content posted on Twitter, for instance, can be informative and relevant for disaster response. In fact, these studies reveal that 8 per cent to 65 per cent of all tweets generated during disasters were informative and relevant (Meier, 2012a). This research, however, is typically carried out months if not years after the disasters in question because collecting, cleaning and analysing these datasets often takes a disproportionate amount of time. Moreover, the datasets are getting increasingly large. More than half-a-million Instagram pictures and 20 million tweets were posted during Hurricane Sandy, for example. In Japan, Twitter users posted more than 177 million disaster-related tweets the day after the 2011 earthquake – that is, 2,000 tweets a second on average. In addition, over 500,000 new Twitter accounts were created that same day. Welcome to the rise of big (crisis) data. Finding actionable and life-saving information in this growing information stack is like finding the proverbial needle in the haystack.

The first innovative response to this big data challenge was the emergence of digital humanitarian volunteers who pioneered early solutions to manage the data deluge. The evolution of this digital humanitarian phenomenon is the subject of the next section.

(Digital) humanitarians

The digital disaster response to the 2010 Haiti earthquake signalled the coming of a new force in the humanitarian space. Volunteers from The Fletcher School at Tufts University launched a live crisis map that detailed some of the damage and resulting needs following the earthquake (Morrow et al., 2011). They populated this map with information from social media, mainstream media and text messages. In parallel, volunteers from the Humanitarian OpenStreetMap community used satellite imagery to create the most detailed street map of Haiti ever made, which also depicted the location of humanitarian infrastructure such as makeshift camps for internally displaced people. The administrator of the United States Federal Emergency Management Agency (FEMA) described these efforts as producing the most comprehensive and up-to-date maps available to the humanitarian community. The US Marine Corps even claimed that the live crisis map of Haiti helped them save hundreds of lives (Meier, 2012b).

This remarkable response was in many ways made possible by the launch of 'Crisis Mappers: The Humanitarian Technology Network' just three months before the devastating earthquake. Many of the volunteers who were instrumental in the digital disaster response were already connected via Crisis Mappers. The network's list-serve played a pivotal role in facilitating rapid information sharing throughout the disaster response phase.

The response to the Haiti earthquake demonstrated a clear potential. The experience was also formative for many digital volunteers who went on to launch and/or coordinate several more crisis maps that same year in response to the Chile earthquake, the Pakistan floods and the wildfires in Russia. This additional experience highlighted the need for a Crisis Mappers Standby Task Force, which was launched in late 2010. Later renamed the Standby Volunteer Task Force (SBTF), this initiative resulted in a more prepared and proactive network of trained digital humanitarian responders. Today, however, the SBTF is only one of several digital volunteer networks each with different or overlapping areas of specialization.

BOX 3.1 The role of volunteer and technical communities

Over the past few years, modern technologies have enabled the rise of various volunteer and technical communities (V&TCs) around the world with varying mandates and capacities. During this period, these V&TCs have shown their abilities in both real crisis situations and simulations, and traditional humanitarian actors are beginning to realize their potential positive impact on humanitarian action.

Many of the higher-profile V&TC activations by traditional humanitarian organizations have been mainly to collect, process and generate information products – which sounds like a humanitarian information officer's job description. However, the difference is generally that the V&TCs are either dealing with a lot of data that needs to be filtered (i.e., big data) or are searching for specific data that could be anywhere on the internet (i.e., the needle in a haystack).

Why are these activities especially important? Most decisions are made based on five cues, ranging from past experience to opinions of colleagues to the latest social media messages. Decision-makers are often either bombarded with too much data or not given enough, which means they are often paralysed and struggle to make decisions. With modern technologies and the ease of sharing information through channels like Twitter, decision-makers are finding it even more difficult to make sense of what is going on and to take the best possible decisions. If a decision-maker is advised to look at Twitter to help make a decision, they often have no idea how to even start.

To understand the importance of providing appropriate information to decision-makers, it is useful to keep one simple, yet important, analogy in mind: that of a mystery versus a puzzle. A mystery does not have a given result and, no matter how much information you gather to help solve it, the challenge will only become more difficult. On the other hand, a puzzle is something with a known result and requires a specific set of information to complete. Adding more information can help find the solution. How to get aid from Port-au-Prince to Léogâne in Haiti is a puzzle. The overall effectiveness of the response to the Haiti earthquake was a mystery until well after the fact and no amount of data or information during the initial response could have predicted the outcome. The message is that there is a need to be very mindful of what data are being collected, for what purpose, and for which decision-maker, in the large taxonomy of decision-makers, are these products.

In this regard, and although their skills and purposes vary, many of the more recently recognized V&TCs are aiming to help collect this increasing amount of data, put it into a digestible format or structure, and provide it to decision-makers to potentially use as one of their decision cues.

During the December 2012 activation of the Digital Humanitarian Network, for example, the solution team (Standby Volunteer Task Force and Humanity Road) was asked by OCHA to search through social media within 12 hours to find pictures or videos of the destruction caused by Typhoon Pablo in the Philippines. In that time, the team searched through 20,000 messages and returned the information in a structured format as requested. The massive amount of social media had now been 'filtered' into something much more manageable for the requesting entity. The data were used to compile a social media map, to produce a set of analytical graphs and to augment traditional in-person assessments. These big data were effectively distilled into something that a decision-maker could use as one cue in helping to make a decision. After the fact, it was revealed that MapAction had been asked to undertake infrastructure damage mapping and that these data would have been a huge asset had they been available in time. An advocacy office noted a few months later that it would have been extremely valuable material for raising the awareness of the emergency and those affected.

In a more recent DHN activation, Translators Without Borders were asked to rapidly translate the basic structure of the new UNHCR web portal for Syria into Arabic. With more than 2 million refugees and a steady exodus of thousands more to neighbouring countries every day, plus the media attention in the Arabic-speaking world, UNHCR urgently needed to make information about this crisis accessible to an Arabic-speaking audience. Those affected by the crisis, both directly and indirectly, require information in their native language. The translation support provided by Translators Without Borders will have a major impact on humanitarian responders in all countries of the region, refugees outside of Syria, internally displaced populations within the country and the global public and professionals following or supporting this crisis. In terms of the direct impact, one question must be asked: how much more value is information in the local language worth than a foreign language when trying to make an informed decision?

As the V&TCs tend to be much earlier adopters of new tools and approaches, it is foreseeable that they will continue to be the ones driving the adoption of such technologies in traditional humanitarian organizations through constructive collaborations and partnerships like the DHN. They will lead the way by showing what is possible, how work can be done differently and how we can better enable decision-makers by using modern technology. As modern technology has reduced the barrier-of-entry into the humanitarian information management world, eventually traditional humanitarian organizations will realize that such technology is not so hard to adopt as well. Essentially, change will be seen. ■

A year after the Haiti crisis, the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) formally activated the SBTF on 1 March 2011 (SBTF blog, 2011a). The SBTF was requested to create a live crisis map of Libya sourced from relevant social media content, such as Twitter, Facebook, Flickr and YouTube. OCHA provided a full list of indicators such as movements of people, health, logistics and security/threat. More than 150 digital volunteers maintained a live map over a four-week activation period, collecting, geo-referencing, analysing and verifying large volumes of crisis information related to these specific categories. The live – but private and password-protected – map was launched within hours of the request. A public map was later made available, but without personal identifying information and with a 24-hour time delay for security reasons.

The chief of OCHA's Information Services Section commended the SBTF for giving OCHA "an output that is manageable and digestible, which in turn contributes to better situational awareness and decision-making" (SBTF blog, 2011a). OCHA's liaison officer with the SBTF also noted that, "OCHA did not have the idle capacity to gather, verify and process the enormous amount of available online information" (SBTF blog, 2011b).

Many traditional humanitarian organizations are unaware that social media content can often be verified. The BBC's User-Generated Content Hub (UGC), for example, has been verifying user-generated content shared on social media for

At OCHA's request, some 150 digital volunteers created the Libya Crisis Map with data sourced from social media networks. They maintained the live map (no longer available) for four weeks, collecting and verifying large volumes of information on categories such as population movements, health and logistics. © OCHA

more than eight years – it was set up in 2005, a full year before Twitter was born. The UGC's expertise in verification directly informed the SBTF's verification practices. Moreover, as OCHA has recently acknowledged: "The evidence suggests that new information sources are *no less representative or reliable* than more traditional sources, which are also imperfect in crisis settings" (OCHA, 2013a; emphasis added). Furthermore, institutionalized crowdsourcing services like national emergency numbers (911 in the United States and 999 in the United Kingdom) receive millions of false calls every year. In the UK, only 25 per cent of 999 calls are relevant and authentic. The vast majority are false or hoaxes. Instead of abolishing these systems, government institutions seek better ways to manage the verification challenge. Digital humanitarian networks seek the same.

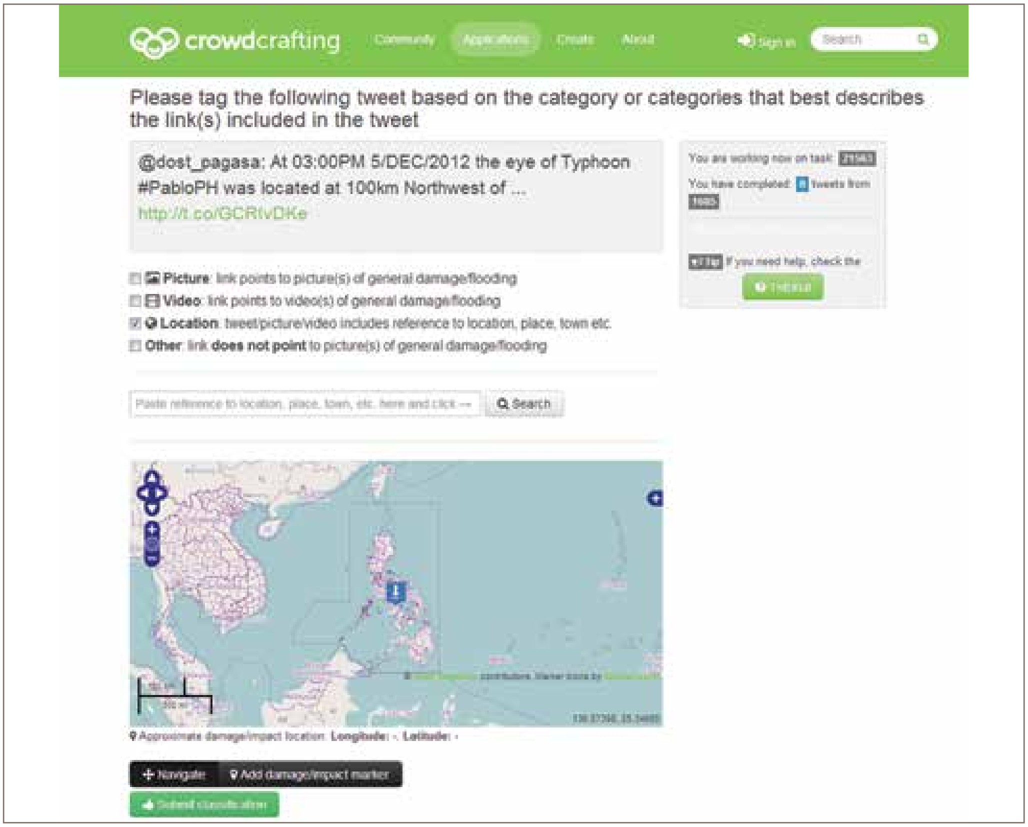
While the Libya crisis map was informative, "the resulting data behind the map was the 'gold mine'" (SBTF blog, 2011b). Indeed, the underlying data were directly integrated into the United Nations' (UN) official Who-is-doing-What-Where (3W) products and added to crisis infographics created by OCHA's information management officers. These were then "printed and shared inside the emergency arena" (SBTF blog, 2011b). Thanks to the SBTF's surge capacity, these information products were created and circulated in record time. Indeed, a process that generally took between two to four weeks was completed in 48 hours.

Since this first activation, OCHA has activated the SBTF another five times. Other organizations that have used the SBTF's services include the World Health Organization, the Office of the UN High Commissioner for Refugees (UNHCR), the UN Operational Satellite Applications Programme, the UN Platform for Space-based Information for Disaster Management and Emergency Response, the Assessment Capacities Project, the US Agency for International Development (USAID) and international media organizations such as the Australian Broadcasting Corporation and Al-Jazeera. The latter two activations emphasize the fact that the media plays a pivotal role in disaster response, which includes providing the public with live crisis maps.

An 'ecosystem' of volunteer and technical communities soon began to form, providing humanitarian professionals with the rapid surge capacity necessary, but often missing, in the hours and days after a sudden-onset disaster. A number of companies like ESRI and Google also began to offer their skill sets and technologies to support this new wave of digital humanitarian action. OCHA recognized the value of an interconnected ecosystem and thus led the launch of the Digital Humanitarian Network (DHN) in April 2012. The DHN's purpose is to serve as the official interface between highly skilled volunteer networks and the humanitarian organizations that wish to use this latent surge capacity during disasters. As a result, formal humanitarian organizations are increasingly working in partnership with DHN.

On 5 December 2012, for example, OCHA activated the DHN to carry out a rapid damage assessment of Typhoon Pablo's impact on the Philippines (DHN, 2012). This assessment was to provide a geo-referenced dataset of pictures and videos from social media showing evidence of damage within 12 hours. The request met the DHN activation criteria, and the network was activated within 60 minutes of receiving the request, with two teams dividing the effort: the SBTF and another volunteer network called Humanity Road.

Partners at the Qatar Computing Research Institute (QCRI) provided more than 20,000 tweets with links to images and videos that had been generated since Typhoon Pablo had made landfall. The SBTF worked with CrowdCrafting, an organization that provides free and open-source micro-tasking solutions, to treat 10,000 tweets. Volunteers accessed a dedicated web site where, after a short tutorial, they were asked to tag tweets. For each tweet, volunteers determined whether the link pointed to a picture or video, whether that picture or video depicted damage related to the typhoon, and whether the tweet contained the necessary



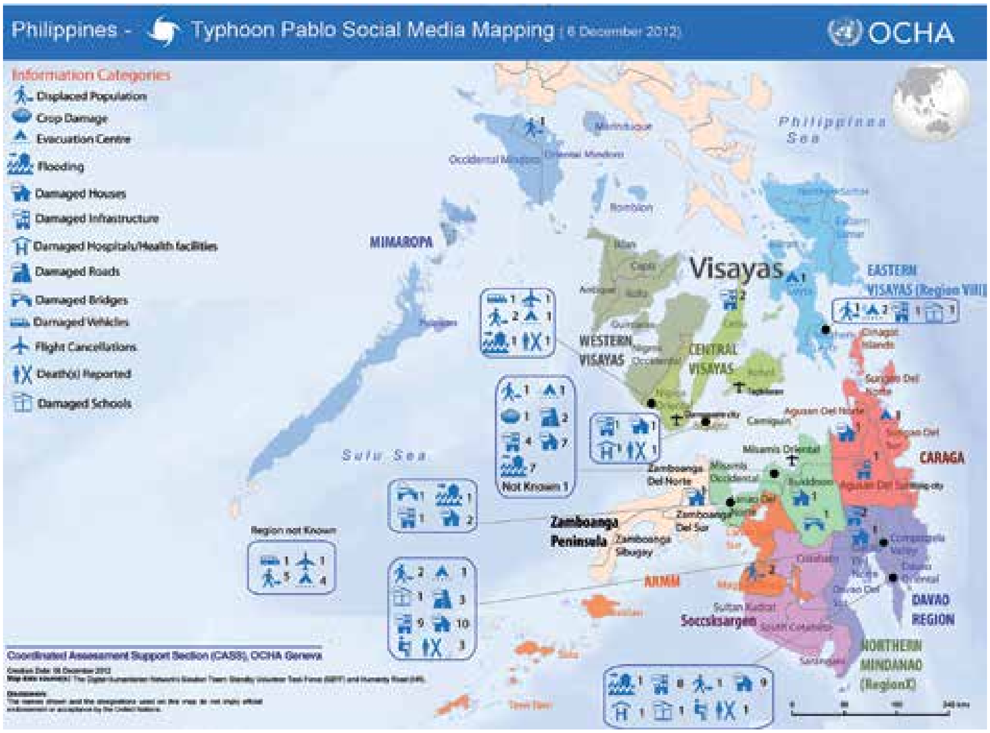
Mobile technologies allow for crowdsourced solutions via web sites such as this one run by CrowdCrafting, an organization that provides free, open-sourced micro-tasking assistance to perform tasks such as image classification, transcription and geo-coding. © CrowdCrafting

geographical information. If yes, the volunteer was asked to locate the geographical information on a map.

This rapid micro-tasking solution was an improvement over the previous spread-sheet approach, more prone to errors and more challenging to use. Furthermore micro-tasking builds in verification mechanisms by asking multiple users to classify the same tweet to improve consistency. As a result of this successful implementation, OCHA is partnering with QCRI to launch MicroMappers – a collection of micro-tasking apps for crisis mapping.

For the Philippines, this use of technology meant that for the first time, and within an unprecedented 12-hour turnaround, OCHA shared with humanitarian staff and partners a crisis map entirely made of crowdsourced, user-generated multi-media content treated on a micro-tasking platform in support of official humanitarian operations.

While DHN members have been at the front line of innovation vis-à-vis humanitarian information management, several humanitarian organizations are also experimenting with new information sources, digital data collection technologies and real-time monitoring platforms. These steps in mainstreaming humanitarian innovation and technology are described in the following section.



In December 2012, OCHA asked the Digital Humanitarian Network to carry out a rapid damage assessment of Typhoon Pablo's impact on the Philippines. This map, created with a geo-referenced dataset of pictures and videos from social media, is the result and was available within 12 hours.
© OCHA

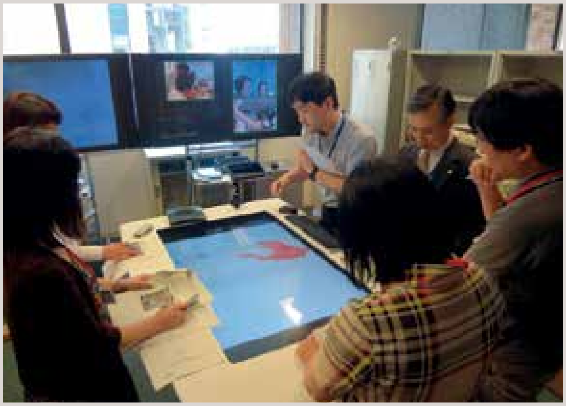
BOX 3.2 A health support system of disaster management using the cloud

The Great East Japan earthquake of March 2011 raised many issues in medical informatics. Loss of patient records and communications were major problems, but information sharing at evacuation centres and in registering displaced people also proved problematic. Because of the high turnover among volunteers and the poor level of information management, for example, the displaced were obliged to answer the same questions repeatedly as new volunteers stepped in.

A proposal to develop a health management system to address these issues was raised in the third special budget for the 2011 financial year by the Ministry of Health, Labour and Welfare. As a result, Japan's National Institute of Public Health has developed a health management system and a health policy supporting system for crisis management on the internet 'cloud'. A cloud-based solution fits the requirements of this system in terms of both scalability and minimizing costs.

This system relies on a Customer Relations Management (CRM) System, which is used in commercial companies to share customer information and offers the capability to track people over time. Here, it is used for displacement and evacuation site management. This program was chosen in order to minimize the development cost and ensure high security for personal information. A geographic information system (GIS) component was also developed to easily understand and overview the disaster area, disaster demographics and the locations of evacuation centres and disaster hospitals, among others, along with their pre-established capacities. Guidelines for operating this system are now being produced at ministry level.

Practically, this system is kept on a local server until the onset of disaster to minimize the maintenance cost. However, it can be rapidly copied to the public cloud in the event of a disaster in order to maximize its scalability and robustness. Several cloud systems are under consideration. However the final decision on which system to use is likely to be made at the onset of a disaster, depending on the nature of the situation.



Headquarters training using Discussion Table.
© National Institute of Public Health, Japan

Interview and data input simulation at the evacuation centre.
© National Institute of Public Health, Japan

From a user perspective, digital discussion tables are used for accessing and sharing the information at the headquarters level. This tool also has the capability to perform multipoint remote conferencing with video and personal computer (PC) screen capture.

The key component of the system, however, was to find a usable and scalable way to identify individuals and their records uniquely. For this purpose, Felica cards were used for personal identification. Felica cards are used, for example, as public transport fare tickets in Japan, and include a physical identity (ID) number. Most cellular phones in Japan also have a Felica card function, making them widespread and easily available. So if a displaced person had some sort of Felica card, it could be used for personal identification by their physical ID number. If they are not in possession of a Felica card, this could easily be provided using a readily available disposable Felica card which they can then attach to any personal belongings.

Other sources of information included a network of web cameras with remote control functions, used to remotely monitor disaster-affected areas. These cameras can send images automatically, triggered by motion detection or at set intervals.

The National Institute of Public Health first used this system in June and October 2012 during its regular three-day health crisis management training course. Each group simulated entering data on displaced people using this system. There were many technical issues in the first course, such as with the ease of entry to the software or network trouble. These were solved in the second course, however, and many suggestions were made to improve the system, including on the data elements and simulation settings. An advanced course was held in January 2013, mainly devoted to the planning of disaster management. The GIS was used along with a paper map to summarize and integrate information coming from the field.

Data input by application software.
© National Institute of Public Health, Japan

Real-time summary report by CRM.
© National Institute of Public Health, Japan

Based on this experience, the National Institute of Public Health is now developing a standard curriculum for disaster management, and the information management system will be incorporated into the content of training courses. CRM can be accessed by mobile phone and/or smartphone and this interface is now being developed. However, it is possible that acute phase information will be entered by other means, such as by satellite phone. Also, health support staff may need to continue to record the results of interviews on paper and enter them in the system later at the office. A summary of the data will be displayed on the GIS, so that it will be much easier to understand the overview of the disaster.

The Disaster Medical Assistance Team will work during the most acute phase of emergency response, and they use an Emergency Medical Information System (EMIS) for data sharing. Discussions are ongoing about how to integrate the EMIS with the health management system. Mental health support teams also work at evacuation centres and use a Disaster Mental Information System to report on their support activities. The National Institute of Public Health is currently negotiating to share data mutually. Broader coordination and harmonization are also needed with other institutions, such as local governments and the Ministry of Internal Affairs. ■

GIS demonstration of disaster site (Mie-Prefecture).
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Humanitarian (early) adopters

Perhaps one of the most important developments with respect to humanitarian innovation in information management among formal humanitarian organization is the American Red Cross's Digital Operations Center, launched in partnership with Dell on 7 March 2012 (Meier, 2012c). This is the first social media centre devoted exclusively to humanitarian and disaster relief efforts. More than 4,000 tweets reference the Red Cross on an average day, a figure that can easily increase tenfold at a moment's notice when disaster strikes. So the centre uses Radian6, proprietary software to monitor and analyse social media in real time. Radian6's 'engagement console' is a web-based tool that enables the American Red Cross to customize specific search queries to collect timely, relevant information and to respond accordingly to users posting the informative content. For example, the Red Cross team can reply to a specific tweet, Facebook status update or blog post directly from the console. The engagement console also includes real-time 'sentiment analysis' that helps to gauge the overall 'emotional state' or mood of eyewitnesses and disaster-affected populations. These and other metrics are displayed using customized timelines, charts and world graphics to visualize relevant social media trends over time. Sentiment analysis was also used in response to the Haiti earthquake by analysing the general mood reflected in the SMS sent by the disaster-affected population. This type of analysis provides an important feedback loop vis-à-vis the general reaction of the affected population – be it a reaction to a disaster or a humanitarian intervention.

The Radian6 platform allows for up to 25 users from the American Red Cross, a number of staff that the organization cannot commit. It therefore turned to digital volunteers, inspired by the proof of concept demonstrated by the SBTF, which had already been in operation for 18 months when the Digital Operations Center went live. It launched a Disaster Digital Volunteer Training Program to train volunteers on how to use the Radian6 platform for digital disaster response and how the technology fits within the organization's overall workflow for humanitarian action. Once certified, volunteers act as an official online Red Cross representative. To date, the training programme has certified more than 50 digital volunteers who operate at the forefront of the American Red Cross's social media response during disasters.

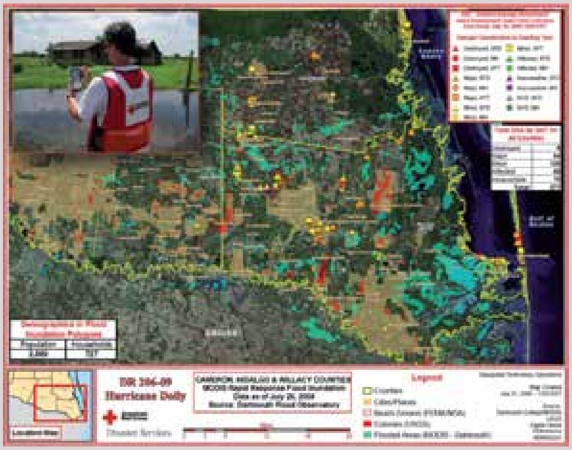
The use of Radian6 does poses a number of challenges for humanitarian organizations. The software licence is particularly expensive and the platform itself was not developed with humanitarian applications in mind. In addition, the humanitarian sector does not represent a financially interesting market for software companies like Salesforce. So these companies rarely invest in maintaining or upgrading the software for disaster response purposes. This explains why free and/or open-source software is an important cornerstone of next generation humanitarian technologies.

BOX 3.3 Increasing effectiveness through information management and visualization

The American Red Cross recognizes the expanding potential for new technologies and their application to benefit humanitarian work. It has been investing in technology that improves information management, processing and visualization, to support coordination and decision-making in disaster management.

Through the visual display of information, mapping and GIS are creating new avenues for improved information management and analysis for the American Red Cross, both domestically and internationally.

Domestically, the American Red Cross has been using mapping and GIS technology to support its operations since the early 1990s. GIS has enabled staff to visualize key spatial trends within communities, like socio-economic dynamics or areas most affected by frequent flooding, providing information that can be shared with relevant authorities to facilitate cooperation around contingency planning and/or proposed mitigation projects. Through long-standing relationships with government agencies and other partners, the American Red Cross has been able to share maps and the data behind them to support analysis and decision-making at management and service delivery levels. Through a web-based platform, interactive maps created at headquarters are shared with local chapters who can then download them, turn layers of data on or off and add additional data to tailor maps to their own needs.



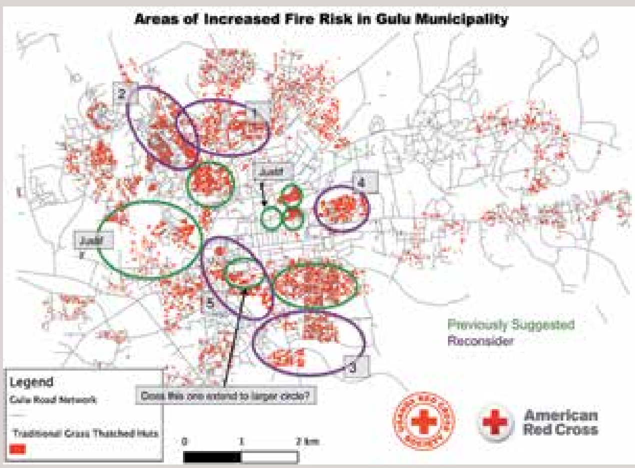
The American Red Cross has been using mobile data collection domestically in medium-scale disasters since 2007. Equipping and training field staff and volunteers to use GPS-enabled devices with pre-loaded damage assessment survey questions has enabled the production of digital maps that display survey results and photos of damaged areas. These maps can be updated in real time as assessments are ongoing. ©American Red Cross

For example, in the aftermath of Hurricane Sandy in October 2012, the American Red Cross used maps to summarize damage assessment survey results from more than 90,000 respondents to help both the Red Cross and government service providers coordinate and target service delivery, such as where to position feeding and assistance vehicles. By overlaying demographic data on these maps, information was provided to decision-makers on the level of resources available within communities to cope with disaster damages. Similarly in 2011, after Hurricane Irene, during which more than 4 million people lost power, the American Red Cross directed its mobile feeding units to areas without electricity based on maps it generated with data from power companies on power access and outages.

In 2012, the American Red Cross tested the power of GIS internationally during the IFRC's cholera epidemic response in Sierra Leone. Working with the IFRC and the Sierra Leone Red Cross Society, American Red Cross mapping staff used primary and secondary data organized by province to create maps illustrating the geographic overlap between trained Sierra Leone Red Cross health volunteers and cholera case rates. These maps helped to direct resource allocation within the response and improve cooperation between the IFRC, the Sierra Leone Red Cross and the Ministry of Health.

Maps can be a powerful tool to help coordinate disaster response activities and visualize relationships between hazards, vulnerabilities and existing resources within communities. This map illustrates the geographic overlap between Red Cross volunteer health workers and cholera cases during an outbreak in Sierra Leone in August 2012. ©American Red Cross

The American Red Cross is also piloting the use of GIS to improve long-term international programming. Basic maps, such as dirt or stick maps, are a core component of the vulnerability and capacity assessment process used by Red Cross Red Crescent societies globally and are excellent tools to help communities organize information and discuss their vulnerabilities, but are not easily preserved or communicated outwardly. The American Red Cross is working with the Uganda Red Cross Society to geo-reference household data from baseline and monitoring surveys to create digital maps that inform project design and implementation. In Gulu, Uganda's second largest city, volunteers have helped the Uganda Red Cross select communities most at risk of fires by digitally mapping the location of huts. In eastern Uganda, open-source data about community assets (churches, schools and evacuation routes) are overlaid onto sophisticated flood models provided by other agencies to create maps that will help communities and Red Cross staff identify assets that are most at risk of flooding. This analysis has the potential to inform early warning systems, helping more precisely identify infrastructure that could be damaged or disabled during floods.



Whereas traditional geospatial analysis performed by national disaster management agencies or research institutions focuses on the large or medium scale, local actors with GIS capacity and training, including Red Cross branches or chapters, can bridge the information gap at the local level. By illustrating the concentration of grass-thatched huts in Gulu, Uganda, this map helped identify communities most at risk of fires. ©American Red Cross

Embracing digital mapping also creates unique opportunities to 'crowd-source' tedious but important mapping tasks through OpenStreetMap (OSM), the openly editable 'Wikipedia of maps'. The American Red Cross has worked with Red Cross staff and volunteers in Chile, Colombia, Indonesia and Uganda to engage volunteers in these mapping projects. The volunteers trace roads, buildings and landmarks into OSM while local Red Cross staff and volunteers map significant community infrastructure, hazards and resources. These exercises increase National Societies' mapping and GIS capacity and produce high-quality base maps and data that are freely accessible to all through OSM's web interface.

The American Red Cross is also working with the IFRC's Pan-American Disaster Response Unit to develop an advanced system for registering and serving people affected by disasters. The system encompasses a range of database tools, which will help disaster response teams quickly register individuals and record the distribution of emergency relief supplies using laptops, tablets, mobile phones and barcode scanners.

Historically, disaster response operations have relied on basic spreadsheets to track the flow of people and supplies in a crisis. While passable, it is extremely difficult to use this approach for processes such as registering large groups, tracking repeat assistance over time, generating real-time reports and verifying identity and eligibility. Recently, the Red Cross Red Crescent developed and promoted Mega V, a light-weight database application for ticket scanning and registration of affected people. The new joint system will expand on this initial work. Using barcoded cards and tickets, the system will help quickly deliver assistance to the right people while allowing teams to coordinate their efforts and better plan operations.

By electronically collecting and managing data, the system will also facilitate better communication with recipients, making it possible to synchronize data across an entire operation, send alerts and updates via text messages and integrate with other mobile services, including social media. Ultimately, this means a more streamlined and efficient relief process, which translates to shorter waits, less duplication, improved service and 'distribution with dignity' for those affected by disaster. The initial version should be launched in mid-2013.

The system is being developed using open-source and licence-free technologies that allow easy transition and adoption by Red Cross Red Crescent National Societies, allowing for local ownership of all data concerning recipients, an important consideration for privacy and long-term sustainability. The system will include parallel paper-based processes for use when technology is inoperable or impractical.

The American Red Cross continues to invest in, explore and develop new technologies because of the benefits initial investments have yielded in terms of improvements in planning, targeting, implementing and coordinating operations. While the transition to new information management systems can be challenging, increases in efficiency and effectiveness have demonstrated that overcoming these barriers is well worth the effort. ■

Traditional humanitarian organizations are not just borrowing innovative methodologies pioneered by digital humanitarians; they are also introducing new solutions of their own. For example, USAID has innovated the concept and practice of 'crowdseeding' for the digital collection of information in conflict zones (Van der Windt and Humphreys, 2012). This approach uses mobile phones and random sampling methods to collect representative data via SMS from conflict zones. For example, local communities in the provinces of North and South Kivu in the Democratic Republic of the Congo (DRC) were randomly selected as part of a USAID conflict mitigation project. Select individuals within these communities were provided with mobile phones and trained on how to report conflict incidents via SMS, thus yielding a statistically significant feed of relevant baseline data.

OCHA is also looking to innovate in the mobile space, proposing to develop a smartphone app for humanitarians in the field to "check into and out of" a disaster area. This novel use of technology seeks to facilitate emergency contact management and aid coordination during emergencies. OCHA has already developed one innovative app, Humanitarian Kiosk, which facilitates the sharing of key, up-to-date humanitarian information (OCHA, 2013b). The organization is also partnering with KoBoToolbox, a digital data collection platform at the Harvard Humanitarian Initiative, and the International Rescue Committee for agile, multi-media data collection in the field.

Meanwhile, the European Research Center for Information Systems (ERCIS) at the University of Muenster in Germany has partnered with the European Union's Joint Research Centre (JRC) and its Global Disaster Alert and Coordination System (GDACS) to develop an innovative mobile technology solution for the web-based portal. GDACSmobile, as the smartphone app is called, is novel in several respects and most importantly with regards to the technology's use of 'bounded crowdsourcing' for the rapid collection of crisis information (Meier, 2013a). Coined back in 2009, bounded crowdsourcing uses 'snowball sampling' to develop a crowd of trusted reporters for the collection of crisis information (Meier, 2009). For example, one person invites five (or more) trusted reporters to collect relevant information and subsequently ask each of these to invite five additional users who they fully trust and can vouch for, and so on. In this way, GDACSmobile can leverage the power of the crowd (open crowdsourcing) with a bounded but flexible network of trusted reporters (bounded crowdsourcing). ERCIS researchers believe this hybrid approach to be the most promising. Importantly, GDACSmobile is also built to be open and interoperable with other data-feeds, which provides for additional flexibility.

Formal humanitarian organizations are also innovating new methodologies for the verification of non-traditional information sources such as social media. In the United States, for example, FEMA launched a 'rumor control' web site to list and tag rumours based on whether they were true or false. The web site reads: "There is a lot of misinformation circulating on social networks regarding the response and recovery effort for Hurricane Sandy. Rumors spread fast: please tell a friend, share this page and help us provide accurate information about the types of assistance available. Check here often for an on-going list of rumors and their true or false status" (FEMA, 2012).

BOX 3.4 Data sharing and exchange in Germany

Over the past decades, challenges in disaster management have changed in Europe. Due to its high population density and strong dependency on technological infrastructure, Germany is exposed to new threats. Robust and self-sufficient solutions are needed. The federal government therefore launched a national programme, 'Research for Civil Security'. During the period from 2007 to 2012, the Federal Ministry of Education and Research invested 123 million euros in interdisciplinary projects. After a successful evaluation process of the first programme, the government decided to launch the second period (2012-2017) with an even bigger budget. The aim is to develop new technologies in order to provide more security without encroaching civil rights. The programme involves application-oriented work within the projects, by incorporating the entire innovation chain – from research to industry and most importantly to end users, such as governmental authorities, fire brigades, hospitals, the police and relief and humanitarian organizations. Research is organized with a focus on demand-oriented concepts, along with actual practice in order to fulfil its overall aim: to improve the protection of people and provide the means to rescue them if necessary.

The German Red Cross was invited to participate in the programme and decided to apply for its pilot project, SPIDER (Security Systems for Public Institutions in Disastrous Emergency Scenarios), which was funded from 2009 to 2012 as part of the national research initiative, Scenario-based Civil Security Research. The objective of research was data exchange in terms of improved communication.

In Germany, civil protection is organized on a federal and inter-organizational basis, so collaboration among the different stakeholders is crucial. This is especially the case in mass casualty incidents, where a huge amount of information must be managed and data sharing is key for optimized disaster management. This is, however, not only a technical challenge. Protecting data, especially personal data, must be treated cautiously, respecting the independence of partners and realizing that the end does not justify the means. Technology – or new concepts of data sharing possibilities – will only be considered as a change for the better, if the humanitarian mission and its execution are not impaired. And technological solutions will survive and prosper only if there is a direct impact in practice. The mutual dependency creates a good environment for cooperative work.

The German Red Cross, as leader of the project, decided to address the issue holistically and brought together a consortium of 11 institutions involved in the data sharing discussion such as the fire brigade, clinics, state police, industrial partners and universities. Within the consortium, the Red Cross worked closely with the technical coordinator, the Communication Networks Institute (CNI) of Dortmund's University of Technology. One of the CNI's main research topics focuses on the development of innovative communication solutions.

Past disasters and crises have shown the necessity of research in supporting information and communication technology. Organizations have developed a variety of diverse and mutually incompatible crisis information systems, which make it difficult to work cohesively. To address this problem, SPIDER aimed at providing a 'system of systems', which should guarantee a better interoperability for information sharing between public institutions. Most important in this process is that legacy systems can coexist, for both financial and usability reasons. Civil protection in Germany is assumed by volunteers, who undergo various training courses, including in German Red Cross technical systems, to prepare them for their mission. Maintaining well-known systems for the future, therefore, ensures a broader user acceptance.

Information should be exchanged in a transparent manner across system boundaries in order to create synergies in the disposition of resources while time-critical processes are accelerated. Within the SPIDER project, the information exchange was achieved by a common XML-based message format, called Protection and Rescue Markup Language (PRML). The PRML is 'human readable' and, therefore, easy to integrate in existing disaster relief management software. One sample application for PRML-based intercommunication is the search for missing people, where the databases of, for example, the German Red Cross, fire brigades and clinics, are brought together via PRML and searched simultaneously.

Another SPIDER project research topic was the deployment of a communications network at the scene of an incident. The analysis of recent crises has led to the conclusion that infrastructure networks, like the public mobile phone network, cannot be used during a crisis, because of panic calls or damaged infrastructure. Therefore, rescue personnel need to be able to deploy their own ad hoc incident network. In SPIDER, this network is based on 'dropped units', which are battery-powered WiFi routers. Dropped units build an automatically configured mesh network. To place these units, special process-integrated placement procedures were investigated and, as a result, they have been integrated into rescue personnel's standard equipment – a case of technology following tactics. The mesh network established by the dropped units enables new IP (internet protocol)-based services, such as video stream transmission from helmet cameras of first responders to the officer in charge. Another service is an interactive situation map, which shows the current position of first responders, if GPS signals can be received. The officer in charge can therefore dispatch rescue personnel and respond quickly to changes during a crisis.

In conclusion, SPIDER enables the federation of diverse disaster relief management using PRML. It builds a system of systems, which forms a rich database for various new services, supporting rescue personnel in the field and decision-makers. SPIDER also provides new approaches for networking first responders at incident scenes. Dropped units can be integrated into the work process and therefore deploy a communications network, without hindering the first responders from carrying out their main tasks. ■

Local emergency managers are also contributing innovative solutions to manage the challenge of misinformation on social media. In Australia, for example, the media unit of the Queensland Police Service (QPS) was particularly proactive during the widespread flooding that has affected the state in the past three years. During the previous two major floods, QPS's media unit made active use of Twitter to intervene and counter the spread of rumour and disinformation. They did this by using the #Mythbuster hashtag to tag every tweet that contained false or misleading information. Here are just two examples of such tweets: "#Mythbuster: Wivenhoe Dam is NOT about to collapse! #qldfloods" and "#Mythbuster: There is currently NO fuel shortage in Brisbane. #qldfloods" (Meier, 2013a). While not everyone in the affected areas is connected to this particular information channel, the fact is that other media channels do exist, such as traditional television and radio broadcasting. Moreover, social networks based on family, friendship, professional and/or religious ties also serve as a crucial dissemination channel. This explains why social network analysis is important to understand the typology of existing social networks in disaster-prone areas is so important.

Local emergency response teams in the United Kingdom and the United States are also innovating with policy-level changes. In 2012, the London Fire Brigade announced that it would add Twitter as a communication channel, allowing members of the public to report fires via Twitter in addition to the traditional emergency telephone system. That same year in the US, the state of Virginia began to roll out the use of SMS for emergencies. These are notable shifts in both policy-making and attitudes towards the use of new technologies for emergency and disaster response. The Philippine government is particularly forward-thinking in this respect. Several days before Typhoon Pablo made landfall, the government used their official Twitter feed (@govPH) to share regular updates and even promoted the use of crisis hashtags for reporting purposes: "Please continue to monitor #PabloPH for updates on typhoon. For relief and rescue, refer to: #reliefPH #rescuePH. Keep safe and informed" (Meier, 2012c). In other words, the Philippine government actively used Twitter as a communication tool and encouraged others to do the same.

Ultimately, the challenge with crisis data has more to do with 'filter failure' than the actual volume of the data in question. Throwing more manual 'filters' (digital volunteers) at big data may not be the solution, however. And while Radian6, the platform used by the American Red Cross, is definitely a step in the right direction, it was not developed with humanitarian users or applications in mind, which explains why the system's automated filters have important limitations. Furthermore, these 'new' monitoring platforms ignore recent innovations and breakthroughs in advanced computing. This is the topic of the next section.

Advanced (crisis) computing

The field of 'advanced computing' has developed two ways to manage big data: human computing and machine computing. The former uses crowdsourcing and micro-tasking platforms to distribute tasks that are easily completed by a 'crowd' of humans. In contrast, the latter uses automated data mining and machine learning to manage tasks that are more difficult or virtually impossible for humans to complete. Both approaches can be used to manage the big crisis data challenge and the related problem of verifying user-generated content. This section briefly highlights the potential that advanced computing holds for humanitarian information management and thus for humanitarian action.

SyriaTracker is one of the longest-running crisis maps. It depicts human rights abuses that have been committed for more than two years now. To collect relevant information, the project uses both human computing (crowdsourcing) and machine computing (data mining). For the data-mining component, SyriaTracker 'repurposed' HealthMap, a data-mining platform developed by Harvard University for the purpose of digital disease detection. Instead of mining through health-related sources in search of possible symptoms, SyriaTracker's version mines through some 2,000 English-based news sources that regularly cover Syria (including pro-Assad sources) in order to identify references to killings and other human rights violations. This approach enabled them to automatically collect more than 40,000 news articles during the first six months of operation. SyriaTracker triangulates this information with the crowdsourcing results for verification purposes. Reports of human rights violations are only added when they can be verified. This in part explains why both USAID and the US Office for

Foreign Disaster Assistance continue to integrate SyriaTracker data into their own official crisis maps and information products.

The repurposing of HealthMap for SyriaTracker was a difficult and arduous process, however. Again, the challenge is one of design. HealthMap was not designed to monitor human rights violations. QCRI's Crisis Computing Team is thus collaborating with OCHA, the American Red Cross and other humanitarian organizations to design and develop a solution specifically geared to their needs. The experimental prototype, called Artificial Intelligence for Disaster Response, or AIDR, is a free and open-source platform that uses micro-tasking and real-time machine learning to automatically identify informative content on Twitter during disasters (Imran et al., 2013). In brief, users 'teach' the platform to recognize what kind information they are specifically looking for and AIDR automatically returns the desired content in real time. This is done using micro-tasking. When AIDR returns tweets that do not provide relevant content, the user identifies the error and the machine 'learns' not to make the error again.

Early results appear promising. Using Twitter data for Hurricane Sandy, for example, AIDR is able to automatically identify tweets that relate to infrastructure damage and the needs of affected individuals, and also which tweets are likely written by eyewitnesses. The accuracy of these algorithms range from 70 per cent to 90 per cent and, thanks to machine learning, becomes more accurate with more data. Recent research in advanced computing has also empirically demonstrated that disaster tweets containing non-credible information spread very differently than credible tweets do. In fact, the credibility of disaster tweets can be predicted with relatively high levels of accuracy simply by monitoring how they spread across Twitter (Castillo, Mendoza and Poblete, 2013). The same is true for fake images shared on Twitter (Meier, 2013b). The team behind AIDR is therefore exploring whether the platform can also be taught to look for non-credible information such as rumours. While the QCRI's ultimate goal is to develop a functional, free and open-source AIDR platform, these early research and development (R&D) efforts are, for now, purely experimental. That said, this is precisely the kind of dedicated R&D in next generation humanitarian technology that is needed to equip humanitarian organizations and digital humanitarian networks with the technologies needed to leverage big crisis data. These important efforts, however, cannot happen by themselves. Enlightened leadership is necessary.

BOX 3.5 Human mobility analysis through big data

Whereas a specialized public continues to debate whether big data is or isn't "the answer to solving the world's most intractable problems" (Crawford, 2013), little has been done to base these discussions on firm conceptual, empirical and methodological grounds. The state of affairs is changing fast, as is everything with big data. One area where welcome developments have occurred and promising avenues are emerging is human mobility analysis – population movements and migratory patterns – through the lens of big data.

First, it is useful to clarify what big data refers to in these contexts and what underpins the excitement it has stirred. As ‘data’ used for public policy and (especially) social science research purposes, ‘big data’ – in lower case – can be defined as “the traces of human actions picked up by digital devices, or as the digital translation (understood in its literal sense) of human actions” (Letouzé, Meier and Vinck, 2013). Others have distinguished what they refer to as “digital breadcrumbs” – structured data such as mobile phone records or credit card transactions – from social media data (Pentland, 2012). Whatever the definition, the point is that these non-sampled data repositories and streams (Horrigan, 2013) are produced by individuals as by-products of their daily activities and thereby hold the potential to tell life stories and show details of social interaction beyond aggregates at high levels of temporal and spatial granularities (Pentland, 2012). So the ‘revolutionary’ dimension (Mayer-Schönberger and Cukier, 2013) of big data is not the volume of these streams nor even their velocity or variety (the famous ‘3 Vs’ initially used to describe big data). Rather, the true novelty comes from their specific qualitative nature as passively generated digital behavioural data – with the 3 Vs or 4 Vs (the fourth V standing for value or variability) being correlates of this fundamental feature. As importantly, “Big Data is not about the data” (King, 2013); rather, ‘Big Data’ (as a field, denoted with capital letters) is about the analytics and being able to extract insights on “how individual people, groups, and societies think and behave” (King, 2013). Of course, advanced statistical, data mining and/or machine-learning techniques are part of the toolkit. But the relevance of any analysis relying on big data ultimately depends on its contextual, ethnographic grounding (Burrell, 2012; Lorentz, 2013).

How does that all play out when attempting to leverage big data to study human mobility? International migration rates and patterns have recently been studied using Yahoo! e-mail data (Zagheni and Weber, 2012) and web log-ins IP geo-location (State, Weber and Zagheni, 2013). But in low- and middle-income countries, mobile phone data – known as Call Detail Records or CDRs – are an attractive source of information on human mobility. A growing academic literature has shown the potential of CDR analysis to infer internal migration patterns, study spatial dynamics in urban slums, model malaria spread, unveil patterns of reciprocity giving after a disaster, etc. Recent CDRs made available by Orange in Côte d’Ivoire were analysed by IBM researchers to develop a new model for optimizing bus routes (Talbot, 2013a). The commonality of these studies is to rely on and take advantage of “how mobile carriers see the world” (UN Global Pulse, 2012) through the information contained in CDRs, including caller ID, location through triangulation of cell towers, receiver ID and location, time and duration of call. Thus, with CDRs it becomes possible to ‘follow’ and map the journey and interactions of an individual – or, rather, of a phone or SIM card – to look for patterns and trends in the data, especially in conjunction with other datasets, and attempt to model and understand dynamic behaviours. For example, it could help address questions such as: how do population movements change in response to rising food prices, weather shocks, disaster events or large-scale violence? And what does it mean in turn for public policy, humanitarian assistance, etc.?

Importantly, both a consequence and a driver of this growing body of knowledge, the field of data analysis from mobile networks is quickly going through a ‘formalization’ phase. First, specific measures and variables have been developed or adapted to characterize and quantify individual and collective mobility

(Nurmi, 2012), to detect, for example, important places, the area of influence or the 'radius of gyration' (a measure of average daily distance covered by an individual). Second, this promising strand of research is being discussed in a growing number of dedicated forums, such as NetMob conferences, and the volume of academic papers using CDRs will almost certainly increase markedly in future months.

As these examples and common sense suggest, using CDRs for mobility analysis raises significant challenges and risks that are not left unaddressed. One is, of course, gaining access to the data. Even when the data are stored in ways that would allow relatively easy transfers, telecom companies are reluctant to share CDRs owing to privacy and reputational considerations. One important avenue here is to devise privacy-preserving mobile phone data sharing and analysis protocols (Talbot, 2013b) as part of the broader 'data philanthropy' movement (Kirkpatrick, 2011; Meier, 2012d). Further, an obvious analytical challenge is the non-representativeness of the data that hinders external validity; in other words the fact that "making population-level inferences using these data is complicated by differential ownership of phones among different demographic groups that may exhibit variable mobility" (Buckee et al., 2013). A complementary argument that highlights the ethnographic requirement of 'sound' big data analysis results from the tendency of many people in low- and middle-income countries to share or exchange phones and SIM cards, which complicates the task of making inferences as to individuals' movements. But research and progress are also happening in response: for example, Buckee et al. (2013) attempted to measure the impact of biases in mobile phone ownership on estimates of human mobility (and found these estimates to be surprisingly robust). Correction methodologies for biases in e-mail data have also been proposed (Zagheni and Weber, 2012), although validation is difficult for lack of reliable 'ground-truthing' data.

CDR analysis in particular does appear to offer great promise to better understand and quantify human mobility in low- and middle-income countries, including in disaster and crisis settings, although much more work is needed to develop robust methodologies and institutional partnerships that will help overcome the challenges, risks, obstacles and gaps alluded to above. But these difficulties should not obscure the fact that the combination of exponential growth rates of mobile phone penetration and data production in low- and middle-income countries and intense interest and efforts from social scientists and policy-makers will, in all likelihood, make human mobility based on CDR analysis standard practice by the end of the decade. ■

Conclusion: Enlightened leadership

The role of technology in strengthening humanitarian information faces many major challenges – but these challenges can be overcome with forward-thinking policies. In other words, innovation in policy is equally important as innovation in humanitarian technology. The American Red Cross's Digital Operations Center was possible thanks to enlightened leadership and vision. The launch of the Digital Humanitarian Network would not have been possible without OCHA's leadership. The use of Twitter by the government of the Philippines and the Queensland Police Service are further examples of forward-thinking leadership, as is the decision by the London Fire

Brigade to use Twitter as a public reporting tool. The support of the UK's Department for International Development (DfID) for the Humanitarian Innovation Fund and their new partnership with USAID on the Humanitarian Technology Fund is also the kind of leadership required to usher in the next wave of humanitarian innovation and technology.

But many challenges remain while new ones are surfacing. These challenges include communicating with and empowering disaster-affected communities, ensuring data-driven decision-making, opening up closed, potentially life-saving data and developing strong protocols for data protection in the network age.

Disaster-affected communities are by definition the first responders. While empowering second-level responders can save lives, the fact is that most lives are saved thanks to local agency and resources. This explains why the United Nations International Strategy for Disaster Reduction has been advocating for a more people-centred approach to early warning and response systems. The purpose of this approach is to "empower individuals and communities threatened by hazards to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life, damage to property and the environment, and loss of livelihoods" (UNISDR, 2006). In other words, a people-centred approach to disaster response seeks to increase local capacity for self-organization and mutual aid, otherwise known as disaster resilience (Tulane University, 2012). Scaling resilience, however, requires far greater emphasis on disaster preparedness than currently exists. Correcting this drastic mismatch in policy priorities will take strong and immediate leadership.

Furthermore, acting in sufficient time, by definition, requires timely, relevant and actionable information. Many humanitarian organizations readily acknowledge that listening to affected communities is a pressing humanitarian imperative: "There is a strong need to systematically involve beneficiaries in the collection and use of data to inform decision making. Currently the people directly affected by crises do not routinely have a voice, which makes it difficult for their needs be effectively addressed" (DfID, 2012). The truth, however, is that the majority do have a voice. The problem is that humanitarian organizations do not have the technical skills or advanced computing technologies to listen. "As the 2010 Haiti crisis revealed, the usefulness of new forms of information gathering is limited by the awareness of responders that new data sources exist, and their applicability to existing systems of humanitarian decision-making," notes OCHA (2013a).

Humanitarian decision-making processes are often not based on empirical data in the first place, even when that data originate from traditional sources. As DfID remarks, "Even when good data is available, it is not always used to inform decisions. There are a number of reasons for this, including data not being available in the right format, not widely dispersed, not easily accessible by users, not being transmitted through training and poor information management. Also, data may arrive too late to be able to influence decision-making in real time operations or may not be valued by actors who are more focused on immediate action" (DfID, 2012). Furthermore, information is sporadic during humanitarian crises, which is why "decisions can be made on the basis of *anecdote* rather than fact" (OCHA, 2013a; emphasis added). For example, "Media reports can significantly influence allocations, often more than directly transmitted community statements of need, because they are more widely read or better trusted" (OCHA, 2013a).

Clearly, traditional humanitarian information management practices and structures face serious challenges that have nothing to do with the new and 'unorthodox' nature of information sources that characterize big crisis data. The fact is that existing information management processes are not very well geared towards actually making use of good data from good traditional sources in the first place. Until these systemic issues are resolved, the full potential of digital humanitarian networks and next generation humanitarian technologies will not be realized. Strong leadership at all levels of the humanitarian industry is required to address these structural failures in decision-making processes.

The vast majority of relevant crisis information is closed and remains inaccessible to formal humanitarian organizations and their digital humanitarian partners. Twitter Inc., for example, limits the number of tweets that can be downloaded (Puschmann and Burgess, 2013). Getting around this restriction requires technical 'work-arounds' (that may violate terms of service) or the ability to pay private sector companies large amounts for full data access (Puschmann and Burgess, 2013). Data licences for Facebook data are rarely if ever affordable by humanitarian organizations, let alone digital volunteers. Telecommunications data, such as SIM card data and Call Record Data, are also notoriously off-limits to the humanitarian community. And yet, groups like Flowminder and UN Global Pulse have demonstrated how valuable this real-time, structured and geo-referenced data is for humanitarian action. Public–private partnerships are critical to create a culture of big data philanthropy for humanitarian action. The forward-thinking efforts of the GSMA's, or Groupe Spéciale Mobile Association's, Disaster Response Programme are imperative in this respect.

Among some human rights researchers and advocates, big data has been described as the biggest-ever threat to human rights. There is much truth to this statement and the humanitarian space is certainly not immune to the serious data privacy and protection challenges that big crisis data pose. That said, "Concern over the protection of information and data is not a sufficient reason to avoid using new communications technologies in emergencies, but it must be taken into account. To adapt to increased ethical risks, humanitarian responders and partners need explicit guidelines and codes of conduct for managing new data sources" (OCHA, 2013a). An example is the recent launch of the first-ever *Code of Conduct for the Use of SMS in Disaster Response*, which was made possible thanks to the enlightened leadership of GSMA's Disaster Response Programme (GSMA, 2013). In 2012, InfoAsAid developed a fully fledged SMS messaging library containing hundreds of 'ready-to-go' SMS tailored for different types of disasters and specific contexts. These messages were carefully developed with data privacy and protection principles in mind. These efforts at codifying 'do no harm' protocols to guide the use of SMS for disaster response also need to be extended to complex humanitarian emergencies. To this end, the 2013 edition of *Professional standards for protection work* published by the International Committee of the Red Cross, is an important step in the right direction (ICRC, 2013). This high-profile policy document includes (for the first time ever) a short section on 'Understanding the risks and advantages linked to new technologies and methodologies' (ICRC, 2013). This kind of leadership is absolutely imperative and much work remains to be done. Donors need to support the research required to develop a fully-fledged policy document entirely devoted to the use of new technologies for crisis response in conflict situations. After all, the humanitarian imperative 'do no harm' does not become any less important in the network age, but more important than ever before.

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Chapter 4

Chapter 4

Technology and the effectiveness of humanitarian action

Technology holds the promise of an ability to detect needs earlier, enable greater scale and speed of responses and enhance specificity of resources transferred to match those needs. It can also increase accountability and reduce the opportunities for corruption and diversion. However, despite overall positive experiences in their use, these technologies have not been systematically adopted in the humanitarian field.

This chapter looks at the four different phases of disaster management (mitigation, preparedness, response and recovery) and discusses the impact of technology on the effectiveness of humanitarian action during each of these stages. At each phase, examples from the field of leveraging technology to improve effectiveness will give an insight into the successes and failures experienced in those efforts.

After looking at the four different stages, the factors that are limiting current approaches to using technology in humanitarian action from being effective will be examined.

Technology for disaster mitigation

The world is full of hazards. When people do not prepare for those hazards, disasters become deadly and cause large-scale destruction. This section will look at how some aspects of technology are used to mitigate such hazards. In particular, early warning systems and using open data for disaster risk reduction are examined.

Early warning systems

The importance of timely disaster warning can never be overstated. Although the international community had been engaged in early warning systems since the 1980s, it was after the devastating Indian Ocean tsunami in 2004, which killed more than 200,000 people, that the international community made a significant investment in improving early warning systems, particularly early warning of tsunamis, around the world. In the years that followed, improvements to the quality, timeliness and lead-time of hazard warnings were manifest. Scientific and technological advances, particularly in computer science and communication technology, have largely driven these improvements (UN, 2006).

In disaster-prone countries, technology can make a critical difference in giving people early warning of events such as earthquakes and tsunamis. Here, a Japanese International Cooperation Agency (JICA) rescue team searches through the rubble of a collapsed building in Padang, Indonesia in October 2009.
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A number of factors are important to make early warning systems effective. In particular, they must fully integrate (UN, 2006):

- Good scientific knowledge of the risks faced
- Highly automated technical monitoring and warning services
- People-centred dissemination of meaningful warning to those at risk
- Community-driven public awareness building and preparedness in what to do when alarms sound.

All of these factors need to be integrated, because the omission of an individual factor means the overall early warning systems will not function as expected. Technology can play an important role in strengthening each of these factors.

Good scientific knowledge of the risks faced

Advances in high-performance computing and the availability of a large number of computers in the cloud (a network of remote servers) have made it possible to compute more complex models for hydrological and seismological risks. This allows decision-makers to make better-informed decisions sooner about which areas to evacuate. Emergency managers have used tools that take advantage of computing technology, for example, the Global Disaster Alert and Coordination System (GDACS), the Humanitarian Early Warning Service (HEWS), UN Global Pulse and SARWeather. GDACS provides automatic impact assessments for a wide range of disasters based on information about the affected area. HEWS collects information about various types of disasters, both sudden-onset and slow-onset emergencies (IASC, 2013). UN Global Pulse leverages social media and mobile text messages to detect trends that could lead to civil unrest and famine (UN Global Pulse, 2013). SARWeather provides high-definition weather forecasts on demand for the affected areas, allowing emergency managers to make operational decisions based on weather conditions (SARWeather, 2013).

BOX 4.1 Drought monitoring and prediction for sub-Saharan Africa

Drought is one of the leading impediments to development in Africa. Much of the continent is dependent on rain-fed agriculture, which makes it particularly susceptible to climate variability. Recurring drought conditions in many regions of Africa, most recently in eastern Africa, have had devastating humanitarian impacts and impose significant reductions in gross domestic product for countries whose economies are tied to agriculture. Climate change and population pressures make the prospect for continued drought impacts and water scarcity more worrisome. Alleviating the impacts of drought across sub-Saharan Africa requires a transition from crisis management to risk management and reduction, including developing national drought policies, increasing coping capacity and adapting to likely future changes at local levels. A key element in managing drought risk is the provision of early warning of developing drought conditions and impacts. Such information can provide governments with the lead-time necessary to implement drought management policies and reduce impacts at all levels.

Approaches to drought monitoring in many low- and middle-income countries have generally been limited, in part because of unreliable monitoring networks and insufficient national capacity. Operational seasonal climate forecasts are also deficient and often reliant on statistical regressions, which cannot provide detailed information relevant for drought assessment. However, the wealth of data from satellites, real-time telemetry and recent advances in large-scale hydrological modelling and seasonal climate model predictions have enabled the development of state-of-the-art monitoring and prediction systems that can help address many of the problems inherent to these regions. Satellite remote sensing in particular is capable of overcoming differences in data availability across political boundaries that have historically hindered monitoring of regional phenomena such as drought.

Various methods for characterizing drought from satellites are based on different retrieved variables, such as vegetation reflectivity, soil moisture, evapotranspiration and water levels, and converted into indices that represent different aspects of drought. Large-scale modelling has improved because of advances in the representation of physical processes through, for example, model inter-comparisons, better input data and validation at various scales. The merging of satellite and model predictions of the hydrological cycle through assimilation has the potential to improve drought monitoring and observation of the hydrological cycle in general. In the United States and Europe, this approach has been used for several years to estimate drought conditions through a combination of hydrological modelling and satellite remote sensing.

In collaboration with the United Nations Educational, Scientific and Cultural Organization's International Hydrological Programme, Princeton University has developed an experimental drought monitoring and forecast system for sub-Saharan Africa. The system merges climate predictions, hydrological models and remote sensing data to provide timely and useful information on drought in regions where institutional capacity is generally lacking and the access to information and technology prevents the development of systems locally. The system's key elements are the provision of near real-time evaluations of the terrestrial water cycle and an assessment of drought conditions.

The system consists of three parts: first, a historic reconstruction of the water cycle for the period from 1950 to 2010. This forms the climatology against which current conditions are compared. Second, the real-time monitoring system (2011–present) is driven by remotely sensed precipitation and atmospheric model analysis data, and tracks drought conditions in real time. The simulated predictions are augmented by satellite remote sensing of soil moisture and vegetation indices. Third, the seasonal forecast component is based on climate predictions from the US National Centers for Environmental Prediction's Climate Forecast System (version 2), which are bias-corrected and downscaled in time and space to drive the land surface model, with initial conditions provided by the real-time monitoring component. The system's predictive skill has been evaluated for 30 years of historic hindcasts and shows potential for providing useful forecasts of developing drought conditions, particularly for the first month.

A key element of the system's development is the transition and testing of the technology for operational usage by African collaborators. In 2012, workshops were held in two regional centres – in Niger (for West

African countries) and in Kenya (covering countries of the Greater Horn of Africa) – where the system was installed on centre servers. Local scientists were trained to run the system and interpret the data output. Feedback was also solicited from scientists and managers from national hydrological, meteorological and agriculture agencies and extension services, who are charged with managing local water resources systems and providing information to farmers. A third workshop will be held in southern Africa.

Given the tremendous impact of drought in Africa, where the growing population is mostly dependent on rain-fed agriculture, the implementation of this system is a key step forward in building capacity through technology and knowledge transfer. In particular, the application of hydrological and climate research into transferable technology with minimal overhead has been made possible and has the potential to reduce the impacts of drought across Africa. However, several challenges to the system's continued development and use have been identified from both feedback from the workshops and ongoing discussion with African collaborators. First, confidence in the predictions of the system is necessary to ensure uptake by users, and a validation and evaluation strategy has been developed to determine the accuracy of the system for tracking drought at local levels. Second, the continued and sustained use of the system is reliant on mechanisms for updating and improving the system, and training local scientists to interpret predictions. This requires mechanisms for sustained knowledge exchange and education, and eventual transfer of ownership to locally relevant systems. ■

Highly automated technical monitoring and warning services

Automated monitoring and warning services allow emergency managers and other interested people to subscribe to e-mails or text messages (SMS) for alerts, but also provide other systems with a standards-based warning message that can be shared by those other systems in multiple new ways. The most common standard for sharing alerts is the Common Alert Protocol (CAP), which many agencies and countries have adopted. CAP allows alerts from a wide range of agencies to be transmitted to broadcasters and software systems in a standardized format. This has allowed for new channels of distribution of emergency messages, such as smartphone applications and web sites (Google, 2013).

People-centred dissemination of meaningful warning to those at risk

Low-tech specialized weather radios, sirens and public loudspeakers are rapidly joined by e-mails, SMS or Twitter messages as channels for warning, arguably contributing to reducing the death toll of disasters. Google started sharing CAP-based alerts on their home page, a webpage that gets hundreds of millions of views every day (Google, 2013). The United States Federal Emergency Management Agency (FEMA) has started leveraging features of mobile network systems to broadcast early warning messages to all mobile phone users within an affected area (Levere, 2013). This, combined with smartphone applications that allow citizens to report their circumstances, gives authorities new ways to determine what the situation is really like after emergency (Microsoft, 2013). More effort must go, however, into covering the last mile of early warning, in particular, how to reach people in remote villages and other places not covered by the more traditional public messaging systems.

Community-driven public awareness building

Even in countries with less developed early warning systems, technology is already playing a key role in improving the ability of communities to become more resilient to disasters. A few months before the devastating floods in Pakistan in 2010, a local non-governmental organization (NGO) conducted disaster risk reduction training in communities along the Indus River in Sindh province. The NGO visited remote villages and used a laptop computer to show inhabitants a training video, intended to raise awareness about preparedness. When Pakistani radio broadcast news of the widespread flooding, these villagers used mobile phones to call friends and relatives living further upriver to get better information about the severity of the situation. Because of this ad hoc early warning system, they were able to move all of their belongings to higher ground and salvage most of their crops before the flood arrived in their area.

The Jalin Merapi early warning network in central Indonesia is another good example of a community-based effort. The network was set up in 2006 following the eruption of Mount Merapi. A local NGO and three radio stations worked together to give the surrounding communities better information about the volcano's eruptive activity. When the volcano erupted again in late 2010, they had more than 800 volunteers and were present on both Facebook and Twitter. Volunteers sorted incoming information, verified and cross-referenced it. Communities made frequent use of the information the volunteers provided and, as the eruption continued, the focus of the efforts moved from warning people about impeding eruption to helping to coordinate requests for assistance.

Issues faced in making early warning systems more effective

Although the past decade has seen great advances in the development of early warning systems, a number of issues still need to be addressed to make them more effective (UN, 2006). These include:

- The lack of topical coverage of observation systems for many hazard types
- The lack of technical capacity and sustainability of systems, in particular in disaster-prone low- and middle-income countries
- The lack of data interchange standards, policies and procedures for exchanging risk-related data
- The lack of open access to data, especially outside of the affected country

- The lack of collaborative efforts in driving these early warning systems and forecast technologies forward.

As mobile phone ownership and coverage becomes commonplace around the world, communities will become more involved in the monitoring and dissemination of early warning information. In Bangladesh, the government and NGOs have, for example, started providing communities with better understanding of climate forecasts and how populations can use them to mitigate the risks they may face.

BOX 4.2 ICT and market price monitoring

The ability of the World Food Programme (WFP) to provide food assistance is dependent on reliable, up-to-date information on the food security situation in a given location. WFP uses a number of tools to assess these needs. One of the most pragmatic is market price monitoring and analysis.

Market price monitoring and analysis is undertaken to provide critical information on food availability and access, and on the functioning of markets that households depend upon to acquire food. With WFP's corporate strategic shift from food aid to food assistance and the increasing complexity of food security (e.g., global food, fuel and financial crises in 2008 and 2009), the importance of market analysis in support of food security analysis has gained prominence.

By keeping a watchful eye on prices of staple foods across markets on a periodic basis, WFP is able to highlight areas of concern for further action. To monitor market prices, WFP, in conjunction with governments and partners, sends monitors to markets globally, including remote areas, to record local price data on a monthly and sometimes even weekly basis. Until recently, the majority of these data were collected using pen and paper in the market and then entered into spreadsheets and transmitted by e-mail at a later date. This process is, of course, prone to errors in data entry and requires several steps which slow the time from data collection to analysis.

To reduce errors and decrease the time lag from collection to entry, WFP began deploying a number of digital data collection tools. Its earliest endeavours in digital data collection were on personal digital assistants (PDAs) equipped with software developed in-house to collect complex surveys in the field. The tool, PDASurvey, has been used for several surveys over the past few years and also for collecting price data. However, PDASurvey pre-dated SMS data transmission and relied on physical port connections to relay data that were collected on the PDA.

Once SMS data transmission tools such as FrontlineSMS and RapidSMS became available, WFP saw a clear potential for further reducing data collection time by allowing enumerators in the field to submit data via SMS to a central repository in real time. While these tools were in their early days, the limiting factor for adoption was the simple character limit of SMS messages, making complex surveys cumbersome over this data transmission protocol. However, price data collection, which usually includes a few short codes on location, date, commodity and price, can be managed through SMS data transmission.

Beginning in 2010, WFP, in partnership with the Famine Early Warning Systems Network (FEWS-NET) and the Food and Agriculture Organization of the United Nations (FAO), piloted the use of SMS for monitoring formal and informal cross-border trade of food commodities and livestock in East Africa, to inform national and regional food security. Volumes of commodities were collected at border points and prices at nearby markets, and submitted through SMS to country servers for validation, cleaning and analysis. General packet radio service (GPRS) and SMS technologies were used to capture trade flow information on key food commodities and livestock. This information was archived in a regional database via an inter-agency portal, and online analysis on demand was made possible allowing governments and humanitarian agencies to analyse and compare the values and quantities of commodities crossing through key border points over time.

As part of this project, WFP archived historical data, developed and tested regional databases, trained monitors and maintained servers. The project's main achievement was real-time price information through SMS. By the end of 2012, the project had evolved to 36 border points and markets monitored in 11 countries in East Africa. The project harmonized and strengthened price data collection methodology and captured volumes traded at cross-border markets. It also facilitated development of a data cleaning tool to improve data quality. Project data have been used, for example, to better understand food availability and access in Somalia and to monitor the impact of the trade ban on cereal flows in Tanzania. The cross-border trade data are used to produce quarterly updates, which are published online.

Another set of price data collection systems using SMS was deployed in four countries in West Africa beginning in 2011. In these systems, enumerators are equipped with mobile phones and freehand SMS messages are sent to a local phone number. Software then 'translates' the content of the aggregated SMS messages and enters the data into a spreadsheet. The system functions with local SMS (keeping costs low) and does not require a web server. The project has greatly simplified the task of collating and reporting on prices in countries where it has been implemented.

From these deployments, WFP learned that SMS works well for high-frequency collection of simple data (such as food prices on a weekly basis) and that national market information systems were able to take on this innovation. The greatest success in terms of the tool's adoption was seen in Niger where the national market information system has switched from paper to SMS for weekly reporting across 70 markets and is now able to draw on real-time data to produce monthly bulletins, entitled *Albichir*. The SMS system has improved the completion rate of weekly bulletins, particularly in remote markets where previously price information was rarely available. This bulletin, produced in collaboration with WFP and FEWS-NET, is an important document for monitoring in a shock-prone country.

All WFP price data feed into a global price data store. Launched in 2011, the data store benefits from several years of price data collection, compiled by WFP country offices, national government agencies and partner organizations. It contains retail and wholesale prices for key staple food commodities at sub-national levels. All of the price information can be explored online.

In addition, WFP has recently launched ALPS (Alert for Price Spikes), a new tool which generates price alerts using the latest available price data for selected markets and commodities. The tool measures how far the observed prices depart from seasonal price trends and generates alerts when the observed price is above the seasonal price beyond an expected level of variation. These alerts facilitate early detection of rising prices and supports decision-making and early action.

As previously noted, SMS as a transmission modality has its limits, but the lessons learned from market price monitoring using SMS have proved the value of real-time data acquisition within WFP's data collection paradigm. WFP is soon to launch GRASP (geo-referenced real-time acquisition of statistics using phones), an Android-based data collection tool which transmits data through GPRS when available but also through a series of SMS messages. This system will also allow real-time data transmission but will go a step further to include complex surveys and further improve WFP's ability to provide assistance to those in need. ■

Open data for disaster risk reduction

Getting baseline risk data for communities in disaster-prone low- and middle-income countries is often very difficult. To explore new approaches to address this issue, the Humanitarian OpenStreetMap team has been piloting an effort to capture information about buildings and building types in earthquake-prone areas in Indonesia, in partnership with the Australia–Indonesia Facility for Disaster Reduction, the Global Facility for Disaster Reduction and Recovery, the Australian Community Development and Civil Society Strengthening Scheme and Indonesia's National Agency for Disaster Management. This pilot works with students and volunteers to map individual buildings with specific attributes. These data feed into risk models for different parts of the country and help decision-makers and the public to better understand the impact a strong earthquake can have (Chapman, 2012).

Another important aspect in enabling resilient societies is to make the baseline risk data publicly available, because policy-makers and the public must have easy access to the right data and facts to inform good decisions. Sharing these data and creating open systems promotes transparency and accountability, and ensures a wide range of actors are able to participate in the challenge of building resilience. This is the focus of the World Bank's Open Data for Resilience Initiative, which aims to reduce the impact of disasters by empowering decision-makers with better information and the tools to support their decisions.

This move towards open access to data follows an increased push from citizens and civil society for increased transparency in all sectors of life. In September 2012, eight governments launched the Open Government Partnership, a multilateral initiative that aims to secure concrete commitments from governments to promote transparency, empower citizens, fight corruption and employ new technologies to strengthen governance. By the middle of 2013, another 47 governments have committed to joining this partnership.

To foster a similar effort within the international humanitarian community, NetHope, in partnership with a number of humanitarian organizations, academic institutions and private sector companies, launched in May 2013 the Open Humanitarian Alliance, which focuses on promoting transparency and information sharing within the humanitarian response community. This alliance aims at promoting increased information sharing and helping to drive the creation of data standards for humanitarian response information.

Technology for disaster preparedness

Once a country has a good understanding of the risks it faces, the next step in its efforts to strengthen resiliency is to prepare actively for those risks. This includes creating contingency plans to save lives and property, as well as preparing the response and rescue services for operations in the case of crisis.

Technology has played an increased role in making preparedness activities more effective in three areas in particular:

- Setting up resource databases and resource mobilization systems that map the available response resources in the country
- Creating knowledge networks that focus on sharing best practices in humanitarian response at both sectoral and geographical levels
- Training humanitarian responders and communities at risk through effective use of technology.

Resource databases

One of the initial technology-related investments that many disaster-prone low- and middle-income countries have undertaken is to create a database of all the resources – human, technical and information – which authorities can call upon during a crisis. A good example of such a database is the India Disaster Resource Network, which contains more than 92,500 records (Government of India, 2005). These initial efforts, which took significant time and cost to accomplish, resulted in a database which was not kept up to date and which authorities were not certain how to use effectively. Later efforts, which focused on addressing these issues, resulted in more advanced systems that not only contain a database to document the available resources, but also include an automated system for mobilizing resources and track information about their availability. By testing these automated mobilization mechanisms regularly, the correctness of the information is ensured.

The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) uses the United Nations Disaster Assessment and Coordination (UNDAC) team, a group of more than 250 emergency managers from around the world, as their first responders to sudden-onset disasters such as earthquakes. The Virtual On-Site Operations Coordination Centre (VOSOCC), which is an automated system and an integral part of GDACS, allows OCHA to alert all 250 members of a potential UNDAC mission. Members can immediately provide information about their availability via a text message or by visiting the VOSOCC web site. OCHA then uses that information to mobilize available members based on their experience, information that is stored in their profile (OCHA, 2013a). The IFRC has a similar system, with more than 1,200 emergency personnel in its Field Assessment and Coordination Team and Emergency Response Units (ERUs) rosters.

Knowledge networks

Among humanitarians, learning and knowledge sharing web sites have replaced the old concepts of field operation guides, handbooks and textbooks. People working on similar issues across the world are now able to share their best practices, processes and mechanisms for making humanitarian action ever more effective. The original goal was simply to share documents, but in today's interactive world, a report or handbook is more likely to get comments or criticism through a number of blog posts or social media streams. This change has led to a more open discussion and the involvement of a broader community of humanitarian actors than before. The first handbooks, processes and reports written by a large set of contributors through an open, collaborative effort are now emerging, rather than the more typical author, editor, reviewer process that was commonplace until just a few years ago.

With the introduction of social networks, the concept of 'communities of practice' has also taken off. These social networking-based sites, such as the *Red de Información Humanitaria para América Latina y el Caribe* (Humanitarian information network for Latin America and the Caribbean), PreventionWeb, International Network of Crisis Mappers or the India Disaster Knowledge Network, allow members to share information with each other and to actively discuss in a semi-structured manner the key topics affecting their sector or geographical interest area, leading to more informed sharing of best practices. The pitfall is that as social networking systems make it easier to create such groups, a myriad have appeared in recent years. It is crucial that the international humanitarian community start providing decision-makers with guidance as to where they can find the most relevant information about the different subjects of humanitarian action. OCHA's work in putting together the humanitarianresponse.info web site is a good first step.

Training of responders

Over the past two decades, there has been a concentrated effort within the humanitarian community to provide training across the globe, especially in disaster-prone low- and middle-income countries. This effort has been very resource intensive, relying upon people taught in person at workshops and courses held in the field or at regional level, sometimes with a train-the-trainer approach. More recently, online training courses, consisting of a combination of audio and visual material in conjunction with automated online testing, have emerged as a first wave of technology-supported training. The IFRC, for example, changed their original basic delegates' training course by moving the more theoretical and historical parts of the training to an online 40-hour course called the World of the Red Cross and Red Crescent. This enabled them to shorten the in-person course and make it more interactive (IFRC, 2012). Recently several humanitarian response organizations, in collaboration with a private sector provider of online training solutions, launched disasterready.org, a site that allows aid workers to get free access to a large set of online training courses specifically designed for the aid worker community (DisasterReady.org, 2013).

There has also been, in the past couple of years, a move towards more social networking-enabled training programmes, such as courses offered by TechChange, the institute for technology and social change, which combine the two aspects of traditional in-person training with the power of online training. Humanitarian workers sign up for courses that run over a predefined period. A recording is made of all lectures given and students are therefore not required to participate at a given time, but can study at their own pace from their home or place of work. Through a combination of tools, they are able to interact with teachers and fellow students and work on assignments either individually or in groups. With the use of technology, the biggest costs of participating in a training course – travel and loss of time from work – can be avoided (TechChange, 2013).

As preparedness efforts continue to grow, such support will likely be made available to communities at risk and thereby contribute to improving their resiliency through the power of technology.

BOX 4.3 Quality in humanitarian education at the crossroads of history and technology

Humanitarian education is a huge undertaking. Each year, for example, 17 million trainees learn first-aid skills through face-to-face (FTF) training programmes run by the 189 National Red Cross and Red Crescent Societies worldwide. People of varied educational backgrounds join their local Red Cross or Red Crescent branch because they want to learn how to do first aid, how to prepare for or recover from disaster, or how to make their community more resilient. They also join to meet other like-minded people, building social ties and using the power of peer education to learn by doing.

FTF training has been efficient in terms of preparing volunteers to perform the tasks assigned to them, and social, peer-education training has also been an important component of the identity of volunteers and their sense of belonging to the organization. However, this formal way of teaching reproduces a one-way, didactic transmission of information, in which volunteers are given the knowledge they need to perform specific tasks. Recent progress in massive open online courses challenge this model, although questions remain about how effective and sustainable such learning approaches are (Daniel, 2012). This trend generates important questions for the IFRC concerning the use of educational technology while maintaining the purpose and quality of humanitarian education (Stracke, 2012).

In 2009, the IFRC published its first online course – World of the Red Cross and Red Crescent – to support the training of its international personnel. Experts developed courses on global health, security and other thematic areas. These courses were delivered through a single 'Learning Platform' which became part of the Red Cross and Red Crescent Learning and Knowledge Sharing Network in 2010. The network initially emphasized accredited learning, thus acknowledging that such learning remains the only valid currency in the professional world, even though Red Cross Red Crescent workers have acquired skills and knowledge in the field that deserve recognition.

By May 2013, less than 1 per cent of the world's 13 million Red Cross Red Crescent volunteers had accessed the Learning Platform. The cost of internet access and the digital divide remain major obstacles. But the number of learners on the Learning Platform doubled in 2012 and its growth rate is accelerating. Users have completed nearly 60,000 online courses since the platform's launch in October 2009, with more than 5,000 course registrations every month. At almost 50 per cent, the completion rate is a major success compared to the 20 per cent that is considered an acceptable rate in e-learning. Eleven National Societies already have more than 1,000 learners on the platform, with the Canadian, French and Swedish Red Cross among the early adopters. In November 2012, the Australian Red Cross, which had never used online learning in training, became the first National Society to adopt the Learning Platform for training all of its 3,300 staff members. It organized a nationwide roll-out and integrated online education into its workforce development strategy, with research already scheduled to document impact on performance.

For the first time, the Learning Platform enables volunteers to tap into a global knowledge community with no intermediaries prescribing or circumscribing what they should learn. By connecting to the platform, volunteers discover learning opportunities that relate to an essential aspect of their engagement: their thirst for learning as the means to changing their reality.

In 2012, following the Learning Platform's success, the IFRC offered a 'new learning' programme using dialogue between learners and peer review to promote open, active learning. In its pilot phase at the Global Youth Conference, 775 people from more than 70 National Societies – four times more than the number of conference attendees – participated in learning 'missions' and 'live learning moments'. Fifty-eight per cent of participants worked consistently on the learning activities, producing more than 140 pages of content. The same percentage said the programme improved their ability to think critically, analyse, evaluate and apply what they had learned about youth issues.

Questions arose about the learning effectiveness and impact of the IFRC's online courses. Perhaps prompted by the legitimate demand that a new medium demonstrate its value, these questions also reveal an attachment to and assumptions about the comparative advantage of traditional learning modalities. However, researchers completed two comprehensive comparative meta-analyses in 2010. Their conclusions were definitive: since 1991, distance learning has delivered equal or better learning outcomes than traditional FTF programmes (Shachar and Neumann, 2010), while 'blended learning' (supplementing FTF instruction with online instruction) has not enhanced learning results (US Department of Education, 2010).

These studies demonstrated that quality is not determined by the means of delivery; however, they did not determine or assess the quality of the pedagogies used, whatever medium or technology. Many online learning technologies of the recent past, including the IFRC's first online courses, were modelled on top-down, legacy training systems – somewhat like early film-making, which started by recording live theatre. As Bill Cope at the University of Illinois explains: "In their basic approach and use in practice, these are heavily weighted to the transmission of centralized knowledge from the center to the periphery." They are "frequently not effective" as the transmitted knowledge is "often abstract and de-contextualized", while "the value of existing local knowledge, practices and understanding" is "not recognized or incorporated into the learning experience" (Cope and Keitges, 2013).

The IFRC is exploring how innovation in learning connects back to National Societies' rich history and culture, how technology might support learning from the local knowledge of National Society volunteers to strengthen cross-cutting knowledge, skill and competency development, and how collaborative learning communities might be developed across language and other barriers for National Society volunteers. More than 50 online courses destined for the Learning Platform are now in the pipeline, with clearly established, open standards for technology, content and pedagogy, aligned to the ISO 19796-1 quality standard for learning, education and training. Every course is now required to have an evaluation framework in place, to collect data that will be used in an annual review process.

But for humanitarian education to truly be transformed, further pedagogical innovation is needed. For example, online educational resources should also be accessible from mobile devices, notes IFRC's new guidelines. This opens up new pedagogical possibilities: non-traditional contexts for learning, reaching remote constituencies and allowing interaction both between teacher and learner, and between learners. New courses, like the public health in emergencies modules, use mobile-first responsive technology to deliver an immersive learning experience to any device (mobile, tablet or desktop) with a modern browser. These courses are grounded in the field experience of IFRC experts and the evidence base. The pedagogical patterns emphasize application of knowledge, analytical skills and the ability to discover, analyse and interpret from a multiplicity of data sources through teamwork.

The ability to recollect information still matters, but developing the skills and competencies that will enable the learner to perform in the face of the unknown takes precedence. ■

Technology for disaster response and recovery

The most difficult period of a disaster is in the immediate aftermath. During this period, humanitarian action needs to be prompt and targeted, and taking the right decisions can make the difference between life and death. Yet it is during these times that decision-makers frequently have to make uninformed decisions, most often due to lack of available information about the situation at hand.

Information and communication technologies can play a key role in these environments and enable better management of the limited resources available to respond. Since the technologies used during response and recovery are in many ways similar, they are considered together, focusing in particular on how technology plays an ever-increasing role in making humanitarian action in the immediate aftermath of a disaster more effective through:

- Improved understanding of the situation
- Improved understanding of the needs of the affected community
- Improved coordination of the overall humanitarian response efforts and the available resources at hand
- Improved ability to mobilize financial support to the response efforts
- Improved ability to involve the affected communities and enable them to respond more effectively themselves.

BOX 4.4 Innovation and technology enhancing field communications

On behalf of the IFRC, the New Zealand Red Cross hosts an Information Technology and Telecommunications (IT&T) ERU. The unit's task is to deploy at very short notice to major disasters anywhere in the world and provide the communications tools that facilitate the response. To this end, the New Zealand Red Cross maintains a stockpile of IT&T hardware and a team of trained technicians (selected for their problem-solving skills). Collectively, they have a wealth of knowledge relating to the capabilities and limitations of the hardware in challenging circumstances and the difficulties of importing radio transmitting devices.

Of particular concern, in the immediate aftermath of a disaster, is the safety and coordination of field personnel as they scope the extent of the damage. The traditional tool for this is the VHF handheld radio, working through a hilltop repeater. A portable VHF repeater is a flexible tool used, when and where required, by those who need communications beyond infrastructure. However, when the unit's manager started looking for one capable of meeting the regulations and frequency allocations of different countries, he was unable to find one that met his needs for portability (IATA, or International Air Transport Association, compliant for personal luggage), simplicity of tuning (no specialist tools) and ease of deployment (weather tight and self-contained). It turned out that such a repeater could not be found but, by collaborating with Tait Communications, the unit has designed a tool that meets its need for international response. This shows that innovation may not need new technology, merely a new way of combining existing tools and a cooperative manufacturer.

Notwithstanding the proven benefits of VHF radio, communication tools of astonishing capability are available today. If a modern radio is placed alongside a modern smartphone, it immediately becomes apparent that the smartphone is smaller, lighter and vastly more capable – and often much cheaper. Furthermore, most people are more familiar with a smartphone and need less training to use one. The weakness of the smartphone is that it cannot communicate where cellular infrastructure is not available. Therefore the IT&T ERU's next project was to free the smartphone from its dependence on cellular infrastructure. It is, of course, possible to have portable cellular infrastructure (femtocells) but the unit has avoided this solution given the complexities associated with importing transmitting equipment and gaining approval from governments and the existing cellular providers.

The unit's manager has freed the smartphone from the cellular infrastructure using two complementary technologies: WiFi mesh using 'store and forward' data; and text via satellite using the Iridium short-burst data module.

Project Serval Rhizome is an open-source Android app that sends data between cooperating phones until the designated target is reached. Because the data are 'store and forward', a contiguous path is not required and carriers of opportunity (a bus, a bicycle, a model plane) can collect the data as they pass and, in turn, pass them on. In this way large quantities of data may be transferred without an established network.

As a faster way of transferring less data, the New Zealand Red Cross has also made use of the InReach device made by DeLorme. This contains the Iridium short-burst data module and can send and receive text from any place on earth with a view of the sky. Because a smartphone is used as the display and keyboard, the information can actually be sent in electronic form. This has the advantage of reducing the quantity of data transmitted as well as sending in a format that can be automatically downloaded into a database for processing and dissemination, thus removing the opportunity for transcription errors and making the data available nearly instantaneously.

This collaboration between the New Zealand Red Cross, DeLorme and Serval has created a communications system with many benefits from the complementary capabilities of the three technologies, including the smarts and sensors of the smartphone; the global reach of Iridium; resilient communications due to path diversity and the store and forward mechanism; the value for money of commercial off-the-shelf components; and a familiar interface that can be used before, during and after the disaster.

The New Zealand Red Cross calls this system 'Succinct Data' in an effort to manage user expectation. It is important that the users realize that this is filling the niche currently met by voice radio: facilitating the safety and management of field personnel, and transmitting their field assessment data to headquarters. It does not provide the bandwidth and speed that people normally associate with data networks. The benefit of this lack of bandwidth is a communication system that slips into the pocket and works without aligning antennae or strict adherence to radio schedules.

Using the same components, a post-disaster public call box could be created. The call box could be placed on a lamppost at eye level, with printed instructions on the outside explaining how to link to the phone by WiFi and download the app. Once the app is installed, the phone will link with the outside world by text over satellite and with local phones, also running the app, by WiFi mesh.

Simple, robust, public communications using existing smartphones and independent of local infrastructure will dramatically increase the contribution that a community can make to help themselves after a disaster and consequently reduce the effort required from responders to compile a common operating picture or facilitate communications between those affected and their concerned family and friends. ■

Situational awareness

In a crisis, getting timely access to information is a matter of life and death. During periods of conflict or in the aftermath of a disaster, information gathering and analysis can become extremely difficult. As a result, decisions are often made without a clear picture of the situation.

Initial efforts in leveraging technology to improve situational awareness involved the use of geographic information systems (GIS). Response organizations and national disaster management agencies would invest in GIS and hire trained GIS experts. However, these systems were expensive and the availability of trained GIS experts, especially in disaster-prone low- and middle-income countries, was very limited. As a result, situational awareness information provided through the maps created by the GIS experts were often available so late that the situation they depicted was outdated. This was particularly true in sudden-onset disasters such as earthquakes.

During these early years, emergency managers believed the concept of a 'common operational picture' was the holy grail of situational awareness. By bringing all the information available about the situation to a single map, all the decision-makers would be able to make correct, well-informed decisions. The truth was that because of the expertise required to create these geospatial situational awareness maps, they often became overloaded or did not contain all the information in a format that made the individual decision-maker able to determine the best course of action.

In 2005, the release of Google Earth, a free, easy-to-use geospatial product aimed at the average computer user, revolutionized the field of geospatial information. A few months earlier, Google had released Google Maps, a web-based mapping tool, which other web sites could integrate. Humanitarian workers quickly started employing Google Earth and Google Maps to create their own simple-to-use situational awareness tools. The use of geospatial-based situational awareness tools, which had previously required substantial investments and were restricted to large response agencies in high-income countries, now became available to users all around the world.

With new, easy-to-use tools available, the concept of a common operational picture evolved as each decision-maker could view the data most relevant to their field. A decision-maker interested in shelter, for example, may need to know where destroyed houses are located, while another, interested in water, may need information about exploitable water sources. Both of them, however, need to have access to the same information about how many people are affected, where they have gathered and who is operating where. This means that all the decision-makers need to have access to the same underlying common operational data, while visualization of that data is very specific to the role each decision-maker has.

In the immediate aftermath of the Haiti earthquake in 2010, a group of digital volunteers around the world worked on a groundbreaking effort called Project 4636 and the Ushahidi Haiti Project, which focused on getting situational awareness information from the people on the ground through text messages and social media. Although this particular effort's influence on the humanitarian response in Haiti was limited, it had a great impact on the way humanitarian response organizations and aid workers viewed the possibilities of what technology could do to enable better understanding of the situation on the ground (Morrow et al., 2011).

Subsequent digital volunteer efforts, run through the Standby Volunteer Task Force and the Digital Humanitarian Network, have shown the value of situational awareness gathering using human sensors on the ground. Immediately after Typhoon Pablo hit the Philippines in December 2012, digital volunteer groups used social media analysis to provide humanitarian organizations with an early indicator of where the brunt of the damage had occurred (Meier, 2012).

When Hurricane Sandy devastated the east coast of the United States in October 2012, a project was set up to use aerial photographs taken in the days after the hurricane. More than 7,000 digital volunteers assessed each photo and rated the amount of damage they saw. The damage severity rating was used to create heat maps of the worst-affected areas. Before this project, it normally took the US Federal Emergency Management Agency more than a week to get a clear overview of which areas were worst hit, but through this effective use of technology, they were able to get that same information in three days (Cotner, 2012).

In summary, today's technology makes it possible to provide decision-makers with high-level information about the situation using myriad information sources, including satellite and aerial imagery, and automatic and human sensors.

An ICE-SAR (Icelandic Association for Search and Rescue) command post at a supermarket in Port-au-Prince, Haiti in January 2010. © ICE-SAR

Needs analysis

Many of the current approaches to humanitarian needs assessment do not provide a coherent picture of humanitarian requirements. This is particularly true in the initial phases of an emergency. Although the aid community has emphasized the importance of good needs assessments, very few commonly accepted assessment methodologies exist within the humanitarian system, which has hampered a wide use of technology in performing needs assessment. The many different methodologies developed by individual agencies and sectors cannot be compared easily against the results of other assessments (ACAPS, 2013).

While the humanitarian community is working towards more standardized methodologies for needs assessment, the technology community is attempting to create tools that enable the data about needs to be collected through commonplace technologies such as mobile phones. A high number of mobile data collection solutions initially appeared on the market, but most organizations have built their solutions around a few popular providers in this space. These most commonly used systems include KoBoToolbox, CommCare HQ, NOMAD, Open Data Kit, Magpi (formerly known as EpiSurveyor), PSI Mobile and FrontlineSMS.

For the most part, humanitarian agencies have found that these solutions have been quickly mastered and easily adopted by staff. In most places, these mobile-based data collection systems have also been well accepted by the affected communities. There are however a number of challenges faced in leveraging these new solutions, some of which are examined in more detail below.

Mobile-based data collection systems have proven to increase the speed, efficiency and accuracy of the data collected. Instead of requiring staff to enter in results from handwritten survey forms, the data are now available to the decision-makers as soon as the assessors return from the field.

The main issues faced by humanitarian organizations implementing mobile-based data collection solutions have been (CaLP, 2011):

- Mobile hardware and software not designed to work properly in austere disaster environments
- High initial costs in acquiring hardware and in configuring software properly for use in different environments and cultures
- Problems due to limitations in connectivity for solutions not designed to function well with intermittent connectivity or off-line
- Long period of time required to configure and set up different needs assessments on the devices

- Security risks, especially in conflict situations, related to carrying mobile phones with large amounts of privacy-related information.

As mobile data collection solutions become more resilient to austere environments, prices of smartphones go down and methodologies for needs assessments are more standardized, many of these issues should become less of a hurdle for the use of mobile solutions for needs assessment gathering.

Coordination and resource allocation

In the past decade, some individual humanitarian response organizations have set up information systems to capture and share information about the needs observed and the response planned, but these systems are seldom designed to share information with other humanitarian organizations. At present, if information is shared, it is generally through PDFs and maps. This reduces the ability of other organizations to use that same information for operational planning and coordination.

At the same time, the availability of voice and data connectivity for humanitarian organizations has improved radically. Satellite-based connectivity solutions have become commonplace in humanitarian organizations' response kits, while the resilience and availability of mobile networks providing data services have increased dramatically. This was clearly evident, both in the Japan tsunami of 2011 and Typhoon Pablo in the Philippines in 2012.

Over the past years, attempts to improve information sharing and coordination of humanitarian response have focused mainly on the creation of web sites and portals that are either geographical or sectoral in nature. With the introduction of the humanitarian organizations' cluster system in 2005, the various cluster lead agencies set up web sites focused on their sector. Most of the information available on these portals is in the form of documents that seldom contain data in standardized reusable format. Although this has improved overall access to information, it still requires the decision-maker to search for and read a large number of documents in order to get a tactical overview of the situation.

National disaster management agencies in high-income countries have taken coordination a step further than the international humanitarian community. A number of solutions have been developed that improve information sharing among emergency operation centres at either the local or the national level. These systems often include a link to the resource database mentioned earlier and allow for resource mobilization and tracking.

Within the international humanitarian community, the International Search and Rescue Advisory Group, a group of international urban search-and-rescue teams,

BOX 4.5 Adapting digital data collection tools for commodity tracking

In April 2012, a large international aid organization was awarded funding for a cross-border programme to supply its partners in various locations in Syria with medicine and medical equipment for clinics and hospitals. Other associates acted as couriers to ferry the supplies across the border.

While the aid organization assumed sole responsibility for procuring and storing the supplies in a neighbouring country, it could not actually cross the border into Syria. Partner organizations and other groups had to pick up the supplies from the organization's warehouse, get them across the border and organize their transport and distribution to clinics and medical facilities in Syria. A remote verification and monitoring system was, therefore, needed to track and report on the movement of goods to ensure that they were delivered to the intended recipients.

Because of the lack of access to Syria and the extremely short time frame to the start of the project, the monitoring system made use of creative remote monitoring methods (using open-source tools such as KoBo for mobile data collection, QR, or quick response, coding and GPS mapping) that integrate with a web application for administration, management and reporting. This system is known as the Commodity Tracking System (CTS) (see figure next page).

Owing to continually changing access to various locations in Syria and a large number of partners for both the transport and the end use of goods, a multi-tiered verification strategy was employed, which aimed at verifying the handover of goods to the transporting organization, tracking (when possible) the movement of packages from the aid organization's warehouse in the neighbouring country to the final destination, and verifying the receipt of goods by the target recipient.

Many methods of remote monitoring were employed during this project. Transporters used smartphones with customized KoBo forms and QR codes to record the location of the packages, and the end user confirmed or denied the shipment's arrival via e-mail, Skype or other means. End users used smartphones with customized KoBo forms and QR codes to scan shipment on arrival, and checked in on a weekly basis via e-mail or Skype.

All methods linked into a single database via several 'bridge' scripts or processes for ease of monitoring and reporting.

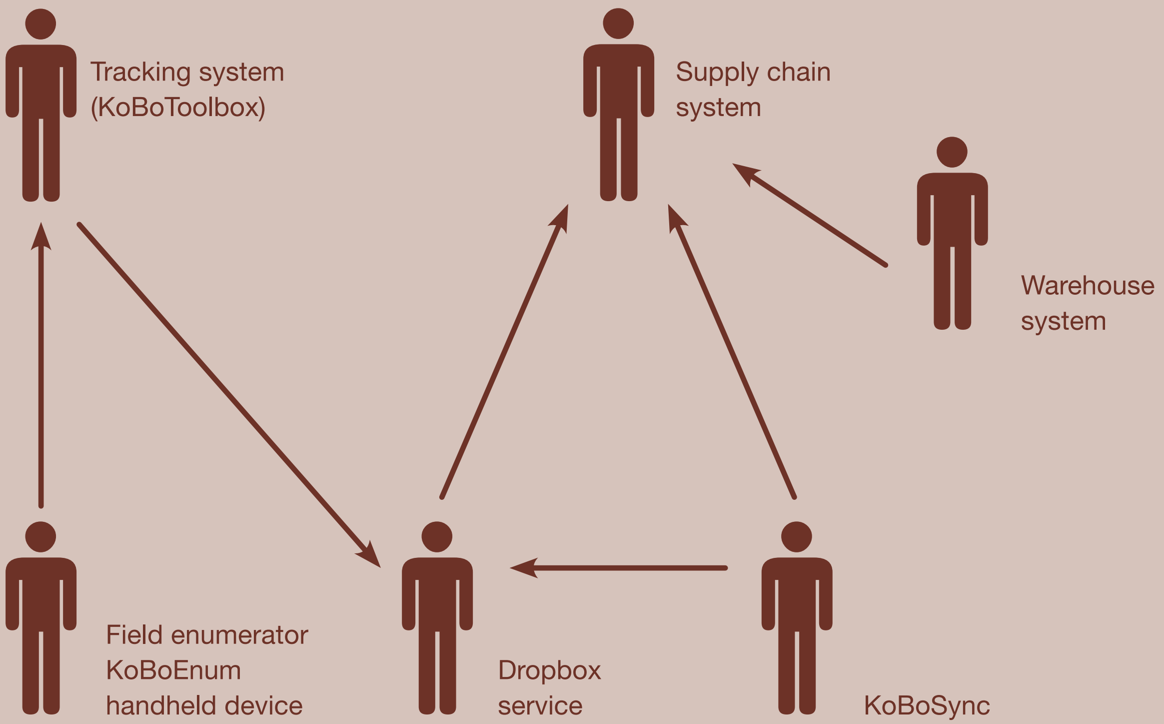
By April 2013, the size of the shipments, which to begin with were very small packages that could be concealed easily, had grown. One of the partners, for example, had moved medical supplies worth about US$ 180,000 in one shipment.

The project has expanded to provide humanitarian aid from another neighbouring country, with operations from a third country already being planned. Given the accumulation of geo-tagged data, there is a good opportunity to display shipment information with a robust mapping solution.

Previously, mobile devices were provisioned and linked to every transporter and recipient, but now a mobile device is included in every shipment and accompanies the shipment to final delivery.

The devices are treated as sunk costs and disposable commodities for the project because the data received are of far greater value.

FIGURE 1 CTS actors



CTS is the parent actor that generally represents the main system, hosted by the aid organization. The mobile data collection system comprises components of the KoBoToolbox, making use of KoBoForm, KoBoEnum (an Android application, a stripped-down version of KoBoCollect) and KoBoSync. The form data gathered via the Android devices are synchronized to a Dropbox folder via the mobile application, DropSync. Periodically, the system will invoke KoBoSync, which is a stand-alone Java application that aggregates data collected by KoBoEnum into a CSV (comma-separated values) file, which is easier to import into the CTS database. Access to the files can be completed by using the Dropbox API (application programming interface). Some initial set-up is required. ■

has long used an online system to share information about the situation following large-scale earthquakes. They use the VOSOCC system developed by OCHA to share situational information in a structured manner and to track the logistics of teams deploying to the affected area (OCHA, 2013a).

For a number of years, the IFRC has used their internally developed system, the Disaster Management Information System (DMIS), to coordinate efforts within the Red Cross Red Crescent Movement. Both VOSOCC and DMIS usually provide current and up-to-date information about the response for the first week of the response. After that, other systems coordinate the information, such as local web sites set up by UN country teams or the national disaster management agencies.

Awareness-raising

When blogs and social media first appeared a few years ago, some members of the humanitarian community saw this new technology as a big threat. It enabled aid workers to communicate directly with a large number of people without the humanitarian organization having any control over the content shared. A number of humanitarian organizations put in place strict bans on the use of these technologies on their networks and a few organizations even went so far as to ban aid workers from using them while on mission. In many cases this was done out of fear of losing control of what the aid worker was writing, fearing they might jeopardize the operations of the humanitarian organization in the countries they were working in.

In the last few years, however, these technologies have become an integral part of humanitarian organizations' mechanism for creating awareness and raising funds for their operations. Aid workers are now encouraged to use social media networks such as Facebook and Twitter to provide an insight into their operations. With increased availability of cheaper bandwidth, aid organizations now also share images from the affected areas through social networking sites. Similarly, the availability of low-cost, high-definition video cameras has pushed organizations towards providing short video clips from the field.

By bringing the potential supporter closer to the reality of the situation, people get a much better idea of what is happening on the ground than they do by watching a one-minute item on the evening news. They get a better understanding of the work done by the humanitarian organization and that increases their level of trust and willingness to support these operations. An effective social media awareness-building strategy has become central to the fund-raising efforts of most humanitarian organizations.

The level of entry for humanitarian organizations to utilize this technology to improve their ability to raise funds is very low. This has enabled a number of smaller NGOs to raise funds through their social networks, something that would have taken significant effort just a few years ago. All the tools needed for driving a successful awareness- and fund-raising campaign for a humanitarian response operation are available online, either free or at a very low cost, as cloud-based services.

Tools that enable people to share the information they read within their own social networks create an opportunity for the message to 'go viral'. One of the most successful awareness-building campaigns that went viral was the *Kony 2012* campaign, which focused on raising awareness about the war crimes of Joseph

Kony, the leader of the Lord's Resistance Army, in the Democratic Republic of the Congo, South Sudan and northern Uganda. Through a well-coordinated social media campaign, the organizers were able to get more than 97 million people around the world to view a documentary about Kony's war crimes (Invisible Children, 2012).

Many of the larger humanitarian response organizations have many followers and subscribers on the main social networking sites. They also make use of celebrity spokespersons to spread their message to an even wider audience. On World Humanitarian Day on 19 August 2012, OCHA, in collaboration with US singer Beyoncé, launched a social media campaign, which aimed at creating awareness about the selfless work that humanitarian workers do every day. In less than a month, the campaign went viral and, with support from other celebrities with large fan bases, such as singers Justin Bieber and Lady Gaga, the goal of sending out more than 1 billion messages of hope on various social networks was not only met but exceeded (OCHA, 2012).

Community-driven response

Most humanitarian organizations agree that it is important to involve the affected communities more in the humanitarian response. By becoming part of the operational planning and execution, the assistance provided is owned by the affected community. A community-driven response also ensures that the community itself better protects those who are helping. This reduces the security issues faced in many humanitarian operations.

During the Horn of Africa famine in 2011, the BBC, Internews and ActionAid worked in partnership with communities in Isiolo, Kenya, who were sent text messages giving them advance notice of aid delivery. This simple involvement of the community meant that people were better prepared for the arrival of aid supplies and the time taken to offload supplies was reduced from three or four hours to 30 minutes (Internews, 2011).

The network age has enabled a qualitatively different model of humanitarian response. Whereas political leaders and aid agencies, often far away from an emergency, once made assumptions about the needs of people in crisis, those people now have the tools to communicate their own expectations. New tools to engage broader social networks, communities and individuals are more effective in determining how people can help themselves and how they want to be helped by others – mobilizing local, national and sometimes global support to meet their needs (OCHA, 2013b).

BOX 4.6 Saving lives with SMS

The impact of mobile phones on how people communicate and get information is undeniable. International Telecommunication Union (ITU) statistics show mobile phone subscriptions grew by 62 per cent in low- and middle-income countries from 2006 to 2011 (ITU, 2013), and this is set to continue with 9.4 per cent subscriber growth expected between 2011 and 2016 in Africa (Portio Research, 2013).

This has a major impact on how humanitarian agencies operate and they have a moral obligation to explore and maximize the opportunities this explosion in mobile phone use can offer in terms of saving and improving people's lives.

After the 2010 Haiti earthquake, the IFRC decided to investigate the potential of SMS as a tool for early warning and disaster preparedness, response and recovery. There were several reasons for this: SMS are common and use minimum network resources; they are often the first service restored after a disaster; and people can keep the information on their phone and share it with others.

The IFRC approached Trilogy International Partners, the parent company of the Voilà network in Haiti. Together they developed the Trilogy Emergency Relief Application (TERA).

Unlike traditional SMS services, people do not have to subscribe to TERA to receive messages, critical for early warning alerts. SMS can also be targeted to a particular region or even a neighbourhood. The system can also be used for simple surveys and responding to information requests.

TERA was launched in August 2010 with a campaign providing advice on preparing for the hurricane season.

Since then, 100 million SMS have been sent – a feat only possible because Trilogy do not charge the IFRC for the SMS they send. This corporate partnership is critical to ensure that messages are sent quickly and not on the basis of available budget.

SMS provide simple and practical information to people at each stage of the disaster cycle, including advice to prepare for disasters and mitigate their impact; health information on common preventable diseases, such as cholera and sexual health; early warning alerts for hurricanes, floods and epidemics; information on accessing local help services after a disaster; details of all Red Cross Red Crescent projects and services; and asking for feedback on services and situations.

Two IFRC evaluations examined the effectiveness of the TERA SMS system in Haiti (Chazaly, 2011; IFRC, 2013). The results are very positive. More than 60 per cent of respondents in the 2013 survey reported receiving an SMS from the Red Cross Red Crescent. Of these, 86 per cent said the information was useful, 72 per cent said they shared SMS with others and 56 per cent reported taking action after receiving an SMS. The most popular and memorable topics of information were disaster preparedness and alerts and advice on cholera. Timeliness, simplicity and practicality of messages were all rated highly – 68, 76 and 75 per cent respectively.

The SMS may also have psychological benefits. In the 2011 evaluation, 12 per cent of respondents said that the SMS made them ‘feel cared for’.

The system has also been popular with programme staff as a means of helping them extend the reach and impact of traditional activities. In 2010, the IFRC disaster preparedness team calculated that SMS helped them reach ten times more people than they would be able to through traditional methods. SMS also proved a valuable tool for sharing sensitive information, such as where to go for help after sexual assault – information that would be difficult to share face-to-face.

Following the success in Haiti, the IFRC and the Sierra Leone Red Cross Society launched TERA in Sierra Leone in May 2013. One of the key elements to success has been the cooperation between the government, the Sierra Leone Red Cross and mobile operators. From the outset, the government sponsored the project and three out of the four mobile operators agreed to support it.

Despite TERA’s success, there have been criticisms concerning the lack of literacy and access to mobile phones, an SMS’s short length and fear that people may consider it ‘spam’. Both evaluations found that information heard through several sources increased the chances of it being trusted, remembered and acted upon. SMS should always be in line with the programme aims and work alongside a suite of other communication channels. Interestingly, the 2013 evaluation found that of those who classed themselves as illiterate, one-third still reported receiving information through SMS.

One of the biggest challenges is using SMS for two-way communication. SMS surveys carried out in 2011 received limited responses. Trilogy’s technical experts suggested using an Interactive Voice Response (IVR) phone line to augment the SMS system. Funding from the Humanitarian Innovation Fund led to the launch of the phone line in May 2012. It allows people to access detailed recorded information through a menu-operated system and take part in surveys by pressing buttons on their phone. The line receives an average 100,000 calls per month.

While there is still plenty of scope to explore how TERA can be used in new ways, it is an excellent example of what can be achieved when technical experts and humanitarians put their heads together – and, for the IVR, when donors are willing to take a chance on something new. Despite the limitations, SMS and TERA is helping the IFRC to build community resilience and save lives by delivering timely, targeted advice to people in a format they like and can easily access. Internally, it helps the IFRC to be more efficient and effective, but perhaps most importantly of all it lets disaster-affected people know that somebody really does care what happens to them. ■

Factors limiting effective use of technology

A number of issues currently limit the effectiveness of technology adoption in the humanitarian context (Petursdottir, 2012). These include:

- Financial cost in implementing technology solutions
- Lack of trust in technologies by intended users
- Digital literacy of the intended users

- Technology acceptance by government and humanitarian organizations
- Reaching affected communities
- Simplicity of solutions
- Incentives for participation in technology-based community solutions
- Demographic representation of the communities participating in the technology solutions.

Financial cost

Technology-based solutions often have high initial costs, limiting smaller humanitarian organizations from using technology effectively. However, they provide significant cost-efficiencies over time that is rarely captured in the aftermath of a sudden-onset disaster. Two trends are helping address this issue. The first is increased collaboration among humanitarian organizations through various consortiums such as NetHope, the Assessment Capacities Project and InterAction. These partnerships enable the economies of scales required to lower the initial investment costs for new technologies. The second trend is the rise of cloud computing which enables solutions to be deployed without the requirement to set up large infrastructures to run the solution.

Trust

Information privacy is relatively new to many low- and middle-income countries. But knowing where the information they share goes and what it is being used for is also important to improving trust. There is an inherent distrust of mobile technology, so that messages or surveys sent out by the government or humanitarian organizations, for example, will have to be transmitted in a way that somehow verifies the authenticity of the sender (Petursdottir, 2012).

Digital literacy

Although mobile phones are widespread among many communities in low- and middle-income countries, many individuals are not experienced in using mobile phones for anything beyond basic voice calls. Computer literacy is even lower. This is coupled with generic literacy issues, which may further restrict users' ability to read text messages or on-screen instructions (Knoche, Rao and Huang, 2010). It is, therefore, essential to design any interaction with these communities in such a way that it does not require extensive knowledge of how to use the phones or how to read and write. One option is to use mobile- or digital-literate facilitators who can perform surveys inside the affected areas using mobile phones, asking the affected population for their input (Petursdottir, 2012).

Technology acceptance

The willingness of governments to use technology as part of a humanitarian response effort may be limited. A culture of holding meetings or using paper-based reporting is still very strong in many governments. A survey conducted by NetHope following the Pakistan floods in 2010 showed that 90 per cent of communication with the government was paper-based. The same may hold true for many response organizations. Their acceptance for trying out new methods, such as mobile technology, may face institutional resistance. Further research on and increased awareness-building about technology-based humanitarian response may assist in bringing about change in this area (Olafsson, 2011).

Reaching affected communities

In most cases, the only way of reaching affected communities via mobile phones is if they are willing to provide you with their mobile numbers for use in the humanitarian response efforts. Without cooperation from mobile phone operators, it is impossible to reach all mobile phone users within a particular area (Petursdottir, 2012). There are, however, recent examples of this kind of collaboration between NGOs and mobile operators, where text messages were sent to all mobile phone users using a particular set of mobile towers. A particularly successful example is the one in which the mobile phone operator Voilà worked with the IFRC to send hygiene and cholera awareness information to people in Haiti (IFRC, 2010).

Simplicity of solutions

Any solution developed for humanitarian response needs to be designed in such a way that it provides a simple and intuitive human-to-mobile interaction. If targeted towards the affected population, the use of symbols and images can be used to address issues such as literacy. However, it is important that these symbols and images correctly reflect the cultural context and can be understood by the communities. All text presented by these applications needs to be clear and written in a language and dialect that is understandable to the intended user (Petursdottir, 2012).

Incentives for participation

Incentives, such as free mobile airtime or prizes for participation in mobile-based community efforts, need to be thought through carefully. Compensation should be appropriate to the time and effort of participating, but the incentive should not become the only reason people take part. It is also important that the incentive does not hinder people from giving their opinion out of fear of losing the incentive opportunity. Simple and small incentives, such as mobile airtime, which can be tracked effectively, should be considered as a preferred mechanism for rewarding people for their time (Petursdottir, 2012).

Demographic representation

It is important to keep in mind that the demographic distribution of mobile phone users within the affected areas may not represent the demographic distribution of the inhabitants of that area. Mobile phones, especially more technologically advanced ones, have higher usage among the younger generation, while older, non-internet-enabled phones will be used by the older generations. In many countries, men may be more likely to own the only mobile phone in the family. Marginalized or minority groups that have low mobile phone ownership need to be identified to ensure that their voice still is heard as part of a mobile phone-enabled disaster response participation (Petursdottir, 2012).

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Chapter 5

Chapter 5

The risks of technological innovation

Although technological innovations – including increasingly autonomous robot technologies and tools developed from nanotechnology – will undoubtedly continue to transform the humanitarian endeavour in new and exciting ways, much of the optimism currently surrounding the role of technology in the humanitarian enterprise appears to be based on two assumptions: first, that adding technology is inevitable; and second, that doing so will generate progress. Despite both great potential and already realized positive effects, technological innovation can also compromise humanitarian action by leading, directly or indirectly, to catastrophic events that will require entirely new types of humanitarian response.

This chapter offers a three-part inventory of the risks potentially associated with technological innovation. The aim is to offer practitioners and policy-makers a set of conceptual categories that will support critical reflection on both the opportunities and the costs of using technology. The first part explores the relationship between technology, accountability and transparency; the potential risks of connectivity and openness; and the emergence of data insecurity and privacy issues as key challenges in humanitarian action. It also considers some implications for humanitarian procurement, as military technology is marketed for civilian purposes. The second part evaluates technology as a source of risk, including the danger of obscuring genuine concerns by focusing on high-profile topics such as cyber-war and drone attacks. The final part considers the effects of technology on the traditional humanitarian use of narratives of suffering and the underlying assumptions that drive the quest for more data to produce such narratives. The chapter concludes with brief observations on key questions that are emerging from the humanitarian embrace of technology.

The turn to technology: what costs to humanitarian action?

Accountability and transparency

Throughout the 1990s, as a result of widespread criticism originating both within and outside the United Nations (UN) system, accountability gained prominence on the agendas of donors and humanitarian actors. In an environment in which accountability systems were viewed as crucial to improvements in humanitarian action, humanitarian organizations began to set standards for

Humanitarians' use of new technology to better respond to the needs of affected populations is not without risks, such as data insecurity and cyber-attacks. The digital divide is a real problem, although solar charging stations, such as this one in Liberia, help overcome it by enabling people to use technology even in remote locations.
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BOX 5.1 Using robot technology in the aftermath of disaster

On 11 March 2011, the Great East Japan Earthquake struck north-eastern Japan. The massive earthquake and associated tsunami devastated the region and led to a nuclear power plant failure. In the areas affected by this complex disaster, Japanese and US-made reconnaissance robots were used to search for chemical, biological or radiological anomalies and to traverse rubble and wreckage. However, no biped walking robots were deployed, even though Japan is a leader in their design and development.

In Japan, industrial robots are currently used on production and assembly lines in factories, 'caring' robots also help people lie down or get out of bed, and housekeeping robots are used for household cleaning.

In difficult situations, such as after a disaster, special protective accessories are needed to enable robots to work, but these are still being investigated and are not yet ready for practical use. At present, in disaster situations, robots can be used for reconnaissance, entering areas where humans cannot go. After the 2011 catastrophe, however, many of the robots deployed could not be used for long, as the amount of debris and high levels of radiation soon rendered them inoperable.

Some high-income countries have developed robots for use in the case of nuclear explosions or nuclear power plant accidents. In extremely difficult and harsh post-disaster environments, however, further technological advances are needed to keep the robots working long enough to use them for rescue and other complicated missions.

Japan is working on the development of tough, mobile biped robots that can tolerate such inhospitable environments and be used in future disaster situations. Once such robots have been perfected, commercial production will be necessary to ensure sufficient robots are ready to be deployed when disaster strikes. ■

accountability and to engage in self-regulation. The humanitarian reforms of the mid-2000s were designed to address continued accusations of waste and mismanagement; to strengthen the UN's Humanitarian Coordinator system; and to ensure, through the use of the Cluster Approach, more reliable and systematic attention to the main sectors of response (Holmes, 2007). It was assumed that making humanitarian action more accountable, transparent and efficient would also make it more legitimate.

This cyclically repeated narrative of institutional and ideological renewal finds its contemporary expression in the drive towards technological innovation. Nevertheless, two key objectives of humanitarian reform – accountability and transparency – are largely absent from discussions about technology. And a third objective, increased efficiency, is not so much discussed as presumed. Today, while increasing access to information technology has broadened the range of stakeholders demanding accountability to include partners, donors and their political constituencies, the people affected and a virtual 'global public', two questions remain largely unasked: first, to whom does the humanitarian enterprise owe accountability? Second, how should such accountability be achieved?

Technological innovation has given rise to a set of specific issues concerning assumptions about the transformative effects of technology; technology's potential to bracket the issue of accountability; and professional identity and level of commitment among new, technology-based actors.

A 2013 report published by the UN Office for the Coordination of Humanitarian Affairs (OCHA), *Humanitarianism in the Network Age*, argues that "everyone agrees that technology has changed how people interact and how power is distributed". While technology has undoubtedly altered human interaction, changes in the distribution of power are far from self-evident. In many parts of the world, the digital divide persists: within communities at risk, access to information technology continues to follow traditional – and deeply unequal – patterns of resource distribution and vulnerability, including variations on the basis of gender. At the same time, settings in which access to technology is more widespread will tend to generate more data. In some cases, protection work or relief distribution may be based on biased or skewed data.

Moreover, even if technological solutions can help to address the challenges posed by spaces of technological scarcity, two underlying issues remain: first, the trend towards self-responsibilization for identifying and voicing need has profound implications for how participation is understood and assessed; second, the ability to use technology to express need does not necessarily imply the empowerment of individuals or communities. Thus, in practical terms, it should not be assumed that communication with affected people through social media or text messaging is inherently equitable or a meaningful way for humanitarians to achieve the goal of placing these individuals at the centre of humanitarian action.

Technological improvements – specifically, remote management (Belliveau, 2013) – have enabled humanitarian organizations to 'stay and deliver' (OCHA, 2011), instead of suspending operations in insecure areas. But when humanitarian operations are handled from a distance, what happens to the practical, tangible aspects of accountability? Face-to-face encounters between aid workers and the people affected should not be romanticized: they are by nature deeply hierarchical and frequently disempowering for the recipient. They nevertheless include, on some level, recognition of the other as *human*. Institutionalizing remote management on a broader scale creates a real danger that institutional notions of accountability towards local populations will cease to take any form that is meaningful from their perspective.

In addition, the attempt to improve humanitarian endeavours through evidence-based action and increasing regularization presents a serious challenge: advanced technologies have heightened expectations of continuously updated information from the field, and thus engendered more reporting, more monitoring and more evaluation. Although the goal is to increase the efficiency and transparency of practice, the energy invested in producing this electronic paper trail should be critically evaluated with a view to enhancing accountability to stakeholders at all levels: how much of this information is accessible and/or meaningful to the populations receiving humanitarian aid?

Another concern relates to the professional identity of new actors in the volunteer and technical communities (V&TCs). Partly because of low barriers to entry, these V&TCs have become involved in activities such as crowdsourcing, internet-based funding efforts and the development of 'disaster drones'. While such work is frequently described as a 'game changer' for humanitarian action, important issues remain unaddressed. Skilled volunteers are a fragile and finite resource, frequently subject to burnout. As mobilization levels fluctuate from crisis to crisis, the level of trust between professional humanitarians and V&TCs may decrease if V&TCs are viewed as unreliable partners.

Moreover, having taken technical know-how and a desire to do good as their starting point, V&TCs may not know or care about key humanitarian principles such as neutrality, impartiality and independence, and may not have enough contextual understanding to assess effectively the impact of their own work in relation to the 'do no harm' principle. Nor is it clear to what extent V&TCs see themselves as engaged in humanitarian action and, therefore, as accountable according to the standards and principles of the humanitarian enterprise. While these challenges are being proactively addressed by part of the V&TC community, both V&TCs and traditional humanitarian actors must shoulder more responsibility for developing common protocols.

While organizations such as the International Committee of the Red Cross (ICRC) have made enormous strides in developing protection standards (ICRC, 2013) for the use of information technology in protection work, many organizations still lack robust guidelines or professional standards for their own use of information technology or for collaboration with V&TCs. The development of such standards is crucial, both to protect the principles of the humanitarian enterprise and to encourage the participation of V&TCs, who possess valuable skills that they are willing to contribute on a volunteer basis.

Analogous concerns apply to software development: 'black-box' (i.e., a complex system or device whose internal workings are hidden or not readily understood) decision-making has for some time been considered a core challenge to the efficacy and legitimacy of humanitarian action. More advanced software has been seen as crucial for advancing evidence-based humanitarian action at the expense of decision-making based on anecdotal evidence or institutional or personal preferences. Nevertheless, as decision-making software proliferates, the prospect arises of 'black-box humanitarian decision-making' 2.0, in which decisions are based on algorithms that may or may not be based on sufficiently contextualized indicators or in accordance with humanitarian law and standards of practice. Perhaps more important, determining whether this is the case may be next to impossible for both administrators and users.

Yet another challenge originates in the extent to which transparency is construed as a sign of the integrity – and legitimacy – of humanitarian action (Strathern, 2000). More than a decade ago, OCHA argued that "perhaps the greatest challenge for this field is creating a culture of information sharing that promotes the systematic collection, use and free flow of data, information and ideas, facilitates informed decision-making and builds trust and commitment among stakeholders" (OCHA, 2002). Today, an avalanche of information on programming and policies available on various platforms seems to answer OCHA's call for transparency in information sharing, but it is important to realize that transparency does not equalize power relations or automatically result in the unveiling of power.

Traditionally, a paucity of transparency has been regarded as an organizational problem that needs to be addressed by changes in procedures, by the elimination of certain institutional structures or habits and, more recently, by the addition of information technology. But transparency is neither neutral nor natural: instead, organizational approaches to improving transparency, such as engaging with a constituency on Facebook, are artificial and constructed. Moreover, in a world characterized by information overload, it is difficult to determine both what is relevant and what is missing.

Finally, transparency also has an internal aspect: technical challenges to transparency have long been considered a problem. Data silos – systems that are *not* designed to facilitate data exchange – have proliferated within the humanitarian community and are believed to greatly complicate transparency.

BOX 5.2 Participatory aid delivery in Aceh after the 2004 tsunami

The Indonesian province of Aceh was devastated by the 2004 Indian Ocean tsunami. In an effort to help the population to develop the skills they needed to identify and find solutions to the problems they faced, the Indonesian Red Cross Society (PMI) and the Irish Red Cross Society set up the Community Outreach Programme (COP).

The programme consisted of a community advocacy unit (CAU) and a media unit. Affected populations could send information about their problems and unmet needs directly to the CAU via SMS. Communication conduits – managed by the media unit and including a radio (Radio Rumoh PMI), a newspaper (Rumoh PMI) and a TV service (Warung Kopi Rumoh PMI) – allowed open discussions between affected populations and service providers.

Individuals and groups sent SMS to a predefined number advertised on local radio stations and in newspapers, to which the COP responded within 72 hours. The SMS were used to drive the actions of project staff. Problems identified included access to basic health services, shelter, water and livelihood and educational grants. Staff directed respondents to appropriate service providers and got back to them by phone or, if necessary, arranged face-to-face interventions.

For more complex requests, such as dealing with local and national authorities and non-governmental organization (NGO) staff, or getting basic services provided to certain, 'forgotten' communities, staff followed up where necessary with field visits and training sessions.

Overall, the COP was a successful and effective project. This was due in part to community involvement in the process. People could voice their opinions and their requests were heard and, in a majority of cases, satisfactorily resolved. In addition, information received via SMS and from the field was used to create interactive media sessions and productions, which in turn relayed the information back to the community via live radio and TV programmes and newspapers.

The COP did face a number of challenges, however. The programme did not actually deliver the services the population requested (shelter, water, livelihoods, etc.) but advocated for these services on behalf of the communities. This meant the team had to approach other, non-Red Cross Red Crescent or government organizations to provide the services and often had to bring up issues of access and the quality of the work being carried out. This sometimes caused tensions between the COP team and staff of the other organizations.

One of the hardest things to overcome was that some service providers took offence at being held accountable to the affected populations and the COP was perceived to have taken on an auditor's role. Some NGOs or donors were delivering services with the best of intentions, but sometimes these were either substandard or not based on the communities' needs.

For example, the COP received 40 requests for help relating to houses being built by an NGO. The houses had unstable roofs and some houses were in a state of ill-repair within months of being built. The COP brought this to the attention of the NGO, which was aware of the problem and was trying to rectify it. At the COP's suggestion, NGO staff participated in a live radio programme to discuss the problem with the population and explain that they were taking steps to deal with their complaints. The NGO subsequently repaired the defective houses.

The COP team received very many SMS requests and had to find an effective way of maintaining the expectations built by the programme and dealing with a vast array of issues. They first categorized issues according to whether they could be dealt with over the phone or whether they required face-to-face interventions. What made the operation most efficient, however, was pooling community issues, which allowed the team to group needs together and thus deal with larger numbers of cases.

The programme worked because it put advocacy at its core, which meant measurable outputs were related directly to people's needs. By using various media channels, communication loops could be developed across the programme, allowing feedback to be constantly updated. Another benefit was that senior management in both Aceh and at headquarters were flexible enough to let the programme evolve as new methodologies were tested and found to deliver the services more effectively.

Team-based responsibilities were the norm. While staff had specific tasks, they also worked across various departments and were able to try their skills at a range of different activities.

A programme officer and an information technology officer, for example, became TV presenters although neither had any previous TV experience. But they were both extrovert personalities who were comfortable in front of the camera and a crowd, and they became celebrities in Aceh. A mentorship programme allowed other volunteers and staff to learn to become, for instance, radio announcers while working on the job.

COP staff were seen by communities to be part of the community itself. This removed some of the barriers that other service providers faced. Staff came from Aceh and from other parts of Indonesia and brought with them their various skills. They felt strongly that they had a responsibility to give the people who did not have a voice an opportunity to be heard and to deliver on their needs. ■

Social media: the limits of sharing

While information sharing and visibility are vital in crises, losing control over information about disasters – or about organizational reputation – can rapidly produce dangerous dynamics on the ground. Excessive sharing of logistical details and procedural standards, for example, can make humanitarian action more dangerous by giving armed non-state actors information concerning project locations, distribution plans, travel itineraries, the whereabouts of partners and so forth (OCHA, 2013). And humanitarian organizations that are perceived as being affiliated with local armed actors or with military stabilization efforts, or as playing the role of 'force multipliers' in an effort to control, contain or manage armed conflict or complex emergencies may suffer a potentially lethal loss of credibility (Collinson, Elhawary and Muggah, 2010).

Humanitarians in the field have always been at risk from misrepresentation of their actions and intentions, either by local or national media or by special-interest organizations (Sandvik, 2013). Today, the instant global reach of social media has rendered the repercussions of misreporting even more serious. Social media, in particular, has the potential to compromise the security of humanitarian workers and other people at risk. Anyone – without revealing her or his identity – can post rumours on Twitter or Facebook (Vis, 2012) regarding the scale or impact of a crisis, the response (or failure to respond) of the government or the humanitarian community, culturally inappropriate actions or theories about the causes of a disaster, which may include the identification of specific culprits or the promulgation of conspiracy theories concerning the reasons why a certain population has been affected by the disaster. While the credibility of tweets may be predicted in certain circumstances (Castillo, Mendoza and Poblete, 2012), in operational terms, the ease with which such rumours can proliferate means that strategies and capabilities for quickly and effectively countering or dispelling such rumours need to be part of the humanitarian toolkit. While V&TCs are actively addressing this challenge – for example through the verification team of the Standby Task Force (SBTF) – these efforts need to be mainstreamed.

Involuntary sharing of information is an increasing problem for humanitarian organizations, which are regularly targeted by cyber-attacks from governments, armed non-state actors and 'black hat' hackers, as well as being systematically subjected to GPS tracking and surveillance. A high number of countries with a history of human rights abuse now employ a range of surveillance technologies, such as Blue Coat Systems and FinFisher, which are capable of censorship, filtering and surveillance. The intent is to gather information to entrap and/or harass civil society actors, including humanitarian organizations (Deibert et al., 2013; Marquis-Boire et al., 2013). Such activities fit into a long-established pattern whereby authoritarian states have attempted to control or deny access to certain types of information on the internet (Deibert et al., 2010 and 2008). As information becomes a key humanitarian resource, control, manipulation and denial of access will inevitably become important operational concerns.

Finally, there is a risk that for humanitarian actors, social media may become an end rather a means. As field presence is outsourced and more organizational resources are directed towards fund-raising and public relations, the quest for visibility may gain prominence over substance. In the late 1980s, the advent of 24-hour broadcasts of emotion-driven stories of humanitarian suffering was criticized for provoking rash or misguided policy responses; such responses were known as the 'CNN effect'. Today, with news of humanitarian disasters and responses continuously available to a near-global audience, the world is facing what might be called 'the CNN effect 3.0', as populism – including nationalistic, ethnic or sectarian-inspired calls to action – gains traction by 'going viral' on YouTube. A related challenge concerns actors who take on the mantle of humanitarianism by using social media to spread a particular message, with little concern for either humanitarian principles or local realities – a phenomenon most infamously exemplified by *Kony 2012*. The film was accused of being a simplistic and misleading comment on a complex conflict (in 2012 Joseph Kony and the remnants of the Lord's Resistance Army were thought to be hiding out in the Central African Republic), encouraging 'slactivism' (actions performed via the internet in support of a political or social cause) and of elevating both Kony and the filmmakers to celebrity status while being disrespectful to those who had suffered from his actions.

BOX 5.3 Towards trustworthy social media and crowdsourcing

Individuals and organizations interested in using social media and crowdsourcing currently lack two key sets of information: a systematic assessment of the vulnerabilities in these technologies and a comprehensive set of best practices describing how to address them. Identifying such vulnerabilities and developing these best practices are necessary to address a growing number of incidents ranging from innocent mistakes to targeted attacks that have claimed lives and cost millions of dollars.

Every negative incident involving social media or crowdsourcing can be attributed to one or more vulnerabilities in the way people use them, the platforms themselves or the technologies on which they are built.

In the town of Nuevo Laredo, on the United States-Mexico border, a group of Mexican citizens came together to track the activity of drug cartels operating in the area by posting information on several web sites. In retaliation, four people were murdered and their bodies left in public locations around the city. The bodies were accompanied by signs listing the web sites where the victims were supposedly posting messages (*Los Angeles Times*, 2011). While it is unclear whether the individuals assassinated were users of the site or scapegoats chosen by the cartels, the Nuevo Laredo murders highlight the challenges of crowdsourcing in areas with actively hostile organizations.

Attackers around the world are learning to find and use information shared online. In Iraq, a mortar strike targeted and destroyed several Apache helicopters shortly after they had arrived at a remote operating base. The US army believes the strike became possible after soldiers uploaded geo-tagged photos of the aircraft to the internet where they were discovered by insurgents, thereby informing the attackers where to aim their munitions (Rodewig, 2012).

The processes used to crowdsource information can also be manipulated by internet-savvy attackers.

During the 2011 Russian parliamentary elections, the country's only independent election-monitoring organization built and deployed a crowdsourced information collection system to track reports of fraud. During the election, a video was circulated on YouTube attacking the credibility of the site and the reports it contained. The video's narrator, a young woman, appeared to submit a series of false reports that were believed and published by the election-monitoring web site. She then used the published false reports as proof that none of the reports on the site could be trusted, calling the crowdsourcing system yet another attempt by hostile nations to slander the country's leadership (YouTube, 2012).

Attackers are also directly targeting online social media platforms. In February 2013, Facebook, Twitter and numerous other high-profile technology companies disclosed that their internal systems had been compromised in a series of attacks attributed to Eastern European criminals (Riley and Satariano, 2013). Although the companies stated that no user information was lost during the breaches, another security researcher recently posted a flaw in Facebook's authentication process that could be used by attackers to gain full access to a user's account information (Brook, 2013).

Vulnerabilities in users' computers can further exacerbate the risks of using crowdsourcing and social media. In Syria, there have been a series of cyber-attacks using custom-made viruses that target activists' computers. Once infected, the computers allow attackers to access the user's usernames and passwords to social media sites, Skype and other online platforms. The stolen credentials are used to impersonate users online in order to spread the virus and compromise other unsuspecting members of the activists' social networks (Brumfield, 2012; Perlroth, 2012).

These incidents highlight some of the many vulnerabilities that exist in the use and construction of social media and crowdsourcing technologies. These vulnerabilities, although numerous, can themselves be used for more than enabling attackers – they can lay the foundation for a robust defence.

The first step in addressing the concerns about these technologies is to find and understand all of the vulnerabilities involved in their operation and construction. The vulnerability assessment process would use the incidents that have taken place as a starting point – identifying the underlying vulnerabilities in their use and operation that made the attacks possible.

Being aware of the range of vulnerabilities involved in a given technology can be leveraged to systematically eliminate or mitigate those vulnerabilities – thereby preventing attacks and avoiding negative consequences.

Professional crowdsourcing organizations are successful because of the extensive work they have done to identify and mitigate the vulnerabilities associated with their technologies. For example, Wikipedia maintains the ongoing accuracy of its crowdsourced articles through a review process that includes alerting reviewers immediately after an article they oversee has been changed so they can ensure the updates meet the site's standards (Wikipedia, 2013).

Many of the steps taken to avoid commonly found vulnerabilities in these technologies can be organized into best practices for social media and crowdsourcing. These best practices would be a set of ready-to-use guidelines that include information about potential vulnerabilities and the actions that can be taken to avoid them.

Best practices for social media would include guidance on ways to identify sensitive types of information that should not be disclosed and ways to detect and respond to inaccurate or fabricated information. Best practices for crowdsourcing would include mechanisms for ensuring accurate judgements from workers and could leverage many of the practices already in use by professional crowdsourcing organizations.

This will not be an easy process – there are a significant number of vulnerabilities in both the operation of these systems and their underlying technology. Similarly, the best practices must apply to everything from users sharing photos between friends and family to the collection and processing of life-or-death information during times of crisis. While it will not be easy, it can be done, and the result will enable individuals and organizations to trust they have the information necessary to make the best use of these powerful new technologies.

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Big data, small data protection?

To facilitate timely response, data must be shared quickly – hence the push for open source programs, for example. But it is absolutely imperative for humanitarians to understand that poor data security generates real-world insecurity.

Regardless of whether the people receiving humanitarian aid find themselves in a jurisdiction with a comprehensive legislative framework that can protect their privacy interests, such interests still exist. Moreover, the right to privacy applies not only to processed data but to 'data exhaust', the unstructured data that potential and actual recipients generate as a by-product of everyday activities. For example, even people without access to mobile phones or the internet may passively produce information through contact with various segments of humanitarian organizations, such as health clinics or food-distribution centres. And just as data can be aggregated to produce a better overview of a crisis, it can be disaggregated to reveal information about individuals or local groups (Global Pulse blog, 2011).

To begin with, in certain contexts, countries may impose extensive information sharing requirements on humanitarian organizations, as a condition for issuing host-country agreements. Although the Privacy International blog (Hosein, 2011) has noted, with respect to the work of the Office of the UN High Commissioner for Refugees (UNHCR), that "UNHCR deals with an extremely vulnerable population: once registered by UNHCR, you are 'protected'", UNHCR does not have complete jurisdiction over the information it collects. Many governments – and not always for benevolent reasons – are interested in integrating UNHCR data into their own registries and surveillance systems (Jacobsen, 2010).

Humanitarian organizations need clear guidelines and standards for how and by whom the information that they collect will be processed, used and stored. The fact that it is possible to build datasets covering particular groups or types of vulnerability does not mean it is ethical, let alone necessary, to do so. It is of key importance that sensitive personal information be dealt with correctly. Specifically, it should not be traceable to the individual, and the integrity of any information that might subject an individual or a community to violence or other forms of reprisal must be maintained. It must be clear who owns the data, with whom it will be shared and under what conditions it may be shared with, or sold to, third parties. Furthermore, liability for computer security breaches that result in harm to affected populations is not theoretical; humanitarian organizations must be aware that such breaches are more than mere violations of internal procedures.

International organizations engaged in humanitarian work are slowly catching up. In 2011, UNHCR announced its aim, with respect to biometric information collected in the context of refugee registration and verification processes, was to conform "with UNHCR policies and international standards on security and data protection, with auditable safeguards and controls covering the integrity of the System and data privacy" (UNHCR, 2011). That same year, the International Organization for Migration published its data protection manual. The revised 2013 ICRC guidelines on protection data contain elaborate provisions for when, how and by whom information can be collected – and the responsibilities and obligations involved in such collection. One can only hope that OCHA's recent call for humanitarian organizations to develop 'do no harm' standards for the secure and ethical use of new forms of data, and to address liability issues, will resonate strongly across the humanitarian field.

Dual-use technologies and humanitarian procurement

Business opportunity is rife in the humanitarian technology business, which means that competence in humanitarian procurement is more important than ever before. As the Western military engagements in Iraq and Afghanistan are winding down and so-called dual-use technologies migrate from military to civilian applications, a critical eye should be cast on the ways in which manufacturers and vendors try to reframe their products, and themselves, as humanitarian.

During periods of economic downturn, governments will be interested in assisting their domestic defence-related industries. By the same token, such industries are likely to engage in extensive government lobbying, with the goal of encouraging the procurement of rebranded 'humanitarian' products and the inclusion of such products on the international policy agenda. A pertinent example is the rise of the 'humanitarian drone'. Drones offer the humanitarian community a range of possibilities with regard to crisis mapping, search and rescue, and, in the future, cargo and relief drops. Hence, humanitarian organizations will soon begin to engage in discussions about the politics and logistics of procuring drones. Meanwhile, drone vendors are struggling to expand their markets by identifying and lobbying for new, humanitarian uses for their products. In light of criticism from activists and the news media, the drone industry is also investing in rendering humanitarian drones acceptable to the general public.

In late 2012, the Association for Unmanned Vehicles Systems International (AUVSI), the largest drone-related interest group in the United States, stated on its newly launched web site: "Unmanned systems increase our human potential. They enable us to execute dangerous and difficult tasks safely and efficiently, saving time, saving money and, most importantly, saving lives." Nevertheless, humanitarian drones hold questionable promise. For one thing, the drone industry has a lacklustre track record with respect to privacy, despite AUVSI's attempt in 2012 to address the issue by publishing a code of conduct, which pledges to "respect the privacy of individuals" (AUVSI, 2012). In addition, drone technology is still relatively expensive and many models experience frequent technical problems or high rates of loss during missions. These concerns have become particularly pertinent as MONUSCO, the UN's peacekeeping mission in the Democratic Republic of the Congo, will begin to use surveillance drones.

It would be unfortunate if the procurement of drones were to crowd out less 'sexy' investments that are vital to, for example, search-and-rescue operations. From a procurement perspective, attention also needs to be paid to the financial and personnel costs of acquiring these technologies: tenders for bids from commercial players should include detailed requirements for the qualifications of humanitarian drone pilots, and contractual agreements should contain provisions for training, skilled imagery analysis and data storage (Sandvik and Lohne, 2013).

BOX 5.4 Disaster logistics during the 2011 Great East Japan Earthquake

After the Great East Japan Earthquake in March 2011, the Japan Medical Association (JMA) sent some 1,400 medical teams to the disaster-affected regions of Tohoku and sought to support local medical providers. Medical supplies were running dangerously low, but the JMA was at a loss as to how to procure and send 8.5 tons of supplies 500 kilometres north of Tokyo. The main bottleneck was the shortage of fuel. Without sufficient fuel, commercial carriers were unable to travel such a long distance, and the JMA had difficulty convincing the government to mobilize the Japanese Self Defense Forces, who were already active in several life-saving missions. Finally, a joint mission involving, among others, the JMA, the Japanese Pharmaceutical Manufacturers Association, which donated the supplies, and the US military, which supplied the transport, was able to deliver the supplies to the affected areas and distribute them to local medical providers, who dispensed them in the evacuation shelters (Kawai, 2012).

Logistics is what gets the right supplies delivered to the right place at the right time, and is crucial in responding to large-scale humanitarian emergencies. Situated in the Pacific 'ring of fire', Japan is no stranger to disasters and has learned from many previous events. For example, after the 1995 Kobe earthquake, traffic restrictions were minimal, which led to heavy congestion that prevented emergency vehicles from reaching the disaster-affected population. After the 2011 earthquake, the Japanese government imposed strict traffic restrictions, which meant emergency vehicles could use major highways, which were quickly restored (Yano, 2011). As vehicles with GPS navigation systems took passable roads, their coordinates were collected, mapped and shared on the web site of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) (Japan Logistics Society, 2011).

The Japanese Disaster Relief Act defines ten official relief items and actions, including food and water, clothing, bedding, educational supplies and health care. These supplies are sent to prefectural primary collection centres and then distributed to secondary centres in cities and towns. Local emergency response headquarters receive requests for supplies from evacuation centres and hospitals, and communicate needs to the secondary collection centres. Supplies are then distributed as requested to the affected populations (Yano, 2011; Mine, 2011). This 'last mile' of the supply chain was the most challenging after the earthquake, because of the lack of pre-arranged contracts between municipalities and freight companies (Mine, 2011), the damage to roads and the shortage of fuel. Many municipalities depended on the Japanese Self Defense Forces' specialized vehicles and helicopters to reach evacuation shelters.

The disaster's scale, however, meant that supplies did not flow according to plan. The bottleneck was often at the secondary collection points, where supplies accumulated as they could not be distributed rapidly because local towns were also devastated and some collection centres were destroyed or unusable. Ad hoc collection centres in usable buildings did not have functional storage facilities, and no one was available to manage the inventory and position the supplies correctly (Japan Logistics Society, 2011). Further complications were caused by badly labelled or incorrectly packed supplies. The Japanese Self Defense Forces or commercial companies were called in to take over the logistics in some areas.

Communications and information management also posed difficulties. With critical infrastructure, including communication lines down, officials faced challenges in locating the 2,000-plus official and ad hoc evacuation centres and assessing their needs. They were able to 'push' supplies to designated locations during the emergency phase, but once this phase was over, they had no way of knowing what was needed where. This lack of knowledge fed rumours of, for example, a shortage of bottled water – which resulted in far too much bottled water being sent from all over Japan, clogging the supply chain and preventing other much needed supplies from being distributed. The same happened when supply shortages were broadcast by the media and through Twitter feeds, and well-meaning citizens donated and brought supplies to collection centres and evacuation shelters.

The unprecedented scale of the disaster also affected the shipment and transport of supplies, owing to the destruction of infrastructure including electrical installations, communication, roads and fuel, and a shortage of available drivers. Normally when an area is affected by a disaster, supplies are shipped from adjacent regions. For the Tohoku region, this was the Kanto region, where Tokyo is situated. In 2011, however, Kanto was also affected by the disaster, so suppliers and delivery services – already trying to respond in Kanto – were unable to help in Tohoku.

Several lessons can be drawn from the 2011 earthquake. First, local municipalities should create, and store locally, pre-packaged supplies based on data gathered before an emergency, including population demographics and local consumption data. Second, every municipality needs a logistics expert, preferably from the private sector through public-private partnerships. The expert should be involved from the start, assembling pre-packaged supplies and positioning them strategically, designating collection and back-up collection points, and designing and implementing an inventory management system. This needs be done together with disaster experts and coordinated with the national response plan. Third, it would be beneficial to have a formal or informal system in place that allows private sector suppliers and freight companies to share resources and coordinate during large-scale disasters.

Fourth, successful disaster logistics is dependent on a number of factors involving multiple stakeholders. Smooth coordination between national and local emergency responders, ministries, civil protection services and the private sector is, therefore, essential. In the United States, the Federal Emergency Management Agency (FEMA) is the primary agency for disaster logistics and its Emergency Support Functions structure coordinates federal inter-agency support in responding to an event. At the global level, humanitarian response is organized in clusters, with the World Food Programme being the cluster lead for logistics. Japan currently has neither a US-style system nor a cluster-type approach, but it needs to begin now to build a mechanism to ensure multi-agency coordination. Finally, technology, including crowd-sourced mapping and digital data collection tools, has a huge potential to improve disaster logistics and obtain geo-localized needs assessment data. The government must embrace these new technologies, forming partnerships with technical communities and tailoring these tools to the needs on the ground. This will improve the speed and quality of response and ensure that the aid reaches the disaster-affected population and meets their actual needs. ■

In the aftermath of disaster, even the most technologically advanced nations may experience the destruction or breakdown of critical infrastructure. In Japan, editor Hiroyuki Takeushi had to revert to writing his newspaper, the *Hibi Shimbun*, by hand. © Lois Appleby/ Internews

Technology as a source of humanitarian disaster

Cyber-attacks, drone wars and the politics of hype

Cyber-attacks and armed drones occupy central roles in current thinking on war. Categories of cyber-attacks include malware (software that contains viruses or worms); zero-day threats, which exploit previously unknown software vulnerabilities; distributed denial-of-service attacks, which are often implemented through the use of botnets (robot networks); and so-called social engineering attacks, which are used to obtain access or information through psychological manipulation. Cyber-attacks can penetrate, interfere with, disrupt, disable, steal or destroy communications, vital information and operating systems.

With the 2013 publication of the *Tallinn Manual on International Law Applicable to Cyber Warfare*, the international community has begun to see cyber-war as 'war', and therefore as subject to the law on the use of force under the UN Charter and international humanitarian law (Schmitt, 2013). Nevertheless, a number of observers have criticized this development – and the militarization of cyberspace that it entails – and have expressed scepticism about the appropriateness of the label: despite frequent media references to cyber-war, hacking and computer viruses never actually kill people – hence, cyber-war "will not take place" (Rid, 2012).

At the moment, armed drones do not present particularly difficult challenges with respect to the applicability of international law. This equation may change, however, as the now-familiar fleets of Predators and Reapers are gradually replaced by wholly automated (and partly autonomous) technologies and humans are gradually removed from the loop. Tomorrow's drones will be able to fly higher and longer, and through WAAS (wide area aerial surveillance) platforms such as Gorgon Stare and Argus (Ackerman, 2012), will be able to collect more detailed surveillance data. Some may be tiny or able to fly in swarms. They will be armed not only with missiles but also with laser weapons, gas, poison or 'less lethal' weapons, which can induce pain through heat or sound (Singer, 2009). Nevertheless, for the present, the greatest difficulties associated with drones are political: first, because they lower the political threshold for resorting to military force; second, because they cause civilian suffering (Stanford Law School and NYU School of Law, 2012; Center for Civilians in Conflict and Columbia Law School, 2012); and third, because they will inevitably proliferate among armed non-state actors.

Futuristic scenarios incorporating cyber-war and drones often feature spectacular events such as 'Cyber Pearl Harbor' and 'Cybergeddon', or spectacular images, such as the reference to 'killer robots' (Human Rights Watch and Harvard Law School, 2012). Such scenarios tend to be driven by the politics of fear and to be associated with particular commercial, military or political agendas (Clarke and Knake, 2010). Although developments in technology and science have been identified as a 'megatrend' for humanitarian action, raising "the possibility of a catastrophic event, which will overwhelm both national capacity and the international humanitarian system" (Ferris, 2011), it is important to maintain a critical perspective.

There is little doubt that drone campaigns cause severe human suffering or that reliance on high technology makes the world vulnerable to cyber-attacks. While humanitarians must be aware of the potential implications of emerging military technologies, discussions about the potential humanitarian costs of these technologies must remain realistic and sober, and not fall prey to the politics of fear. To the extent that technology is viewed as a potential source of disaster, the focus should be on existing vulnerabilities in critical information infrastructure and on the mundane routines and practices that are required to keep society – including humanitarian organizations – going. In the realm of mandate, strategy and programming, humanitarian organizations must be prepared to assist in restoring critical infrastructure, while at the same time managing, through leadership and solid administrative capacity, to maintain internal operation.

Urbanization, technological risk and everyday contingency planning

The risks emerging at the intersection between technological dependence and the danger of critical information infrastructure collapse in the world's growing megacities offer a good example of vulnerability to technological disaster. The world's population, currently estimated at more than 7 billion people, will be 9.1 billion by 2050. Half the world's population now lives in cities, a proportion that will rise to 70 per cent by 2050, and 95 per cent of urban population growth will occur in low-income countries. As highlighted in the *World Disasters Report 2010*, humanitarian agencies increasingly see the need to 'go urban' and are struggling to find new ways to address crisis situations, from natural hazards and epidemics to urban violence and asymmetrical conflicts.

Yet many of the crisis situations facing humanitarians today are structural: the pressures of urbanization threaten to overwhelm the critical infrastructure that supports energy supply, waste collection, sewage systems and access to clean water, as well as telecommunications, food production, public health, transportation and financial services. In turn, these critical systems are operated by critical information infrastructure, such as the World Wide Web and supervisory control and data acquisition (SCADA) systems, the industrial control systems that run most critical infrastructure.

The crucial role of SCADA systems and global connectivity and the emergence of an 'internet of things', whereby objects embedded with sensors are linked to the web, render urban areas particularly vulnerable to disturbances in the functioning of interdependent networks. In addition to the risk of external attacks, damage to critical information infrastructure may occur through design errors or manufacturing failures, including mechanical malfunctions or coding errors. Damage can also occur through human error or by a combination of human and mechanical error. A critical infrastructure collapse could lead to worst-case scenarios, including fires, flooding, environmental harm and loss of basic services.

Humanitarian contingency planning must address the needs of the civilian population, while maintaining the integrity of the humanitarian operation in the midst of a breakdown in critical information infrastructure. Instead of perceiving a malfunction in such infrastructure as a 'sudden-onset crisis', humanitarian organizations need to understand that these systems are inherently insecure. Most of the components are developed in the private sector, where profit motives and competition, not security, drive system design. Furthermore, these systems constitute attractive targets, making them even more vulnerable (Dunn Cavelty, 2005). As interventions become increasingly reliant on vulnerable information technology, humanitarians need to find new ways of ensuring data security. In response, the notion of cyber-resilience has found its way into humanitarian aid, reflecting in many ways a broader humanitarian concern with resilience. Resilience is here defined as any action that re-establishes an unsettled equilibrium or successfully copes with stress. In the case of critical information infrastructure, resilience entails good security practices, flexibility and redundancy (Kaufmann, 2013).

BOX 5.5 Lessons from the Fukushima nuclear accidents

The March 2011 nuclear accident in Fukushima, Japan was triggered by the 9.0-magnitude earthquake and devastating, 10- to 15-metre-high tsunami. This nuclear accident shocked the world because it happened in Japan, the word's third largest economy and a scientific powerhouse, and also during the decade of 'nuclear renaissance', when nuclear power was considered a source of alternate low-carbon energy. As a result of the accident, the German, Swiss and Italian governments decided to phase out the use of nuclear power as an energy source.

The Japanese government set up a ten-member independent commission to investigate the accident in December 2011. The government mandated the commission to investigate direct and indirect causes of the accident; responses, damages, sequence of events and actions taken and their effectiveness; and the history of decisions and approval processes regarding nuclear energy policies. It was also mandated to recommend measures to prevent future nuclear accidents

The commission visited nine nuclear power plants, held public meetings, interviewed some 1,000 individuals including prominent politicians, nuclear plant workers, nuclear industry and safety experts from Japan and elsewhere, and sent out questionnaires to some 20,000 evacuees. It submitted its report to the government in July 2012.

The report noted that the accident could have been prevented if proper measures had been implemented. These measures were international standards recommended by the International Atomic Energy Agency (IAEA) and other sources. It also concluded that the Fukushima nuclear accident was a 'manmade disaster' due to the actions of those who were and are involved in and accountable for the use of nuclear energy in Japan, organizational problems with both TEPCO (Tokyo Electric Power Company, which operated the Fukushima plants) and the government, and issues concerning a number of subjects from earthquakes, emergency response and evacuation to public health and welfare.

The commission's report also looked at problems associated with weak governance of TEPCO and other major utility companies, and Japan's lack of critical core concepts of nuclear regulation to protect both people and the environment. It noted that the government had lost the credibility and trust of the Japanese people, and that it could take decades to regain them. Another point the report made was that in an ever-more inter-connected and inter-dependent world, transparency is essential for organizations and governments to be taken seriously by people around the world.

The report made seven specific recommendations: the government should monitor the nuclear regulatory body; crisis management should be reformed; the government should be responsible for public health and welfare; operators should be monitored; laws relating to nuclear energy should be reformed; a system of independent investigation commissions should be developed; and the criteria for a new regulatory body should be created.

The commission stressed that its processes had been transparent and that it was important to share its report and the lessons learned from the Fukushima nuclear accident with people in Japan and the rest of the world. It urged the Japanese government to consider its recommendations. The commission also advised all those involved in nuclear energy to increase their efforts to build trust in the safety of nuclear power by: following and implementing international standards and rules without delay; being transparent in all actions – transparency is the foundation of accountability and trust; working together at the international level including organizing international training programmes; and setting up a set of international licensing and standards, similar to that of the airline industry. ■

Does knowing (more) about human suffering reduce inertia?

One of the attractions of mapping technology and social media is the possibility of knowing more about the nature and scale of human misery. Vivid, personalized images of pain and distress are intrinsic to effective communication with a global audience, and UN agencies and other NGOs spend considerable resources carefully framing their messages about urgent human needs (Sandvik, 2009). Observers have noted that a strong narrative and striking visual representations can generate humanitarian constituencies for particular causes, and that written and visual images of suffering and innocence reliably evoke a compassionate response (Wilson and Brown, 2009).

Two issues temper the potential benefits of technology in this regard, however. First, it is worth exploring the ethics of the 'technological knowing' of suffering. In the early 1990s, human rights activists embraced 'witnessing' as a strategy, presenting it as an "act of advocacy that may furnish a response to the plight of distant victims" (Givoni, 2011). But when does witnessing become a tool of repressive governance? Is it naïve to think that exposure limits inhumane acts? When do platforms like YouTube put activists or victims in danger? Despite the growing online circulation of images of victims and survivors, there has been limited discussion of crucial issues, including safety, consent and ethics, particularly with regard to people who are filmed. These images are reworked and re-contextualized beyond the control of their "humanitarian intention" (Gregory, 2010). A case in point is the plight of Neda Soltani, an Iranian woman who was forced into exile after mistakenly being identified as a dead protester on Facebook during the 2009 Iranian Green revolution (BBC, 2012).

Second, humanitarians must develop a more nuanced understanding of the links between technology and politics. Photos and graphics can have a real impact on how conflicts and disasters are understood, assessed and addressed. Yet there appears to be an unacknowledged assumption that the more precise and high resolution the technology, the greater the resulting moral outrage. Further, information is valuable only if humanitarians have the capacity and will to act on it. Otherwise, it risks creating new expectations (particularly in terms of protection of civilians) that humanitarians cannot meet. Hence, humanitarian actors must think carefully about their assumption of a causal relationship between knowledge about suffering and political action. As is sadly evident from the history of humanitarian (in)action, there is no necessary link between knowing about human suffering and responding to it.

Conclusion

Whereas the 'new humanitarianism' that emerged in the mid-1990s focused on human rights-based approaches to humanitarian endeavours and later on humanitarian reform, the new humanitarianism of today is about technological innovation. The goal of human rights-based approaches was to reconstruct power relationships on an ethical and moral basis, and the goal of humanitarian reform was to improve humanitarian action through structural change. But much of the optimism currently surrounding the role of technology in the humanitarian enterprise appears to be based on two assumptions: first, that adding technology is inevitable; and second, that doing so will generate progress.

Current discussion of 'humanitarian technology' does not look back to a past when humanitarian action did not rely on technological solutions to crises. Particularly in the field of early warning, there has been a focus (over several decades) on developing and integrating technological solutions into humanitarian work. Instead, conversations about the role of technology in humanitarian endeavours focus on an unprecedented opportunity to understand more about and respond more effectively to humanitarian crises. But some caveats are in order. First, a number of optimistic assumptions about the role of technology in humanitarian action must be questioned: that technology shifts or decentralizes power; that it increases accountability; or that local participation through text messaging or the use of social media automatically equals either an infusion of local knowledge into humanitarian action or leads to the empowerment of the people affected.

Local knowledge is essential to forecasting, mitigating and coping with disaster. Big data do not speak for themselves; they are not objective, and proper interpretation relies heavily on ethnographic contextualization and a critical understanding of how indicators are generated. Although both legitimacy and political relevance are increasingly tied to quantitative data, long-running debates about ownership and participation remain important – perhaps more important than ever. Humanitarians should carefully consider how to ensure that increasingly sophisticated forecasting models incorporate localized factors and inputs (Peters-Guarin, McCall and Guan, 2012). Even methodologies that include a participatory element, such as sentiment analysis, in which affected populations send text messages indicating their location and their urgent needs (Meier, 2010), should only be one part of the humanitarian toolkit (Srivastava, 2009; Kawasaki, Berman and Guan, 2013).

In response to the proliferation of both information and crises, the possibility arises of using technology to crowdsource not only the mapping of relief needs, but also the distribution of relief itself (Meier, 2012). By its very nature, humanitarian aid has always been crowdsourced – through family, friends, neighbours, tribesmen and fellow believers. But institutionalizing crowdsourcing of aid distribution is problematic. First, it might lead agencies or donors to abdicate responsibility for responding to less 'sexy' crises. Second, skilled and trained V&TC volunteers are a scarce and unstable resource – and not trained or prepared to operate in war and disaster zones.

In tandem with the growth of the humanitarian enterprise in the aftermath of the cold war, predictions about a humanitarian crisis of legitimacy and concerns about the integrity of the key humanitarian principles of neutrality, impartiality, universality and humanity have been cropping up at regular intervals. The embrace of technological innovation presents humanitarians with a new set of challenges to the sanctity of these principles. It also raises new questions in a very old discussion: what is humanitarian action and who are the humanitarians?

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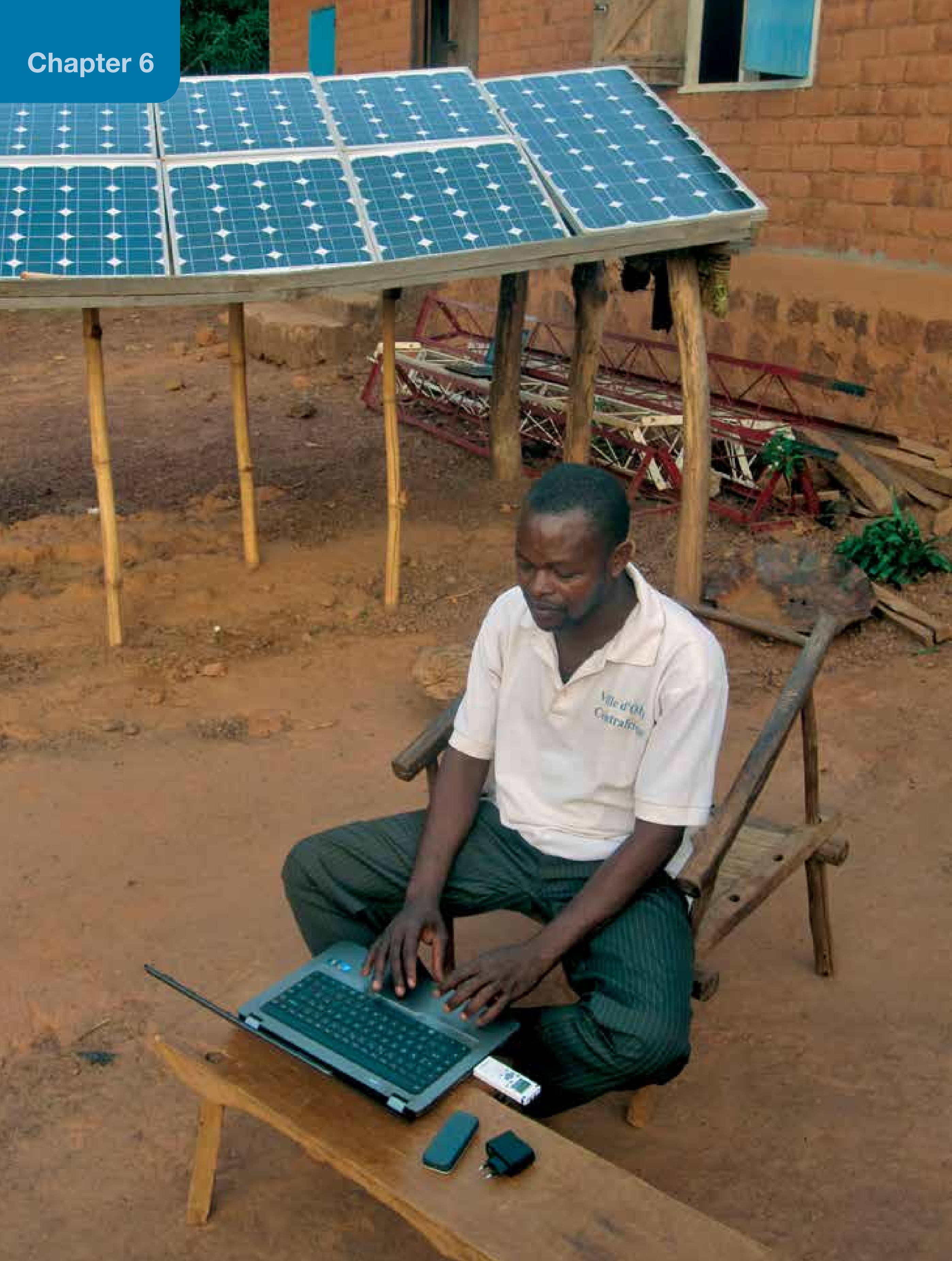
Chapter 6



Chapter 6

Humanitarian norms and uses of information

For many years, domestic response to major disasters relied on formal teams and a loose enterprise consisting of many large and small humanitarian organizations with defined roles, operating within a clear and organized chain of command. Specialized rescue workers helped victims at the scene and then internal or external agencies provided temporary shelter, food and water for the displaced populations (Noji, 2005).

Since the early 1990s, there has been a significant effort to improve the collective standards and competence of this humanitarian enterprise (Sphere Project, 2011), following extensive analysis of the relief operations after the Rwandan genocide (Eriksson, 1996).

New technological advances now challenge many aspects of this humanitarian enterprise. The hierarchal information structure of humanitarian response has been reordered with the advent of technology and perceived lower barriers for entry into the 'field of play'. Rapid developments in information and communication technology (ICT), including networks such as Crisis Mappers and Télécoms sans Frontières, have introduced immediacy and access to the particular disaster context and have thus allowed more people to engage and enter the aid effort. Volunteers and private agencies new to the more established and trained humanitarian groups are now undertaking a more direct and intimate role in managing information flows and connecting to affected populations in many far-flung parts of the world.

These relatively new advances in all forms of communication carry the possibility of creating practical improvements in all aspects of relief efforts anywhere in the world. Yet, despite living in the most technological age ever, the disaster response seen in the 2010 Haiti earthquake was not optimal (Kirsch, Sauer and Guha-Sapir, 2012). The profusion of medical teams and non-governmental organizations (NGOs) that responded to the Haitian earthquake undermined coordination attempts and both technical and ethical standards in acute medical care were allowed to lapse. Eye-witness accounts emerged of battlefield-style amputations with limited or no anaesthesia and provision of medical care that would not have been accepted in high-income countries. Clearly, even hard-won lessons may not be applied under the pressure of manifest need and large numbers of humanitarian responders, many of them new to the field.

Haiti in 2010 also saw the first field deployment of many technologies with the potential to support disaster assessment and response. In view of the difficulties

Technological advances mean that ICTs can be used in humanitarian action even in the most remote locations. But building and strengthening a concept of professionalism among digital volunteers and humanitarian actors will require education, training and the development of codes of conduct.
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experienced by seasoned humanitarian agencies, it raises the question whether it is prudent to first 'test-drive' new ICTs in such a large and complex crisis. Nevertheless, the deployment occurred and now offers much opportunity to reflect on the challenges and opportunities these new technologies present to the humanitarian community.

BOX 6.1 Humanitarian response in Haiti

At 16:53 on 12 January 2010, an earthquake measuring 7.0 on the Richter scale struck approximately 25 kilometres west of Port-au-Prince, the capital city of Haiti, at a depth of 13 km. Around 230,000 people were killed and more than 2 million inhabitants were left homeless. The quest for shelter meant that 19 per cent of the country's population was internally displaced (Schultz et al., 2011). In the space of 35 seconds, the lives of Haitians and the landscapes of their country were permanently altered.

In the next hours and days, Haiti experienced an international humanitarian relief operation where proximity to the United States lowered barriers to entry and led to an influx of a multitude of outside teams, many of them entirely inexperienced in disaster response.

The reaction to this cataclysmic act of nature was swift with more than 350 emergency teams from all over the world attending immediately in the aftermath. Brazil, Canada, Cuba, Dominican Republic, Israel, Italy, the United Kingdom and the United States sent more than 1,000 people each, comprising of a mixture of military and disaster relief personnel.

Infrastructure was decimated in Port-au-Prince. Thirteen of the 16 government ministries were destroyed and 50 hospitals rendered unusable. The major share of immediate medical and surgical relief was borne by foreign teams.

A number of things worked well in the immediate response in Haiti. For example, a complete multilingual version of Google Person Finder was operational within 72 hours of the earthquake and led to the formation of the Google Crisis Response team. Ushahidi, in conjunction with Tufts University in the United States, provided a platform for crowdsourcing via the 4636 SMS Shortcode and plotted nearly 4,000 distinct events. GIS mapping allowed layered and detailed satellite maps to be created. These maps included accurate and up-to-date information pertaining to the situation on the ground.

Some things did not work as well, however. These included the seemingly useless public health messages sent out by the 4636 SMS Shortcode system. Recipients considered that these SMS lacked personal relevance.

The coordination of hundreds of agencies with differing agendas posed huge logistical barriers and often resulted in an underuse of valuable assets. The Canadian forces field hospital, for example, performed 167 operations over 39 days and most of these were unrelated to the initial earthquake (Talbot et al., 2012).

The rescue effort was expensive by all measures. The United States government deployed four search-and-rescue teams supported by FEMA, which rescued 47 survivors at a cost of US$ 51 million (FEMA, 2010). ■

Selected humanitarian technologies: opportunities and challenges

Electronic medical records

The emergence of technological tools for disaster response serves not just to connect responders with existing data sources but also to augment response capabilities within and between responder organizations. The use of electronic medical records (EMR) in disaster response was reported in detail in the response to the 2010 Haiti earthquake by two different field hospitals: the field hospital in Fond Parisien, managed by the Harvard Humanitarian Initiative (HHI), and the mobile field hospital set up by the Israeli Defense Forces (IDF) and deployed on a football field in Port-au-Prince.

The two examples highlight opposite ends of a spectrum of the 'heaviness' of technology deployed. The HHI Operational Medicine Institute at Fond Parisien used an existing iPhone app, designed originally in the United States for domestic inpatient ward use, installed on responders' personal phones. The IDF deployed three full-time staff to establish and maintain a wired and wireless network of hospital computers, barcode scanners and mobile digital X-ray machines. Each of these groups reported on the benefits gained in census tracking, patient identification and efficiency and continuity in delivering care (Levy et al., 2010; Callaway et al., 2012).

A particular strength of EMR systems in disaster response, as highlighted by IDF hospital staff, is in overcoming language barriers. Data collection can be done in a language familiar to local staff and affected populations, and the results easily converted to the language of the responding agency (Leaning, personal communication, 2013). EMR systems are becoming commonplace in medical informatics in high-income countries. Disaster responders from these countries can quickly introduce such familiar systems into the local disaster-affected situation.

The parallel concern, however, is that deploying such a system creates a high barrier to entry. Local caregivers must own a smartphone and be computer-literate. The EMR can only be integrated into existing systems if these also have such capabilities. These requirements risk widening the gap between responder and local providers, inhibiting the integration of locally trained staff in response efforts and preserving the existing distance between international disaster medical response and national health systems.

A key value tenet in humanitarian practice is to build a partnership between aid responders and local staff and to have external resources strengthen existing health systems, rather than provide temporary replacement separate from the local network of providers, medical facilities and other humanitarian responders (HAP, 2010a).

BOX 6.2 National authorities' use of satellite imagery in response to disaster

In the last decade, a number of large-scale disasters have devastated nations – whether low-, middle- or high-income – around the world.

Geospatial data – especially when converted to understandable maps – have proved useful during the first stages of response operations. Satellite imagery supports the geographic information management of a disaster by providing data related to the extent and severity of damage, geophysical characteristics of the area, most severely affected locations, access routes and population settlements.

To tailor satellite imagery to operational needs, satellite sensors and their options must be set for different types of disaster and situation. For instance, imaging radar has an all-weather capability and is particularly adapted to hazards such as floods and landslides. Image resolution is also important, as medium-resolution images provide a snapshot of the overall effect while high-resolution images can depict damage to road networks or even individual buildings. The usefulness of satellite images, however, depends on weather conditions and might need verification by direct field observation.

Satellite imagery has been used extensively in the aftermath of disasters. For instance, the first image of the area affected by the 2011 Japan earthquake was published the day after the event. Satellite images of the 2004 Indian Ocean tsunami recorded the tsunami's front wave, assessed the extent of damage and was useful in coordinating relief operations. When Hurricane Sandy hit the north-east coast of the United States in 2012, satellite data helped the public to stay ahead of the storm and be prepared to evacuate. After flash floods in the area of Leh, India in 2010, satellite maps helped to identify rapidly affected locations.

The International Charter "Space and Major Disasters" was set up in 2000. In collaboration with the United Nations Office for Outer Space Affairs (UNOOSA) and the UN Institute for Training and Research's Operational Satellite Applications Programme (UNOSAT), it works with space agencies worldwide to make satellite data available for disaster management authorities. Since its inception, the charter has been activated in response to some 330 disasters, from floods and hurricanes to earthquakes and ice jams. National disaster management authorities in countries that are not charter members can also request data, thus maximizing use of the charter's capabilities and resources to assist affected populations.

However, use of modern satellite and remote sensing technology is still limited, especially in low- and middle-income countries. The charter stipulates that the applicant authority in a country must be able to download and use the maps produced. But many countries lack this capacity. Also, data derived from the satellite imagery would be more useful for disaster response if it were integrated with other layers of geographical data and processed by GIS tools. Such data either do not exist in some low- and middle-income countries, or are not accessible by relief organizations.

These limitations are due to several reasons, all interrelated: socio-economic development and infrastructure; integrated digital data; skilled human resources; political concerns and data security; accountability; and inter-organizational coordination.

In general, the development of information and communication technologies is in line with a society's socio-economic development. Accessibility to reliable digital data, computer networks and internet connections depends upon well-developed infrastructure. In addition, many low- and middle-income country governments often lack enough skilled human resources for generating and/or analysing digital and remote sensing data and turning satellite photos, if available, into actionable data.

Complex political environments and concerns related to data security may also mean military and security services remain in control of the information flow, digital data access and internet broadband speed, which could result in very limited access for civilian relief organizations and even national disaster management organizations. Basic technological vulnerability and problems with technical security intensify this problem. If, for example, a disaster hits a location considered important for national security – near a nuclear plant or an armoury, for example – governments may prefer not to activate the charter to avoid foreign governments publicly analysing their territory. Similarly, in a disaster affecting several countries, governments may not want international bodies scrutinizing border areas.

If geospatial data are available, they should be accessible by organizations coordinating operations on the ground. The 2012 earthquake in north-western Iran affected a vast rural area of scattered settlements. Satellite images were produced, but were not used by relief organizations and were not linked to other layers of data like population numbers. As a result, relief organizations had no idea of the number of people affected until three days after the quake.

The gaps in access to geospatial data also present a challenge in events that require the involvement of international organizations. The information divide between national and international partners affects coordination mechanisms, which may result in late and non-efficient service delivery. It also impacts the balance of power among partners: although national governments are officially in charge of relief coordination, international organizations may have more detailed information about geographical distribution of damage and resources. The UN cluster system is best placed to bridge this gap.

To increase the use of geospatial data and particularly satellite imagery, several measures should be taken. International bodies, especially UNOOSA, UNOSAT and the International Charter, should help the capacity-building efforts of national governments and strengthen regional platforms. In addition, the use of satellite information by disaster management authorities must be promoted. This requires strengthening the infrastructure and enhancing national partners' technical capacities. Raising the awareness of national governments and further research to demonstrate the technology's effectiveness and efficiency in relief operations (focusing on the number of lives and amount of money that can be potentially saved), will help to encourage national capacity-building investments by both national and international organizations. To enhance intra-governmental collaboration for generating geospatial data and information sharing, coordination between national space agencies, disaster management authorities and geo-informatics organizations is a necessity. This must be included in national disaster management plans and ratified by the highest authorities. It might call for new arrangements of data integration, security and sharing inside the government.

The aim of all these efforts is to ensure that the information generated is available and understandable for direct use by emergency managers whether at headquarters or in the field. ■

Mobile phones

The bulk of rapid mobile phone coverage (numbering 6.8 billion in 2013) is occurring in low- and middle-income countries, among populations most likely to be affected by disasters. Mobile phones have a significant role to play in the 'democratization' of disaster response, shrinking the gap between responder and recipient, and allowing better access to information for all – but only when and where networks are available. Once again the 2010 Haiti earthquake is the best example of such an opportunity, as it was perhaps the first large disaster affecting a very 'connected' population.

The majority of Haitian cellular services before the earthquake were provided by Haitel, Comcel and Digicel. Only Haitel had built towers to withstand earthquakes and hurricanes; the others largely used small towers on top of private buildings, most of which were destroyed in the 2010 quake. Consequently, Haitel was the only network still running immediately after the earthquake but, quickly overwhelmed with the volume of traffic, it went down ten days later. By then, the other two networks had restored some service, and although people queued for hours to recharge their phones at the kiosks of enterprising generator-owners, the volume of mobile phone traffic out of Haiti over that time shows that the affected population was very much reconnected. Voilà (formerly called Comcel) was partially operational within 12 hours of the quake and Digicel took about ten days.

The post-disaster analysis of cell services in Haiti varies widely in assessment of value. Some commentators were critical of the downtime affecting some cell subscribers, claiming that "Haiti's cellular network failure cost lives" (Highleyman, 2010) by crippling critical government communication mechanisms and preventing people from calling for help. Others praised the life-saving utility of mobile phone services in the same situation (Large, 2010). When mobile phone services were available, they were used by the affected population to contact friends and relatives for reassurance, reunification, pleas for help and external support.

Text messaging also sprang up in the immediate aftermath of that disaster, as short-code SMS services enabled people to request help where needed and be kept abreast of new information via SMS public service announcements.

The Haiti experience with mobile phones warrants close attention to the issue of how technology innovation without advance preparation of public and professional users can prove beneficial or harmful in disaster situations. Confusion about roles and responsibilities in mobile phone use was introduced after the earthquake with the 4636 SMS Shortcode, which was advertised as a line for texting in urgent information and requests for help. This line was initially to be processed solely by Ushahidi but then, without much advance notice or discussion, the Thomson-Reuters Foundation began to rely on the same line for public service announcements. This dual use resulted in confusion at both ends of the chain, with those in dire need receiving, as a response to a call for help, a message about hand hygiene, while volunteers processing messages for Ushahidi were confounded by masses of texts coming to them apparently in reply to public announcements that they did not know had been sent out on the same number. This confusion was rectified quickly when the parties realized that they were sharing a shortcode, but provides a valuable lesson for future planning and communication (Meier and Munro, 2010).

The increasing use of and reliance on cellular phone networks, by both responders and disaster victims, brings new actors into the humanitarian space, particularly for-profit telecommunications companies which do not ordinarily consider themselves to have a humanitarian mandate or responsibility. Yet access to a powerful technology carries important responsibilities for all actors to 'do no harm' to those who in all probability will rapidly rely on it for a range of intended and not-intended uses. Major humanitarian norms of accountability, professional training and role responsibilities come into play with this accelerating, swift and highly accessible communications technology.

Another concern of relevance to humanitarian norms is the question of anticipatory planning and then longer-term sustainability. As disaster responders and affected populations increasingly rely on the connectivity established by mobile phone networks, where should the responsibility lie for creating networks in disaster-prone areas, building in added redundancy and resilience as the crisis unfolds and bearing the cost of repairs and maintenance long after the humanitarians have left? Télécoms sans Frontières has occupied a leading position in this space for 15 years and recently some commercial companies have donated their networks and resources in acute disasters. But growing demand from responders and affected populations has recruited an increasingly complex set of technical actors (from NGOs, governments and commercial communications companies) who may or may not readily come to the table to participate in discussions about shared investment and coordinated action.

Mapping and crowdsourcing

One of the most significant outcomes of the rise of digital technologies in disaster response is the rapid growth in the field of crisis mapping – a relatively new sector, which held its first international conference in 2009.

The utility of good maps begins with simple orientation. With the expansion of geographic information systems (GIS) mapping, however, information far beyond the spatial can be presented, with layers of data showing existing cartography, satellite images, pre- and post-disaster changes, power outages, population movements, location of people in need, political violence, landslide risk and more.

The term 'crisis mapping' refers to just that – creating maps by combining information from multiple sources. Crisis maps, created by groups like Ushahidi, OpenStreetMap and Google, are almost universally 'open', meaning that they are available and accessible to all with access to the internet, appropriately configured computer software and modest computer literacy. The premise of openness is in fact complex: more information, gathered from more diverse and diffuse sources and displayed in time and space, is more likely to be more accurate and more comprehensive – and thus better. And such better information will support more timely and appropriate humanitarian response and, therefore, better outcomes for the affected populations.

The major recent shift in crisis mapping – in terms of how information is gathered and sourced – was spurred by experience with crowdsourcing during the Kenya election violence in 2007 and then the 2010 Haiti earthquake. Crowdsourcing is a blanket term covering an array of ways in which many people contribute small amounts of data to form an aggregated larger dataset, usually via electronic means. For crisis mapping, crowdsourcing takes the form of people (usually civilian survivors of disaster) texting, e-mailing, posting or tweeting short bits of information about their situation (e.g., "water point at this location working" or "people trapped under rubble" or "violent demonstration at this location"). Many thousands of data points like these are processed centrally by an organization, such as Ushahidi, and used to populate maps, creating layers of time stamped and in some instances geo-referenced information about events, infrastructure, human movement, services and needs.

These crisis maps, a combination of existing cartography, satellite images, field reports and crowdsourced data, are used to create information-rich, up-to-date, dynamic fact-pictures to guide responders on the ground and humanitarian officers at headquarters.

Crowdsourcing has rapidly become accepted by the mainstream in the corporate world. In the humanitarian community, where the stakes of acting on misinformation are much higher, gaining trust for crowdsourced data has been more difficult, although progress is being made in recognizing the value of participatory mapping. Participatory mapping was practised before modern technology appropriated the term: humanitarians have always asked people on the ground to draw their own maps, adding detail and nuance to the overall assessment of the situation. Now that maps are increasingly created from pictures taken from satellites, capturing ground-level details is even more important. The local 'sociology of knowledge' (Berger and Luckmann, 1967) lies exactly in those details that cannot be seen from the air nor apprehended by outsiders. How well maintained is that flood wall? Who lives in that house and how easily could they evacuate along a particular route? Which social groups would not be able to stay in that area?

The value of technology in this sector is in facilitating that input from affected populations on a much wider scale via crowdsourcing. Where an individual humanitarian worker previously had to interview people in person to obtain each piece of that fact-picture, local populations can now contribute to that collective body of knowledge en masse via SMS, e-mails and tweets.

BOX 6.3 Communities changing humanitarians' behaviour

Digital technology has changed how the humanitarian sector operates and humanitarians' ability to communicate with affected populations is no longer impaired by sub-standard communication equipment. New technologies are giving communities a stronger voice and their expectations are changing. But humanitarians need to change their behaviour to meet those expectations.

The environment has changed dramatically. No longer is it necessary for humanitarians to travel to remote villages to ask people if they need help. Satellite images can now be downloaded and supply geographically based, accurate situational reports. This allows humanitarian actors to prioritize delivery. New actors and players are also on the scene, from the ICT and private sectors to digital volunteers, and play a role in how humanitarians respond.

Although humanitarians cannot control the amount of information being disseminated, what they can do is coordinate what happens on the ground. Coordinating a disaster response, following the expectations of those affected, is a challenging and critical area to manage.

SMS and social media channels are used to deliver messages and information directly to people's phones. In some instances, tweets are sent or Facebook pages updated.

Humanitarians see these new technologies as life-saving tools and believe they have the capacity to deliver aid like never before. It is now a normal procedure for every organization or group responding to a disaster to tweet information announcing their deployment and to update the world on their activities as they hit the ground.

A new breed of humanitarian responders have become akin to reality TV stars, updating people and responding to requests for information in real time as they wander through the carnage of a disaster. Responders' careers can be built upon how many followers they have on Facebook and Twitter.

With the new tools available to the humanitarian sector, organizations now have the ability to report on the inflated numbers of people they communicate with. They work on a scale never experienced before in the history of humanitarianism, which identifies gaps in the digital humanitarian model. What does this mean in a hyper-connected disaster and what does it look like if you are part of an affected population? What does it mean if you are the one receiving the information being disseminated and responding to the information requests from the many humanitarian responders? How to turn information into outcomes?

Technology should not be the driver, but the tool. Technology should assist in the delivery of outcomes. Technology should allow responders to listen and gather the information they need to make changes and informed decisions for those in need or affected by disaster. The information received should identify ways to deliver services more effectively.

An opportunity exists to redefine the paradigm of humanitarian response. No longer should it be seen that humanitarians are disseminating information or engaging in order to change the behaviours of affected people. The information humanitarians receive from those affected should change their own behaviour. An opportunity exists to break away from the traditional top-down models of aid delivery and to build responses directly based on the needs of people.

All humanitarian actors are part of this massive shift. The change is not only about the tools they use to communicate in disasters, but how humanitarians become more accountable to the affected populations they serve. It should not be about telling people what to do, but about listening to what they have to say.

Aid organizations will not have a choice about whether they engage with the people they serve – the question will be how they engage. It should no longer be a debate but a common understanding that people can be the drivers of their own recovery.

The new technologies allow a broader part of the population to voice their opinions on how services should be delivered. It will be the communities' voices that will demand the change.

Along with the voice of the community, the catalyst for change will be funding. As the global pool of humanitarian funding is used by more players, those who recognize this change by engaging, listening and delivering effectively will attract the lion's share of the funds.

When aid organizations arrive in a disaster setting, the fundamental belief is that they are there to help. This is no different than when responders send a message to people before, during or after a disaster. As soon as people receive the information, they believe that something is going to change, that help is on the way. There are expectations. This is amplified when humanitarians ask people to respond to the message and provide them with information or a coordinate of their location.

In these hyper-connected disasters, humanitarian actors need to focus their attention on these expectations.

Numerous options are available to set up electronic systems that allow humanitarians to send and gather information. New systems are being developed daily by the army of programmers looking at ways to help. As proven during the 2010 Haiti earthquake, anyone with an internet connection can potentially participate in a disaster. During that disaster, the humanitarian sector accepted and encouraged the participation of the global community. How to manage the expectations with so many different players communicating with affected populations?

The information flows cannot be controlled nor do they need to be. But what humanitarians need to do is capture the information, manage it and present it in a way that allows them to understand the needs clearly. The needs must be identified and then must be met.

As a collective, the humanitarian sector has to ensure that the focus does not shift too far from delivery to connectivity. There needs to be a balance. The evolution of technology is moving faster than the humanitarian sector's ability to deliver. The future will reflect the sector's ability to keep up with the changes and adapt accordingly.

Somebody needs to do the work. The effective delivery of services is what makes a difference to communities and affected populations. At this point in time, technology, by itself, has not given the humanitarian world a way to physically deliver outcomes on the ground. ■

The example of Hurricane Sandy

The digital humanitarian future envisioned by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) could be assessed in nascent action during Hurricane Sandy, which hit the east coast of the United States in October 2012, after leaving a trail of destruction through the Caribbean. The storm inflicted severe damage along the New York and New Jersey coastlines and the technologically well-equipped response highlights some of the strategic and operational advantages and normative pitfalls in humanitarian use of crowdsourced crisis maps.

Palantir and Team Rubicon

Palantir is a private company that works with large, often 'dirty' (i.e., data that contain errors) datasets in the business and academic arena, including health care, insurance and other commercial enterprises. Their philanthropic team was deployed to a site in the Rockaways (in the New York borough of Queens) in the days after Hurricane Sandy struck the north-east shores. The team immediately set about modifying their existing programs to suit the situation. The power of 'big data' permits filling that critical gap between incomplete or incompatible data sources and what responders on the ground must have available to organize and direct their work effort. Palantir provided this link in a partnership with Team Rubicon, a military veterans' organization which could deploy thousands of volunteers with different skills but lacked data analytic capabilities. Bringing in data from satellites, weather stations, the United States Federal Emergency Management Agency (FEMA), locations of open pharmacies and stores, social and medical vulnerability data, municipal planning, live power information, aerial imagery of flooding, hospital information and mobile clinics, the Palantir team created comprehensive maps and situation reports which provided powerful guidance to Team Rubicon's response effort (Daniel Tse, Palantir, personal communication, 2013).

Palantir's philanthropic work highlights the growing role of non-traditional players: corporate philanthropists who are not yet included in governments' or international agencies' plans and are not among the expected disaster responders. Yet it takes only a few examples of successful humanitarian interaction for relationships to be built and trust to be established. The chance to integrate new and innovative digital partners in the humanitarian space is now at hand.

FEMA's Innovation Team

The move towards a technologically advanced mode of disaster response is coming from the public sector as well. Hurricane Sandy was the first disaster in which FEMA deployed their new Innovation Team, which established a centre in the Red Hook (New York) IKEA store, and set about working with other technology groups, and directly with affected people, to get them connected to the internet, allowing contact with loved ones, family reunification and rapid access to FEMA's online system for registering for assistance (OCHA, 2013a; Serino, 2013). The provision of connectivity and communications as a basic need in disaster is a new phenomenon, but one gaining support. Reflecting this new priority, OCHA (2013b) notes, "Easy access to data and analysis, through technology, can help people make better life-saving decisions for themselves and mobilize the right types of external support." Information, and the technology needed to access and harness it, is necessary for both affected populations and responders, and is building a place for itself alongside the more traditional needs such as food, shelter and water.

MapMill crowdsourced damage assessment

Within two days of Hurricane Sandy, the US Civil Air Patrol released new aerial photographs of the affected coastlines to OpenStreetMap at the request of FEMA. OpenStreetMap set up 'MapMill', a crowdsourced damage assessment platform, designed to map broad trends in storm damage. The platform was open access and widely publicized. It asked volunteers to look at an aerial photograph and assess storm damage (with one keystroke) as simply 'OK', 'Not OK' or 'Bad'. Without any sort of formal assessment training, more than 3,000 volunteers assessed 24,000 images (Chan, 2012). Each of these small pieces of assessment helped FEMA determine the degree of damage in different areas along the coast, with the aim of helping the agency plan post-disaster recovery efforts. The question is though, did it actually help?

Whether FEMA used the findings or not, this particular case offers an example of how digital tools in disaster response offer an avenue for meaningful contributions from spontaneous volunteers across the world, even those without disposable income to donate or formal skills.

BOX 6.4 The Digital Divide Initiative

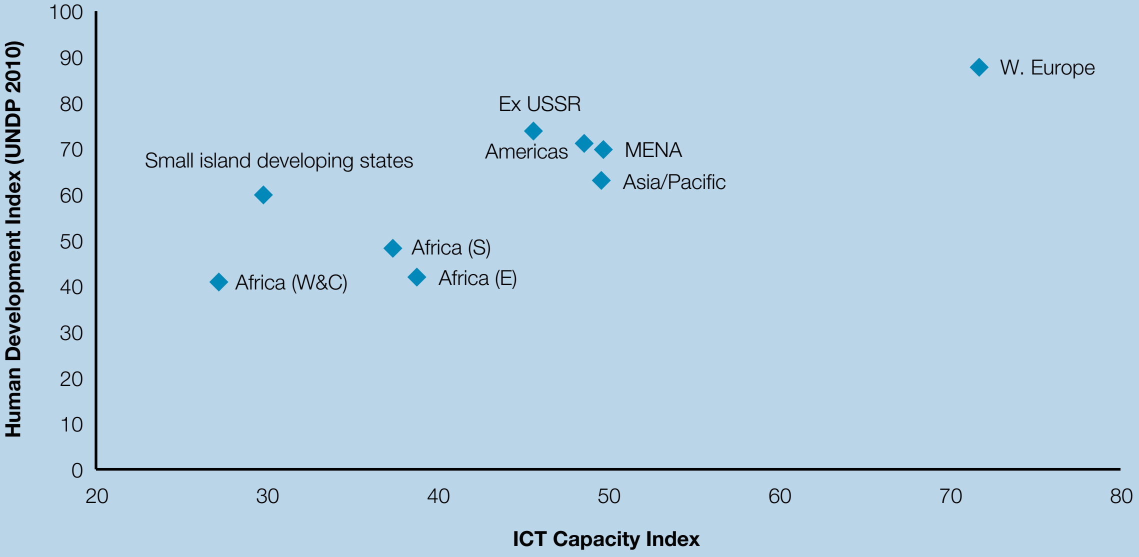
The information technology revolution has profoundly affected the way the IFRC carries out its work. National Societies and their staff now have unprecedented access to information and the capacity to engage, interact and influence through their place in the global information environment. Internal and international coordination is transformed by accessible, low-cost, real-time communications, bringing benefits in day-to-day work and when responding to emergencies.

This revolution has not reached everyone equally. The world's most deprived areas and communities have watched as new ways of working and communicating have brought opportunities to some, but not to them.

National Societies in the poorest countries are often the first to respond to disaster. They are located in parts of the world threatened by floods, tropical storms or earthquakes, and poverty renders their populations vulnerable. They are essential in delivering assistance to the 'last mile', but are often deprived of the technological tools which would allow them to be even more effective. This organizational deprivation is rendered particularly stark when compared with the capacities of National Societies in high-income countries, armed with the latest computers, satellite communications and specialists. In a crisis, the resulting 'digital divide', between those with the technology and those without, can reduce the latter to the status of secondary partners in their own country.

To assess this digital divide's impact on National Societies, the IFRC carried out a survey of their ICT capacity and derived an ICT capacity index to indicate the extent to which each National Society could call on the technology it needed to carry out its functions. The results, averaged by regions, are plotted in Figure 1 against the UN Development Programme's Human Development Index to show how a country's development level affected its National Society's ability to benefit from the ICT revolution.

FIGURE 1 ICT capacity index and Human Development Index



As might be expected, National Societies in high-income countries, such as western Europe, are benefiting from strong ICT, and those in poor countries are struggling. The scores for National Societies in the most developed countries in Asia and the Americas are similar to western Europe, pushing up their regions' averages and masking their neighbouring countries' comparative weakness.

National Societies in Africa and in the small island developing states of the Pacific, the Caribbean and the Indian Ocean face particular challenges in the effective use of ICT. In these areas, resources are scarcest, ICT skills and education at a premium and the telecommunications infrastructure the least developed.

They also face important humanitarian challenges and their National Societies need to be able to function effectively with the help of modern technological tools.

Certain barriers to effective ICT use were reported by many National Societies. Chief among these was access to skills; technical expertise is in short supply in low- and middle-income countries, and technicians can often command higher salaries than National Societies can afford to pay. Also at a premium is the management expertise required to identify the ways in which technology can make a strategic contribution and guide the organization through planning and implementation.

At the technical level, seemingly trivial problems caused real hardship to many. Inability to update the web site, virus infections, hardware failures and filled hard disks, for example, provided a constant obstacle to getting work done in too many National Societies. The divide also exists within some National Societies: headquarters, located in a capital city and with access to connectivity, skills and support services, may use technology successfully, but the picture may be very different in local branches.

The study revealed some interesting insights, with some National Societies doing worse than could be expected from their country's development level. There are two main reasons for this: some of these National Societies are in small island developing states and, although income from the tourist industry elevates the country's development level, local organizations may be weak due to small populations, isolation and lack of skills, and disproportionately expensive connectivity and technical services. In others, leadership struggles to understand the opportunities offered by technology or perceives it as a threat.

But some National Societies working in poor countries and in challenging conditions are using technology effectively and imaginatively. Their leaders have embraced the possibilities offered by ICT, but they have also benefited from extensive international assistance in response to disasters affecting their countries. This indicates that working in a poor country need not be an insuperable obstacle to effective use of ICTs and that, with the right approach and some help, National Societies can benefit from modern technology no matter where they are.

This is why the IFRC has created the Digital Divide Initiative. This programme aims to ensure that all National Societies, no matter how difficult their environment, have the ICT capacities they need to carry out their vital work. Over a four-year period, 80 National Societies are being helped, often with very basic support, such as stabilizing and simplifying systems, connecting local branches, training technical staff and managers, providing antivirus and office automation software and setting up a support network of service providers. The IFRC is also trying to ensure that the National Societies can maintain these services in the long term.

The Digital Divide Initiative goes further than just helping the National Societies that face the greatest difficulties. By using the IFRC's global presence and reputation, it is negotiating agreements with technology companies to ensure the best deals for all National Societies. It is encouraging National Societies to help each other, and identifying and helping to develop the technologies that will revolutionize the delivery of humanitarian assistance in the future. Its ultimate aim is that the IFRC is the most imaginative, innovative and effective user of technology in the humanitarian world. ■

The state of the art: humanitarian norms and uses of information

Humanitarian norms

Wars and disasters disrupt the normal social and political order and create a potential ethical vacuum. Large populations flee their homes; communities break up; responder roles are fluid; boundaries between non-combatants and hostile forces are murky; urgent needs often outstrip available resources; and rules of distribution can rapidly become ambiguous. The core norms of current humanitarian response derive from:

- Four of the International Red Cross and Red Crescent Movement's seven Fundamental Principles: humanity; impartiality; neutrality; and independence.
- Precepts from international humanitarian law (IHL), international human rights law (IHRL) and mass casualty experience in war and disaster, which include protection of civilian populations and assets, capacity to deliver effective triage, obligation to respect rights of all individuals and attention to vulnerability, inclusion, 'voice', transparency and accountability.
- Public health and medical ethics, with an emphasis on autonomy and inherent dignity of patients so that they are seen as ultimate arbiters of their own fate, informed consent requirements regarding treatment and research, and exigent standards for overriding autonomy and consent in emergency settings (e.g., Siracusa Principles).

Within this category of ethics, of particular importance to new entrants to the humanitarian field, such as 'digital' humanitarians, is the requirement that all providers adhere to the highest standards of professionalism: creation of a relationship with affected populations and peers based on respect and mutual trust; maintenance of high technical competence and expertise in one's field; and agreement to be held accountable for the quality, efficiency and appropriateness of service delivery.

Seven strategic requirements, common to both conflict and disaster response, derive from these norms. Each demands sophisticated ethical reasoning and each can be enhanced or degraded by the quality and quantity of information available.

- Access to affected populations must be based on assessed needs, not convenience or political preference. Information is critical to this assessment as is professional capacity to maintain perceptions of neutrality and non-partisanship in the often extended and incessant negotiations required to sustain whatever access is initially granted. Similarly, information relating to high levels of ongoing human rights abuses may prove pivotal in decisions to stand down a humanitarian operation, speak out against the violations and leave the area. Access and exit decisions are among the most ethically demanding and often depend on the amount of high-quality information that can be harnessed to support one choice or the other.

- Population-based triage in situations where available resources outstrip the numbers in need may require distributing food, public health inputs or medical care to those who are most likely to survive. These decisions require experience and seasoned judgement and are among the most stressful faced by public health and medical responders.
- Aid must be distributed not only to disaster-affected populations, but also to host and surrounding communities. Issues of equity, particular for crises occurring in areas of chronic poverty and stress, argue that the international community cannot focus solely on individuals affected by disaster or conflict, but also on the communities that take them in.
- Attention to vulnerable populations must focus on protecting their rights to life, safety, health and dignity. During flight and in refugee and internally displaced people's settings, women, children and adolescents, and the elderly are often considered particularly vulnerable to harm, neglect or abuse. In active conflict settings, young and older men or community leaders may be specific targets of attack or recruitment.
- Family tracing and reunification must be an early priority in all relief operations. Psychosocial support to survivors, whose distress in large measure comes from uncertainty about the fate of loved ones, begins with efforts to find out where relatives may have fled and bringing them back together.
- Responding to the needs of the local population requires respectful interaction and shared responsibility for gathering information, making assessments based on that information and monitoring and evaluating the effectiveness and fairness of aid delivery. Transparency, accountability and partnership are themes that should inform all aspects of this process.
- Building local capacity among national staff in all sectors has become a major intermediate-time requirement of humanitarian action in the field. This strategy has developed in response to human rights norms, where mitigation of gaps in power and resources requires attention to issues of inclusion, voice and accountability.

These norms and strategic requirements have been codified in multiple ways, most notably as the Code of Conduct for the Red Cross Red Crescent Movement and NGOs in disaster relief (IFRC, 1994) and UN General Assembly resolutions 46/182 (UN, 1991) and 58/114 (UN, 2004), and in Sphere's Humanitarian Charter (2011) and the

People in Aid Code of Good Practice (2003). These documents all frame humanitarian action in the context of field deployment, which begs the question of their applicability to digital volunteers, removed in both distance and nature from traditional humanitarians.

Current digital practice in humanitarian operations – normative and technical gaps

Digital volunteers come from diverse backgrounds and geographical locations, and contribute in a variety of ways. For example, the Standby Task Force, an online community of people ready to assist in digital disaster response, includes people from 95 countries, speaking 85 languages. Digital volunteers can be part of prominent companies (Google's engineers were allocated 20 per cent of their work time to dedicate to disaster response after the March 2011 earthquake in Japan). They can come together as NGOs (like Ushahidi) and online communities (Standby Task Force) or serve as technology practitioners who apply their expertise solely to the humanitarian space. Or, as seen with FEMA's online volunteers, they can be concerned non-professionals equipped with some computing knowledge and located anywhere in the world.

New digital volunteers evoke cautionary concerns from seasoned field-based responders. These volunteers are often not identifiable beyond an internet username yet they seem to have responsibility for processing potentially urgent requests for help and feeding these back to responders on the ground in the absence of a system of accountability. They seem relatively ignorant of humanitarian

The KoBoToolbox, shown here, is a toolkit for digital data collection in the field.
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principles, codes of conduct and historical lessons. They do not understand field constraints and issues of access and security. They are not familiar with concepts of vulnerability and voice. They relish problems but resort to technological solutions without apparent respect for the friction introduced by context, culture and politics.

OCHA recently released *Humanitarianism in the Network Age* (2013b), a policy document that examines the opportunities and challenges marked by the rising importance of crowdsourcing, digital humanitarian response and the next generation in humanitarian technology. The changing paradigm is described as: "not simply a technological shift [but] also a process of rapid decentralization of power. With extremely low barriers to entry, many new entrants are appearing in the fields of emergency and disaster response. They are ignoring the traditional hierarchies, because the new entrants perceive that there is something they can do which benefits others" (OCHA, 2013b).

Crowdsourcing can help affected populations to shape the response to their plight – the more crowdsourced crisis information there is available, the more it can reflect the needs and priorities of the citizens in need of help.

But substantial ethical risks are attached to the current methods used to gather and aggregate crowdsourced data and to the crisis mapping approach more generally.

In terms of gathering information, crowdsourced data can rapidly be crippled by countermeasures, such as flooding the system with misinformation or invading the programs with malware. Information obtained through crowdsourcing can also be used to track backwards, so that individual or aggregated sources, defined by a certain geographic area settled by certain groups of interest, could be identified and potentially targeted for exposure or reprisal. Reports of human rights abuses, which are important to obtain, would require layers of encryption to travel on electronic pathways with a secure veil of confidentiality or anonymity. But this would complicate or vitiate the easy utility of crowdsourcing.

Aggregating crowdsourced data demands substantial technical and ethical expertise. Are all data points of equal relevance, accuracy and substance? What choices are implied by the selection of a particular unit of analysis – can an individual speak for a population? How is a community defined? Is one person's expressed suffering equivalent to another's, when lives are at stake?

Taking information building blocks at face value and then building a data edifice on them may mask some essential errors – is the library map derived from a politicized source or time? Are there omissions of importance on the map supplied by that one clan? Are translators reporting key nuances? Do these pre-existing health records convey adequate information to serve as a baseline?

The use of satellite technology to inform a crisis map has proved powerful but problematic, as the HHI's Satellite Sentinel experience has shown (HHI, 2012). An apparent fact picture separated by 24 hours may mask important interim changes on the ground or the area outside the perimeter of the satellite image may harbour risks that are not anticipated or ascertainable because of the pre-determined GPS grid for the next photo.

The obligations embedded in the potential of crowdsourcing also require further consideration. A current overarching uncertainty is when and whether to share information discernible to the technical and content analysts with the general public whose lives are and will be affected by this information. If good information is needed for responders to develop relevant life-saving strategies of early warning and relief, then it is, at least in some measure, of equal or greater need to the local affected population. As OCHA (2013b) argues: "The freedom to seek, receive and impart information is enshrined in the Universal Declaration of Human Rights. This means that Governments and aid agencies, particularly well-resourced international actors, have an operational obligation to help communities, local authorities and NGOs to generate, access and use information. This elevates information to the level of a basic need in humanitarian response. Information is not water, food or shelter, but in the list of priorities, it must come shortly after these."

The need to know is conceptually collapsing with the right to know. It has become evident how poorly this obligation has been fulfilled. The capacity of digital methods to support steps in this positive direction must be very carefully balanced against the risks of doing harm.

BOX 6.5 Eye in the sky

The Satellite Sentinel Project (SSP), launched in December 2010, is a singular example of what is possible when commercial satellite technologies and global media networks are used to enhance near-real-time human rights and humanitarian action. SSP had unprecedented access to both satellite imagery and the resources necessary to disseminate critical information across the globe. But, three years later, important questions about the ethical and operational implications of the SSP model are beginning to circulate in academic and humanitarian communities.

The project began "with the goals of deterring a return to full-scale civil war between northern and southern Sudan and deterring and documenting threats to civilians along both sides of the border" (SSP, 2012). Though publicly characterized as a programme for the protection of vulnerable populations, referencing deterrence in the mission statement clearly indicated a commitment to monitoring armed actors rather than just civilian populations. By choosing to focus on the imminent threat of full-scale civil war, SSP operations would inevitably be high tempo and unfold in near-real time. Adopting the classic documentation posture of mainstream human rights and advocacy NGOs would have hobbled the project's potential and ultimately made it irrelevant to the populations it was designed to serve.

Another element positioned SSP to transcend traditional documentation work. Through a partnership with DigitalGlobe, SSP had access to high-resolution satellite imagery over the non-permissive environment of the contested territories between Sudan and South Sudan. With access to more non-classified high-resolution imagery than any other academic or NGO programme in history, as well as priority tasking, SSP had the technical capacity to visually confirm and document threats to vulnerable populations in near-real time. SSP's pursuit of an atrocity-deterrence platform raises important questions about the future of humanitarian action.

While leading operations for SSP, Harvard Humanitarian Initiative researchers faced new challenges as they attempted to reconcile the gap between SSP's capacity to inform and unintended consequences that could result from their reports. SSP's 19th report concerned what was believed to be an impending attack on the Sudanese town of Kurmuk (HHI, 2011). The operational decisions that led to the report's publication highlight the practical and ethical challenges humanitarians will face as they attempt to engage in these types of early warning activities.

On 19 and 21 September 2011, SSP obtained imagery showing Sudan Armed Forces (SAF) convoys engaged in operations throughout Blue Nile state. These images coincided with a Sudanese government official's statement about an impending attack against Kurmuk, the Sudan Peoples' Liberation Movement-North (SPLM-N) stronghold. Previous attacks had resulted in reports of widespread violence against, and targeting of, civilians. Based on these indicators, HHI researchers adopted an early warning posture and began to determine if they could reduce the risk to a vulnerable civilian population by publishing imagery of SAF forces.

HHI was limited to a diagnostic role in SSP, simply reporting what they could scientifically extrapolate about the situation on the ground using visual, ground and open-source data. The degree of confidence in their analysis would reflect the reality that the data available were inherently incomplete and often unverifiable.

All available information related to the armed forces, extant imagery and historical behaviour was incorporated into theories concerning the potential threat to civilians. Any report released would only offer an interpretation of available information, not conclusive findings – a nuance likely to be lost after publication, so HHI needed to anticipate how SSP's findings might be interpreted by the media, policy-makers or armed actors on the ground. Once they determined that the forces in the imagery posed an imminent threat to civilians, HHI had to make crucial decisions concerning SSP's role in a shifting situation.

The report's possible outcome in Sudan should not be understated. Within hours of receiving and analysing imagery, SSP could broadcast its reports in time for the morning African news cycle, thus pushing information to affected populations via radio and television broadcast.

Regardless of the final report's accuracy, HHI had to determine if publishing these images and corresponding analysis could inadvertently cause harm on the ground. The decision-making process necessary to engage in early warning requires a complex understanding of missing information rather than connecting data points. Actors can change tactics, targets and tempo. HHI did not want its report in any way to escalate the conflict, create new military targets or add to civilians' vulnerability.

HHI researchers address some of these issues with self-imposed standards, but each report raises new and unique challenges. For example, previous reports included no coordinates for locations of armed actors or civilian targets. In the case of Kurmuk, some indicator of the location and vector of SAF units was essential for informing vulnerable populations. In an early warning context, these challenges are compounded by countless variables beyond the practitioner's scope.

If SSP's report prompted an evacuation of Kurmuk, could a US-based remote sensing operation – which had no way of knowing exactly what threats civilians in a conflict zone were facing – improve the safety of the population fleeing the town? Civilian flight from Kurmuk could put an already vulnerable population in the path of other threats outside the scope of available imagery. Due to the near-real-time reporting, each additional piece of information could change events on the ground. SSP's public release strategy meant all armed actors had equal real-time access to every report. Information about an SAF trajectory or location might simply result in SAF adapting its strategy. In the case of Kurmuk, SSP's report may have led SAF to alter its plans and attack a different target.

On 23 September 2011, SSP released its report warning of the impending attack on Kurmuk (HHI, 2011). The Sudanese government immediately condemned it, while SPLM-N captured media coverage with corroborative propaganda. The next major SAF attack was on Sali, a nearby town. Kurmuk was not attacked by the SAF until 3 November. Without an impartial feedback mechanism on the ground, SSP had no way of determining if the report had accurately predicted SAF intentions, if Kurmuk was ever the intended SAF target or if SSP prompted civilian flight from Kurmuk.

As civilian access to remote sensing and information dissemination platforms increase, cases like this demand further study. With the possibility of remote access to conflict zones and vulnerable populations, the role of human rights and humanitarian actors is rapidly changing. Normative frameworks, including the Red Cross Red Crescent and NGO code of conduct (IFRC, 1994) or the Humanitarian Accountability Partnership's principles (2010b), will become irrelevant if they cannot adapt to new circumstances and guide the next generation of humanitarian decision-makers. As new projects use access to technology in an attempt to affect the dynamics of a conflict from afar, they face a new frontier fraught with risk. Unlike governments or militaries, there are no clear rules concerning what a civilian programme like SSP can publish, so these challenges must be proactively addressed by the practitioners themselves. ■

Closing the technical gaps

More robust data processing

The current discourse from leading responders, including the United Kingdom's Department for International Development (DfID) and OCHA, emphasizes the inclusion of the voice of affected people in response planning as a humanitarian imperative. As a recent DfID report states: "Currently the people directly affected by crises do not routinely have a voice, which makes it difficult for their needs be effectively addressed" (DfID, 2012). Telecommunications technology can provide that voice disaggregated, but how can responders and planners actually listen to, let alone sort, analyse, verify and act on, millions of voices at once? After the 2011 earthquake, Japanese Twitter accounts generated more than 2,000 tweets about the disaster per second. During Hurricane Sandy, 20 million tweets and half a million Instagram pictures were posted.

Such information overload in disaster scenarios is overtaking the ability of even technologically advanced volunteer organizations to make sense of it. Outsourcing the translation and mapping of hundreds, even thousands, of texts to a widely distributed network of volunteers (micro-tasking) worked in 2010 in Haiti, but as populations become larger and more connected, and disasters even larger in scale, human computing reaches its limits.

Beyond direct tweets with information, data can be gleaned from much wider sources: every text message and posted photo carries a geo-tag, news reports can be checked against each other to verify rumours about developing situations and satellite images can show population movements. Each one of these is a potential source of useful information. These multiple sources constitute big data.

More powerful analytics

The next phase in humanitarian technology is harnessing machine learning, artificial intelligence, to find meaning in big data. The leaders in using machine learning and artificial intelligence to glean useful information from unstructured data began in the private sector, but have now moved into the humanitarian space. Crimson Hexagon, a machine learning algorithm for disaster relief, developed by Gary King at Harvard University, is used by CNN and Bing and has been deployed with UN Global Pulse to help predict food security emergencies (King, personal communication, 2013). Ushahidi has developed its SwiftRiver platform. A forthcoming paper from the Qatar Foundation Computing Research Institute shows that machine learning can be sufficiently effective to work with tens of thousands of tweets to correctly identify eye-witness accounts and accurately classify information between 80 and 90 per cent of the time (Imran et al., 2013).

Improved verification technologies

A barrier to the utility of new digital methods in humanitarian crises is a mistrust of crowdsourced and other non-traditional data. Yet, the digital volunteer community is leading the way in rigorous fact checking. Social media in disaster scenarios often provide a mill for rumour and speculation (Meier, 2011), so perhaps the most interesting development is the potential to use crowdsourced open data from social media itself to combat the spread of unfounded information in crisis situations. Currently, most verification happens on a case-by-case basis, with volunteers working to assess the quality of the information source and to triangulate reports with other sources. Advances are now under way to facilitate verification on a much larger, faster scale. Research has shown both in general and in crisis situations that analysing the content and the author of tweets, and how they are re-tweeted and then criticized, can accurately predict the veracity of the information contained in the original tweets (Tanaka, Sakamoto and Matsuka, 2012; Mendoza, Poblete and Castillo, 2010). The next step is incorporating that analytic program into data processing software and machine learning.

From digital volunteers to humanitarian professionals

The concept of professionalism is central to the ethos of the modern humanitarian system. Building and strengthening this concept within the digital humanitarian community will require committing to education and training, developing professional codes of conduct and building relationships with other actors in the crowded humanitarian sector. To become a trustworthy partner in the humanitarian world is to be very good at what you do, to deport yourself in close and respectful compliance with general norms and to work very well with others.

Professional education and training

The inaugural crisis mappers conference in the United States was held in 2009, a significant milestone in signalling to the international community that the sector was moving towards professionalism and a long-term role in disaster response. The annual conference is growing in attendance and profile each year, and is attracting more attention from the wider humanitarian community.

Training programmes are now beginning to appear: the Standby Task Force was launched at the 2010 International Conference on Crisis Mapping to organize digital volunteers into a flexible, trained and prepared network ready to deploy in crises and MapAction, an open-source mapping platform with deployment experience in Haiti, Pakistan, Japan and other disasters, has held monthly formal training sessions for its volunteers and certifies the capability of all team members before deployment.

Development of professional codes of conduct

Momentum for accountability and guiding principles is coming from within the digital humanitarian community. Some of the most sensitive information pertains to protection and geographic distance does not diminish the security and protection consequences of handling, using and distributing this information. The 2011 crisis mappers conference recognized the responsibility that protection work carries and made recommendations for additions to the ICRC's *Professional standards for protection work* (ICRC, 2013) to encompass digital humanitarianism. Those recommendations are now incorporated to a large extent, with the 2013 update noting the urgency of including reference to "data management and new technologies".

At a more technical level, the GSMA, the international group of more than 800 telecommunications companies devoted to standardizing GSM mobile phone services that cover the majority of the world's 6.8 billion mobile phone subscriptions, launched the SMS Code of Conduct for Disaster Response in February 2013 (GSMA, 2013). The code includes guidance on deciding whether an SMS system should be deployed in response to a disaster, integrating the SMS system with existing systems, issues of pricing, confidentiality and coordination, and determining exit strategies.

In many ways the digital humanitarian community is naturally aligned with humanitarian principles, in its insistence on openness, accessibility and inclusion. If digital response seeks to be seen and relied upon as an integral part of global disaster response, however, more formal codes of conduct are required. Furthermore, the goal for the future should be the creation of codes that serve a common meeting ground, reflecting the broader intent to together accomplish better outcomes.

BOX 6.6 Technologies and the Movement's Fundamental Principles

The table below is a matrix bringing into relation the seven Fundamental Principles of the Red Cross and Red Crescent, broken down into components, as well as articulated with their underpinning humanitarian values (based on an analysis of the 1979 Pictet commentary).

Fundamental Principle	Components of the Fundamental Principles	Underpinning humanitarian values
Humanity	■ Alleviate and prevent suffering ■ Protect life and health ■ Assure respect for and protection of the individual	■ Active goodwill and solidarity ■ Human dignity and well-being ■ Mutual understanding and peace
Impartiality	■ Non-discrimination ■ Actions solely guided by needs, proportional to the degree of suffering and prioritized on the basis of urgency ■ No individual action or decision on the basis of prejudice or personal preference	■ Equality of rights ■ Respect for diversity ■ Objectivity
Neutrality	■ No taking sides in armed conflicts ■ No engagement in controversies of a political, racial, religious or ideological nature	■ Confidence (trust) ■ Self-control and discipline ■ Freedom of action and objectivity
Independence	■ Not letting political, economic, social, religious, financial or public pressure interfere with or dictate Red Cross Red Crescent line/action ■ Auxiliary to public authorities ■ Maintain autonomy to be able to act in accordance with the Fundamental Principles	■ Sovereignty ■ Cooperation ■ Freedom of action and confidence
Voluntary service	■ Freely accepted commitment ■ No desire for gain ■ Selflessness	■ Spirit of initiative and discipline ■ Spirit of altruism and solidarity ■ Spirit of service and generosity

Fundamental Principle	Components of the Fundamental Principles	Underpinning humanitarian values
Unity	■ One National Society per country ■ Open to all ■ Active in entire country	■ Harmony and cohesion ■ Diversity and pluralism ■ Confidence
Universality	■ Universal vocation ■ Equality of National Societies ■ Solidarity	■ Openness to all in the world ■ Cooperation ■ Mutual assistance

Selected pros and cons include:

Selected pros of digital technology	Fundamental Principle	Rationale
Identify people in need more quickly and easily	Humanity	Consequent easier alleviation or prevention of human suffering, and protection of life and health
	Impartiality	Facilitated application of impartiality as action solely guided by the needs identified, which the access to diversified sources of information (thanks to technology) confirms to be accurate and objective
Increase the voice and the meaningful and active participation of affected communities (e.g., in assessment, service delivery and decision-making)	Humanity	Consequent reinforcement of people-centred action, respect for and protection of the individual, which is called for by humanity and facilitated and enhanced by technology
	Impartiality	Consequent easier needs identification and strengthened impartiality as action solely guided by needs
Empower affected communities to stand up for their needs and rights	Neutrality	Consequent decreased need to advocate on behalf of vulnerable communities, an action possibly perceived as taking a stance against others, such as the authorities, and thus potentially affecting the Red Cross Red Crescent's neutrality
Increase accountability and transparency of humanitarian actors towards affected people (e.g., through communication with populations affected, feedback on or rating of performance through mobile phones)	Humanity	Consequent reinforcement of people-centred action, which is called for by humanity and could be guaranteed and sanctioned by technology in case of non-compliance. Feedback and assessment from affected people are to be taken into consideration and affected communities given the possibility to exert greater pressure and influence the former asymmetric model of humanitarian action to enable interaction at a level of equality between affected people and humanitarian actors
	Impartiality	Consequent enhanced guarantee of non-discriminatory decisions and actions, and action prioritized on the basis of vulnerability and urgency
Increase visibility and brand of humanitarian organizations	Independence	Consequent enhanced awareness and understanding of authorities, partners and public of Red Cross Red Crescent's operational procedures, auxiliary status and respect for emblem
Diversify sources of funding	Independence	Consequent decreased dependence on a sole or few, disproportionately powerful, sources of funding, potentially imperilling independence of humanitarian actors
Increase interconnection, cooperation and solidarity between individuals, communities and organizations	Humanity	Enhanced compassion and active humanity by interconnected people worldwide
	Voluntary service	Enhanced desire by individuals to provide disinterested assistance to vulnerable people and service to the community and to become a volunteer
	Universality	Enhanced universality as an expression of solidarity and cooperation between humanitarian organizations, communities and individuals

Facilitate volunteer management and develop new volunteering possibilities, providing services from a distance (e.g., e-volunteering)	Voluntary service	Facilitated update of volunteer database, improvement of registration system and follow-up
Increase networking and internal and external information sharing and institutional memory	Unity	Facilitated 'commonly stated storyline' or cohesion at organizational level Improved operational effectiveness
Selected cons of digital technology	**Fundamental Principle**	**Rationale**
Increase the digital divide and leave unheard individuals or communities with no access to technology and thereby increase their vulnerability and isolation, in particular people affected by 'silent' or underfunded disasters	Humanity	Alleviation and prevention of human suffering, protection of life and health of people possibly imperilled for those without access to technology, in particular in 'silent' disasters (i.e., those not profiled by media)
	Impartiality	Needs identification possibly incorrect and action not prioritized on the basis of urgency and vulnerability
	Unity	Openness to all possibly questioned with regard to the channels of recruitment
Limit traditional human interaction	Humanity	Scope for applying active humanity face-to-face reduced, including support for humanitarian values of respect and care for fellow beings
Overstretch influence and/or bias of media and donors regarding which disasters and communities get most attention and funding	Impartiality	Enhanced pressure and publicity created by media and donor reliance on technology
	Independence	Increased risk of being media- and donor-driven rather than needs-driven
Shape untraditional and new partnerships and groupings, especially due to social media, of people on the basis of personal affiliation, beliefs, etc.	Impartiality	Humanitarian action based on objective needs, proportional to the degree of suffering or vulnerability, and priorities based on vulnerability or urgency imperilled
Instrumentalize data and information	Impartiality	Accuracy and objective analysis of data and information imperilled as collected or available in huge quantity, and humanitarian action based on objective needs imperilled
Imperil access to vulnerable communities	Neutrality	Public positioning of government or group with which humanitarian actors are associated portrayed by communication technology as non-neutral
Retain volunteers	Voluntary service	Real or perceived inconsistency between the 'advertised' and the organizational reality and action solicited, among volunteers recruited through technology

Building relationships

The adoption of ICT tools into disaster response is contingent on the trust of the humanitarian organizations on the ground, which will depend on developing dialogue, relationships and partnerships between humanitarians and volunteer networks. A significant part of building the trust required for these relationships will be the participation of digital volunteers and their organizations in conferences and meetings that evaluate recent operations, critique and elaborate applicable norms and policies, and generally engage in the same intellectual and community discussions that the traditional humanitarian community expects of its own workers and volunteers.

Building this relationship requires active outreach from both sides on practical, normative and ideological matters. DfID (2012) and OCHA (2013b) have recently published policy papers that explicitly embrace digital tools as necessary and powerful in future crisis response. Similar policy shifts can be seen in FEMA's establishment of an online think-tank focusing on technological innovation and their successful deployment of a field innovation team in response to Hurricane Sandy. The digital humanitarian community has also recognized that the interests of those affected by disasters will be best served by a united humanitarian world, one which draws on the potential for synergy between players with different and complementary skills. This recognition is reflected in publications like the Digital Humanitarian Network's freely available practical guide (Capelo, Change and Verity, 2012), which aims at helping traditional humanitarian organizations navigate and optimize collaboration with digital volunteers.

Practical familiarity with working together will also be essential, as each sees how the other works in different ways to pursue normatively aligned goals. This practical experience has been promoted through simulation, with the Standby Task Force activated for an OCHA simulation at New York's Columbia University and the field simulation organized by Harvard's Humanitarian Studies Initiative.

Conclusion

Humanitarians always lament the lack of information when they face hard decisions yet they take pride in acting during the 'fog of war'. The advent of digital information and communication systems may reduce that fog but make the decisions even more consequential. Early warning may become practically possible, but who should be warned and when? Immediate survivors will all make themselves known, but the equipment and personnel are sufficient to reach only a few. Children reported missing have been found but they are now being taken across the border.

As digital humanitarians acquire prowess in their trade and strive to meet the same high standards as relief workers, expectations will rise for everyone. Best practice will need to get better; failures will show up more acutely. Perhaps it is not too much to hope that the humanitarian community, faced with grave and global risks, will leverage the power of new technologies to mobilize people in danger, provide robust alerts, deliver substantive aid and ward off for millions the brunt of what lies ahead.

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Chapter 7

Chapter
7

Innovation, evaluation and diffusion of humanitarian technology

Digital technologies such as computers, cellular phones and internet, introduced since the late 1970s, have become an integral part of operations for disaster preparedness, mitigation, response and recovery. Although these technologies have been around for three decades and are widely used among humanitarians, several new trends in technological innovations are cause for great excitement, but are also the source of scepticism within the humanitarian community. These new trends are:

- The dramatic increase in accessibility to mobile technologies (due to a decrease in the costs of these devices), increased connectivity (especially in Africa and Asia), an increase in available open-source technology and improved usability
- Technology fusion, which is the integration of information networks, mobile technology hardware and applications, and social media and mapping platforms into readily available single mobile devices such as laptops, mobile smartphones or tablets with access to unlimited data from multiple sources and in multiple formats (big data).

Increased accessibility (to data, networks, technology) and technology fusion are transforming the range of tools and data sources available to humanitarian actors (Pham and Vinck, 2012).

This *World Disasters Report* has, so far, discussed how increased access, networking and technology fusion impact coordination, information management and action in disaster prevention, mitigation, response and recovery. One of the most powerful arguments made is how, in an increasingly connected world, disaster communities can be engaged directly in dialogue and two-way communication, rapidly improving humanitarians' understanding of the needs of affected communities and the local context, and enabling communities to build their own response. This local information and communication, together with the rise of global data from satellites or social networks for example, provide an unprecedented ability to prepare, prevent and respond to crisis. Local communities, which have always been the primary source of information and response, are now becoming more fully engaged in humanitarian action than ever before. At the same time, the rise in information and communication also provides unique abilities to coordinate humanitarian action and be more accountable to local

Greater accessibility to mobile technologies, increased connectivity and improved usability mean that information and communication technologies are used increasingly in disaster situations. While some humanitarians embrace these new technological trends, others are sceptical of their utility and acceptability by both humanitarian actors and disaster-prone communities.
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communities. Finally, it provides unique tools to mobilize financial support and volunteer communities to support response efforts.

The report further highlights some of the risks and challenges that may emerge as a result of technological innovations. It also cautions about the risks involved and the barriers to successful integration and deployment of technology, such as the financial cost of technology solutions, the lack of trust by users, the digital competency of users and implementers, acceptance of technology by key stakeholders and the level of complexity in the solution. To address these barriers, the report recommends, among others, to build a better understanding of information ecosystems in disaster-affected communities, keep solutions simple, improve transparency and coordination, develop incentives for participants and, more generally, be mindful of the characteristics of the communities participating in the technology solutions, including demographic representation.

This chapter will elaborate on some of these points and propose a framework to address a gap in the discussion around humanitarian technologies: what are the criteria and factors that should be considered when evaluating technological innovations applied to humanitarian action and what are the factors that can influence the rapid diffusion of some technologies versus others?

In a world where humanitarians are presented with new ideas and new technologies every day, they need to be able to distinguish what is promising, what works and what is very likely to fail; what has the potential for wider application and diffusion, and what does not. The recent 'evaluation paradigm shift' experienced in the humanitarian field is a welcome trend, but when it comes to evaluating technologies themselves, the record is rather poor – even through non-systematic means. What is left is first and foremost a growing body of anecdotes or weak science, but little concrete evidence thus far. This chapter's aim is to provide a systematic approach to identify, prioritize and implement the appropriate technological innovations and evaluate their impact and scalability.

BOX 7.1 Technology in disaster management in the Philippines

Over the past few years, the Philippine Red Cross has modernized its response, risk reduction, recovery and preparedness activities. These efforts include the distribution of relief items using cash vouchers where applicable to reduce shipment and overhead costs, as well as electronic cash transfers for livelihood and shelter repair kit grants which capitalize on SMS technology in transferring money to affected populations. The Philippine Red Cross's disaster risk reduction activities use modern early warning notification and mapping using GIS (geographic information systems) and web-based data management systems to store community baseline data.

The Red Cross has also been developing ways to improve the condition of vulnerable communities and using technology to make the National Society more accessible. These include the development of information, education and communication materials for both adults and children, and of mobile phone games and apps for online registration of volunteers, as well as using social media and 'text blasts' (sending mass text messages to a group of people) to disseminate early warning notifications to the public.

Furthermore, the Philippine Red Cross has reorganized its operations centre to serve the Philippine population and fulfil its mandate as the government's auxiliary. The operations centre has three main objectives: monitoring of possible disaster occurrences; coordination between the field and headquarters; and early warning notification.

The operations centre uses 'powertext', a telecommunications tool, for early warning and field communication. The tool enables the Red Cross to send SMS to volunteers, staff and disaster-affected communities, and to receive distress signals and feedback from affected people. The tool helps the Philippine Red Cross to bridge the 'last mile' gap and ensure that end-to-end early warning has been achieved.

Technology has proved very useful in emergency response, search and rescue and assessments. In data gathering and analysis, the use of GPS and GIS to map out affected areas where the Red Cross and other organizations are working makes it easier for decision-makers to approve recommendations for interventions. During an emergency response, when all cell networks and power lines are down, the use of satellite phones has proved to be very efficient in communicating with the operations centre in order to send updated reports and receive commands from management.

In areas where applicable, the Philippine Red Cross also uses technology in its recovery efforts such as livelihood and shelter repair kit grants. These cash transfers are sent through SMS and recipients can withdraw the items at identified merchants in their area. These initiatives lessen the security risks for humanitarian workers bringing money into remote areas and contribute to the local economy of the affected region. It may also empower families who can decide how best to spend the money in order to improve their living conditions. The Red Cross ensures proper monitoring of such schemes.

Lastly, in the Philippine Red Cross's disaster risk reduction programmes, technology has been used to create community maps – a fusion of local knowledge and science. The community maps are now being combined with those produced by national mapping and early warning agencies. This makes it easier than before to safeguard and retrieve a community's vulnerability and capacity assessments. The use of computers and web-based tools makes the work faster and easier.

Using the internet through web-based groups has also proven valuable in learning from other communities and countries in the region by sharing experiences and good practices in disaster risk reduction. E-learning platforms and online courses are the best tools for humanitarian workers to study even when they are working in the field.

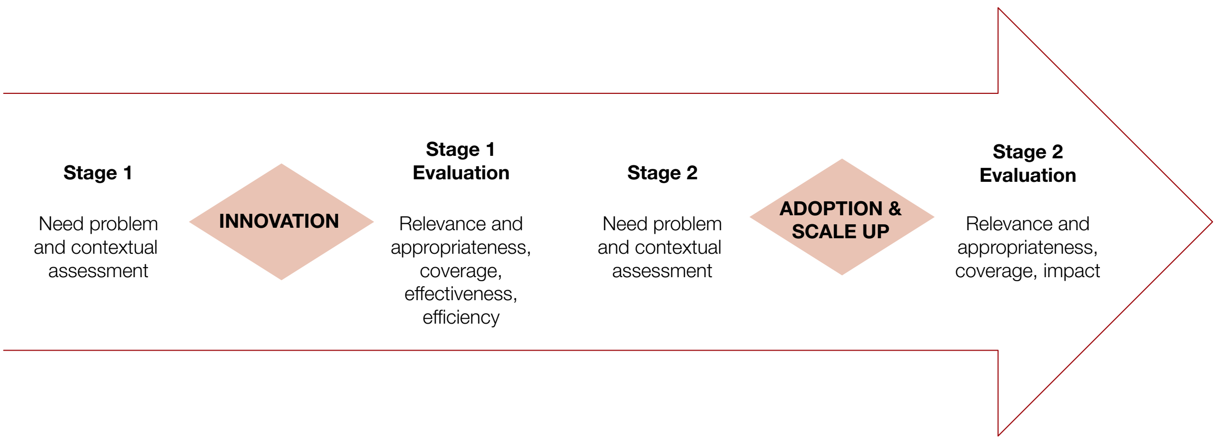
The Philippine Red Cross's experience shows that technology makes humanitarian response activities more efficient. Evaluations are needed to identify the areas where improvements have been greatest. Continued research, evaluation and development are core to the activities of the Philippine Red Cross, in order to take advantage of existing opportunities and improve its action. ■

Towards an evaluation framework for humanitarian technology

To generate the type of evaluation and evidence that should ground the use and diffusion of humanitarian technologies, existing approaches must be developed to manage, evaluate and diffuse evaluations in a broader context. Two principles underpinning these approaches are that innovation, its evaluation and diffusion are active and dynamic processes, and that these processes involve evolving interactions among individuals, institutions and situational factors as well as attributes of the innovation itself. Barriers and risk for failures can enter at any stage of these processes. As such, ongoing monitoring of development and implementation is essential to troubleshoot and address problems as they arise. In addition, each of these stages should be part of a learning environment for subsequent actions – thus creating a continual cycle of learning for the entire process of innovation, evaluation and diffusion.

The three key action points in successful technology deployment in humanitarian actions are innovation, evaluation and diffusion.

FIGURE 7.1 Innovation, evaluation and diffusion cycle



Innovation is "an idea, practice, or object that is perceived as new by the individual or other unit of adaption" (Rogers, 2003). From this definition, innovation is relative. The Humanitarian Innovation Fund (HIF), which supports the identification and sharing of solutions to the challenges facing effective humanitarian assistance, took this definition one step further by including the purpose and outcomes of the innovation, which in turn imply that innovation is a process: "Innovations are dynamic processes which focus on the creation and implementation of new or improved products and services, processes, positions and paradigms. Successful innovations are those that result in improvements in efficiency, effectiveness, quality or social outcomes/impacts" (HIF, 2013a).

The most successful innovations usually begin when a problem or challenge is recognized, defined and articulated. This provides an innovation opportunity space for a solution or an idea which helps address the problem or challenge. A humanitarian crisis, almost by nature, provides many opportunities for innovation as the problems and needs are unprecedented and the sense of urgency during the crisis offers space for rapid innovative thinking and development. On the other hand, although many successful innovations arise in the midst of a crisis, for example Ushahidi, it is not ideal in terms of potential risks for failure and untoward impact on humanitarian operations (OCHA, UN Foundation and Vodaphone Foundation, 2011).

Most successful innovations arise from research, evaluation and commitment to learning from the process. Documenting and learning from success and failure are essential to the innovation and diffusion process. Innovative ideas need to be tested or prototyped before they are piloted in the field and, ultimately, if proven successful, fully integrated into humanitarian programmes. These ideas also must match the needs of the affected community and the problems at hand; this is consistent with the Sphere standard of having disaster-affected populations actively participate in the design, implementation and evaluation of humanitarian programmes (Sphere Project, 2011).

To manage this process, a technology roadmap is needed. "A technology roadmap is a plan that matches short-term and long-term goals with specific technology solutions to help meet those goals. It is a plan that applies to a new product or process, or to an emerging technology. It helps reach a consensus about a set of needs and the technologies required to satisfy those needs; it provides a mechanism to help forecast technology developments and it provides a framework to help plan and coordinate technology developments" (Garcia and Bray, 1997).

Technology, however, can show promise and success in its proof of concept or pilot phase, but may not scale up or be diffused to large applications. The effective diffusion of technologies will require strategic and deliberate communication between actors, gathering support and capacity building. The key words here are strategic and deliberate. The World Health Organization (WHO) has outlined the fundamental elements of the process in developing effective scale-up strategies (WHO, 2010; see Table 7.1).

TABLE 7.1 The WHO Scale-up Strategy

Step 1	*Plan actions to increase scalability.* Issues significant to the scale-up process include credibility (if the innovation has sound evidence or proven advocates), relevancy (if the innovation adequately addresses problems-at-hand), advantage (if the innovation is advantageous over other alternatives) and appropriateness (if the innovation fits the needs and context of the user).
Step 2	*Increase capacity of implementing user organization.* The type of user organization will vary, from public to private or singular to combined institutions. Regardless of institution size or association, the user organizations most prepared for scale-up are composed of members with a perceived need for the innovation and the motivation to advocate for its introduction.

TABLE 7.1 The WHO Scale-up Strategy

Step 3	*Assess environment and coordinate planning actions around success.* Through ongoing assessment, it will be important to analyse environmental factors influencing scale-up. Understanding the political system, policy infrastructure, donor culture, relationship between government and civilians, and socio-economic context of the site where expansion should occur is critical for providing a realistic understanding of outcomes.
Step 4	*Increase capacity of resource team to support scale-up.* Identifying an appropriate resource team involves recruiting individuals who had previously helped facilitate the development and testing of innovation. However, it is beneficial to add to that skill set other competencies such as managerial expertise and advocacy.
Step 5	*Make strategic choices to support vertical scale-up.* Scale-up on the vertical platform requires an understanding of macro-level policy, development and financing. Given that many activities must institutionalize the innovation according to broad-based changes in the system, the first consideration is national programme advocacy.
Step 6	*Make strategic choices to support horizontal scale-up.* The connotation of horizontal scale-up indicates wide-scale reproduction of innovation. Yet rather than the all-too-common 'mechanical repetition' of innovation, truly effective horizontal scale-up calls for expansion that will adapt to different environments.
Step 7	*Determine the role of diversification.* Diversification, or 'functional scale-up', may be applicable if relevant needs are identified that can supplement the original innovation. Often, the added intervention may promote scale-up efforts by drawing attention to a previously unidentified issue, creating demand for increased implementation.
Step 8	*Plan actions to address spontaneous scale-up.* Unplanned dissemination of innovation may occur when either the user organization or resource team determines an unforeseen need or an event that creates a need. Although 'spontaneous' scale-up is possible to wield using similar strategies as 'planned' scale-up, implementation efforts done hastily may lead to situations where the innovation is incompletely replicated and therefore does not yield the same results.
Step 9	*Finalize scale-up strategy and identify the next steps.* Effective strategy for scale-up requires more than a raw sum of the previous eight steps. It is necessary to balance different elements of the process, combining ingenuity with organization, prioritizing what is important, when it is needed and what is feasible. When finalizing the scale-up strategy, an appropriate operational plan will identify effective action steps that address each recommended component of scale-up.

Source: WHO, 2010.

BOX 7.2 Aid recipients' status check and technology: Mega V

Following the 2010 Haiti earthquake, National Red Cross and Red Crescent Societies were faced with the immense challenge of delivering aid to 400,000 affected people every month.

The normal procedure for a relief operation is to deliver cards to targeted families and to plan relief distributions accordingly. The cards are used to ensure that people present themselves to the right distribution point and that items are collected only once per recipient.

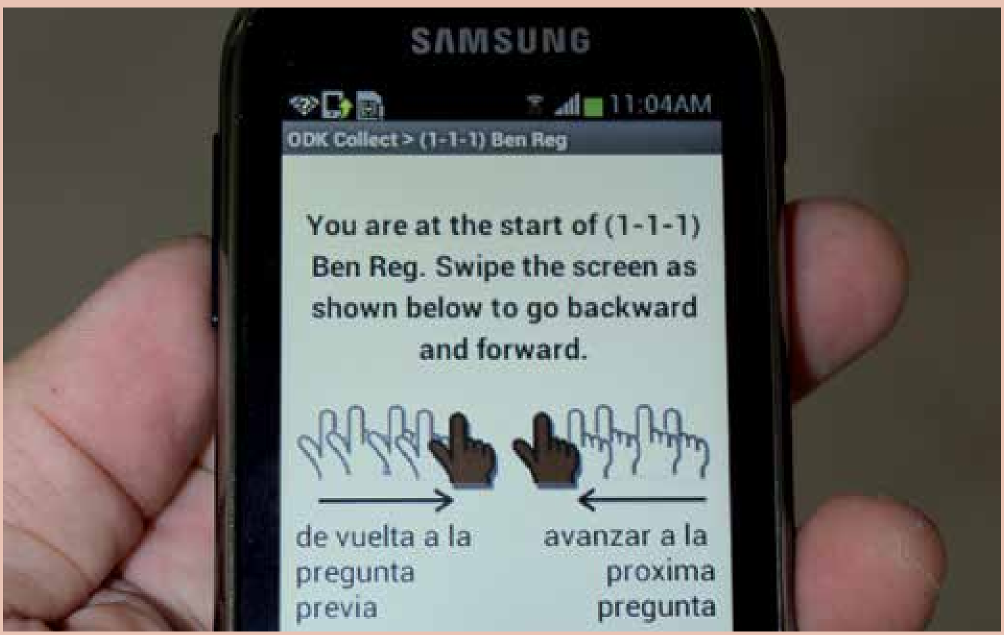
Rapidly, however, people in the camps started making very high-quality duplicates of the recipients' cards, which made them difficult to distinguish from the original ones. This resulted in critical security issues during the distributions, as people ended up having to fight for their items and many legitimate recipients with original cards lost out because items were no longer available due to the scam.

As a result, a careful screening and verification process was established, requiring every card to be manually checked against the list of affected people, a process that could take an average of three minutes per person. As a result, it was not uncommon to see lines of recipients (including the elderly and pregnant women) waiting for up to six hours (depending on the camp). IFRC personnel were often exhausted at having to work under such difficult conditions. This process proved unmanageable in camps with more than 1,000 families. Unfortunately, most of the camps housed between 2,000 and 8,000 families.

In order to resolve this problem, the Mexican Red Cross created a tool, Mega V, to make the verification process more efficient and rapid. A digital barcode scanning tool was created that could be used to quickly scan and verify the recipient's status, rather than manually reviewing registration documents. The change was immediate and revolutionary, with a reduction of the validation process from two to three minutes per person to just a few second on average, increasing both the security and dignity of the distribution and the affected population's satisfaction in the process.

At a training session, a Mexican Red Cross emergency responder uses the Mega V to scan a barcode, which will give him immediate information about a recipient's status. © IFRC

As a result of the increased speed of validation, the rate of hygiene kit distribution also dramatically increased to more than 25,000 kits a week by five teams of local Haiti Red Cross Society volunteers, compared to an earlier rate of 10,000 kits per week distributed by more than seven international Emergency Response Units and participant National Society teams.



The Mega V tool contains easy-to-follow instructions and is thus accessible to all volunteers and staff, whether or not they are used to working with smartphones and scanners. © IFRC

The overall procedure implies a huge reduction in both time and cost of resources (less than 2 per cent of the time it took before for checking affected people, and more than twice the rate of kit distributions), saving volunteers and staff time. Furthermore, the process is easily replicable and transferable for other relief activities with no additional development time.

Having proved successful in Haiti, the barcode scanning tool was improved by the IFRC and used in Guatemala, following a tropical depression in 2011 which unleashed torrential rain, causing landslides and flooding across the country. Once again barcode scanning was used during distributions and the results were similar: delivery times were reduced and recipient satisfaction significantly increased. As a result of the implementation of these tools, the Guatemalan Red Cross's aid delivery was also more efficient which saved time and money.

The tool was most recently used in Bolivia following floods in early 2013. Ramon Flores, a Regional Intervention Team member who specializes in assisting National Societies in the implementation of these new tools, went to Bolivia to support the operation and implementation of the distribution tool. Flores explains that in past operations the Bolivian Red Cross conducted distribution with lists compiled and checked manually using the recipients' name and identification document. Then on the day in which the distribution was scheduled to take place, each person's name had to be found on the lists in order to receive the aid, which was a sluggish process. Once again the resulting change was astonishing. "By using the barcode registration system the Bolivian Red Cross was able to gather 1,230 families from 30 communities in a single location, and was able to deliver aid to them in a record 29 seconds per family," says Flores. This positive change is perhaps best expressed in the reaction of two women who spoke with Flores after they had received their aid. They said they had originally planned on being at the distribution for three hours and were pleasantly surprised when the distribution was completed after only one hour. ■

Conceptual framework for innovation, evaluation and diffusion

Applying the above innovation process, funding and evaluation criteria to the humanitarian context, Figure 7.2 provides a conceptual framework outlining the factors affecting the innovation, evaluation and diffusion of technologies based on the Active Learning Network for Accountability and Performance in Humanitarian Action (ALNAP) 8th *Review of Humanitarian Action* (ALNAP, 2009), theories of innovation management (Bessant and Tidd, 2008) and diffusion of innovation (Rogers, 2003). Whether an organization is in an innovation stage, evaluation stage or scale-up stage, a similar framework for assessment can be used throughout the project. As the case studies in this report and the literature show, five major factors affect the level of success of developing innovation, its evaluation and its diffusion: the type of disaster humanitarian actors are responding to; the characteristics of the innovation; the actors involved; the project resources and capacity; and the socio-political environment in which it operates.

FIGURE 7.2 Conceptual framework for innovation, evaluation and diffusion

Source: Adapted from Ramalingam, Scriven and Foley, 2009.

Type of disaster

Humanitarian actors operate in environments that are intrinsically dynamic and unstable. This contrasts with the typical technology design environment in other settings such as the private sector, where development, deployment, operation and maintenance take place in fairly familiar and stable environments and where requirements are better understood. As illustrated by the various case studies in this report, different technologies are needed for different environments and at different phases of humanitarian action. When an area with limited infrastructure or technology is hit by a sudden-onset disaster, it is not the right time to start implementing new ways of working or testing new technology. For example, certain technologies may operate well in slow-onset disasters but not in rapid-onset events. In a slow-onset disaster environment, more time is available for innovation design and deployment. The case study on using new technologies for cash transfer programming by the Cash Learning Partnership (see Box 2.3) also highlights the issues. It shows that when a sudden-onset disaster strikes an area with limited infrastructure or technology, the use of electronic payment systems through mobile phones is unlikely to succeed. Slow-onset disasters and/or areas of chronic crisis, on the other hand, offer opportunities to support systematic adoption of new technology and the development of new electronic cash transfer models.

Innovation or technology attributes

Types of innovation

The words 'innovation' and 'technology' are sometimes used interchangeably. The HIF adapted Bessant and Tidd's model (2008) for characterizing various types of innovations using their inherent attributes. These are product innovations, process innovations, position innovations and paradigm innovations.

Product innovation is defined as changes in the things (products or services) that an organization offers. These may be as significant as the introduction of personal computers or mobile phones for example, but may also refer to new services like electronic cash transfers or new online training.

A second category of innovation is identified as process innovation, or changes in the ways in which products and services are created or delivered. Digital data collection using handheld devices as an alternative to paper-based methods is a good example in the humanitarian sphere.

The delivery of online humanitarian training introduced over the last few years by the IFRC, for example, illustrates a mix of both product and process innovations: new product and content were created for online education, but first and foremost, it was an innovative process to deliver existing training material adapted for online learning (see Box 4.3).

Third, position innovation is defined as the changes in the context in which the products or services are framed and communicated, or even used. The repurposing of mobile phones in the hands of communities at risk to serve as tools for humanitarian accountability (e.g., via feedback to humanitarians) or as a source of information for damage assessments (e.g., via information crowdsourcing) are examples of such innovations.

Finally, paradigm innovations are changes in the underlying mental models which shape what the organization does. The delivery of humanitarian training mentioned as an example of product and process innovations was also arguably a paradigm innovation. For the IFRC, it meant moving away from traditional person-to-person models of education through their network of National Societies and volunteers towards online communities. Technologies enabling two-way communication and local participation and ownership in humanitarian action are also paradigm innovations enabling people-centred humanitarian action rather than the traditional top-down approach.

BOX 7.3 Localizing technology

Technological innovation in humanitarian aid has accelerated rapidly, even in the last five years. SMS alerts for community information services have been widely adopted, mobile data collection using handheld devices has become a feature of many humanitarian operations and satellite imagery is used to support responses. Yet the investigation and development of these approaches have, by and large, focused on the needs of relatively wealthy agencies based in mainly high-income countries and often specifically for large-scale emergencies and sudden-onset disasters.

There are excellent reasons for this. Mega-emergencies such as the response to the 2010 Haiti earthquake are often more fully funded, and so have room for innovation. Agencies are extremely stretched, so are forced to look outside their usual avenues of operation to get aid where it is needed. Higher-income agencies are more likely to be aware of, and meet, the innovators who are part of the wave of new tools and ideas. But now, when the sector has begun to take information and communication technology tools seriously, it is an excellent time to think critically about the missed opportunities inherent in the way humanitarians are targeting the development and adoption of these technologies.

Most emergencies do not make the news. The vast majority of crises are responded to by local actors – the 'last-mile' responders who generally live locally and get there first, and who may belong to local religious or civil society groups rather than one of the major humanitarian alliances. Even when a crisis makes the international radar, many emergencies are 'neglected': underfunded, underreported and consequently underserved by the mainstream humanitarian sector. Local actors are not only crucial to emergency response, they are often the only show in town. In a world facing climate change-related shifts in weather patterns, more frequent extreme weather events and severe challenges to the livelihoods and safety of billions of people, preparedness and resilience at the local level should be the focus of significant and concerted investment. Yet, in technology innovation, what has happened is just the opposite.

There are, however, significant opportunities. Local and national humanitarian organizations all over the world struggle to communicate with staff and manage information, particularly where connectivity is poor. Information gaps cripple effective management, staff performance and situational awareness. Supporting low-cost data collection, community engagement, operational management and accountability mechanisms could transform the capacity and effectiveness of emergency responders in low- and middle-income countries.

The three examples given above – bulk SMS messaging, smartphone or PDA (personal digital assistant) data collection, and satellite imagery – are remarkable developments and save time, money and lives. But consider the infrastructure they require. SMS is expensive and needs excellent targeting and management to be used effectively. Relationships with operators are time-consuming to build and may not be fruitful for an unknown community group. Most alternatives require a steady internet connection. Mobile data collection requires the right handset, which may be expensive and relatively fragile, and may require regular charging. Most require a GPRS (or general packet radio service) signal or direct upload to get data back to a central point. And satellite imagery without interpretation by skilled technicians is less than useful, even if small responders could get access to such resources.

By thinking first and foremost about the context in which such organizations operate, it is possible to identify the tools that will work for them, sustainably, without ongoing intervention by outside actors. Hardware should be low-cost, ideally rugged, and easy to repair or replace locally. It should be able to operate without steady power – laptops are good for this – and any fuel should be locally available and not prohibitively expensive (airtime top-ups or recharges count in this category). Tools that are easy to use, if possible without training, are best and, ideally, the interface should be easy to translate into a local language. If the technology is intended to be used by a community, it is also necessary to consider how accessible the platform is for them.

Focusing on local and national response agencies builds community resilience to crisis, a critical element of global preparedness. SMS, used thoughtfully, could bridge the gap between remote branches, staff and their management by supporting robust data flows that can be used to understand and improve response efforts and help respond to increasing demands from donors for monitoring data and value for money (DfID, 2011). These are data humanitarians have never had before, which would radically alter their ability to make statements about the volume and effects of emergencies globally and pool their collective ingenuity in responding to them. ■

Attributes of innovation

A separate, useful way to think about technologies is the perceived attributes of the innovation: the diffusion of innovation theory pointed out five attributes of innovation that impact adoption and diffusion, including their relative advantage, compatibility, complexity, 'trialability' and 'observability' (Rogers, 2003). These attributes are useful for developing evaluation criteria.

The relative advantage simply describes the degree to which the innovation is perceived as better than the idea it supersedes. New technologies are often perceived as having an inherent advantage over traditional approaches. However, this may not always be the case, especially in the short term, for several reasons. First, a learning curve is often associated with each technology adoption, i.e., the technology may make a programme less efficient and effective at the beginning. These issues will resolve over time and, in the end, the project will reap the potential benefits, but it is important to be able to establish the relative advantage early on and identify constraints to prevent abandonment of the project.

Furthermore, sometimes a proposed technology does not match the needs of the situation. For example, analysis has shown that digital data collection is superior to paper-based data collection in almost every way (speed, quality, security, ability to do complex questions and computations within forms), but that paper still offers some flexibility (e.g., making notes beside responses to provide more detailed explanation) that, for now, are less practical on handheld devices. Thus, digital data collection has clear comparative advantages for collecting structured and semi-structured data but in certain situations where data are mostly unstructured, paper might be best suited. Adoption of digital data collection, nevertheless, is increasingly widespread because of the significant advantages it offers.

Adoption and diffusion of humanitarian technology also depend on a second attribute, its compatibility, the degree to which the innovation is perceived as being consistent with the existing values, past experiences and needs of local populations. The relative success of digital data collection using mobile phones is not only the result of its inherent comparative advantages over a paper-based approach, but also results from a high level of compatibility. The process of collecting data is ultimately the same as a paper-based approach – questionnaires can even be made to look alike. While data entry is replaced by data synchronization, the processes of creating forms and collecting and analysing data remain very similar. Compatibility, on the other hand, may be one of the main hurdles to the use of methods to crowdsource information. Humanitarians are used to their needs assessment approaches and rarely rely on outside sources for the purpose of decision-making. Many of the concerns about privacy and the use of big data or drones for humanitarian purposes also reflect issues of compatibility with prevailing standards and principles.

A third factor is the complexity, the degree to which the innovation is perceived as difficult to understand and apply to the local context. 'Advanced' or 'cutting-edge' technology is sometimes misconceived as more complex – and, as such, unsuited for organizations without considerable in-house technology expertise and/or more resources. This is sometimes true: the use of satellite imagery for humanitarian purposes, such as estimating damage or population displacement, will remain limited to a few actors that have the capability to conduct these analyses and the means to acquire imagery. But in many cases, information technologies are developed to specifically address these concerns and are aimed at reducing complexity from the standpoint of those acquiring, managing or using the technology. This natural tendency to avoid advanced technology and new developments could be counter-productive and translate into a failure to adopt systems that are more robust, reliable and usable and have a greater impact.

Finally, trialability, the degree to which the innovation may be experimented with on a limited basis and is flexible to modification, and observability, the degree to which the innovations are visible and tangible to key stakeholders and the local population, are also important attributes and criteria for evaluation. Digital data collection on handheld devices, crisis maps or online humanitarian training all have very evident outputs and are easy to interact with from a user's standpoint.

BOX 7.4 Digital data collection in emergencies

Data collection has often been a weak point in the work of humanitarian organizations. Actual assistance, it is argued, is of greater value than tracking or monitoring the activities carried out. The IFRC has recognized the potential for digital data collection and has worked with partners to design a survey methodology and improve the timeliness of the entire data collection cycle.

In 2011, the Rapid Mobile Phone-based (RAMP) survey methodology was piloted in malaria prevention programming in Kenya, Namibia and Nigeria. Using the experience of these pilots, the IFRC (2012) published the RAMP survey toolkit, which includes the technical considerations in designing a RAMP survey, a practical field guide for implementing a RAMP survey and a guide for instructors training a RAMP survey team.

RAMP survey questionnaires are created using web-based, freely accessible mobile phone-based Magpi (previously EpiSurveyor) software. Once the application has been downloaded to compatible mobile phones via a 2G network connection, questionnaire forms can be downloaded to the phone. In the field, data can be collected and stored on the phone without the need for a network connection. Following data collection and when in 2G range, data can be sent in real time to the secure server for storage. All parties with viewing access to the EpiSurveyor account can view the data at any time in any place in the world. Data can be exported for analysis in txt, xls or mdb format. Figure 1 summarizes the RAMP process.

FIGURE 1 How does RAMP work?

Data management and rapid data analysis continue to be a challenge in emergency contexts. The Red Cross Red Crescent may be implementing more than 100 emergency operations at any one time. While many of these are small, local incidents that rely on volunteers and communities for response and recovery activities, some are large-scale disasters involving many Movement partners. In this complex environment, there is a growing need to demonstrate impact, improve performance and deliver activities across a broad range of contexts and a variety of scale, but with consistent quality. Part of this process includes improving assessments and ensuring baselines are conducted, regular monitoring occurs and operations are critically evaluated to ensure improvement and dissemination of best practice.

Although piloted in malaria prevention, RAMP will be expanded and used in other programme areas. For example, the IFRC is exploring the use of mobile data collection in emergency contexts to carry out health surveys and SMS monitoring of health status for rapid results for programme managers.

The RAMP methodology and Magpi platform were tested recently in a field-based training course of the Emergency Response Unit's community health module and psychosocial support component for deployment in rural Zimbabwe. The system was tested in a number of contexts, including performance of knowledge, attitude and practice surveys, and the results were extremely positive. The system was easy to use, provided rapid data collection and management of information and real-time analysis.

The IFRC has also explored the use of SMS for community-based disease surveillance systems. Community health workers and volunteers sent SMS reports on key health indicators on a weekly and monthly basis. This model is highly cost-effective and scalable because it uses simple mobile phones that users already possess. Diseases are tracked in a similar way, with data collected on a limited number of diseases and reported on a daily, weekly or monthly basis. This allows for real-time disease surveillance and data management. Health programme managers can share the data with health ministries and other local authorities in order to decide on an appropriate response.

RAMP has the potential to address a variety of areas in the context of emergencies, including baseline and site needs assessments; registration; distribution of relief items; community-based disease surveillance; health management information systems' monitoring of programme outputs; communications and monitoring of affected populations; and monitoring early warning systems.

The IFRC has identified multiple benefits in its experience with digital data collection. Using mobile phones means data are available more rapidly for analysis, reporting and decision-making. Daily bulletins and complete reports can be generated and made available via direct e-mails or posted on a dedicated web site.

The web-based platform allows for a shared, online library of survey forms that can be rapidly adjusted to the emergency context for immediate use in the field. The electronic database can also be used to compare responses across contexts and with partners to build a body of evidence related to impact in emergencies.

In addition, the use of mobile phones can enhance quality control in data collection. Real-time error analysis and field correction are possible, using automatic skip patterns, custom logic and validation when completing the survey forms. The work rate, productivity and quality of survey teams can be remotely monitored and feedback provided. It is also easier to back up data, and directly transferring data from phone to an online platform (which can then be exported to Excel and a statistical programme) reduces potential errors of repetitive data entry.

The IFRC also found it to be more cost-effective as it reduces use of paper, data entry, transportation and associated costs.

But adopting a new technology also brings challenges. The technology is always changing in both capacity and cost, which makes it difficult to develop guidance, training and budgeting. As an organization adopts better and more affordable technology, guidance, protocol and training courses need to be revised accordingly. Competition among software providers is rife, and it can be difficult to determine which option is best suited for particular organizational and contextual needs.

Some users noted that they missed having a paper record of surveys to check answers and follow up with those collecting the data. However, this can be addressed by recording answers on paper and using a phone application to transmit data rapidly for analysis and reporting – but, of course, this adds to the work load.

Are users afraid of new technology? The IFRC found that this was not as widespread as could be expected, although the learning curve was a bit steeper with older generations. With the rapid spread of mobile phone technology, however, it is readily accessible and understood in most contexts and regions of the world. ■

Passive versus active innovations

Another term often used to classify information systems is whether the system is active or passive. In public health surveillance, for example, an active surveillance system employs staff members to regularly contact health-care providers or the population to seek information about specific health indicators, whereas a passive system is based on reports submitted from hospitals, clinics, public health units or other sources.

Humanitarian technologies, especially those relating to data collection, may similarly be classified as active or passive. Active technologies, such as digital data collection tools, require active human input, training and distribution. Passive technologies collect information without active user input in the field, for example a GPS (Global Positioning System) device, which records the movements of actors on the ground or the movement of humanitarian goods, or satellites, which collect imagery on a regular basis over areas where a disaster is unfolding. Active systems require more investment in training and human resources, while passive technologies may be less prone to human errors and require less training but may require more initial investment in design, pilots and infrastructure. Passive systems may also raise concerns around privacy and consent of those about whom information is collected.

Giving local people a voice and hearing what they say are among the most important outcomes of increased use of new technologies by humanitarians. © Jacobo Quintanilla/ Internews

BOX 7.5 HumaNav: the humanitarian navigation solution

The problems posed by the delivery of development and humanitarian aid are a reflection of the multiplicity of complex challenges faced in situations of disaster. The uncertainty and unpredictability of events, the difficulty of access from a geographical, political and security perspective are ever greater. Thus, increasing emphasis is now placed on the safety and security of staff on the ground and on vehicle fleet management.

The aid and development community operates an estimated combined global fleet of more than 70,000 units. Confronted with both the need to be more efficient in increasingly complex environments and the demand for increased accountability of aid and development organizations to donors, affected populations and staff, traditional means of communication for monitoring and locating assets on the field are no longer sufficient.

While the aid and development community is increasingly aware of the value and utility of satellite-based technologies in addressing these challenges, they generally do not have the in-house knowledge and experience to implement and fully benefit from them. The United Nations (UN) General Assembly mandated the UN Institute for Training and Research (UNITAR) to provide UN organizations with applied research and solutions to support their functions and objectives. UNITAR's Operational Satellite Applications Programme (UNOSAT) delivers integrated satellite-based solutions for humanitarian relief, security, peace and socio-economic development. Based on identified needs, UNOSAT decided to create the Humanitarian Navigation Solution (HumaNav) in partnership with a French company, Novacom Services.

HumaNav aims to bridge the gap between security, safety and the effectiveness of humanitarian transport missions by providing tracking, navigation and data capture for the aid community's vehicles by combining various spatial and terrestrial technologies to address four principal needs. The first concerns security for staff, vehicles and cargo, with 24/7 real-time GPS tracking and transmission of critical information by SMS or voice communication between drivers and their base. Routes can also be monitored and 'geo-fences' (or virtual perimeters) created, with alerts or notification. Road safety is the second requirement. Transportation is the greatest single occupational health and safety risk faced by field staff. The monitoring and control of speeding and of drivers' behaviour, hours and performance through onboard data capture results in significantly fewer crashes. Third, effectiveness of the fleet is essential. For example, HumaNav can analyse vehicle utilization rates in order to make fleet management more effective: the larger the fleet, the greater the impact reduced fuel consumption and costs can have on the organization's bottom line. Finally, HumaNav can help reduce the environmental footprint of fleets. Improved fleet effectiveness and journey management will lead to smaller fleets and fewer kilometres travelled with a commensurate reduction in fuel consumption and CO_2 emissions.

In March 2012, HumaNav was endorsed at the annual conference of the Working Group on Emergency Telecommunication as a real-time geo-localization system adapted to meet minimum requirements to address humanitarian fleet security and safety issues.

HumaNav is the result of more than four years of development and discussions with the humanitarian community and the fleet forum, including a two-year pilot phase, undertaken with the support of CNES, the French Space Agency, in which 100 ICRC and UNHCR (Office of the UN High Commissioner for Refugees) vehicles were tested in six countries in Africa and Asia.

To ensure real-time monitoring of humanitarian vehicles at any point on the planet, HumaNav incorporates different spatial and terrestrial technologies. The onboard vehicle equipment provides an accurate position (GPS) at any time and transmits this position by means of wireless telecommunication systems (GPRS GSM mobile phone system covering all urban areas) or satellite (for areas not covered by GSM networks). The information transmitted in real time by the vehicles is received via the internet, reviewed, treated and analysed on the HumaNav platform.

HumaNav is the most advanced worldwide, multi-source humanitarian navigation system, regardless of the location, the telecommunication channel or the type of vehicle. The system responds to the needs of users because it is a customized solution based on tried and tested methodologies and offers a single point of contact to assist and train users. HumaNav is also a neutral solution in that it is not bound to any proprietary hard- or software, but works with several hardware companies and telecom operators. HumaNav's offer is also evolutive and open to the latest technology. It allows users already equipped with different terminals to be connected to the HumaNav platform. Finally it is a participative effort and is updated regularly based on feedback received from the humanitarian and development community.

HumaNav assembles available commercial solutions in order to respond to the actual needs in humanitarian and development fleet operations. The HumaNav community aims to address the needs expressed by partner organizations, whatever their size or geographical location, and to share best practices among users.

The HumaNav community is forum of exchange for humanitarian fleet managers and security officers, who meet periodically during workshops to discuss innovative products, services and technical developments with independent experts and the private sector.

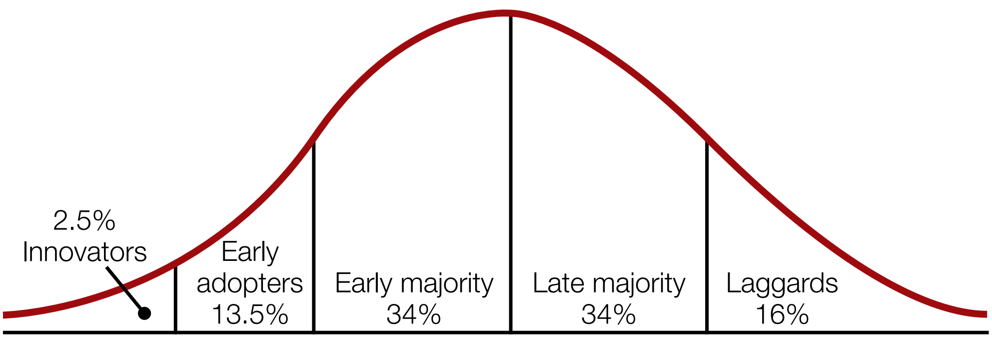
More than 1,000 vehicles are now equipped with HumaNav systems. The solution has already been adopted by UNHCR, ICRC, the World Food Programme and non-governmental organizations and humanitarian operations. ■

Actors

Actors involved in implementing and testing humanitarian technologies can have a small or a great influence on the innovation's adoption and its adoption rate. These actors can be affected individuals or communities, response organizations or people implementing the innovation and their institution, donors, the private sector or government entities. These actors possess varying levels of support, attitudes and perceptions of the innovation's advantages or disadvantages. Each actor has different capacities, personal and institutional interests, cultures, beliefs and values, and other attributes that may shape and contribute to difficulties encountered in successfully adopting these technologies. A systematic strategy for the gathering of information concerning these numerous influencing factors could be valuable in guiding innovation and diffusion.

Rogers' individual innovativeness theory (2003) can help to assess each actor's characteristics. The theory is based on who adopts the innovation and when. A bell-shaped curve is often used to illustrate the distribution of individuals that adopt an innovation (see Figure 7.3). The first group to adopt the technology is labelled the innovators. Innovators are known as visionaries, risk-takers and pioneers who lead the way. Early adopters, the second group, adopt the technology early on and are instrumental in scaling up the process by spreading the innovation to others. The innovators and early adopters persuade the third group, the early majority. The fourth group, the late majority, waits to make sure that adoption is in their best interests. The laggards make up the final group. These actors are highly sceptical and resist adopting until absolutely necessary and, in many cases, may never adopt the innovation (Rogers, 2003). It is important to identify this last group early on as they may be the ones who prevent technology from being adopted and diffused.

FIGURE 7.3 The adoption curve



Source: Rogers, 2003.

The role of actors is also essential in responding to the outputs of humanitarian technology. For example, crowdsourced and crowdseeded information platforms in places like the Central African Republic (see Box 2.5) or eastern Democratic Republic of the Congo (see Box 2.1) have shown that data collection works – affected communities may be willing to send information, although this may be conditioned by incentives (e.g., payment per SMS) or expectations (e.g., aid will come). Other actors, including humanitarian organizations, are typically less willing to share information, either because of confidentiality concerns or because they see no benefits from participating. Perhaps more importantly, there is no evidence that humanitarian actors use or respond to the information available to them on these platforms. This may reflect a range of issues, from availability of resources to respond, to trust in the information available. Regardless of their motives, understanding these actors' behaviour is essential for successful innovation.

Resources

By design, most humanitarian funds are only available once an emergency or disaster is declared and most of these funds are restricted for specific uses within a certain time period. Experienced humanitarian actors are aware of these windows of opportunity (as well as space for innovation) and will have the capacity and resources ready to seize them; others will not. The limitation of this mode of operation is that investment in technology is based on immediate concerns rather than long-term considerations. However, implementing new technology requires new knowledge and skills for all actors involved. Implementers need to define appropriate use for the technology and how to use it for their programmes, donors need to know the technology's capability, benefits and limitations, and affected populations need to know how to adopt it. This process requires time and advance investment. It means some organizations need to have the initial innovation already designed and have proof of concept or completed a pilot project.

Obtaining financial funding to test and pilot new applications of technology can be challenging. Two notable funding sources exist for these specific innovation, evaluation and evaluation processes: the Humanitarian Innovation Fund (HIF, 2013b) and the Humanitarian Innovation Initiative, a joint project of the United States Agency for International Development (USAID) and the United Kingdom's Department for International Development (DfID) (USAID/DfID, 2013). Both HIF and USAID/DfID make small amounts of seed funding available to projects at the problem-recognition and innovation stage. This is part of HIF's small grant competition and USAID/DfID's Stage 1 funding. Both funding sources also offer larger grants to evaluate the innovation in real settings and to assess its potential impact (HIF's large grant facility and USAID/DfID's Stage 2 funding). Finally, both also offer mechanisms to fund the refinement, diffusion and scale-up of an innovation (HIF's small grant facility and USAID/DfID's Stage 3 funding). Both of these funding sources require rigorous documentation of lessons learned in terms of the innovation based on six evaluation criteria: relevance; appropriateness; cost effectiveness; efficiency; coverage; and impact. In addition to these major funding sources, 'challenges' are hosted by foundations and other specialized funding agencies.

BOX 7.6 Donor perspective on the challenges of funding innovation

Humanity United, a US-based foundation, and USAID together launched the Tech Challenge for Atrocity Prevention, which offered prizes for innovative technical solutions to some of the most intractable problems in the field of atrocity prevention. The lessons from this experience might be useful to funders thinking of using a similar approach to spur innovation in the humanitarian field.

The organizers used a challenge format for a number of reasons. As grant-makers are normally constrained in terms of what kind of organizations they support (not-for-profits, etc.), the challenge format allowed them to reach out to a much wider range of actors – including individuals and companies – that have technological skills, but might never have worked on human rights issues before. The format also allowed them to offer prizes (ranging from US$ 2,000 to US$ 10,000) that are far smaller than their normal grants, without dramatically increasing transaction costs.

The process started in 2012, when a joint Humanity United–USAID working group came up with a list of potential challenge statements, i.e., problems in the atrocity-prevention field that might be amenable to technological solutions. These draft challenge statements were sent out to subject and technical experts for their comments.

Based on their feedback Humanity United–USAID finalized five specific challenge statements, including: 1. develop technologies to better identify, spotlight and deter intentional or unintentional third-party enablers of atrocities (e.g., non-state actors such as multinational corporations, financial institutions or those who provide logistical support); 2. develop technologies that can enable the documentation of relevant evidence that may be used to deter or hold perpetrators accountable, while minimizing the risk posed to those collecting this information; 3. create a model to help identify community-level risk factors that make communities more or less likely to experience acts of violence, using existing public datasets on national and sub-national violence; 4. improve secure communications with and between conflict-affected communities or those at imminent risk; and 5. develop affordable, trainable and scalable technologies to allow non-governmental organizations and human rights activists to gather more information or verify existing information from hard-to-access areas (i.e., where governments intentionally try to prohibit access).

The Tech Challenge was split into two rounds: the first round was launched in October 2012 and featured two of the sub-challenges above (third-party enablers and documentation of evidence). InnoCentive, a third-party challenge platform, hosted these two sub-challenges. Winners received cash prizes.

Overall, 88 submissions from participants in 22 countries were received for the two sub-challenges. These were judged against four criteria: innovation; potential impact; feasibility; and scalability.

While Humanity United–USAID were pleased with the submissions, they wanted to increase both the quantity and the quality before the second round. The main lessons learned were as follows:

Outreach is everything

Outreach efforts for the first round were somewhat wholesale and ad hoc – an e-mail blast to partners, social media and a press release. Humanity United–USAID assumed that many of the participants would come from within InnoCentive's own community of registered users.

In order to increase the quantity and quality of submissions for the second round, they realized they would not only have to reach a larger audience, but also spend much more time proactively identifying possible participants and urging them to submit their ideas.

Before the second round, Humanity United–USAID changed their approach to focus much more on targeted outreach. They compiled a list of 299 organizations that could either contribute or could put them in touch with others who might be interested. They then reached out to each of these individually, explaining the Tech Challenge and offering to answer any questions. In addition, they also increased media outreach. Finally, they diversified the number of third-party platforms that were used for the second round, in order to access a greater number of potential participants. Whereas in the first round they had only used InnoCentive, in the second round the three remaining sub-challenges were split between three different platforms (InnoCentive, OpenIDEO and TopCoder).

Provide as much context as possible

Following the first round, Humanity United–USAID realized that many of the participants had struggled for the simple and understandable reason that, while they had a technological background, they did not fully understand the situations in which their innovations might be used. They lacked the necessary context. Although some level of background information was provided during the first round, it wasn't enough. The organizers had fallen into the trap of assuming that everyone would have a certain baseline knowledge about human rights and conflict situations. This came through most clearly, for instance, in their use of human rights jargon.

For the second round, the challenges were framed with a specific participant in mind – someone who had technological skill, but had never worked on human rights issues before. This meant the organizers had to include far more background and contextual information than they had originally thought necessary.

Be clear as to expectations

In the first round, many of the submissions were overly broad. For the second round, more guidance was given about what kinds of tools and technologies might be appropriate, including, where possible, technical specs. Humanity United–USAID also asked applicants to be more explicit about how their ideas might overcome significant implementation challenges. Finally, they clarified that they would favour more developed ideas (i.e., those that were close to prototypes).

The second round of the Tech Challenge was launched in March 2013 and announced the winners in July. The changes above were successful in increasing the number and quality of submissions, compared to the earlier round. For instance, the secure communications sub-challenge received 111 submissions and the sub-challenge on gathering information from hard-to-access areas received 166. That said, the challenge format is still something of a blunt instrument – a wide net is cast, in hopes of finding a few interesting ideas. Actually developing, piloting and scaling an innovation is a separate process altogether. ■

Socio-political and environmental context

Of course, innovation does not take place in a vacuum. The context in which it occurs is important. Non-permissive environments may, for example, prevent the deployment of technology as common as smartphones equipped with GPS capabilities or long-range data transmission that could bypass state control. Search and rescue robots, for example, were shown to be ineffective in the highly challenging context of the nuclear disaster at Fukushima (see Box 5.1). Depending on the technology, basic infrastructure may be needed, but not available. SMS-based systems, for example, assume the availability of network and devices in the community. In the Central African Republic, an assessment of efforts at improving communications between humanitarians and affected communities showed that some of the major challenges had to do with basic availability of spare parts for radio equipment or fuel to run the generators (see Box 2.5). But the assessment also showed that less obvious factors must also examined in evaluating the success of a technology. Organizations' behaviours and culture must be examined. In this case, the mutual distrust between humanitarians and local media, and the humanitarians' tendency to trust only their own source of information, were major challenges and continue to be hurdles for the widespread adoption of data-sharing technologies.

Conclusion: Bringing it together

The conceptual framework outlined in this chapter provides guidance in the assessment of humanitarian technology – its potential for success and impact. This provides insight into the design and development of appropriate technology in a given context; it also provides a means to assess the success of a prototype or small-scale pilot implementation and directions for scaling-up.

By carefully documenting each stage, powerful and insightful data can help design the following stages and assess the impact. Lessons learned from the case studies in this report, as well as the literature, suggest that baseline data and assessment are rare but essential to the success of humanitarian technology innovation, evaluation and diffusion. Systematic documentation and assessment of the factors outlined help clarify the purpose of the technology, what it is expected to do, why and for whom. This defines the scope of the deployment by having a clear understanding of the implementing organization's internal capacity and limitations and provides insights into the environment in terms of openness to the technology and capacity to adopt it. This then helps base the innovation process within a theory of change and provides a baseline for future comparison and evaluation. It should also be noted that the evaluation's timing is essential. Often, when technology is introduced, the project may be less efficient and effective for a period because staff and users are learning to use the system. Thus, evaluating too soon might result in a perception that the technology is not working and induce some organizations to abandon it prematurely.

During the early stages of a programme, it is essential to organize training courses for staff, with experts guiding the process. Without technology support and training, the programme can turn to failure. Yet one of the challenges is that most humanitarian technologies are created by non-humanitarian actors who do not always have the resources to provide such guidance and support. Another, and quite widespread, problem for humanitarian organizations is that staff trained in specific technologies may move to other organizations. As the knowledge is not institutionalized, it may be quickly lost. Each actor or potential adopter must become knowledgeable technology adopters in order to scale up activities.

In summary, appropriate implementation of the innovation, evaluation and diffusion processes requires being responsive to disaster situations by matching the approach to the needs, constraints and opportunities available. In a time of financial crisis and renewed focus on humanitarian accountability, assessment of trade-offs, costs and resources must be measured against benefits of investing in technology for humanitarian actions. Ultimately, the most important benefits are the reduction of suffering, preservation of family stability and human dignity, and prevention of lives lost. Whether or not humanitarian technology contributes to these objectives must be rigorously evaluated.

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Solar power enables remote communities to use new information and communication technologies, such as here in Liberia. With people on the ground better able to supply information about a disaster's immediate effects, humanitarian actors will be able to better target and improve their response.
© Tino Kreutzer

Disaster data

According to the Centre for Research on the Epidemiology of Disasters (CRED), 364 natural disasters and 188 technological disasters were reported worldwide in 2012.

The number of natural disasters is the second lowest of the decade, while the number of technological disasters is the lowest of the decade, almost half the number for the peak year of 2005.

The number of deaths caused by both natural and technological disasters was the lowest of the decade.

The number of deaths caused by natural disasters (9,656) is 90 per cent below the average for the decade, much lower than the peaks of 2004 (242,010 deaths), 2008 (235,272 deaths) and 2010 (297,730 deaths).

Early warning saves lives. Philippine Red Cross staff and volunteers issue typhoon warnings from their amphibian. © Mollie Godinez/ Philippine Red Cross

The deadliest natural disaster was Typhoon Bopha which hit the Philippines in December killing 1,901 people. Although deadly, this disaster caused far fewer fatalities than the Indian Ocean tsunami in December 2004 (226,408 deaths) or the January 2010 earthquake in Haiti (222,570 deaths). The second deadliest natural disaster of 2012 was a flood triggered by monsoon rain which killed 480 people in Pakistan. Eighteen natural disasters each caused the death of at least 100 people, for a total of 5,348 or 55 per cent of all deaths from natural disasters. Floods accounted for 37 per cent of deaths caused by natural disasters and windstorms for 32 per cent.

The number of people killed by technological disasters (6,050) is 28 per cent lower than the decade's average. The event that resulted in the highest number of deaths (366) was a fire at a penitentiary centre in Honduras. The sinking of a ferry-boat in Papua New Guinea was the deadliest transport accident with an estimated 246 deaths and missing, while the deadliest industrial accident was a fire in a textile factory in Pakistan (240 deaths).

In 2012, the numbers of people reported affected by both natural and technological disasters were the lowest of the decade.

The number of people reported affected by natural disasters (139 million) is much lower than the peaks of 2003, 2010 and 2011. In 2012, floods accounted for 53 per cent of the number of people reported affected by natural disasters. The most severe occurred in April and June in China, affecting respectively 17 and 13 million people. Eight other floods affected between 1 million and 9 million people for a total of 36 million. The drought in Kenya, Sudan and Ethiopia affected 8 million people. Thirteen droughts affected more than 1 million people each, for a total of 28 million. Typhoon Bopha affected 6.3 million people in the Philippines. In China, typhoons Haikui and Damsey affected, respectively, 6 million and 3.8 million people. An earthquake in Guatemala affected 1.3 million people.

Technological disasters affected, proportionally, very few people. Moreover, the year's total of 24,000 people affected is 80 per cent lower than the decade's average. Three disasters affected more than 1,000 individuals: an explosion in an ammunition depot in the Republic of Congo (13,323); a gas leak in the Republic of Korea (3,178); and a fire in a village in Nepal (2,067).

In 2012, natural disasters cost US$ 157.5 billion, the fifth highest of the decade.

Hurricane Sandy cost US$ 50 billion, a drought affecting the South-West and Mid-West of the United States cost US$ 20 billion, and two consecutive earthquakes in the Ferrara region of Italy in May, US$ 15.8 billion. Twenty-three natural disasters (12 storms, 6 floods, 4 droughts and 1 earthquake) caused damages costing between US$ 1 billion and US$ 8 billion for a total of US$ 53.5 billion. The costliest wildfire caused damages amounting to US$ 600 million in Colorado, USA, and a cold wave in northern Italy cost US$ 132 million.

For technological disasters, in 2012, damages are reported only for the gas leak in the Republic of Korea (US$ 30 million) and for the fire in a village in Nepal (US$ 1 million).

EM-DAT: a specialized disaster database

Tables 1–13 on natural and technological disasters and their human impact over the last decade were drawn and documented from CRED's EM-DAT: International Disasters Database (www.emdat.be). Established in 1973 as a non-profit institution, CRED is based at the School of Public Health of the Catholic University of Louvain in Belgium and became a World Health Organization (WHO) collaborating centre in 1980. Although CRED's main focus is on public health, it also studies the socio-economic and long-term effects of large-scale disasters.

Since 1988, CRED has maintained EM-DAT, a worldwide database on disasters. It contains essential core data on the occurrence and effects of more than 20,000 natural and technological disasters in the world from 1900 to the present. In 1999, a collaboration between the United States Agency for International Development's Office of Foreign Disaster Assistance (USAID/OFDA) and CRED was initiated.

The database is compiled from various sources, including United Nations (UN) agencies, non-governmental organizations, insurance companies, research institutes and press agencies. Priority is given to data from UN agencies, followed by OFDA, governments and IFRC. This prioritization is not a reflection of the quality or value of the data but the recognition that most reporting sources do not cover all disasters or may have political limitations that could affect the figures. The entries are constantly reviewed for redundancies, inconsistencies and the completion of missing data. CRED consolidates and updates data on a daily basis. A further check is made at monthly intervals. Revisions are made annually at the end of the calendar year.

The database's main objectives are to assist humanitarian action at both national and international levels, to rationalize decision-making for disaster preparedness and to provide an objective basis for vulnerability assessment and priority setting.

Data definitions and methodology

CRED defines a disaster as "a situation or event, which overwhelms local capacity, necessitating a request to national or international level for external assistance (definition considered in EM-DAT); an unforeseen and often sudden event that causes great damage, destruction and human suffering".

For a disaster to be entered into the database, at least one of the following criteria must be fulfilled:

- Ten or more people reported killed
- 100 people or more reported affected
- Declaration of a state of emergency
- Call for international assistance.

The number of people killed includes people confirmed as dead and people missing and presumed dead. People affected are those requiring immediate assistance during a period of emergency (i.e., requiring basic survival needs such as food, water, shelter, sanitation and immediate medical assistance). People reported injured or homeless are aggregated with those reported affected to produce a 'total number of people affected'.

The economic impact of a disaster usually consists of direct consequences on the local economy (e.g., damage to infrastructure, crops, housing) and indirect consequences (e.g., loss of revenues, unemployment, market destabilization). In EM-DAT, the registered figure corresponds to the damage value at the moment of the event and usually only to the direct damage, expressed in US dollars (2012 prices).

In 2007, a new natural disaster category classification was introduced in EM-DAT. This new classification was initiated by CRED and Munich Re, and brought together CRED, Munich Re, Swiss Re, the Asian Disaster Reduction Center (ADRC) and the UN Development Programme (UNDP). The goals were to create and agree on a common hierarchy and terminology for all global and regional databases on natural disasters and to establish a common and agreed definition of sub-events that is simple and self-explanatory.

This classification is a first step in the development of a standardized international classification of disasters. It distinguishes two generic categories for disasters (natural and technological). Natural disasters are divided into five sub-groups, which in turn cover 12 disaster types and more than 32 sub-types. The five sub-groups and 12 types are as follows:

- **Biological disasters**: Insect infestations, epidemics and animal attacks (the two last categories are not included in the *World Disasters Report*);
- **Geophysical disasters**: Earthquakes and tsunamis, volcanic eruptions, dry mass movements (avalanches, landslides, rockfalls and subsidence of geophysical origin)
- **Climatological disasters**: Droughts (with associated food insecurities), extreme temperatures and wildfires

- **Hydrological disasters**: Floods (including waves and surges), wet mass movements (avalanches, landslides, rockfalls and subsidence of hydrological origin)
- **Meteorological disasters**: Storms (divided into nine sub-categories).

Technological disasters remained unchanged and comprise three groups:

- **Industrial accidents**: Chemical spills, collapse of industrial infrastructure, explosions, fires, gas leaks, poisoning and radiation
- **Transport accidents**: Transportation by air, rail, road or water
- **Miscellaneous accidents**: Collapse of domestic or non-industrial structures, explosions and fires.

In Tables 1–13, 'disasters' refer to disasters with a natural and technological trigger only, and do not include wars, conflict-related famines, diseases or epidemics.

The classification of countries as 'very high, 'high', 'medium' or 'low human development' is based on UNDP's 2012 Human Development Index (HDI). For a small number of countries, which do not appear in the HDI, the World Bank's classification of economies by the countries' level of income is used as reference ('high', 'upper middle' 'lower middle' and 'low').

In both EM-DAT and the tables in this annex, data are considered at country level for many reasons, including the fact that it is at this level that they are reported most of the time and also due to issues regarding possible aggregation and disaggregation of data. For droughts or food insecurities, which are often multi-year events, their impact over time is taken into account.

Bearing in mind that data on deaths and economic damage from drought are infrequently reported, CRED has adopted the following rules as regards data for droughts:

- The total number of deaths reported for a drought is divided by the number of years for which the drought persists. The resulting number is registered for each year of the drought's duration.
- The same calculation is done for the reported economic damages.
- For the total number of people reported to be affected, CRED considers that the same number is affected each year that the disaster persists.

Some disasters begin at the end of a year and may last some weeks or months into the following year. In such cases, CRED has adopted the following rules:

- With regard to the number of people reported affected, the total number is recorded for both the start year and the end year.

- For the number of people reported killed, CRED distinguishes between sudden-onset disasters (earthquakes, flash floods, landslides, etc.) and slow-onset disasters (wildfires, some floods, extreme temperatures, etc.) as follows:
  - Sudden-onset disasters: All those killed are registered according to start year of the disaster
  - Slow-onset disasters: The total of all those killed is divided by two and a half is attributed to each year of persistence.
- Reported economic damages are always attributed to the end year of the disaster. This is because damage is related to both the strength of a disaster and its duration.

By using these rules, some data bias correction is attempted. However, they are far from perfect and CRED will try to improve them, as well as the database as a whole, in the future.

Caveats

Key problems with disaster data include the lack of standardized collection methodologies and definitions. The original information, collected from a variety of public sources, is not specifically gathered for statistical purposes. So, even when the compilation applies strict definitions for disaster events and parameters, the original suppliers of information may not. Moreover, data are not always complete for each disaster. The quality of completion may vary according to the type of disaster (for example, the number of people affected by transport accidents is rarely reported) or its country of occurrence.

Data on deaths are usually available because they are an immediate proxy for the severity of the disaster. However, the numbers put forward immediately after a disaster may sometimes be seriously revised, occasionally several months later.

Data on the numbers of people affected by a disaster can provide some of the most potentially useful figures, for planning both disaster preparedness and response, but they are sometimes poorly reported. Moreover, the definition of people affected remains open to interpretation, political or otherwise. Even in the absence of manipulation, data may be extrapolated from old census information, with assumptions being made about percentages of an area's population affected.

Data can also be skewed because of the rationale behind data gathering. Reinsurance companies, for instance, systematically gather data on disaster occurrence in order to assess insurance risk, but with a priority in areas of the world where disaster insurance is widespread. Their data may therefore miss out poor, disaster-affected regions where insurance is unaffordable or unavailable.

For natural disasters over the last decade, data on deaths are missing for around 20 per cent of reported disasters, data on people affected are missing for some 25 per cent of disasters and data on economic damages are missing for 82 per cent of disasters. The figures should therefore be regarded as indicative. Relative changes and trends are more useful to look at than absolute, isolated figures.

Dates can be a source of ambiguity. For example, a declared date for a famine is both necessary and meaningless – a famine does not occur on a single day. In such cases, the date the appropriate body declares an official emergency has been used. Changes in national boundaries cause ambiguities in the data and may make long-term trend analysis more complicated.

However, in some cases, available data may differ greatly according to sources, be more or less documented estimations and/or subject to controversies. In these cases, CRED always compiles all available data or analysis to try to make its own documented estimation, which can be revised when more accurate data are provided.

Information systems have improved vastly in the last 25 years and statistical data are now more easily available, intensified by an increasing sensitivity to disaster occurrence and consequences. Nevertheless there are still discrepancies. An analysis of quality and accuracy of disaster data, performed by CRED in 2002, showed that occasionally, for the same disaster, differences of more than 20 per cent may exist between the quantitative data reported by the three major databases – EM-DAT (CRED), NatCat (Munich Re) and Sigma (Swiss Re).

Despite efforts to verify and review data, the quality of disaster databases can only be as good as the reporting system. This, combined with the different aims of the major disaster databases (risk and economic risk analysis for reinsurance companies, development agenda for CRED) may explain differences between data provided for some disasters. However, in spite of these differences, the overall trends indicated by the three databases remain similar.

The lack of systematization and standardization of data collection is a major weakness when it comes to long-term planning. Fortunately, due to increased pressures for accountability from various sources, many donors and development agencies have started paying attention to data collection and its methodologies.

Part of the solution to this data problem lies in retrospective analysis. Data are most often publicly quoted and reported during a disaster event, but it is only long after the event, once the relief operation is over, that estimates of damage and death can be verified. Some data gatherers, like CRED, revisit the data; this accounts for retrospective annual disaster figures changing one, two and sometimes even three years after the event.

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TABLE 1 Total number of reported disasters,[1] by continent, level of human development[2] and year (2003–2012)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total[3]
Africa	170	164	170	202	184	173	156	133	162	122	1,636
Americas	126	138	139	105	133	144	115	143	129	114	1,286
Asia	294	321	360	308	262	240	233	253	235	211	2,717
Europe	96	98	125	98	104	58	75	99	49	91	893
Oceania	20	23	16	18	11	13	19	18	15	14	167
Very high human development	*176*	*182*	*201*	*178*	*174*	*140*	*135*	*170*	*124*	*158*	*1,638*
High human development	*227*	*278*	*242*	*199*	*203*	*214*	*195*	*195*	*184*	*163*	*2,100*
Medium human development	*201*	*203*	*243*	*229*	*199*	*170*	*161*	*176*	*169*	*137*	*1,888*
Low human development	*102*	*81*	*124*	*125*	*118*	*104*	*107*	*105*	*113*	*94*	*1,073*
Total	**706**	**744**	**810**	**731**	**694**	**628**	**598**	**646**	**590**	**552**	**6,699**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] In Tables 1–13, 'disasters' refer to those with a natural and/or technological trigger only, and do not include wars, conflict-related famines, diseases or epidemics.

[2] See note on UNDP's Human Development Index country status in the disaster definitions section in the introduction to this annex.

[3] Since slow-onset disasters can affect the same country a number of years, it is best to use figures on total numbers to calculate annual averages over a decade rather than as absolute totals (see the methodology section in the introduction to this annex).

Note: Some totals in this table may not correspond due to rounding.

With 552 disasters reported, 2012 is the year with the decade's lowest number of disasters, very far below the peak of 2005. Among continents, the number of disasters was the lowest of the decade in Africa and Asia, the second lowest in the Americas, the third lowest in Oceania and the fourth lowest in Europe (but close to its average for the decade).

In 2012, numbers of disasters were at their lowest level in countries with high and medium human development, their second lowest level in low human development countries and at their fourth lowest level in countries with very high human development.

Over the decade, Asia remains the continent most frequently affected, with 40.6 per cent of all disasters. Africa comes second with 24.4 per cent of all disasters.

TABLE 2 Total number of people reported killed, by continent, level of human development[1] and year (2003–2012)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Africa	6,160	4,246	3,192	5,780	3,821	3,027	3,180	3,054	3,509	3,028	38,997
Americas	2,080	8,439	5,434	1,563	2,921	2,737	2,245	226,458	3,372	2,060	257,309
Asia	39,030	238,360	90,841	20,648	15,827	235,622	9,995	17,749	29,138	8,481	705,691
Europe	73,373	1,259	1,026	5,837	1,665	807	1,363	57,073	1,667	1,704	145,774
Oceania	64	35	46	24	273	25	888	140	221	433	2,149
Very high human development	*74,284*	*2,301*	*3,851*	*6,030*	*2,459*	*1,582*	*3,544*	*58,800*	*22,492*	*2,417*	*177,760*
High human development	*35,604*	*52,650*	*6,060*	*10,042*	*5,217*	*93,380*	*5,313*	*11,379*	*7,643*	*5,513*	*232,801*
Medium human development	*8,384*	*189,890*	*87,772*	*14,640*	*13,128*	*143,557*	*6,729*	*9,278*	*5,352*	*5,678*	*484,408*
Low human development	*2,435*	*7,498*	*2,856*	*3,140*	*3,703*	*3,699*	*2,085*	*225,017*	*2,420*	*2,098*	*254,951*
Total	**120,707**	**252,339**	**100,539**	**33,852**	**24,507**	**242,218**	**17,671**	**304,474**	**37,907**	**15,706**	**1,149,920**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] See note on UNDP's Human Development Index country status in the disaster definitions section in the introduction to this annex.

Note: Some totals in this table may not correspond due to rounding.

In 2012 the number of people reported killed was the lowest of the decade, much lower than the 2004, 2008 and 2010 peaks. In Asia, the number of people reported killed was the lowest of the decade and the second lowest in Africa and in the Americas. In Oceania and Europe, however, the numbers were, respectively, the second and fourth highest of the decade. The number of people reported killed was 12 times lower than the average for the decade in the Americas and eight times lower in Asia and Europe. In Oceania, the number of people killed by disasters was twice as high as the decade's average. Compared to other continents, Africa reported proportionally more people killed than its share for the decade. The numbers of people reported dead were the second lowest of the decade in countries with low and medium human development and the third lowest for countries with very high and high human development.

The disaster with the highest death toll in 2012 was Typhoon Bopha which killed 1,901 people in the Philippines. However, this number is much smaller than the 226,408 deaths caused by the 2004 Indian Ocean tsunami, the death toll of 222,570 fatalities in the 2010 Haiti earthquake or the 138,375 deaths caused by Cyclone Nargis in Myanmar in 2008. The other major disasters of the decade were the 2008 Sichuan earthquake in China (87,476 deaths), the 2005 Kashmir earthquake (74,648 deaths), heatwaves in Western Europe in 2003 (72,210 deaths) and in Russia in 2010 (55,736 deaths), and the Bam earthquake in Iran in 2003 (26,796 deaths).

TABLE 3 Total number of people reported affected, by continent, level of human development[1] and year (2003–2012), in thousands

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total[2]
Africa	28,539	36,174	22,856	26,665	12,530	22,653	42,636	37,765	31,417	42,675	303,910
Americas	3,849	9,557	8,308	1,455	9,119	20,314	7,046	12,744	11,832	5,582	89,805
Asia	235,689	132,860	129,717	119,101	190,885	182,754	174,056	292,534	217,987	89,815	1,765,398
Europe	1,546	538	525	260	1,651	268	141	834	79	581	6,423
Oceania	38	119	28	38	172	105	77	549	484	258	1,869
Very high human development	*2,023*	*6,068*	*6,921*	*784*	*3,766*	*15,056*	*2,993*	*5,632*	*5,172*	*818*	*49,233*
High human development	*225,727*	*62,491*	*86,628*	*102,250*	*129,753*	*164,201*	*152,504*	*268,196*	*198,953*	*72,922*	*1,463,624*
Medium human development	*18,001*	*94,921*	*48,627*	*23,281*	*67,405*	*28,609*	*31,281*	*36,872*	*33,891*	*33,416*	*416,306*
Low human development	*23,909*	*15,768*	*19,259*	*21,203*	*13,432*	*18,228*	*37,178*	*33,725*	*23,783*	*31,755*	*238,241*
Total	**269,660**	**179,248**	**161,435**	**147,519**	**214,356**	**226,094**	**223,956**	**344,426**	**261,799**	**138,912**	**2,167,404**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] See note on UNDP's Human Development Index country status in the disaster definitions section in the introduction to this annex.

[2] Since slow-onset disasters can affect the same people a number of years, it is best to use figures on total numbers affected to calculate annual averages over a decade rather than as absolute totals.

Note: Some totals in this table may not correspond due to rounding.

In 2012 almost 139 million people were affected by disasters; the lowest total of the decade and less than half of the number affected in the peak year of 2010 (344 million). In Asia, the number of people reported affected was the lowest of the decade and the third lowest in the Americas. Inversely, it was the highest of the decade in Africa, the third highest in Oceania and the fourth highest in Europe.

Although Asia accounted for almost two-thirds of people reported affected, the number remained below its average for the decade of 80 per cent. However, with 31 per cent of people reported affected, Africa was largely above its average of 14 per cent for the decade. The number of people affected living in countries of very high and high human development was the second lowest of the decade, but was the decade's third highest rate for countries of low human development and the sixth highest in countries of medium human development.

TABLE 4 Total amount of disaster estimated damage, by continent, level of human development[1] and year (2003–2012) in millions of US dollars (2012 prices)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Africa	6,908	2,041	40	261	726	977	185	62	1,038	929	13,167
Americas	26,653	80,081	202,343	8,128	17,520	68,679	15,873	81,821	69,222	103,582	673,902
Asia	29,558	80,603	32,496	26,776	38,268	126,230	18,926	40,149	280,093	28,004	701,102
Europe	22,917	2,216	18,481	2,767	24,403	4,971	12,954	18,949	2,998	24,201	134,856
Oceania	740	671	258	1,465	1,592	2,683	1,846	17,562	20,982	855	48,654
Very high human development	*57,046*	*136,241*	*219,861*	*14,599*	*56,928*	*73,209*	*30,734*	*107,799*	*303,136*	*126,978*	*1,126,530*
High human development	*27,996*	*13,575*	*16,190*	*15,420*	*16,373*	*123,141*	*11,450*	*27,395*	*65,394*	*25,945*	*342,878*
Medium human development	*1,255*	*15,094*	*17,493*	*9,374*	*8,461*	*6,682*	*7,351*	*14,925*	*5,658*	*4,241*	*90,534*
Low human development	*479*	*704*	*73*	*4*	*747*	*509*	*249*	*8,423*	*145*	*406*	*11,739*
Total	**86,776**	**165,613**	**253,617**	**39,396**	**82,509**	**203,540**	**49,784**	**158,542**	**374,333**	**157,570**	**1,571,681**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] See note on UNDP's Human Development Index country status in the disaster definitions section in the introduction to this annex.

Note: Some totals in this table may not correspond due to rounding.

As mentioned in the introduction, damage assessment is frequently unreliable. Even for existing data, methodologies are not standardized and the financial coverage can vary significantly. Depending on where the disaster occurred and who reported it, estimations may vary from zero to billions of US dollars.

The total amount of damage reported in 2012 was the fifth lowest of the decade. In the Americas and in Europe, the amount of damages was the second highest of the decade and the fifth highest in Africa. In Asia and Oceania, however, the amount of reported damages was, respectively, the third and fourth lowest of the decade. The Americas accounted for almost 66 per cent of damage and Europe for 15 per cent, higher than their respective 43 and 9 per cent average for the decade.

The contribution of very high human development countries to the total amount of damages climbed to 80 per cent, an amount greater than their 72 per cent average for the decade. Inversely, high human development countries accounted for only 16 per cent of damage (decade average: 22 per cent). The two costliest disasters in 2012 occurred in the United States. Hurricane Sandy cost US$ 50 billion and a drought in the South-West and Mid-West regions cost US$ 20 billion. Two earthquakes that hit Italy's Ferrara region cost more than US$ 15 billion.

TABLE 5 Total number of reported disasters, by type of phenomenon and year (2003–2012)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total[1]
Droughts/food insecurity	23	19	28	20	13	21	31	27	23	29	234
Earthquakes/tsunamis	40	42	25	24	21	23	22	25	30	30	282
Extreme temperatures	26	19	29	32	25	11	26	34	19	52	273
Floods[2]	160	135	193	232	219	175	159	189	159	141	1,762
Forest/scrub fires	14	8	13	10	18	5	9	7	7	7	98
Insect infestation	n.d.r.	12	n.d.r.	1	n.d.r.	n.d.r.	1	n.d.r.	n.d.r.	n.d.r.	14
Mass movement: dry[3]	n.d.r.	1	n.d.r.	1	n.d.r.	3	1	n.d.r.	n.d.r.	1	7
Mass movement: wet[4]	21	16	12	20	10	12	29	32	18	13	183
Volcanic eruptions	2	5	8	12	6	7	3	6	6	1	56
Windstorms	86	128	131	77	105	111	87	91	84	90	990
Subtotal climato-, hydro- and meteorological disasters	*330*	*337*	*406*	*392*	*390*	*335*	*342*	*380*	*310*	*332*	*3,554*
Subtotal geophysical disasters	*42*	*48*	*33*	*37*	*27*	*33*	*26*	*31*	*36*	*32*	*345*
Total natural disasters	**372**	**385**	**439**	**429**	**417**	**368**	**368**	**411**	**346**	**364**	**3,899**
Industrial accidents	52	81	76	64	53	38	43	36	32	25	500
Miscellaneous accidents	45	62	66	33	43	30	27	47	34	26	413
Transport accidents	237	216	229	205	181	192	160	152	178	137	1,887
Total technological disasters	**334**	**359**	**371**	**302**	**277**	**260**	**230**	**235**	**244**	**188**	**2,800**
Total	**706**	**744**	**810**	**731**	**694**	**628**	**598**	**646**	**590**	**552**	**6,699**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] Since slow-onset disasters can affect the same country a number of years, it is best to use figures on total numbers to calculate annual averages over a decade rather than as absolute totals (see the methodology chapter of this annex).

[2] Includes waves and surges.

[3] Landslides, rockfalls, subsidence, etc. of geophysical origin.

[4] Landslides, avalanches, subsidence, etc. of hydrological origin.

Notes: Some totals in this table may not correspond due to rounding. In this table, n.d.r. signifies 'no disaster reported'. For more information, see section on caveats in the introductory text to this annex.

In 2012, the number of natural disasters was the second lowest of the decade and the number of technological disasters the lowest. The number of volcanic eruptions and floods was, respectively, the lowest and second lowest of the decade. However, the number of extreme temperature episodes, droughts and earthquakes was, respectively, the highest, second highest and third highest of the decade.

Among natural disasters, floods were the most frequent disaster (39 per cent), although their number was the second lowest of the decade. The second most frequent disasters were windstorms (24.7 per cent), close to their 25.4 per cent average for the decade. Extreme temperatures, which were the third most frequent disasters in 2012, represent 14 per cent of all natural disasters, double their decade's average of 7 per cent.

The numbers of all types technological disasters were the lowest of the decade, with transport accidents remaining the most frequent.

TABLE 6 Total number of people reported killed, by type of phenomenon and year (2003–2012)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Droughts/food insecurity	38	80	88	208	n.a.	6	2	2	n.a.	n.a.	424
Earthquakes/tsunamis	29,617	227,290	76,241	6,692	780	87,918	1,888	226,735	20,946	711	678,818
Extreme temperatures	74,748	556	814	5,104	1,044	1,608	1,212	57,064	806	1,758	144,714
Floods[1]	3,770	7,102	5,754	5,845	8,565	4,029	3,534	8,571	6,142	3,574	56,886
Forest/scrub fires	47	14	47	16	150	86	190	135	10	22	717
Insect infestation	n.d.r.	n.a.	n.d.r.	n.a.	n.d.r.	n.d.r.	n.a.	n.d.r.	n.d.r.	n.d.r.	n.a.
Mass movement: dry[2]	n.d.r.	44	n.d.r.	11	n.d.r.	120	36	n.d.r.	n.d.r.	16	227
Mass movement: wet[3]	707	313	646	1,638	271	504	657	3,402	314	504	8,956
Volcanic eruptions	n.a.	2	3	5	11	16	n.a.	323	3	n.a.	363
Windstorms	1,030	6,609	5,294	4,329	6,035	140,985	3,287	1,498	3,103	3,071	175,241
Subtotal climato-, hydro- and meteorological disasters	*80,340*	*14,674*	*12,643*	*17,140*	*16,065*	*147,218*	*8,882*	*70,672*	*10,375*	*8,929*	*386,938*
Subtotal geophysical disasters	*29,617*	*227,336*	*76,244*	*6,708*	*791*	*88,054*	*1,924*	*227,058*	*20,949*	*727*	*679,408*
Total natural disasters	**109,957**	**242,010**	**88,887**	**23,848**	**16,856**	**235,272**	**10,806**	**297,730**	**31,324**	**9,656**	**1,066,346**
Industrial accidents	1,444	1,797	2,281	1,857	1,667	776	933	1,061	684	787	13,287
Miscellaneous accidents	1,438	2,115	2,669	1,126	909	895	911	1,507	755	1,112	13,437
Transport accidents	7,868	6,417	6,702	7,021	5,075	5,275	5,021	4,176	5,144	4,151	56,850
Total technological disasters	**10,750**	**10,329**	**11,652**	**10,004**	**7,651**	**6,946**	**6,865**	**6,744**	**6,583**	**6,050**	**83,574**
Total	**120,707**	**252,339**	**100,539**	**33,852**	**24,507**	**242,218**	**17,671**	**304,474**	**37,907**	**15,706**	**1,149,920**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] Includes waves and surges.

[2] Landslides, rockfalls, subsidence, etc. of geophysical origin.

[3] Landslides, avalanches, subsidence, etc. of hydrological origin.

Notes: Some totals in this table may not correspond due to rounding. In this table, n.a. signifies 'no data available' and n.d.r., 'no disaster reported'. For more information, see section on caveats in the introductory text to this annex.

In 2012, deaths caused by natural and technological disasters were at their lowest level of the entire decade. Among natural disasters, the number of deaths due to earthquakes and tsunamis was the lowest of the decade, much lower than the average for the decade. The number of deaths caused by both floods and mass movements of geophysical origin were the second lowest of the decade and deaths from windstorms the third lowest.

Deaths from transport accidents were the lowest of the decade; deaths from industrial accidents, the third lowest.

TABLE 7 Total number of people reported affected, by type of phenomenon and year (2003–2012), in thousands

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total[1]
Droughts/food insecurity	80,968	34,398	30,643	44,371	8,278	37,481	109,666	136,280	75,559	40,837	598,482
Earthquakes/tsunamis	4,194	3,147	6,187	3,859	1,382	47,580	3,221	6,937	1,748	2,903	81,160
Extreme temperatures	1,890	2,140	2	63	988	79,171	856	892	4,427	636	91,066
Floods[2]	169,515	117,569	75,027	31,124	177,840	46,066	58,983	188,870	141,398	74,276	1,080,667
Forest/scrub fires	184	21	7	3	1,785	59	12	30	15	5	2,120
Insect infestation	n.d.r.	n.a.	n.d.r.	n.a.	n.d.r.	n.d.r.	500	n.d.r.	n.d.r.	n.d.r.	500
Mass movement: dry[3]	n.d.r.	0.4	n.d.r.	0.01	n.d.r.	1	3	n.d.r.	n.d.r.	n.a.	4
Mass movement: wet[4]	459	230	10	432	9	5	44	2,460	7	4	3,660
Volcanic eruptions	25	53	341	379	51	40	57	171	46	10	1,171
Windstorms	11,758	21,383	49,117	67,112	23,974	15,652	50,583	8,749	38,545	20,216	307,089
Subtotal climato-, hydro- and meteorological disasters	*264,774*	*175,741*	*154,806*	*143,106*	*212,875*	*178,435*	*220,642*	*337,282*	*259,950*	*135,974*	*2,083,584*
Subtotal geophysical disasters	*4,219*	*3,200*	*6,528*	*4,237*	*1,433*	*47,621*	*3,281*	*7,108*	*1,793*	*2,913*	*82,335*
Total natural disasters	**268,993**	**178,941**	**161,335**	**147,343**	**214,308**	**226,056**	**223,923**	**344,389**	**261,744**	**138,887**	**2,165,919**
Industrial accidents	646	157	16	137	3	14	6	27	1	4	1,010
Miscellaneous accidents	15	102	77	35	41	21	23	7	48	17	387
Transport accidents	5	48	6	4	4	4	5	3	6	3	88
Total technological disasters	**667**	**307**	**100**	**175**	**48**	**39**	**33**	**37**	**55**	**24**	**1,486**
Total	**269,660**	**179,248**	**161,435**	**147,519**	**214,356**	**226,094**	**223,956**	**344,426**	**261,799**	**138,912**	**2,167,404**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] Since slow-onset disasters can affect the same people over a number of years, it is best to use figures on total numbers to calculate annual averages over a decade rather than as absolute totals (see the methodology chapter of this annex).

[2] Includes waves and surges.

[3] Landslides, rockfalls, subsidence, etc. of geophysical origin.

[4] Landslides, avalanches, subsidence, etc. of hydrological origin.

Notes: Some totals in this table may not correspond due to rounding. In this table, n.a. signifies 'no data available' and n.d.r., 'no disaster reported'. For more information, see section on caveats in the introductory text to this annex.

In 2012, the number of people reported affected by either natural or technological disasters was the lowest of the decade. Among natural disasters, floods affected the most people in 2012 (more than 74 million), but this represents the fourth lowest number of people affected by floods during the decade. Droughts affected almost 41 million people and windstorms 20 million. The number of people affected by transport accidents was the lowest of the decade, those of people affected by industrial or miscellaneous accidents the third lowest.

TABLE 8 Total amount of disaster estimated damage, by type of phenomenon and year (2003–2012) in millions of US dollars (2012 prices)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Droughts/food insecurity	924	1,819	2,301	3,572	560	231	2,187	3,491	10,806	25,480	51,372
Earthquakes/tsunamis	10,297	46,907	7,886	3,909	16,584	91,510	6,481	49,803	235,066	18,616	487,061
Extreme temperatures	15,621	n.a.	470	1,139	n.a.	23,401	1,177	486	797	153	43,245
Floods[1]	25,655	12,985	20,697	9,283	26,569	21,092	8,563	50,196	72,741	25,609	273,389
Forest/scrub fires	7,605	4	4,407	1,070	5,092	2,592	1,621	2,180	2,998	1,200	28,767
Insect infestation	n.d.r.	n.a.	n.d.r.	n.a.	n.d.r.	n.d.r.	n.a.	n.d.r.	n.d.r.	n.d.r.	n.a.
Mass movement: dry[2]	n.d.r.	n.a.	n.d.r.	n.a.	n.d.r.	n.a.	n.a.	n.d.r.	n.d.r.	n.a.	n.a.
Mass movement: wet[3]	56	13	65	46	n.a.	n.a.	165	1,345	n.a.	n.a.	1,689
Volcanic eruptions	n.a.	n.a.	n.a.	171	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	171
Windstorms	26,618	102,295	217,297	20,206	32,741	64,714	27,958	29,611	51,925	86,481	659,846
Subtotal climato-, hydro- and meteorological disasters	*76,479*	*117,116*	*245,237*	*35,315*	*64,963*	*112,030*	*41,670*	*87,309*	*139,267*	*138,923*	*1,058,308*
Subtotal geophysical disasters	*10,297*	*46,907*	*7,886*	*4,080*	*16,584*	*91,510*	*6,481*	*49,803*	*235,066*	*18,616*	*487,231*
Total natural disasters	**86,776**	**164,024**	**253,123**	**39,395**	**81,547**	**203,540**	**48,151**	**137,113**	**374,332**	**157,539**	**1,545,540**
Industrial accidents	n.a.	1,094	482	n.a.	963	n.a.	1,633	21,167	n.a.	30	25,368
Miscellaneous accidents	n.a.	n.a.	12	1	n.a.	n.a.	n.a.	263	1	1	278
Transport accidents	n.a.	496	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	496
Total technological disasters	**n.a.**	**1,589**	**494**	**1**	**963**	**n.a.**	**1,633**	**21,430**	**1**	**31**	**26,142**
Total	**86,776**	**165,613**	**253,617**	**39,396**	**82,509**	**203,540**	**49,784**	**158,542**	**374,333**	**157,570**	**1,571,681**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] Includes waves and surges.

[2] Landslides, rockfalls, subsidence, etc. of geophysical origin.

[3] Landslides, avalanches, subsidence, etc. of hydrological origin.

Notes: Some totals in this table may not correspond due to rounding. In this table, n.a. signifies ‘no data available’ and n.d.r., ‘no disaster reported’. For more information, see section on caveats in the introductory text to this annex.

Estimates of disaster damage must be treated with caution, as the financial value attached to infrastructure in high-income countries is much greater than in low- and middle-income countries. While reporting is better for large disasters, the low reporting rates of direct damage make analysis difficult.

In 2012, estimated damages from natural disasters were the fifth highest of the decade, with the amounts close to their average for the decade. The greatest estimated damage was caused by windstorms; the estimated amount for 2012 was the third highest of the decade. Hurricane Sandy accounted for almost 60 per cent of all damages from storms. Floods were the second greatest cause of reported damages; the amounts were the fifth highest of the decade, but close to their average for the decade. Droughts were third cause of damage but 78 per cent of their reported amounts must be attributed to the drought in the South-West and Mid-West regions of the United States. The fourth major cause of damages was earthquakes, but the two tremors in Italy’s Ferrara region accounted for 85 per cent of all earthquake damages.

TABLE 9 Total number of reported disasters, by type of phenomenon, continent and level of human development[1] (2003–2012)

	Africa	Americas	Asia	Europe	Oceania	VHHD[1]	HHD[1]	MHD[1]	LHD[1]	Total
Droughts/food insecurity	132	47	40	13	2	23	50	59	102	234
Earthquakes/tsunamis	20	42	178	33	9	61	131	72	18	282
Extreme temperatures	3	40	63	166	1	174	46	43	10	273
Floods[2]	449	355	691	215	52	408	470	517	367	1,762
Forest/scrub fires	8	40	10	33	7	73	15	7	3	98
Insect infestation	13	n.d.r.	n.d.r.	n.d.r.	1	1	n.d.r.	6	7	14
Mass movement: dry[3]	1	2	3	n.d.r.	1	n.d.r.	4	2	1	7
Mass movement: wet[4]	13	36	121	7	6	18	64	70	31	183
Volcanic eruptions	5	21	20	1	9	6	20	20	10	56
Windstorms	86	335	384	123	62	445	291	181	73	990
Subtotal climato-, hydro- and meteorological disasters	*704*	*853*	*1,309*	*557*	*131*	*1,142*	*936*	*883*	*593*	*3,554*
Subtotal geophysical disasters	*26*	*65*	*201*	*34*	*19*	*67*	*155*	*94*	*29*	*345*
Total natural disasters	**730**	**918**	**1,510**	**591**	**150**	**1,209**	**1,091**	**977**	**622**	**3,899**
Industrial accidents	50	30	374	44	2	50	345	79	26	500
Miscellaneous accidents	98	50	200	64	1	98	117	158	40	413
Transport accidents	758	288	633	194	14	281	547	674	385	1,887
Total technological disasters	**906**	**368**	**1,207**	**302**	**17**	**429**	**1,009**	**911**	**451**	**2,800**
Total	**1,636**	**1,286**	**2,717**	**893**	**167**	**1,638**	**2,100**	**1,888**	**1,073**	**6,699**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] See note on UNDP's Human Development Index country status in the disaster definitions section in the introduction to this annex. VHHD stands for very high human development, HHD for high human development, MHD for medium human development and LHD for low human development.

[2] Includes waves and surges.

[3] Landslides, rock falls, subsidence, etc. of geophysical origin.

[4] Landslides, avalanches, subsidence, etc. of hydrological origin.

Notes: Some totals in this table may not correspond due to rounding. In this table, n.a. signifies 'no data available' and n.d.r., 'no disaster reported'. For more information, see section on caveats in the introductory text to this annex.

During the decade, Asia accounted for 41 per cent of the total number of disasters but for 75 per cent of industrial accidents, 66 per cent of mass movements of hydrological origin, 63 per cent of earthquakes/tsunamis, 48 per cent of miscellaneous accidents and 39 per cent of windstorms. Africa accounted for 24 per cent of the total number of disasters but for 92 per cent of insect infestations, 56 per cent of droughts/food insecurities and 40 per cent of transport accidents. The Americas accounted for 19 per cent of the total number of disasters but for 41 per cent of wildfires and 34 per cent of windstorms. Europe accounted for 13 per cent of the total number of disasters but for 61 per cent of extreme temperatures and for 34 per cent of wildfires. Oceania accounted for 2.5 per cent of the total number of disasters but for 16 per cent of volcanic eruptions, 7 per cent of wildfires and insect infestations, and 6 per cent of windstorms.

TABLE 10 Total number of people reported killed, by type of phenomenon, continent and level of human development[1] (2003–2012)

	Africa	Americas	Asia	Europe	Oceania	VHHD[1]	HHD[1]	MHD[1]	LHD[1]	Total
Droughts/food insecurity	257	4	163	n.a.	n.a.	n.a.	150	143	131	424
Earthquakes/tsunamis	3,289	223,910	449,941	1,257	421	21,215	166,837	267,716	223,050	678,818
Extreme temperatures	62	2,043	6,807	135,455	347	135,504	2,850	4,869	1,491	144,714
Floods[2]	6,849	9,865	38,986	1,040	146	2,429	16,315	27,660	10,482	56,886
Forest/scrub fires	127	75	67	244	204	551	47	62	57	717
Insect infestation	n.a.	n.d.r.	n.d.r.	n.d.r.	n.a.	n.a.	n.d.r.	n.a.	n.a.	n.a.
Mass movement: dry[3]	98	48	71	n.d.r.	10	n.d.r.	165	52	10	227
Mass movement: wet[4]	609	1,000	7,181	59	107	301	5,115	2,245	1,295	8,956
Volcanic eruptions	6	23	334	n.a.	n.a.	n.a.	23	328	12	363
Windstorms	1,450	10,885	162,250	388	268	6,565	13,997	150,059	4,620	175,241
Subtotal climato-, hydro- and meteorological disasters	*9,354*	*23,872*	*215,454*	*137,186*	*1,072*	*145,350*	*38,474*	*185,038*	*18,076*	*386,938*
Subtotal geophysical disasters	*3,393*	*223,981*	*450,346*	*1,257*	*431*	*21,215*	*167,025*	*268,096*	*223,072*	*679,408*
Total natural disasters	**12,747**	**247,853**	**665,800**	**138,443**	**1,503**	**166,565**	**205,499**	**453,134**	**241,148**	**1,066,346**
Industrial accidents	1,906	649	9,704	999	29	1,051	8,465	3,035	736	13,287
Miscellaneous accidents	2,242	2,135	7,615	1,435	10	3,337	2,705	6,637	758	13,437
Transport accidents	22,102	6,672	22,572	4,897	607	6,807	16,132	21,602	12,309	56,850
Total technological disasters	**26,250**	**9,456**	**39,891**	**7,331**	**646**	**11,195**	**27,302**	**31,274**	**13,803**	**83,574**
Total	**38,997**	**257,309**	**705,691**	**145,774**	**2,149**	**177,760**	**232,801**	**484,408**	**254,951**	**1,149,920**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] See note on UNDP's Human Development Index country status in the disaster definitions section in the introduction to this annex. VHHD stands for very high human development, HHD for high human development, MHD for medium human development and LHD for low human development.

[2] Includes waves and surges.

[3] Landslides, rock falls, subsidence, etc. of geophysical origin.

[4] Landslides, avalanches, subsidence, etc. of hydrological origin.

Notes: Some totals in this table may not correspond due to rounding. In this table, n.a. signifies 'no data available' and n.d.r., 'no disaster reported'. For more information, see section on caveats in the introductory text to this annex.

During the decade, Asia accounted for 61 per cent of people reported killed by disasters, but for 93 per cent of deaths from windstorms, 92 per cent of deaths from volcanic eruptions, 80 per cent of deaths from mass movement of hydrological origin and 73 per cent of industrial accidents. The Americas accounted for 22 per cent of deaths from disasters but 33 per cent of fatalities caused by earthquakes. Thirteen per cent of deaths occurred in Europe but the proportion is of 94 per cent for deaths from extreme temperatures and 34 per cent for wildfires. Africa accounted for 3 per cent of deaths from disasters, but for 61 per cent of those caused by droughts, 39 per cent of deaths caused by transport accidents, 17 per cent of those from miscellaneous accidents and 14 per cent of those from industrial accidents. Around one death from disaster per thousand occurred in Oceania but this region concentrates 28 per cent of deaths from wildfires and more than 1 per cent of deaths from mass movements of hydrological origin and from transport accidents.

TABLE 11 Total number of people reported affected, by type of phenomenon, continent and level of human development[1] (2003–2012), in thousands

	Africa	Americas	Asia	Europe	Oceania	VHHD[1]	HHD[1]	MHD[1]	LHD[1]	Total
Droughts/food insecurity	269,549	8,921	318,733	1,279	n.a.	3,500	306,445	76,559	211,977	598,482
Earthquakes/tsunamis	381	8,912	70,714	538	614	4,450	57,071	15,616	4,022	81,160
Extreme temperatures	8	5,221	85,318	517	2	322	88,083	2,440	221	91,066
Floods[2]	29,303	43,037	1,005,608	1,943	776	18,005	760,980	283,169	18,513	1,080,667
Forest/scrub fires	10	902	25	1,170	13	981	1,129	4	6	2,120
Insect infestation	500	n.d.r.	n.d.r.	n.d.r.	n.a.	n.a.	n.d.r.	n.a.	500	500
Mass movement: dry[3]	1	3	0.4	n.d.r.	n.a.	n.d.r.	1	3	n.a.	4
Mass movement: wet[4]	36	95	3,518	0.4	11	24	2,630	579	427	3,660
Volcanic eruptions	295	399	426	n.a.	51	12	528	308	323	1,171
Windstorms	3,480	21,736	280,532	940	401	21,896	245,780	37,416	1,998	307,089
Subtotal climato-, hydro- and meteorological disasters	*302,885*	*79,912*	*1,693,734*	*5,850*	*1,203*	*44,728*	*1,405,049*	*400,166*	*233,641*	*2,083,584*
Subtotal geophysical disasters	*677*	*9,313*	*71,141*	*538*	*665*	*4,462*	*57,601*	*15,928*	*4,345*	*82,335*
Total natural disasters	**303,562**	**89,225**	**1,764,875**	**6,388**	**1,869**	**49,189**	**1,462,650**	**416,094**	**237,986**	**2,165,919**
Industrial accidents	121	566	312	11	0.002	27	842	41	100	1,010
Miscellaneous accidents	211	6	151	20	n.a.	8	119	156	105	387
Transport accidents	16	8	60	4	0.3	9	14	15	50	88
Total technological disasters	**348**	**580**	**523**	**34**	**0**	**44**	**975**	**212**	**255**	**1,485**
Total	**303,910**	**89,805**	**1,765,398**	**6,423**	**1,869**	**49,233**	**1,463,624**	**416,306**	**238,241**	**2,167,404**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] See note on UNDP's Human Development Index country status in the disaster definitions section in the introduction to this annex. VHHD stands for very high human development, HHD for high human development, MHD for medium human development and LHD for low human development.

[2] Includes waves and surges.

[3] Landslides, rock falls, subsidence, etc. of geophysical origin.

[4] Landslides, avalanches, subsidence, etc. of hydrological origin.

Notes: Some totals in this table may not correspond due to rounding. In this table, n.a. signifies 'no data available' and n.d.r., 'no disaster reported'. For more information, see section on caveats in the introductory text to this annex.

During the decade, the highest proportion of people reported affected by disaster was in Asia (81 per cent), but Asia accounted for 96 per cent of people affected by mass movements of hydrological origin, 94 per cent of those affected by extreme temperatures, 93 per cent of those affected by floods, 91 per cent of those affected by windstorms and 87 per cent of those affected by earthquakes. Africa accounted for 14 per cent of people affected by disasters but for 55 per cent of those affected by miscellaneous accidents, 45 per cent of those affected by droughts and 25 per cent of those affected by volcanic eruptions. The Americas accounted for 4 per cent of people affected by disasters but for 74 per cent of those affected by mass movement of geological origin, 56 per cent of those affected by industrial accidents and 43 per cent of those affected by wildfires. Less than 1 per cent of people affected by disasters were located in Europe but they accounted for 55 per cent of those affected by wildfires, 5 per cent of those affected by miscellaneous accidents, almost 4 per cent of those affected by transport accidents and 1 per cent of those affected by industrial accidents. Fewer than one person affected by disaster in a thousand were located in Oceania, but they accounted for 4 per cent of those affected by volcanic eruptions.

High human development countries accounted for 68 per cent of the total number of people reported affected by disasters but for 97 per cent of those affected by extreme temperatures, 83 per cent of those affected by industrial accidents and 80 per cent of those affected by windstorms. Medium human development countries accounted for 19 per cent of the total number of people reported affected by disasters but for 74 per cent of those affected by mass movements of geological origin, 40 per cent of those affected by miscellaneous accidents and 26 per cent of those affected by volcanic eruptions. Low human development countries represented 11 per cent of the total number of people reported affected by disasters but for 56 per cent of those affected by transport accidents, 28 per cent of those affected by volcanic eruptions and 27 per cent by miscellaneous accidents. Very high human development countries accounted for only 2 per cent of the total number of people reported affected by disasters but for 46 per cent of those affected by wildfires, 10 per cent of those affected by transport accidents and 7 per cent of those affected by windstorms.

TABLE 12 Total amount of disaster estimated damage, by type of phenomenon, continent and level of human development[1] (2003–2012) in millions of US dollars (2012 prices)

	Africa	Americas	Asia	Europe	Oceania	VHHD[1]	HHD[1]	MHD[1]	LHD[1]	Total
Droughts/food insecurity	n.a.	32,228	10,633	8,512	n.a.	34,841	16,258	128	145	51,372
Earthquakes/tsunamis	7,035	43,588	388,949	22,101	25,387	346,428	108,926	23,154	8,552	487,061
Extreme temperatures	n.a.	1,687	24,273	17,286	n.a.	18,973	22,878	1,395	0.13	43,245
Floods[2]	3,909	40,662	179,672	36,073	13,072	82,011	141,686	47,645	2,047	273,389
Forest/scrub fires	459	14,770	300	11,261	1,978	28,259	33	475	n.a.	28,767
Insect infestation	n.a.	n.d.r.	n.d.r.	n.d.r.	n.a.	n.a.	n.d.r.	n.a.	n.a.	n.a.
Mass movement: dry[3]	n.a.	n.a.	n.a.	n.d.r.	n.a.	n.d.r.	n.a.	n.a.	n.a.	n.a.
Mass movement: wet[4]	n.a.	543	1,146	n.a.	n.a.	16	959	714	n.a.	1,689
Volcanic eruptions	n.a.	171	n.a.	n.a.	n.a.	n.a.	171	n.a.	n.a.	171
Windstorms	792	518,913	94,902	37,021	8,217	592,997	50,026	16,325	498	659,846
Subtotal climato-, hydro- and meteorological disasters	*5,160*	*608,803*	*310,926*	*110,153*	*23,267*	*757,096*	*231,841*	*66,681*	*2,690*	*1,058,308*
Subtotal geophysical disasters	*7,035*	*43,759*	*388,949*	*22,101*	*25,387*	*346,428*	*109,097*	*23,154*	*8,552*	*487,231*
Total natural disasters	**12,195**	**652,562**	**699,875**	**132,254**	**48,654**	**1,103,525**	**340,937**	**89,835**	**11,242**	**1,545,540**
Industrial accidents	972	21,065	728	2,602	n.a.	22,730	1,939	698	n.a.	25,368
Miscellaneous accidents	n.a.	275	3	n.a.	n.a.	275	2	n.a.	1	278
Transport accidents	n.a.	n.a.	496	n.a.	n.a.	n.a.	n.a.	n.a.	496	496
Total technological disasters	**972**	**21,340**	**1,227**	**2,602**	**n.a.**	**23,005**	**1,941**	**698**	**497**	**26,142**
Total	**13,167**	**673,902**	**701,102**	**134,856**	**48,654**	**1,126,530**	**342,878**	**90,534**	**11,739**	**1,571,681**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] See note on UNDP's Human Development Index country status in the disaster definitions section in the introduction to this annex. VHHD stands for very high human development, HHD for high human development, MHD for medium human development and LHD for low human development.

[2] Includes waves and surges.

[3] Landslides, rock falls, subsidence, etc. of geophysical origin.

[4] Landslides, avalanches, subsidence, etc. of hydrological origin.

Notes: Some totals in this table may not correspond due to rounding. In this table, n.a. signifies 'no data available' and n.d.r., 'no disaster reported'. For more information, see section on caveats in the introductory text to this annex.

Estimates of disaster damage must be treated with caution, as the financial value attached to infrastructure in high-income countries is much greater than in low- and middle-income countries. While reporting is better for large disasters, the low reporting rates of direct damage make analysis difficult.

During the decade, Asia accounted for 45 per cent of the reported damages but for 80 per cent of costs attributed to earthquakes/tsunamis, 68 per cent of those related to mass movements of hydrological origin, 66 per cent of those caused by floods and 56 per cent of those caused by extreme temperatures. The Americas accounted for 43 per cent of the reported damages but for 99 per cent of costs related to miscellaneous accidents, 83 per cent of those related to industrial accidents, 79 per cent of those related to windstorms and 51 per cent of those caused by wildfires. Europe accounted for 9 per cent of the reported damages but for 40 per cent of those caused by extreme temperatures, 39 per cent of those caused by wildfires and 17 per cent of costs caused by droughts. Oceania accounted for 3 per cent of reported damages but for 7 per cent of those caused by wildfires and 5 per cent of costs caused by earthquakes. Africa accounted for less than 1 per cent of the reported damages but for 3 per cent of those caused by industrial accidents. Almost 72 per cent of costs related to estimated damage were reported from very high human development countries and 22 per cent in countries with high human development.

TABLE 13 Total number of people reported killed and affected by disasters by country and territory (1993–2002; 2003–2012; and 2012)

	Total number of people reported killed (1993–2002)	Total number of people reported affected (1993–2002)	Total number of people reported killed (2003–2012)	Total number of people reported affected (2003–2012)	Total number of people reported killed (2012)	Total number of people reported affected (2012)
AFRICA	**39,148**	**260,598,810**	**38,997**	**303,910,050**	**3,028**	**42,674,985**
Algeria	1,568	111,903	3,160	364,846	83	103
Angola	1,364	329,321	646	2,867,503	16	1,839,500
Benin	126	834,283	375	1,182,578	21	55,000
Botswana	23	144,276	n.a.	10,016	n.d.r.	n.d.r.
Burkina Faso	28	239,940	475	6,170,007	53	2,871,030
Burundi	59	1,989,349	444	6,917,372	n.d.r.	n.d.r.
Cameroon	637	6,234	856	92,706	25	51,980
Cape Verde	18	46,306	60	1	n.d.r.	n.d.r.
Central African Republic	126	80,396	245	79,775	28	3,893
Chad	131	1,886,977	175	7,358,763	20	2,213,631
Comoros	256	n.a.	486	352,085	40	65,156
Congo, Democratic Republic of the	1,785	240,347	3,663	231,689	110	4,535
Congo, Republic of	567	131,631	473	109,904	337	22,967
Côte d'Ivoire	406	290	277	114,064	36	n.a.
Djibouti	146	341,125	196	1,523,339	n.d.r.	n.d.r.
Egypt	2,356	170,379	2,627	7,828	92	66
Equatorial Guinea	2	850	103	4,450	n.d.r.	n.d.r.
Eritrea[1]	133	10,815,725	56	4,007,043	n.d.r.	n.d.r.
Ethiopia[1]	905	24,362,532	1,504	67,491,824	n.a.	5,805,679
Gabon	44	n.a.	94	80,421	1	77,845
Gambia	63	37,250	61	498,746	n.a.	428,000

TABLE 13 Total number of people reported killed and affected by disasters by country and territory (1993–2002; 2003–2012; and 2012)

	Total number of people reported killed (1993–2002)	Total number of people reported affected (1993–2002)	Total number of people reported killed (2003–2012)	Total number of people reported affected (2003–2012)	Total number of people reported killed (2012)	Total number of people reported affected (2012)
Ghana	603	1,170,969	630	661,674	10	n.a.
Guinea	366	226,161	437	135,291	110	54
Guinea Bissau	217	103,222	169	90,956	29	n.a.
Kenya	1,778	98,687,487	1,880	30,616,421	101	4,030,670
Lesotho	1	1,165,251	66	2,910,590	n.a.	725,515
Liberia	70	7,000	15	536,926	n.d.r.	n.d.r.
Libya	174	28	647	125	55	n.a.
Madagascar	652	3,725,669	1,171	6,963,135	112	335,599
Malawi	689	25,173,229	241	13,410,256	51	2,023,085
Mali	119	34,776	284	9,802,370	n.a.	3,500,000
Mauritania	169	2,544,394	183	4,188,061	10	700,025
Mauritius	8	4,350	13	n.a.	n.d.r.	n.d.r.
Mayotte (FR)	n.d.r.	n.d.r.	54	12	33	n.a.
Morocco	1,647	939,827	1,517	140,271	80	7,537
Mozambique	1,718	9,129,978	626	6,629,763	33	109,958
Namibia	19	726,409	264	1,424,950	n.a.	650
Niger	174	7,317,941	208	28,850,550	91	3,530,952
Nigeria	7,419	923,165	5,721	9,043,950	764	7,016,007
Reunion (FR)	16	3,700	2	90	n.d.r.	n.d.r.
Rwanda	325	1,977,951	193	5,046,245	5	11,160
Saint Helena (GB)	n.a.	300	n.d.r.	n.d.r.	n.d.r.	n.d.r.

TABLE 13 Total number of people reported killed and affected by disasters by country and territory (1993–2002; 2003–2012; and 2012)

	Total number of people reported killed (1993–2002)	Total number of people reported affected (1993–2002)	Total number of people reported killed (2003–2012)	Total number of people reported affected (2003–2012)	Total number of people reported killed (2012)	Total number of people reported affected (2012)
Sao Tome and Principe	n.d.r.	n.d.r.	33	34	n.d.r.	n.d.r.
Senegal	1,509	881,986	383	2,217,002	52	907,032
Seychelles	5	8,037	3	4,830	n.d.r.	n.d.r.
Sierra Leone	865	200,025	569	21,285	n.d.r.	n.d.r.
Somalia	2,729	4,020,689	904	15,522,969	86	32,205
South Africa	2,146	531,292	1,319	15,435,348	100	126,431
South Sudan, Republic of[2]			47	157,000	47	157,000
Sudan	1,118	8,471,224	1,313	13,388,931	136	3,335,418
Swaziland	30	1,507,059	25	906,685	n.d.r.	n.d.r.
Tanzania	2,241	15,255,619	1,215	9,992,067	154	1,000,140
Togo	3	291,905	168	299,785	n.d.r.	n.d.r.
Tunisia	61	137	656	34,203	n.d.r.	n.d.r.
Uganda	971	3,245,117	1,197	5,038,658	47	18,436
Zambia	252	3,203,389	410	3,633,317	45	80
Zimbabwe	311	27,351,410	458	17,341,340	15	1,667,646
AMERICAS	**79,105**	**59,148,667**	**257,309**	**89,805,408**	**2,060**	**5,582,255**
Anguilla (GB)	n.a.	150	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Antigua and Barbuda	6	11,684	n.a.	30,800	n.d.r.	n.d.r.
Argentina	478	731,982	615	470,255	106	20,352
Aruba (NL)	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Bahamas	1	n.a.	93	30,582	25	4
Barbados	0	2,000	1	3,381	n.d.r.	n.d.r.

TABLE 13 Total number of people reported killed and affected by disasters by country and territory (1993–2002; 2003–2012; and 2012)

	Total number of people reported killed (1993–2002)	Total number of people reported affected (1993–2002)	Total number of people reported killed (2003–2012)	Total number of people reported affected (2003–2012)	Total number of people reported killed (2012)	Total number of people reported affected (2012)
Belize	75	145,170	11	68,000	n.d.r.	n.d.r.
Bermuda	18	n.a.	4	n.a.	n.d.r.	n.d.r.
Bolivia	734	857,936	840	2,230,107	43	69,105
Brazil	2,068	21,425,712	3,639	7,881,055	89	224,029
Canada	471	83,768	79	40,276	11	1,500
Cayman Islands (GB)	n.a.	300	2	n.a.	n.d.r.	n.d.r.
Chile	312	601,200	890	3,070,260	10	29,799
Colombia	3,118	2,122,711	2,611	12,783,727	114	128,697
Costa Rica	135	909,129	134	432,745	8	10,285
Cuba	301	8,768,851	289	3,703,327	14	123,496
Dominica	16	5,891	2	7,870	n.d.r.	n.d.r.
Dominican Republic	773	1,026,195	1,282	458,201	61	57,104
Ecuador	1,251	492,162	401	992,145	61	71,984
El Salvador	1,884	2,086,201	588	502,128	n.d.r.	n.d.r.
Falkland Islands (GB)	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.
French Guiana (FR)	n.a.	70,000	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Greenland (DK)	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Grenada	n.a.	210	40	61,650	n.d.r.	n.d.r.
Guadeloupe (FR)	24	899	1	153	n.d.r.	n.d.r.
Guatemala	1,059	348,530	2,294	5,787,416	44	1,598,227
Guyana	10	1,252,600	34	409,774	n.d.r.	n.d.r.

TABLE 13 Total number of people reported killed and affected by disasters by country and territory (1993–2002; 2003–2012; and 2012)

	Total number of people reported killed (1993–2002)	Total number of people reported affected (1993–2002)	Total number of people reported killed (2003–2012)	Total number of people reported affected (2003–2012)	Total number of people reported killed (2012)	Total number of people reported affected (2012)
Haiti	4,168	1,649,265	229,643	5,191,138	157	236,362
Honduras	15,292	3,082,665	950	1,015,197	379	125,596
Jamaica	27	31,872	57	621,066	1	215,850
Martinique (FR)	2	3,610	3	106	n.d.r.	n.d.r.
Mexico	3,723	2,934,635	1,532	11,517,840	124	136,079
Montserrat (GB)	32	13,000	n.a.	200		
Netherlands Antilles (NL)	17	40,004	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Nicaragua	3,533	1,765,274	405	559,986	9	29,500
Panama	53	40,170	137	115,785	6	9,448
Paraguay	168	525,354	419	1,954,625	5	1,495,945
Peru	3,015	2,633,302	3,960	8,546,855	427	894,662
Puerto Rico (US)	120	164,885	43	9,790	n.a.	n.a.
Saint Kitts and Nevis	5	12,980	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Saint Lucia	4	1,125	11	3,000	n.d.r.	n.d.r.
Saint Pierre et Miquelon (FR)	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Saint Vincent and The Grenadines	4	100	n.a.	7,909	n.d.r.	n.d.r.
Suriname	10	n.a.	25	31,548	n.d.r.	n.d.r.
Trinidad and Tobago	5	627	3	1,760	n.d.r.	n.d.r.
Turks and Caicos Islands (GB)	43	n.a.	89	1,818	n.d.r.	n.d.r.
United States	5,489	4,563,121	5,423	20,955,135	318	93,151
Uruguay	99	27,347	48	144,220	n.d.r.	n.d.r.
Venezuela	30,552	706,047	711	163,578	48	11,080

TABLE 13 Total number of people reported killed and affected by disasters by country and territory (1993–2002; 2003–2012; and 2012)

	Total number of people reported killed (1993–2002)	Total number of people reported affected (1993–2002)	Total number of people reported killed (2003–2012)	Total number of people reported affected (2003–2012)	Total number of people reported killed (2012)	Total number of people reported affected (2012)
Virgin Islands (GB)	n.a.	3	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Virgin Islands (US)	10	10,000	n.a.	n.a.	n.d.r.	n.d.r.
ASIA	**809,565**	**2,573,218,592**	**705,691**	**1,765,397,512**	**8,481**	**89,815,484**
Afghanistan	10,249	8,432,885	4,341	4,695,613	429	51,501
Armenia	85	3,819,954	1	n.a.	n.d.r.	n.d.r.
Azerbaijan	596	2,446,611	56	128,999	5	22,499
Bahrain	143	n.a.	79	60	10	0
Bangladesh	9,988	66,524,324	12,562	75,433,641	712	5,701,490
Bhutan	239	66,600	24	20,028	n.d.r.	n.d.r.
Brunei Darussalam	n.a.	n.a.	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Cambodia	1,148	25,446,614	731	2,547,015	14	71,500
China, People's Republic of[3,4]	35,500	1,313,651,642	114,500	1,279,546,748	1,092	44,605,865
Georgia	222	1,412,890	13	118,282	5	106,036
Hong Kong (China)[3]	191	6,802	99	19,266	38	100
India	78,492	818,564,227	41,045	161,623,479	1,026	4,281,193
Indonesia	7,789	8,096,162	182,343	10,802,610	295	52,630
Iran, Islamic Republic of	6,289	113,517,411	30,517	864,749	391	68,350
Iraq	113	7	1,564	74,746	4	n.a.
Israel	106	1,897	77	20,250	n.d.r.	n.d.r.
Japan	6,462	1,863,685	21,320	1,454,108	186	102,288
Jordan	114	330,577	65	85	n.d.r.	n.d.r.

TABLE 13 Total number of people reported killed and affected by disasters by country and territory (1993–2002; 2003–2012; and 2012)

	Total number of people reported killed (1993–2002)	Total number of people reported affected (1993–2002)	Total number of people reported killed (2003–2012)	Total number of people reported affected (2003–2012)	Total number of people reported killed (2012)	Total number of people reported affected (2012)
Kazakhstan	247	644,216	300	134,569	43	14,400
Korea, Democratic People's Republic of	610,678	74,434,811	1,641	4,813,221	147	3,137,550
Korea, Republic of	2,474	641,598	1,043	192,955	27	6,298
Kuwait	2	200	44	76	n.d.r.	n.d.r.
Kyrgyzstan	228	69,660	308	2,047,968	16	11,050
Lao People's Democratic Republic	193	3,274,525	80	800,077	n.d.r.	n.d.r.
Lebanon	10	527	173	17,082	n.d.r.	n.d.r.
Macau (China)[4]	n.a.	3,986	n.a.	133	n.d.r.	n.d.r.
Malaysia	831	109,368	214	476,444	n.d.r.	n.d.r.
Maldives	10	n.a.	133	28,963	n.d.r.	n.d.r.
Mongolia	238	3,370,061	115	2,219,884	n.d.r.	n.d.r.
Myanmar	560	362,368	139,376	3,247,580	40	86,486
Nepal	3,901	1,149,070	2,623	2,852,705	141	27,072
Oman	53	91	169	20,224	n.d.r.	n.d.r.
Pakistan	6,577	16,141,380	82,081	49,095,176	1,125	5,050,613
Palestine (West Bank and Gaza)[5]	14	20	5	2,765	n.a.	1,500
Philippines	7,805	35,935,720	14,139	68,621,776	2,427	12,528,291
Qatar	n.d.r.	n.d.r.	49	n.a.	19	n.a.
Saudi Arabia	965	2,044	1,284	24,674	67	165
Singapore	n.a.	1,317	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Sri Lanka	603	5,437,648	36,011	8,139,533	53	2,316,021

TABLE 13 Total number of people reported killed and affected by disasters by country and territory (1993–2002; 2003–2012; and 2012)

	Total number of people reported killed (1993–2002)	Total number of people reported affected (1993–2002)	Total number of people reported killed (2003–2012)	Total number of people reported affected (2003–2012)	Total number of people reported killed (2012)	Total number of people reported affected (2012)
Syrian Arab Republic	322	668,377	211	3,900,410		
Taiwan (China)	3,545	1,166,212	967	2,360,344	32	35,060
Tajikistan	303	6,330,790	268	3,310,336	3	8,087
Thailand	2,415	29,458,501	10,390	59,656,977	12	9,735,674
Timor-Leste[6]	1	2,508	4	11,177	n.d.r.	n.d.r.
Turkmenistan	51	420	15	n.a.	n.d.r.	n.d.r.
United Arab Emirates	140	139	65	8	n.d.r.	n.d.r.
Uzbekistan	131	1,223,988	73	5,116	n.d.r.	n.d.r.
Viet Nam	8,572	28,318,206	3,291	14,598,372	107	356,535
Yemen	970	288,553	1,282	1,469,288	15	1,437,230
EUROPE	**36,237**	**38,577,692**	**145,774**	**6,422,643**	**1,704**	**580,553**
Albania	11	205,484	93	670,932	18	230,020
Austria	283	70,494	378	1,421	5	n.a.
Azores (PT)	74	1,215	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Belarus	61	63,468	36	1,981	n.a.	130
Belgium	77	5,289	2,198	1,332	3	0
Bosnia and Herzegovina	62	10,504	25	402,662	4	10,347
Bulgaria	47	6,959	142	52,145	38	38,160
Canary Islands (ES)	23	730	145	550	n.d.r.	n.d.r.
Croatia	87	4,000	828	2,916	7	1,500
Cyprus	59	3,057	48	110	n.d.r.	n.d.r.

TABLE 13 Total number of people reported killed and affected by disasters by country and territory (1993–2002; 2003–2012; and 2012)

	Total number of people reported killed (1993–2002)	Total number of people reported affected (1993–2002)	Total number of people reported killed (2003–2012)	Total number of people reported affected (2003–2012)	Total number of people reported killed (2012)	Total number of people reported affected (2012)
Czech Republic	74	302,171	546	20,315	32	n.a.
Denmark	8	n.a.	5	2,072	n.d.r.	n.d.r.
Estonia	934	170	14	100	1	n.a.
Finland	11	33	24	415	n.d.r.	n.d.r.
France	688	3,566,459	21,226	541,130	12	n.a.
Germany	390	566,456	9,586	2,818	20	9
Gibraltar (GB)	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Greece	544	161,356	439	15,344	33	200
Hungary	191	147,236	696	42,470	16	n.a.
Iceland	34	282	n.a.	n.a.	n.d.r.	n.d.r.
Ireland	45	4,500	2	800	n.d.r.	n.d.r.
Isle of Man (GB)	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Italy	937	128,767	21,123	90,942	136	26,764
Latvia	27	n.a.	65	n.a.	10	n.a.
Lithuania	70	780,000	64	n.a.	30	n.a.
Luxembourg	20	n.a.	170	n.a.	n.d.r.	n.d.r.
Macedonia, Former Yugoslav Republic of	223	13,171	35	1,113,593	1	5,100
Malta	283	n.a.	112	31	n.d.r.	n.d.r.
Moldova	62	2,655,037	38	246,098	21	13,204
Montenegro[7]	n.d.r.	n.d.r.	1	13,636	1	5,300
Netherlands	142	268,294	1,996	133	13	117

TABLE 13 Total number of people reported killed and affected by disasters by country and territory (1993–2002; 2003–2012; and 2012)

	Total number of people reported killed (1993–2002)	Total number of people reported affected (1993–2002)	Total number of people reported killed (2003–2012)	Total number of people reported affected (2003–2012)	Total number of people reported killed (2012)	Total number of people reported affected (2012)
Norway	270	6,130	22	612	n.d.r.	n.d.r.
Poland	984	240,968	1,242	107,315	214	370
Portugal	134	3,602	2,842	151,163	n.d.r.	n.d.r.
Romania	444	248,688	676	148,167	86	7,539
Russian Federation	7,275	2,988,969	59,021	1,192,996	520	49,029
Serbia[7]	128	79,716	34	136,244	25	88,234
Serbia-Montenegro[7]	n.d.r.	n.d.r.	63	40,569	n.d.r.	n.d.r.
Slovakia	74	48,015	201	11,637	5	n.a.
Slovenia	n.a.	700	309	13,655	n.a.	12,000
Spain	602	18,071,668	15,637	24,886	14	641
Sweden	67	162	7	n.a.	n.d.r.	n.d.r.
Switzerland	134	6,803	1,098	5,611	39	n.a.
Turkey	19,750	5,216,674	2,454	535,422	183	49
Ukraine	585	2,408,644	1,733	440,346	209	88,055
United Kingdom	323	291,821	400	390,074	8	3,785
OCEANIA	**3,482**	**31,745,999**	**2,149**	**1,868,876**	**433**	**258,229**
American Samoa (US)	n.d.r.	n.d.r.	40	25,563	n.d.r.	n.d.r.
Australia	385	29,656,944	815	471,757	79	16,000
Cook Islands (NZ)	19	1,644	n.a.	2,810	n.d.r.	n.d.r.
Fiji	80	428,730	84	118,408	17	27,945
French Polynesia (FR)	13	511	21	3,411	n.d.r.	n.d.r.

TABLE 13 Total number of people reported killed and affected by disasters by country and territory (1993–2002; 2003–2012; and 2012)

	Total number of people reported killed (1993–2002)	Total number of people reported affected (1993–2002)	Total number of people reported killed (2003–2012)	Total number of people reported affected (2003–2012)	Total number of people reported killed (2012)	Total number of people reported affected (2012)
Guam (US)	229	21,635	1	300	n.d.r.	n.d.r.
Kiribati	n.a.	84,000	n.a.	85	n.d.r.	n.d.r.
Marshall Islands	n.d.r.	n.d.r.	n.a.	600	n.d.r.	n.d.r.
Micronesia, Federated States of	47	30,423	1	7,008	n.d.r.	n.d.r.
Nauru	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.	n.d.r.
New Caledonia (FR)	n.a.	n.a.	2	1,100	n.d.r.	n.d.r.
New Zealand	4	3,417	271	609,676	14	457
Niue (NZ)	n.d.r.	n.d.r.	1	702	n.d.r.	n.d.r.
Northern Mariana Islands (US)	n.a.	300	3	200	n.d.r.	n.d.r.
Palau	1	12,004	n.d.r.	n.d.r.	n.d.r.	n.d.r.
Papua New Guinea	2,527	1,355,351	584	501,357	311	200,000
Samoa	n.a.	n.a.	165	13,324	12	7,739
Solomon Islands	4	89,990	75	32,378	n.a.	4,836
Tokelau (NZ)	n.d.r.	n.d.r.	n.a.	26	n.d.r.	n.d.r.
Tonga	n.a.	23,071	84	561	n.d.r.	n.d.r.
Tuvalu	18	150	n.a.	n.a.	n.d.r.	n.d.r.
Vanuatu	150	37,809	2	78,358	n.d.r.	n.d.r.
Wallis and Futuna (FR)	5	20	n.a.	1,252	n.a.	1,252
World	**967,537**	**2,963,289,760**	**1,149,920**	**2,167,404,489**	**15,706**	**138,911,506**

Source: EM-DAT, CRED, University of Louvain, Belgium

[1] Prior to 1993, Ethiopia was considered one country, after this date separate countries: Eritrea and Ethiopia.

[2] In July 2011, South Sudan separated from Sudan and became an independent country.

[3] Since July 1997, Hong Kong has been included in China as a Special Administrative Region (SAR).

[4] Since December 1999, Macau has been included in China as a Special Administrative Region (SAR).

[5] Since September 1993 and the Israel-PLO Declaration of Principles, the Gaza Strip and the West Bank have a Palestinian self-government. Direct negotiations to determine the permanent status of these territories began in September 1999 but are far from a permanent agreement.

[6] Since May 2002, Timor-Leste has been an independent country.

[7] Until 2006, Serbia and Montenegro formed first the Federal Republic of Yugoslavia followed by a more decentralized state union named Serbia and Montenegro. In 2006, Montenegro proclaimed its independence.

Notes: Some totals in this table may not correspond due to rounding. In this table, n.a. signifies 'no data available' and n.d.r., 'no disaster reported'. For more information, see the section on caveats in the introductory text to this annex.

Over the last decade, the highest numbers of deaths per continent were reported in Nigeria (Africa), Haiti (the Americas), Indonesia (Asia), the Russian Federation (Europe) and Australia (Oceania). The highest numbers of disaster-affected people per continent were reported in Kenya (Africa), the United States of America (the Americas), China (Asia), the Russian Federation (Europe) and Papua New Guinea (Oceania). Compared to 1992–2003, the past decade has seen the number of deaths caused by disasters rise by 19 per cent; the number of people affected by disasters, however, has decreased by 27 per cent.

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The Fundamental Principles of the International Red Cross and Red Crescent Movement

Humanity The International Red Cross and Red Crescent Movement, born of a desire to bring assistance without discrimination to the wounded on the battlefield, endeavours, in its international and national capacity, to prevent and alleviate human suffering wherever it may be found. Its purpose is to protect life and health and to ensure respect for the human being. It promotes mutual understanding, friendship, cooperation and lasting peace among all peoples.

Impartiality It makes no discrimination as to nationality, race, religious beliefs, class or political opinions. It endeavours to relieve the suffering of individuals, being guided solely by their needs, and to give priority to the most urgent cases of distress.

Neutrality In order to continue to enjoy the confidence of all, the Movement may not take sides in hostilities or engage at any time in controversies of a political, racial, religious or ideological nature.

Independence The Movement is independent. The National Societies, while auxiliaries in the humanitarian services of their governments and subject to the laws of their respective countries, must always maintain their autonomy so that they may be able at all times to act in accordance with the principles of the Movement.

Voluntary service It is a voluntary relief movement not prompted in any manner by desire for gain.

Unity There can be only one Red Cross or Red Crescent Society in any one country. It must be open to all. It must carry on its humanitarian work throughout its territory.

Universality The International Red Cross and Red Crescent Movement, in which all societies have equal status and share equal responsibilities and duties in helping each other, is worldwide.

World Disasters Report 2013

Focus on technology and the future of humanitarian action

This year's *World Disasters Report* focuses on technology and the future of humanitarian action. The report explores the ways in which information and communication technologies assist international and national actors, governments, civil society organizations and communities at risk to prevent, mitigate and prepare for the impact of a disaster and, in its aftermath, respond, recover and rebuild affected areas. The report examines how technologies can help put communities at the centre of humanitarian action and considers the challenges and limitations, including the diminishing direct interaction between aid workers and communities at risk, and the emergence of new actors who are not necessarily grounded in humanitarian principles and ethical guidelines. It also argues for a more systematic evaluation of the contribution of technology to humanitarian action.

The *World Disasters Report 2013* features:
- Humanitarian technology
- Community-centred humanitarian action
- Innovations in humanitarian information
- Technology and humanitarian effectiveness
- Risks and challenges of humanitarian technology
- Technology and humanitarian principles
- Evaluation and diffusion of humanitarian technology
- Disaster data

“*Technology is transforming the world – and how people cope with disasters – in ways we are only beginning to understand. Humanitarian agencies recognize that as our operating environment changes, so must we. This World Disasters Report contains a lot for us to think about and reminds us that the driving force behind change is not technology, but people.*”

Valerie Amos,
United Nations Under-Secretary-General for Humanitarian Affairs
and Emergency Relief Coordinator

“*The era of hyperconnectivity presents the human race with an invaluable opportunity to boost its resilience to natural disasters. By harnessing the constructive power of ICT, we can better manage preparedness, mitigate loss and in so doing help empower vulnerable populations against some of nature's harshest effects.*”

Klaus Schwab,
Founder and Executive Chairman, World Economic Forum

Published annually since 1993, the *World Disasters Report* brings together the latest trends, facts and analysis of contemporary crises and disasters.

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