Applying Technology to Crisis Mapping and Early Warning in Humanitarian Settings

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ABOUT THE HARVARD HUMANITARIAN INITIATIVE

The Harvard Humanitarian Initiative (HHI) is a university-wide center involving multiple entities within the Harvard community that provide expertise in public health, medicine, social science, management, and other disciplines to promote evidence-based approaches to humanitarian assistance.The mission of the Initiative is to relieve human suffering in war and disaster by advancing the science and practice of humanitarian response worldwide. Harvard Humanitarian Initiative fosters interdisciplinary collaboration in order to:

- Improve the effectiveness of humanitarian strategies for relief protection and prevention;
- Instill human rights principles and practices in these strategies;
- Educate and train the next generation of humanitarian leaders.

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INTRODUCTION

The purpose of this Working Paper on Crisis Mapping is to briefly analyze the current use, and changing role, of information communication technology (ICT) in conflict early warning, crisis mapping and humanitarian response.[1] We demonstrate that ICTs have the potential to play an increasingly significant role in three critical ways by: facilitating the communication of information in conflict zones, improving the collection of salient quantitative and qualitative conflict data, and enhancing the visualization and analysis of patterns.

The Organization for Economic Co-operation and Development (OECD) recently carried out a major review of operational conflict early warning systems. In March 2009, the OECD published their findings in a comprehensive report entitled: "Can Violence be Prevented? The Future of Operational Conflict Early Warning and Response Systems." One of their main findings relevant to this Working Paper:

Technological advancements have played an important role in improving the efficiency and effectiveness of early warning systems. Most inter-governmental and non-governmental systems, however, have not gone beyond the use of email and websites for dissemination, and communication technology for data collection. Governmental and some inter-governmental systems do benefit from access and resources to use satellite and GIS[2] in their analysis and reporting. However, access to technology remains very unequal between systems. Existing analytical tools fundamentally over-simplify complex and fluid violent conflicts and situations of state fragility. They vide simple snap-shots that are quickly outdated and the quality of analysis suffers from data deficits.

This working paper will draw on the same conceptual framework to identify the cutting edge developments in our field, the lessons learned, and the best practices. This framework takes into account the "big world" and "small world" context.

The "big world" denotes a Western governmental, institutional and top-down perspective while the "small world" describes a Southern, local community perspective with associated capabilities and agendas. The parallel big-world-small-world approach also serves to shed light on how both "worlds" can connect and inform each other with the use of appropriate protocols, platforms and interoperable technologies.

In this paper, we discuss six critical information pathways relevant for conflict early warning, crisis mapping and humanitarian response. As depicted in Figure 1, pathways exist: (1) between "big world" headquarters and their offices in the field; (2) among "big world" field-offices; (3) between "big world" field-offices and "small world" organizations and affected populations; (4) among "small world" organizations; (5) between "small world" organizations and affected populations; and (6) between or within "small world" affected populations themselves.

The impact of the information revolution on each of these pathways is more extensive than ever before. The diffusion of ICTs coupled with new ICT-enabled participation will further expand and shift these pathways from unidirectional information flows to two-way and peer-to-peer networked modes of information exchange. The potential impact on conflict early warning, crisis mapping and humanitarian response is significant, and raises important questions for the

1 Research used to write the papers in this working paper series on crisis mapping was generously supported by grants from Humanity United.

2 GIS refers to Geographic Information Systems which store, integrate, analyze and display geographic information.

organization of formal response.[3] The challenges and opportunities are no less significant.

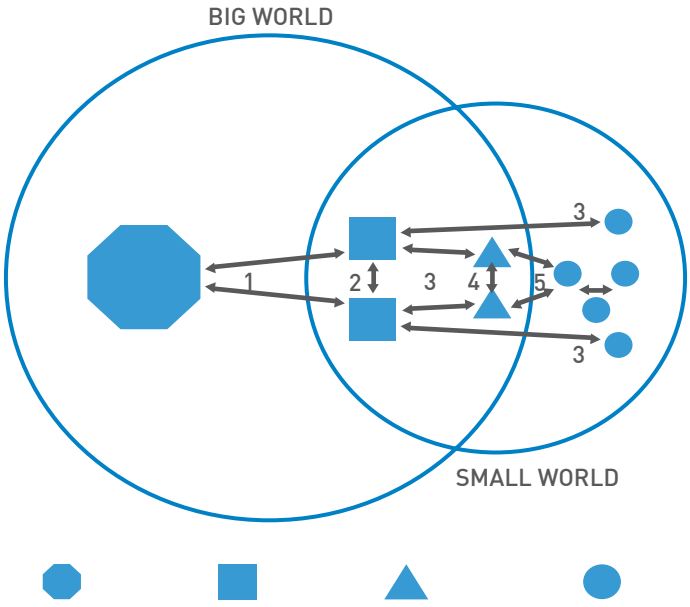
By analyzing the varied uses of ICTs in fields that are typically early and/or creative adopters of technology, this study seeks to identify their applicability to our own field in the hopes that these technologies might improve the impact of our own work on conflict early warning, crisis mapping and humanitarian response.

This first working paper will address the use of ICTs for communication purposes in conflict zones. The second and third working paper in the series will address information collection and visual analysis respectively. Each working paper will highlight existing projects or case studies; draw on informative anecdotes; and/or relay the most recent thinking on future applications of ICTs.

This working paper is not meant to be exhaustive since humanitarian technology as a field of study and practice is still in formative phases. The analysis that follows is simply one step forward in trying to understand where the field is headed. We very much welcome feedback and input from fellow colleagues in the community.

The communication of information is a necessary and critical component of any conflict early warning, crisis mapping and humanitarian response initiative. Indeed, "Communicating in Crises" was one of the four Working Groups set up at the OCHA[4] Symposium on Information for Humanitarian Action in 2007. In this section, we first identify recent examples of modern communication technologies in action. We then articulate the most significant challenges posed by adopting and using these ICTs. In the third section, we outline potential solutions that may address some of these challenges. The section concludes with a summary of the main findings. Throughout, we draw on the "big-world-small-world" framework outlined in the introduction to this series.

FIGURE 1: The "big world" and "small world" conceptual



3 Leysia Palen and Sophia Liu (2007). "Citizen Communications in Crisis: Anticipating the Future of ICT-Supported Public Participation," CHI Proceedings, April 28 – May 3, San Jose, California.

4 The UN Office for the Coordination of Humanitarian Affairs

EXAMPLES OF ICT IN ACTION

1 | Big World Examples

The United Nation's World Food Program (WFP) is the largest field-based humanitarian agency in the world. Together with the Office of the United Nations High Commissioner for Refugees (UNHCR), WFP sent over 10,000 text messages during Fall 2007 to communicate information on relief operations to some 50,000 Iraqi refugees in Syria. Shortly thereafter, WFP announced a formal partnership with Vodafone to overhaul the WFP's existing emergency telecommunication systems.

This example is important because it highlights the increasingly critical role of communication technology in the "big world" vis-à-vis direct communication with affected populations (pathway 3 in Figure 1). The agency's new partnership with Vodafone will lead to more systematic use of "SMS broadcasting" as a means to enable direct communication with beneficiaries. Furthermore, since SMS allows for two-way communication, future broadcasts may also allow affected communities to participate directly with the "big world" in relief efforts.

2 | Small World Examples

During the post-election violence in Kenya during January of 2008, the national broadcast and print media rarely relayed current and specific information on the unfolding violence. Instead, this communication gap was filled by some 800 bloggers who communicated the unfolding violence via blog posts, pictures, YouTube videos and Twitter updates. Many of these bloggers took to the streets to observe the developments with their own eyes. As early as 6:00 am on the day of the election, some bloggers began to report concerns over voting irregularities.

In the Democratic Republic of the Congo (DRC), a local initiative to help child soldiers defect would have been impossible to coordinate without the use of mobile phones and SMS by local villagers. As militias entered villages, word would quickly spread to identify which child soldiers were looking to defect.

These instances of innovative use of mobile phones and blogs suggest the potential for these new technologies to support grass roots movements for social activism and citizen journalism.

CHALLENGES OF ICT IN CRISIS SETTINGS

Communication in crisis zones does face two very real and important challenges. The first challenge is access to communication technology. Access is most often limited due to political imperatives and lack of economic development. The second challenge is security, both in terms of field-security and data-security. (Data validation will be addressed in the second working paper). These challenges affect the "big world" and the "small world" in similar and different ways. Note that these challenges necessarily pose constraints on data collection as well.

1 | Big World Challenges

From the perspective of the "big world" interest in promoting the uses of ICT for understanding and responding to crises, the major challenges of access and security arise from the lack of economic development, the prevalence of oppressive regimes, and the increasingly hostile environment for humanitarian aid workers throughout the developing world.

Access to communication technologies during crises in the developing world is often constrained by limited economic development. The lack of information communication infrastructure as well as basic (and reliable) utility infrastructure in developing countries presents important limitations for the widespread use of ICTs. For example, the lack of broadband access or limited mobile phone coverage beyond state capitals presents important hurdles for real-time and sustained communication from the "big world" to the areas in crisis as well as blocks or severely limits information flow from the affected region out to the "big world."

Political factors and territorial sovereignty continue to constrain and define the scope and timing of humanitarian response efforts. Access to communication technologies becomes an important problem when repressive regimes, such as the military junta in Myanmar, restrict the use of VSATS[1] and BGANS[2] in humanitarian relief operations. Télécoms Sans Frontièrs (TSF), was forced to leave Burma during the relief efforts following Cyclone Nargis since they were not allowed to deploy these technologies. The government of Sudan regularly switches off the mobile phone network when authorities are engaged in activities that the government does not want reported. Since the invasions of Afghanistan and Iraq, ensuring the security of humanitarian workers in the field has proven to be more challenging than ever and communications between and among field workers, their local agencies, and their "big world" headquarters is closely monitored and viewed with high suspicion. Communicating any kind of information the local authorities or the regime considers sensitive information places humanitarian workers in further danger. In the Sudan, humanitarian and human rights workers have managed to bring or send important information out of the country but often at great personal risk.

It is unclear how advanced and effective some repressive regimes are in acquiring and using surveillance technologies. However, the most comprehensive empirical study on state censorship and surveillance of the Internet published in 2008 suggests that regimes are becoming increasingly savvy in their ability to control and monitor communication.[5] Furthermore, repressive regimes have recourse to both technical and nontechnical means of limiting communication — namely intimidation and imprisonment.

2 | Small World Challenges

From the standpoint of using ICTs to support information flow in the "small world," the challenges of access and security are more pronounced. Access is greatly limited by social and economic factors. The most widely spread information communication technology in the developing world continues to be the radio — because radios are cheaper, easier to fix and more robust. However, mobile phones are becoming increasingly widespread in developing countries and developing countries now account for the majority of mobile phone subscribers worldwide. Internet use in developing countries is also expected to increase substantially in the next two years albeit at a much slower pace than mobile phones.

1 VSAT refers to a Very Small Aperture Terminal, a small two way satellite ground station with a dish antenna that transmits narrowband data such as polling, radio frequency identification and credit card transactions, or broadband data such as internet.

2 BGAN refers to the Broadband Global Area Network, a global satellite internet network enlisting portable terminals usually used to connect laptops to broadband internet in remote areas.

5 Deibert, Ronald; Palfrey, John; Rohozinski, Rafal and Jonathan Zittrain. 2008. Access Denied: The Practice and Policy of Global Internet Filtering (The MIT Press).

An important impediment, however, continues to be the combination of limited access to electricity and cheap, efficient rechargeable batteries. In fact, wiring "the last mile" is largely a problem of electricity, according to communication technology experts. In Zimbabwe, for example, near-daily power outages followed by power surges make using the Web an unreliable tool for communication. Mobile phone services are also highly inconsistent with some mobile phone users reporting that text messages can sometimes take hours to send.

Access to communication technology, and communication itself, is also restricted for political purposes. In Zimbabwe, Internet cafes and radio stations are all closely monitored and controlled by the regime. The same is true of Ethiopia. In

Timor-Leste, the government maintains a monopoly over the mobile phone network and has little incentive to add coverage beyond the capital city from which the state-owned company derives the majority of the profit. In Burma, the military junta closely controls the sale of SIM cards and prices of mobile phones.

In terms of security, radio broadcasts can often be traced to a specific location, which places activists in danger. Mobile phones are even easier to trace, either by technical means of triangulation or via state sanctioned regulations, which oblige users to register their phones. In Lebanon, efforts to use SMS as part of a community-based conflict early warning and response initiative have met considerable resistance due to concerns about personal security. The individuals involved in the project do not feel safe using text messages because multiple groups, governments and intelligence organizations regularly intercept
this type of communication. To this end, the local implementing partner of the early warning project is very resistant to using SMS unless security and protection of their network is assured.

In sum, access and security present important challenges in big and small worlds. The question is whether there is reason to be optimistic that these challenges can be met with technical and/or tactical solutions.

POTENTIAL SOLUTIONS

The following section presents the results of a critical inventory of existing communication technologies and their potential capacity to meet the challenges that have been identified. The findings are somewhat positive but we note the persistent real problems, related to access and security, that still block timely and substantive communication from Small World zones to the Big World during periods of active conflict or in circumstances of severe political oppression.

1 | Big World Potential Solutions

In this section, we address the ways in which the Big World can make use of technologies that could potentially resolve some of the "small world" communication challenges. In general, ICTs tend to be more useful for communication purposes when they are mobile. Mobile technologies are typically linked to a relatively distributed and decentralized communication network. This feature means that mobile ICTs are not prone to a single point of failure. Here we address the following mobile or distributed forms of ICTs: walkie-talkies, radios, Internet, Skype, and satellite communication such as satellite phones.

Walkie-Talkies Commercially available walkie-talkies have become increasingly more sophisticated with time, but the average range of 25 square kilometers is still limiting and, as is the case for any devise-based communication technology, customs officials can confiscate the units at the port of entry.

Radios In situations where the UN is already present, the use of radio base stations such as Codans provides for secure countrywide communication. The Red Cross and Red Crescent, Oxfam, Care, Save the Children, Médecins Sans Frontières (MSF), and the International Organization for Migration (IOM), also use Codans. The radios are flexible and can interface with other communication mediums including VHF (very high frequency radio waves), UHF (ultra high frequency radio waves), satellite communication, and public telephone systems.

Internet If Internet communication is permitted and possible, then a number of information communication platforms are available. The Virtual On-Site Operations Coordination Centre (OSOCC), for example, is an operational platform maintained by UN OCHA that facilitates both communication and storage of (primarily) qualitative data. The main purpose of the platform is to facilitate decision-making for international response to major disasters though real-time information exchange by all actors in the international disaster response community. Users have the opportunity to create e-mail and SMS messages that are sent automatically to subscribers about critical situation updates during disaster response operations. Discussion forums are also available on Virtual OSOCC for any area of interest, including information exchange on best practice and lessons-learned after disaster response operations.

Skype Secure communication is allegedly possible via Skype — assuming, again, that access to the Internet is possible and permitted.[6] Only the National Security Agency (NSA) is said to possibly have enough computing power to decrypt Skype calls. Indeed, the German government has repeatedly expressed their frustration over the inability to intercept Skype conversations to crack down on organized crime. Skype uses a 256-bit long encryption key; a length that experts say would theoretically require a literal eternity to crack. However, some still speculate that Skype has a "back door" entry that allows third parties to intercept conversations.

Satellite Communication The most recent development in this technology is 10 kilo GSM mobile phone network developed by the EU funded project Wireless Infrastructure over Satellite for Emergency Communications (WISECOM) project. This technology enables rescue workers to set up communications with the world mobile and landline networks in a matter of minutes. The system works anywhere there is satellite coverage, i.e., almost everywhere in the world.

At the "big world" level, if a government renders the use of satellite communication technology illegal, humanitarians with satellite phones can (and many do) smuggle them across borders and then use the phones clandestinely at their own risk. If intercepted, customs officials at ports of entry will confiscate phones. Once inside, however, the technology can be used more easily without being detected. This tactic among organizations is one of the only real, albeit partial and unsatisfactory, solutions at the moment.

A possible alternative communication technology is the Ground Antenna Transmit and Receive, or GATR, an ultra-light inflatable satellite communication device with an ultraportable antenna encased inside. The GATR provides superfast broadband satellite connection at any location in a disaster zone. It is designed for disaster-relief responders who require digital information-video, Internet, and calls in and out of remote places. The device weighs about 70 pounds and fits into two backpacks. In addition, GATR can be powered

6 Not surprisingly, a number of repressive regimes block the Skype website to prevent individuals from downloading the software and registering an account.

by a car's cigarette lighter or a small generator. The technology was used at a Red Cross shelter following Hurricane Katrina and served as an electronic lifeline to the outside world.

However, for conflict zones there are obvious problems with the GATR in its current configuration. Its visible size (even when packed and then certainly when deployed in operational mode) and its weight make it impossible to bring into a country's port of entry without the permission of authorities. In addition, the current $50,000 price tag on GATRs makes it prohibitive even for many "big world" organizations.

2 | Small World Potential Solutions

In this section, we identify innovative technologies that may serve as potential solutions to "small world" challenges. These include: (1) technologies that can provide access to electricity in remote locations; and (2) the following communication technologies: Internet (blogs), radios, SMS, flash drives and "sneakernet." Tactical solutions to maintain personal security and data security are also addressed.

Chargers Limited social and economic development in crisis-prone regions means that access to communication technology is limited by access to electricity. A number of solutions to address this problem are just coming online, ranging from portable solar panel chargers and wind-up chargers to bicycle powered chargers and wind-powered chargers, although these are unlikely to become widely available any time soon. Nevertheless, they are important steps in the right direction.[7] Solutions for "small world" challenges are often more likely to be found at the local, community level as described below.

Internet (blogs) The violence in Kenya was documented by hundreds of bloggers armed with cameras and mobile phones. Their numerous blog entries were considerably more timely and informative than the national media. Because of the volume of information they were providing to the public, their accounts could be triangulated with other blogs and local media. However, Internet diffusion in Kenya is less than 5 percent. To this end, blog posts were regularly read on local broadcast radio stations, thus allowing for the wider dissemination of information to even the most rural corners of Kenya. Indeed, 90% of Kenyans have access to a radio.

Radios In Zimbabwe there are no independent radio stations and permits to broadcast information are required by law. Besides The *Herald,* a government newspaper, only the state-run television and radio stations provide daily news. Local communities are therefore rarely able to access independent news sources. To this end, SW Radio Africa broadcasts into Zimbabwe from London. The station does so on multiple frequencies to avoid being jammed by the government. Another example is the dial-up radio technology designed by activists in the US for specific use within Zimbabwe. The software program allows users to record and/or upload audio files that are then automatically made accessible via a dedicated telephone number. Mobile phones and regular fixed-line telephones can then be used to dial up access to the broadcasts.

SMS After radios, mobile phones are often the most prevalent technology used to communicate in the developing world. The use of SMS is particularly widespread, as recently witnessed during the post-election violence in Kenya. Toolkits such as Frontline SMS enable NGOs to run SMS campaigns directly from a computer. TXTmob is an open source program that also facilitates SMS broadcasting. These tools could be used in the future to facilitate mass communication in

7 India, for example, is installing solar-powered GSM systems for remote and rural areas.

crisis zones. It is important to recognize that integrated (or networked) technologies can also help to connect the "last mile." Zimbabweans themselves are increasingly turning to SMS in creative ways by integrating texting with radio broadcasts. SW Radio Africa, for example, sends text messages to some 25,000 listeners a day with thousands more subscribing every week. Furthermore, the communication pathway is not just one-way. The station uses a local phone number in Zimbabwe so listeners can send texts or leave voicemails without having to pay for international calls to the UK.

Flash Drives Access to information is often restricted for political reasons. In many countries with repressive regimes, Internet access is highly restricted and telephone conversations regularly surveyed. Communicating politically sensitive information is therefore a challenge. Some activists have therefore collaborated with a technology design initiative to develop flash drives (or thumb drives) with several innovative features. The flash drives developed can exchange data directly without requiring a computer. Because few have access to computers in some of these authoritarian states, the customized flash drive is also designed to be accessible via regular television sets. In other words, text-based documents and YouTube videos can be viewed on TV sets.

"Sneakernet" Such innovations are examples of what "sneakernet" can achieve. The term is used to describe the transfer of electronic information by physically carrying removable media from one machine to another. (Sneaker refers to the shoes of the person carrying the media). Another example of "sneakernet" is the use of cassette tapes in Zimbabwe. A number of Zimbabweans who do have access to international news have begun to copy the broadcasts on cassette tapes, which they then distribute to long-distance bus drivers. The latter play the tapes to bus occupants on long trips to distant towns and villages.

Field and data security Mobile phones can be easily traced. Activists and members of resistance groups therefore remove the batteries from their phones when not in use. Switching the phones off is not sufficient. They also use multiple SIM cards when engaged in tactical and strategic action. Unregistered SIM cards are easily bought on the parallel (black) market and are therefore not traceable to a particular individual. Other precautions include not adding any numbers to the phone's address book and frequently deleting text messages along with any call data.

In terms of secure SMS communication, CryptoSMS.org provides a free-and-open-source tool to encrypt text messages. Lastly, a tactic called "beeping" is also widely used across Africa, which simply consists of communicating simple messages by letting a phone ring a pre-designated number of times to indicate a specific message. The advantage of this practice is that "beeping" is free and cannot be traced.

SUMMARY AND CONCLUSION

ICTs have demonstrated the potential to markedly improve communication in crisis zones and enable multiple information pathways bridging the "big world" and "small world" context. The challenges of making ICTs more widespread for communication purposes are two-fold: access and security. Access to technology in countries facing unfolding crises is limited for both socio-economic and political reasons. The security implications are also two-fold: security of field staff personnel and local communities on the one hand, and data security on the other. Potential solutions at the "big world" level include expensive new communication technologies that can easily be confiscated by customs officials upon entry and clandestine tactics. Potential solutions at the "small world" level include the use of "technologies of liberation" developed for activists by activists but these peer-to-peer or community-to-community tactics do not easily support getting the warnings out to

the "big world."

The main conclusion to draw here is the importance of technology design, i.e., intentionality in design. In the "big world," the conflict early warning, crisis mapping, and humanitarian response community has the option of making more extensive use of existing technologies already employed in disaster management for application in conflict settings. For example, the "big world" can pulse warnings to the "small world" using SMS broadcasting. The applicability of disaster communication technologies to conflict zones, however, is limited since a host of other issues such as armed violence and state oppression present specific obstacles not typically encountered in disaster contexts. In other words, communication technologies for disaster zones are not designed for conflict environments.

The significance of technology design is particularly evident at the "small world" level — as the Cuba flash drive and Zimbabwe dial-up radio examples demonstrate. Using technologies of liberation that are designed for a specific political, economic, cultural and/or conflict context are more likely to be effective than those technologies designed for disaster management.

We have identified the need for design and development of communication technologies in conflict zones that are intentionally aimed at allowing societies to bridge the gap between Big World and Small World, permitting messages to get out as well as in, and without compromising the security of local people. The constraints are significant but a focus on this intention might well accelerate innovation in this critical arena.