A Fragile Link:
Disaster Relief, ICTs and Development

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Abstract— When disasters strike and aid agencies pour in to help the survivors they are increasingly making use of advanced information and communication technologies (ICTs). For remote areas of developing countries, this use of ICTs may be the community's first exposure to these technologies. And while the role of these ICTs is primarily linked to disaster response and recovery, in certain situations they can be transitioned for use in development programs. This paper discusses the crucial factors in design and deployment of relief ICTs that are likely to influence their ultimate use as tools for development. Derived from cases developed through secondary data, the factors are broken into those related to communication technology transfer and those related to information technology transfer. The theoretical and practical implications of these findings are also discussed.

Index Terms—**socioeconomic development, ICTs, inter-organizational coordination, relief**

I. INTRODUCTION

Many of the poorest regions of the world make the headlines for the first time when disaster strikes. And it is because they are poor that they are often the hardest hit victims of disasters. Interestingly, however, the disaster may be one of the area's first encounters with advanced information and communication technologies (ICTs). The ICTs are brought in by the hundreds of inter-governmental organizations (IGOs) and non-governmental organizations (NGOs) that typically descend on the stricken area to provide short-term relief. These organizations require ICTs to communicate with their headquarters as well as with one another on the ground. But what are the potential implications of these relief ICTs as complements to programs for long term socioeconomic development? Furthermore, what steps can be taken to insure a greater likelihood that ICT use will make the transition between disaster and development?

This research examines these questions and in particular views this transition as a coordination action, which occurs between actors and organizations embedded in larger inter-organizational networks. In this context, while the transition of ICTs from relief to development can provide many benefits, it will face many hurdles. To identify the factors that influence the relief-to-development transition we begin with a discussion of the factors that affect ICT use in relief. Following this, we present evidence from two cases, which represent the provision of both information and communication technologies. The cases are subsequently analyzed and discussed, including the implications of our findings for both scholars of ICTs for relief and development as well as for practitioners.

II. DISASTER RELIEF AND ICTS

When disaster strikes the response occurs in what is generally seen as 4 stages: 1. emergency or rescue, 2. relief, 3. recovery and 4. reconstruction or development. During the first stage action is taken by local organizations whereas the second stage, relief, may be carried out by hundreds of organizations from both near and far. During this second stage the primary goal is to see to the short-term needs of survivors, including health care, food, shelter and clothing. The organizations involved in relief are diverse and consist of governmental (including military), inter-governmental (IGO) and non-governmental organizations (NGO). NGOs themselves represent a large group of diverse organizations and can be described based on their scope, i.e. how large a geographical area (international, national or community) they serve as well as their orientation, i.e. the services they provide. These services are of three general types: 1.welfare (charity), 2. development and 3. advocacy (which influence policy- and decision-making) [1]. While some organizations involved in disaster response are predominantly in the relief category, a large number provide both relief and development services. Thus, while the transition of ICTs between relief and development frequently involves changes in personnel and organizations, in the case of a large I/NGO, the transition may be carried out within the same organization.

A. ICT systems and benefits

It is in this relief context, when critical tasks such as caring for survivors are being undertaken by a large number of organizations, that ICTs can provide so many benefits. While these benefits are often derived from the combined

functionalities of information sharing, storage and retrieval and communication, in this paper we argue that for transition there can be important differences. To account for these differences we consider *communication technologies* to include the physical infrastructure — for example, telecommunications infrastructure or computer hardware, and by *information technologies* we refer to software applications and computing technologies that are used to perform specific tasks.

For relief efforts, communication has been referred to as "the central nervous system" [2]. Without communication coordination is impossible, and lack of communication will result in limited information exchange, leaving organizations unclear on tasks and responsibilities. Communication technologies enable workers on the ground to communicate with headquarters as well as with other field staff. Communications technologies typically used in relief include fixed and wireless/satellite internet connections (VSATs), cell and satellite phones and radio.

While the use of various communication technologies for relief has exploded, adoption of more sophisticated information technologies has been slower. In particular technologies that aid in coordinating logistical processes, used extensively in private industry, are not widely used in the relief sector.

Information technologies in relief are important for sharing and processing information. Information during emergencies is classified into situational (what has happened), operational (what is being done) and educational/policy (what should be done now/next) [2]. Collection and dissemination of situational information is problematic [2], and it is not enough to have just timely information: information must be gathered from different sources, with different values and the preferences of stakeholders must also be taken into account [3]. Information technologies typically used in relief include shared/relational databases, GIS systems, inventory control systems and decision support systems.

B. Challenges

The transition to development will be shaped by the challenges faced by ICT deployment for relief. In particular, the challenges emerge from both the physical and organizational context as well as the general hurdles presented by inter-organizational coordination.

1) Physical and organizational context

Disasters can be either natural (floods, earthquakes, etc.) or man-made and it is the latter that has grown in number in the last decades [4]. Both scenarios may create a challenging environment for ICT deployment with a lack of fixed infrastructure, poor or non-existent transportation, lack of power, and exposure to weather (lack of structures). Both scenarios may also create challenges in gaining permissions to build systems, particularly with importing and operating wireless systems that typically require a license. While the Tampere Convention waives license requirements in signatory countries in times of disasters, it is still in its infancy in terms of ratification and implementation.

Furthermore, the political, economic and social tensions that lead to man-made disasters can also exacerbate natural ones. Thus, the natural/man-made dichotomy is a false one, in that the two frequently interact [5]. However, despite these interdependencies, an important difference lies in the response to these crises, with natural disasters being perceived as emergencies more so than protracted conflicts. Furthermore, information about a humanitarian disaster often represents a threat to the government's sovereignty, and tensions between humanitarian goals and political considerations also impede information flow about an emergency [2].

Thus, it is impossible to ignore the implications of the political context for relief [6]. The relationship is bi-directional: the local politics creates burdens for relief, and relief itself may foster increased political tensions. For example, during conflict situations it is rare for NGOs to be allowed access to civilians on both sides of the conflict [7,8]. If access is not allowed to both sides of civilians, relief organizations could in turn be accused of political bias and perhaps of providing the means for even prolonging conflicts [7]. This could be either because the negotiations that allow NGOs to operate can legitimize warring factions, or because donor money could flow into non-civilian channels.

The implications are that ICT deployments will be influenced by both the nature of the disaster and, as will be discussed below, the conflict in NGO missions that are more pronounced in conflict situations.

While certain inter-organizational issues will present hurdles for ICT deployment, there are a significant number of intra-organizational issues as well. Some are inherent to the complexity of the relief task while others are similar to those of implementing ICTs in small organizations (in the case that the NGO is small) and yet others are directly related to relief NGOs. Related to the relief task, research has shown that the amount of operational information flowing through an organization during a disaster response can be overwhelming [2]. Furthermore, coordination relies on information flows which in disasters have been shown to produce too little, too much, incomplete or inaccurate information. Additionally the relief operations may suffer from a lack of communication between the field and emergency operations center, which may be further hampered by language barriers and a command and control mentality. Finally, important for ICT-based communication, coordination is often interrupted by equipment failures [9].

Alternatively, constraints related to organizational issues include a lack of staff, lack of ICT skills, donor-imposed limitations, distributed organizational structure, and headquarters/field role conflicts. The first two of these constraints are inherent in the non-profit sector. However, for relief NGOs the problem is exacerbated by the emphasis on low overhead. Donors demand that most of their money be spent directly on victims and items such as staff salary (and indeed IT equipment itself) are considered overhead. This leads agencies to rely on volunteer staff which in general are

less skilled and with their more transient nature present challenges for ICT system development [10]. Furthermore, staff shortages not only make ICT deployment more challenging, it also makes information collection in general difficult [3].

The final two constraints, namely distributed organizational structure and headquarters/field role conflicts are particularly problematic for larger relief organizations. Many of the largest relief organizations actually consist of many individual national organizations united under an umbrella organization. In such an organization uniform ICT deployments are challenging. This is particularly true given the very different environments of developing country offices. These offices serve as headquarters to field personnel active in relief. It is frequently the need for coordination between headquarters and field that drives the provision of communication technologies. However, even the most sophisticated technology cannot solve the conflict of knowledge and authority. By this it is meant that relief workers on the ground understand the conditions and constraints presented by the disaster and frequently know what needs to be done, but infrequently have the authority to do so. Conversely, staff at headquarters are given the power to act but lack an understanding of what is happening on the ground [11].

2) Inter-organizational coordination

While ICT deployments within an organization are challenging, relief requires coordination between agencies, an even bigger challenge. Thus, inter-organizational ICT deployments will be affected by the problem they are designed to solve. It should also be noted that many of the challenges of inter-organizational coordination cannot be solved by ICTs.

The reasons coordination presents a challenge to organizations in general, including relief agencies, include differences in funding bases and organizational goals, professional and organizational status hierarchies, and the tendency of each organization to try to maximize its own autonomy [12]. Due to the growing numbers of international relief organizations, coordination has become more complex. Partly as result of this, a lack of coordination among (international) relief organizations has become a significant problem, with delayed or inefficient relief as a consequence [13]-[15]. High profile examples of these problems were seen in the lack of coordination in creating 'survivor databases' during the U.S. hurricane Katrina relief effort as well as the Gates' Foundation award to seven of the world's largest relief NGOs to fix the coordination failures that surfaced during the tsunami relief effort.

In examining inter-organizational coordination for relief and in particular for ICT deployment, it is important to recognize that NGOs exist on the ground at disaster locations embedded in a network of relations. Research has examined these networks and found that network structure and composition have implications for relief results [16]-[18]. In general networks present many benefits for NGOs including increased specialization of participating firms [19], improved access to learning, knowledge and technology exchange [19]-[21]. In

these networks coordination is achieved through the use of *conventions*, or accepted ways of doing things, that emerge from the need for rational justifications that can be accepted by members of the network [22].

It is important to note here that while we consider both developed country relief (which can also face extensive coordination issues) as well as developing country relief, an important difference exists. This difference, which actually exists along a continuum, is the extent of development of government emergency management systems or disaster preparedness. Thus, when international relief organizations respond to a disaster in a country with a fairly well developed national response system, they will find themselves embedded in this system. Indeed, in much of the U.S. research on disasters the primary focus is on the network of federal, state and local government agencies, which are a comparatively tightly coupled group, with little attention to NGOs and private firms [23].

Successful coordination in all actions is highly dependent on interdependencies and communication. Interdependencies have been described as either pooled, sequential or reciprocal, each requiring a corresponding type of coordination [24].

In *pooled* interdependence, efficient coordination is accomplished through standardization [24],[25], which fixes relationships among units [26]. For example, maintaining a shared inventory database across several organizations is a standardized policy. Standardization is the easiest way to coordinate. Conversely, with *sequential* interdependence, coordination is accomplished through planning (e.g., in a supply chain). With this type of interdependence organizations develop plans to coordinate a series of decisions yet to be made [26]. Finally, in *reciprocal* interdependence, coordination is accomplished through ongoing mutual adjustment of units, i.e., when the outputs of each unit become inputs for other units. Mutual adjustment is the most difficult method for coordination [26]. Consequently, the type of coordination among organizations prescribes the communication process involved [27].

All three types of interdependencies can be found in relief operations, with NGOs developing standards, planning and trying to formulate mutual adjustments. These general coordination strategies can also be translated to strategies for ICT deployment.

Empirical studies on coordination have found general factors that facilitate inter-organizational coordination include informal contacts, good historical relations with other organizations, common commitment, existence of common language, accessibility to other organizations, professionalism, standardization, structural similarities, scarce resources and frequent external communications [25], [3]. Reasons for coordination failure include, in addition to factors opposite to mentioned above, the lack of communication and, if communication occurs, lack of trust between parties [28], as well as cultural and technical incompatibilities between organizations [3].

Thus, inter-organizational coordination for relief is a complex challenge and the use of ICTs is only one of many ways to address them (see [9]). Furthermore, it has been noted that communication technology that aids in coordination cannot in itself ameliorate issues of hierarchy, goal conflicts or authority dislocation [11]. These limitations and the issues surrounding the transfer of ICTs from relief to development are demonstrated in the following cases.

III. CASES

The following two cases illustrate the implications that ICTs used in relief efforts can have for serving as complements to development programs. Separately, they represent the possibility of transfer of both communication and information technologies.

A. Gujarat Earthquake

On January 26, 2001 a devastating earthquake measuring approximately 6.9 on the Richter scale hit Gujarat State in Northwest India. After the immediate relief response by local NGOs and Indian government agencies, a rapid influx of a large number of NGOs and IGOs, both national and international, followed. Within 36 hours of the earthquake, the World Health Organization (WHO), for example, was able to set up two response sites, with WHO personnel arriving from not only Indian and nearby (Indonesia, Nepal) country offices but also as from the South East Asia regional office [29].

Joining WHO and many others was the United Nations Development Program (UNDP), which since 1998 has born the responsibility for relief management for the UN agencies. UNDP's need to develop a more comprehensive oversight of survivors' needs in Gujarat, as well as the actual support being provided by a variety of governmental and non-governmental organizations, stimulated an initiative to develop improved coordination structures to better match supply and demand of relief services.

To this end the UNDP asked UN volunteers to come to the field to liaise between different humanitarian organizations to collect information regarding relief activities, with the ultimate goal of bringing organizations together to provide relief and development services in a more coordinated manner. This information provided a means for UNDP to coordinate efforts between different local coordination units and to eliminate duplicate relief efforts. One of these national UN volunteers was Hemang Karelia, an IT specialist who had been involved in many development projects, and his job became collecting data on specific relief activities and providing damage assessments (see [30]).

In the beginning, the information Karelia and colleagues obtained from the various relief organizations was put into a database. This was added to an already existing GIS (geographic information) system with pre-disaster information from a state government agency, the Remote Sensing and Communication Centre. This allowed visualization of the area by generating maps. Subsequently, the information that was gathered in this database was published online, on UNDP's website for the earthquake, to allow third parties to view the information as well (see [31]).

This information collection and sharing exercise paved the way for further coordination. The UNDP in cooperation with Kutch Nav Nirman Abhiyan (KNNA – a network of 28 NGOs) and Gujarat State Disaster Management Authority (GSDMA), initiated the foundation of the Kachch Rehabilitation cell (KRIC) [30], where all relief and development activities from the district of Kachch – the worst hit district in Gujarat - were brought together. This system was developed to centralize information from 33 sub-centers across the district of Kachch as set up by Abbiyan, that each in turn covered 15 to 20 villages in all the sub-districts of Kachch. The use of these so-called *setus* enabled NGOs and governmental organizations to reach citizens from villages and vice versa, allowing for a two-way flow of information. Information exchange included such issues as citizens´ claims on damage, progress on construction, and information on health status of affected people[1]. Additionally, information of these setus was brought together in one web-based database, the Rehabilitation Information Management System (RIMS), and a Health & Education Information Management System (HEIMs) was also developed [30]. Both systems became accessible through the UNDP earthquake website, with both systems containing information of ongoing reconstruction programs that are web-enabled for wide reach.

As described by Hemang Karelia, the implications of this coordinated information gathering and dissemination system include the provision of information that "proved to be very vital as this was the first intervention by us to redirect the relief efforts to some rural areas which were deprived of any assistance and prevent the duplication of efforts in the same areas"[30].

B. Kosovo

Unlike the earthquake case discussed above, the Kosovo's relief effort was in response to a man-made disaster: war. The conflict in Kosovo caused 1 million ethnic Albanians to flee the area becoming refugees. The following paragraphs describe an internet access project that initially was set out to help these refugees by providing telecommunication facilities and then developed into a lasting institution in the Kosovo recovery.

The project, known as IPKO, was created in fall 1999, at the height of the Kosovo refugee crisis, by Paul Meyer and Teresa Crawford, two Americans in collaboration with Akan Ismaili, a Kosovar. The original goal of the project was to provide internet access to refugees in a Macedonian refugee camp. To that end a satellite dish with a year of free satellite time was provided by Interpacket, a private company. However, this dish was never actually installed in the camp as the refugees were able to return to Kosovo sooner than expected. Given this turn of events, Meyer and Crawford convinced the owners of

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1 See http://www.tiems.org/files/datasets/unisdr2/CD2/preparedness/8296.pdf . Last accessed 12/18/2005.

the dish to move it to Priština, the central town of Kosovo, to allow a broad range of Kosovars to make use of the year of free satellite time. In addition to the support of Interpacket, the project team also secured backing from various international organizations, including such influential ones as the United Nations and the International Rescue Committee (IRC). This support benefited IPKO in a number of ways, including attainment of a tax-free status [32].

In Priština, IPKO built a network of repeaters, microwave dishes and routers (donated by an American and a Latvian company [34]) initially with the intent to connect aid organizations in the area via a shared satellite link. Because power outages were frequent in Priština, the equipment required a power generator, and its capacity had to be adapted to match the demand, which was indeed growing [32].

In addition to selling access to IGOs such as the UN and NATO, IPKO was also providing telecom services to the local government and media. This revenue enabled the telecom service organization to provide free internet access to 30 leading members of Kosovo civil society, including the National Theater, several departments at the local university and hospitals [32],[33].

In March 2000, IPKO transitioned from humanitarian relief to development. It was handed over from the IRC and re-established as the *Internet Projekti i Kosovës*. Akan Ismaili, one of original IPKO founders and a former systems operator for a Balkans network human rights organization [34], became the Executive Director. After the year of free satellite service expired in September 2000, IPKO found that its revenue streams covered the monthly service cost of $30,000, and began expanding its wireless and fiber-optic connectivity. Furthermore, the satellite dish that had originally be loaned to the project was eventually donated to IPKO [33],[34].

This transition required IPKO to re-assess its role: should it concentrate on supporting the civil society or should it promote information technology to a broader segment of society? Previously, in the immediate aftermath of the war, the organization was able to do both, however as life was becoming more complicated in Kosovo, it was increasingly difficult to do both effectively. Akan Ismaili chose the strategy of promoting the use of information technology. His vision was that Kosovo had many advantages that might enable it to become an information technology center in the region, not least because 70% of the population was under the age of 30 [32].

Although Kosovo has yet to establish itself as an IT center of the region, IPKO has made clear progress in promoting IT use in Kosovo. Currently, the organization is run entirely by Kosovars [32]. Its wireless network covers over 80% of the populated area in Kosovo, including under-serviced rural areas with little or no access to telecommunications. Its customer base exceeds 1,700 organizations and 6,000 private users [35].

IV.   ANALYSIS

These two cases both demonstrate the potential that ICTs used in relief hold for development efforts and suggest circumstances that appear to account for a successful transition.

A.   *The potential of relief ICTs for development*

The potential for development identified in these cases differs according to their underlying technical characteristics and their uses (communication versus information technology).

The continuing role that communication infrastructure for relief can play for development is supported by the considerable interest in this area, both by IGOs as well as equipment manufacturers. This interest is partly due to increased expectations for communication and advances in communication technologies, but is also driven by cost. Few donors would choose to support a $15,000 monthly satellite phone bill, as was the case for one organization in Kosovo [32]. Thus, there exists an impetus to continue to innovate to drive down costs and improve quality, which can benefit both relief and development agencies.

While the infrastructure deployed in emergency situations may have design features that make it less ideal for long term use (e.g. reliance on alternative power sources, more rugged and hence expensive design), 'ideal' may be less important in situations where other choices are non-existent. While much progress has been made in recent years on availability of telecommunications infrastructure in developing countries (see [36] [37]), disaster areas are likely to represent a step backwards in terms of telecommunications development. Thus, even in areas where existing telecommunications services will be re-built, relief communications infrastructure can play an important long term role by allowing individuals and organizations to maintain information collection and sharing practices, whether for disaster-related or non-disaster-related activities. Furthermore, as is clearly demonstrated in the Kosovo case, the relief communications infrastructure may enable an area to leapfrog to an infrastructure-based competitive telecommunications market, a situation that may have taken years if not decades to develop. The advantages of a competitive market, which may include lower prices and more geographically dispersed access, have important implications for long term socioeconomic development across many sectors.

In the Gujarat case we see the implications for development of an information system. In particular, the system (both organizational and technical) established in the relief operation provided the groundwork for further system development. Also, information from the relief phase became the basis for coordinating longer term development activities, through the web-based information provision, and moreover, as indicated by Hemang Karelia, the use of the information system has speeded up the transition phase to development.

The ability to collect and disseminate information for development programs has a number of benefits for local recipients as well as NGOs. The information may enable more relevant and timely development programs as well as more efficient use of scarce resources. For the NGOs, at a minimum,

a transition of relief to development can mean that the information gathered through the relief system can serve as a baseline for better tracking of development outcomes.

In addition to the direct effects of relief ICTs for development, indirect effects have also been observed. In response to the January 2001 earthquake in El Salvador the UNDP undertook similar action to that of Gujarat. In El Salvador, the UNDP's initial efforts focused on registrations of people, tracking donor resources, and other information collection and dissemination to support a variety of organizations and people. The web-based nature of information dissemination allowed for broad utilization by a wide variety of organizations. However, it did more than just that. While this project started as a short-term relief project, it served as a trigger for people to start using the Internet for development purposes, as it provided the only means through which this specific information could be found. This occurred at a time when only 1.25% of the population used the Internet and its value for development programs and for economic development were not generally recognized.

B. Circumstances of successful transition

In addition to highlighting some of the potential benefits relief ICTs can bring to development, the cases also provide clues as to some of the circumstances that may account for their success.

In the case of Gujarat, it is possible that the successful transition of the ICT systems from relief to development was due to 4 different factors. The first of these is the institutionalization of the coordination in information gathering and dissemination between the NGOs during the relief stage. While NGOs must coordinate to survive, coordination agreements can range from loose couplings to more formalized or institutionalized arrangements. In the Gujarat case the establishment of the 'information cell' by the UNDP, KNNA and GSDMA represents a formalization of the coordination arrangement, which likely contributed to the coordination longevity. Collaboration in information collection during the relief phase helped institutionalize cooperative structures.

The second factor we believe contributed to the transition was the involvement of governmental development agencies. Expanding beyond the traditional network of IGOs and international NGOs to include the local government development agency was important for several reasons. First, it provided foresight into the kinds of information that would be needed. It also provided insight into the development process.

The third factor was the involvement of local IT experts. The local UN volunteers were invaluable in their ability to both negotiate the local context and implement ICTs.

The fourth factor was to not only have a government organization involved, but further to have representatives of that organization on the ground. This is especially advantageous if the IT staff on the ground also has experience in working with local government agencies

Whereas the Gujarat case represents the transition of information technology from relief to development, the Kosovo case tackles the difficult transition of communication infrastructure. Here we find 4 significant factors that likely contributed to the success of this transition.

First, the support of an influential international organization, International Rescue Committee, was important at the early stage of the project. Not only did it enable the group to obtain benefits such as tax breaks, but it also was useful in protecting the ISP from attempts of the government to monopolize the backbone, as happened, for example, in neighboring Macedonia.

Second, similar to the Gujarat case, commitment of the local specialists appeared to be crucial to the success of the project. As is typically the case, the non-local relief personnel move on. Participation of local specialists provides an understanding of the local context and as compared to relief teams composed entirely of non-locals they bring an additional source of motivation, knowing that they are contributing to the long term development of their region or country. Furthermore, the possibility to transition the people, as well as the technology, from the relief to the development process aids in stability.

Third, IPKO addressed an urgent relief as well as ongoing need, namely the lack of telecommunications services in a post-war territory. This raises an important point; not all ICTs used in relief are appropriate for or will be needed in development. Both here and in the Gujarat case (with the information gathering and distribution tools), the relief ICTs clearly had value for development initiatives.

Fourth, the business model of providing internet access for fee to those who are able to pay for it (such as NATO and United Nations agencies) while at the same time subsidizing access to those who are not (civil society groups, university) added a civil society supporting dimension to IPKO's work. Establishing this 'good will' likely had implications for development of Kosovo's civil society, as well as allowed IPKO to build a social network which likely adds to its current success.

V. DISCUSSION

The findings presented above have implications for both theory and practice. As discussed earlier, the process of transitioning ICTs from relief to development is both an IT and an organizational challenge. While inter-organizational coordination may have been the impetus for the development of a relief system, as shown above further coordination, sometimes with new actors will be required for the development transition.

These insights have implications for relief and development studies, particularly in the areas of inter-organizational networks. In particular, to fully understand the relief to development transition will require understanding of both relief networks and development networks as well as interactions between the two. Network interaction is a rarely researched topic even in the broader literature of commercial network operations. An exception is the work of [38], who

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