

# Repairing Human Infrastructure During Crises

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**Abstract.** Infrastructure in a society takes on different forms: physical, technological, and human, or social. These three forms of infrastructure are intertwined and interdependent. When one infrastructure is damaged in a natural catastrophe or war, then this can affect how the other infrastructures function. We are interested in how, when the human infrastructure is damaged, people can switch reliance to the technological infrastructure to be resilient. Since 2008 we have conducted interviews with people who experienced the 2006 Israeli-Lebanon war and the 2nd Gulf war in Iraq. There are many novel and emergent ways that ICTs have been used by our informants to repair and rebuild their social infrastructure. This research suggests models and new technology designs for crisis informatics.

## Considering Infrastructure in Crises

Infrastructure is generally defined as the underlying framework of a structure or system. A society relies on infrastructure to function, ranging from power grids to provide electricity to highways for transportation. People and their connections to each other also constitute an underlying foundation for society, a social infrastructure. In studies of crises, most attention has been given to single “types” of infrastructure without a lens on how infrastructures of a society can be intertwined and related to each other. In this position paper I will focus on the

physical, technological, and human (or social)<sup>1</sup> infrastructures and how they exert mutual effects during crises. By physical infrastructure, I refer to the physical foundation of roads, buildings, bridges, sewers, water pipes, etc. By technological infrastructure, I primarily refer to computing infrastructure supporting communication and the sharing of information, consisting of routers, servers, computers, wireless connectivity, landlines, satellites, cell phones, television, and so on. ICTs would be a part of technological infrastructure.

But human infrastructure in my view has not received enough attention during crises, particularly in its foundational role in a society and its relationship to other types of infrastructure. We consider the human infrastructure to be the underlying foundation of a social system constituted by the pattern of relationships of people, through various networks and social arrangements. It is not just a single person's social network that constitutes human infrastructure but rather a *network of networks, or arrangements*. It is not any single group or social network that exists as human infrastructure, but rather the holistic constellation of networks, groups, relationships and patterns of communication that exists as a framework for any society or social unit.

Residents in a society depend on human infrastructure for a range of activities in their daily lives, i.e. for work, socializing, education, health care, entertainment, transportation and so on. The human infrastructure can be comprised of family members and friends, work colleagues, neighbors, doctors, shop and restaurant owners, taxi drivers, policemen, administrators, and so on. Human infrastructure is far broader than a social network. For example, an administrative assistant in one's workplace may not be part of one's social network but this person is part of the human infrastructure, as he or she supports the functioning of the workplace by delivering messages, dealing with financial or travel information, scheduling meetings, and conducting other support activities. Similarly, a pharmacist, nurse, or doctor may not be members of one's social network but they support people in maintaining and restoring health and supplying medications. Without an intact human infrastructure people cannot carry out familiar routines.

Commonly though, relationships concerning infrastructure are not so clearly delineated. For example, communication among people involves all three infrastructures. People may use cell phones or email to communicate or they may travel on roads using cars or public transport to meet each other. Depending on conditions people may also change how they use and rely on infrastructure. For example, if in a war zone one road is destroyed, then in order to meet people might take an alternative road that is still intact. Alternatively, people may cease

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<sup>1</sup> I use the terms 'human' and 'social' infrastructures interchangeably here.

travel and instead use email or telephone to communicate with others without physically meeting.

Star and Ruhleder [8] describe how human infrastructure is interwoven with technological and physical infrastructures. They describe how infrastructure is generally invisible (such as plumbing) until it breaks down when it then becomes visible. When a computer network goes down then suddenly people become aware of it. Especially in a war environment, when roads are not passable or when electricity is not available then the physical and technological infrastructures becomes highly visible. As infrastructures are intertwined, changes in the use of one infrastructure may also affect how other infrastructures are used. For example, when a new technology is adopted, new conventions of practice must be developed which in turn can change collaborative relationships. Whereas physical infrastructure is slow to change (e.g. a new building requires time for design and construction) human infrastructure is highly dynamic [3]. People can readily reconfigure social arrangements, and consequently communication and coordination. My interest is in how the social infrastructure can reconfigure to adapt to an environment that is affected by a crisis.

When human infrastructure is affected at a micro level (e.g. when an individual cannot meet face-to-face with colleagues and the individual must find new ways to communicate remotely with colleagues), then this new communication pattern can have an amplifying effect on practices at a more macro group or even societal level. An example is when critical mass in the adoption of a communication technology occurs.

We argue that when one infrastructure is damaged, as in a natural catastrophe or war, then people can change their relationship with a different infrastructure to be resilient, i.e. as a supporting structure to carry out their activities [1]. For example, if during a war a teacher and classmates are unable to travel to school, then students may switch to using the Internet to interact with others, e.g. by sharing coursework or getting lessons online.

Our view is that in times when the human infrastructure is disrupted, it must be rebuilt, reconnected, or “rewired”. In many cases of environmental disruption, the technological information and communication infrastructure remained intact but it was the human infrastructure that was disrupted. The events of 9/11 and the 2006 Israeli-Lebanon war are examples showing that while Internet connections and cell phone reception were still available (after 9/11, the technological information and communication infrastructure in the World Trade Center area was destroyed while the surrounding area technological infrastructure was intact), the human infrastructure was severely affected. After 9/11, thousands were killed, entire

companies such as Cantor Fitzgerald were destroyed, and many remained missing for days after the attacks [5].

## Infrastructure Repair

Since 2007, we have been conducting “ethnography at a distance” to understand how people use ICTs to repair their human infrastructure during an environmental disruption. We have conducted over 130 semi-structured long interviews with people who lived in Israel during the 2006 Israeli-Lebanon war, and in Iraq, during the 2nd Gulf war. Details of the methodology and the research settings can be found in [4,6,7]. Wars differ from other types of disasters such as weather events as there are continual threats and emergencies. Following Powell’s model [1] we focus on activities that occur after the acute emergency stages. Thus, we are focusing on activities in the recovery phases of a disaster.

## ICT to repair Infrastructure

In our data we discovered emergent uses of available ICTs to improvise new coordination patterns. These uses of ICTs were used for a range of activities such as responding to threats and creating new structures for education. I will detail a few of these examples to illustrate the intertwining of the technical with the human infrastructure.

One example of an emergent use of ICT was the use of SMS for siren warnings. The origin of this new practice began in a few villages in the north of Israel in 2006 during the Israeli-Lebanon war. The villages switched from audio siren warnings to using SMS to relay warning messages. One informant described that her village did not even have a working siren warning and they only received siren warnings through SMS on their cell phones. Sending SMS siren warnings increased people’s competency to react. The direct intent of the message was as a cell phone notification that informed them to take shelter. These SMS warnings however were also used as awareness notifications. When people traveled away from their homes they could still receive the SMS messages and could find out if their neighbors or if their homes were within siren range. Importantly, people also passed these SMS siren messages on to others, such as their children or parents, to notify them of impending rockets. Thus, people utilized their human infrastructure in conjunction with the technological information and communication infrastructure to expand their capacity for time and location awareness of potential rockets. Using SMS enabled people to notify others in their social network (and beyond) about the warning who were not even present in the threat area. It also served as a redundancy mechanism as people would send duplicate SMSs to

others in addition to the official SMS notification, to make sure they were aware of it.

Another case is from Iraq. Prior to the war Iraqis could freely travel on roads. When the war started, travel on roads became dangerous not only due to bombings but also due to roadblocks which were operated by various sects and insurgents. In order to travel to work and to attend school our informants described how they set up cell phone networks in which individuals would call others within their community (e.g. their neighborhood, workgroup, or university) who they knew would be traveling the same route that they had, in order to help others avoid dangers and delays they had encountered. Students would call to inform other students that there were no classes because of roadblocks or explain less time consuming alternate routes. This network helped people decide which direction was the safest to travel. Whereas today there are similar types of route notifications on the Internet such as map mashups, these mashups may not be customized to a person's particular travel route. In Iraq, this practice was based on available technologies (cell phones) that were widely adopted. This use of cell phones shows again how people changed their reliance to a combination of the technological and human infrastructure to enable them to restore (at least partly) their ability to travel.

### **Psychological resilience**

ICTs also provided psychological support in navigating through dangerous areas. For example, one informant, who is European, was working in Israel when the conflict broke out, and chose to remain. He described how he relied heavily on his cell phone and a web cam to communicate with his family in Europe before and after making the 45- minute drive to work, and before going to bed. Other informants reported using their cell phones more heavily during the war to call relatives before they drove somewhere, e.g. to work. Many other examples of a similar vein were reported. In these cases, people used ICTs to connect to others in their social network to help them to be psychologically resilient in the environment.

### **ICTs to restore social interaction**

Informants in both of our countries reported that they changed their mode of interactions with friends and family, from meeting far less face-to-face to using technology to interact. This change was most pronounced in Iraq where culturally people were accustomed to meeting face-to-face. After the war in Iraq started, the level of trust in unfamiliar people declined rapidly as strangers could be insurgents, spies, or terrorists. Even students at the university reported that they did not trust other students. As a result people began to rely more heavily on ICTs to socialize: adopting email, Instant Messaging, social networking sites, and

Internet chat rooms. Medical students reported starting an online forum to discuss coursework. The Israelis also reported changing their social practices from meeting face-to-face to online and telephone interaction. All our informants reported using cell phones to a far higher degree during the war than before or after the war. When people went into bomb shelters in Israel they made a series of quick phone calls to close friends and relatives to let them know they were safe.

Informants also reported switching to virtual work practices to be resilient in the environment, as many could not physically travel to work. Working with colleagues online instead of meeting face-to-face enabled people to continue to work independent of their disrupted physical environment. Though virtual work practice is common in many western cultures, virtual work practice was very new for our informants. For example, five Israeli researchers were able to continue working on a research article with laptops and Internet connections, even though they were all constantly changing residences. An Israeli army reservist was able to seamlessly continue to work with his colleagues when he was called into the army. A CEO of a small company was able to continue working virtually as she continually changed residences. Informants in Israel reported that they were able to continue working even in bomb shelters with laptops and Internet connections. Some described how their international colleagues did not know that they were interacting from a bomb shelter. In fact, as some informants described, it was precisely their aim to create an impression among their business partners and clients that they were resilient in work and not affected by the physical disruption in their environment.

Iraqis also reported developing virtual work practices. A journalist explained how two reporting groups in northern and southern Iraq began to use the Internet and cell phones to communicate rather than traveling across the country. Other journalists informed us that Internet access at home allowed them to extend their working hours beyond the limit imposed by the curfew and daylight hours by continuing their work from home. Other professionals reported that they could continue working using their laptops even when there was a power outage.

## Human Infrastructure

Any type of environmental change can provide a trigger for new practices to develop. Crises in particular provide slippage or opportunities for people to develop new practices. The human infrastructure as it existed before the war in both societies developed rifts due to the continual threats which made it difficult to conduct normal routines. For Iraqis, the degradation of trust restricted people's face-to-face interaction. The use of ICTs enabled people to repair these breaks in the infrastructure so that they could continue their routines.

Work organizations have given attention to developing effective plans for coping with major environmental disruptions, e.g. short term plans for evacuation and saving lives, protecting buildings from further harm, and longer term plans for rebuilding the technological information and communication infrastructure. What is less common, however, are for organizations to consider plans that exist for rebuilding the human infrastructure. Our data show that repairing the human infrastructure through using technological resources is a way for people to be resilient who are facing continual threats in their society. Though not a silver bullet, ICTs provided a range of alternative resources for people to use to continue to act. Many of our informants relied on cell phone usage which remained in service much of the time even when the Internet was down (in Iraq).

## Further Issues to explore

I am interested in exploring more deeply the relationship of technological resources and the human infrastructure in crisis settings during the recovery stage of disasters [1]. Future work I am interested in is:

- The relationship of the technological and human infrastructures in nonwestern countries. Although the Internet is becoming a global phenomenon, in many countries, such as Iraq, the Internet is used by only a small percentage of the population. One of the challenges new technology users face is the steep learning curve involved with understanding and being able to utilize such technologies.
- Data-mining of social media. Internet archives, such as the blogosphere or forums in the aggregate can provide a view into how a society is experiencing a crisis. There is a large potential to study what large-scale social media data can reveal about how a society reacts to a war or other crisis.
- Mobile technologies in the recovery process. The use of mobile technologies continues to grow globally and their use during disruptions becomes increasingly important. Countries are also moving quickly towards more sophisticated 4G platforms. This expands the possibilities of how smart phones and new applications might support the repair of routines, e.g. in administering health advice.

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