Emerging Science and Technology to support Disaster Emergency Response

Global natural disasters in 2016 combined to cause economic losses of USD210 billion, an amount 21 percent above the 16-year average of USD174 billion. Notable events during the year included major earthquakes in Japan; Hurricane Matthew in the United States and Caribbean; catastrophic summer flooding in China, Europe, and the United States; several extensive severe weather outbreaks in the United States; major wildfires in Canada and the United States; and drought across parts of Southeast Asia and Africa. The top three perils—flooding, earthquake and severe weather—combined for 70 percent of all economic losses in 2016. While at least 72 percent of catastrophe losses occurred outside of the United States, it still accounted for 56 percent of global insured losses. This highlights the continued protection gap in many areas around the world.

The risk of disasters is accumulating rapidly, with climate change increasing the intensity and frequency of extreme weather events and urbanization exposing greater numbers of people to their impacts. Over the last decade, China, the United States, the Philippines, Indonesia and India constitute together the top 5 countries that are most frequently hit by natural disasters. Each year, natural disasters, compounded by climate change and conflict, cause more than $500 billion in losses.

Disasters like this can cripple any country and erase hard-fought development gains. To prevent such devastation, whether social or economic, an effective framework for recovery must be in place before a disaster strikes, says World Bank. “Put simply, resilience is about people’s capacity to anticipate, prepare for, withstand and recover from a range of shocks and stresses, without compromising their long-term prospects.” “While technology cannot address all barriers to resilience, it is a powerful enabler in strengthening resilience characteristics and empowering communities.”

“Communities and households with access to accurate and timely information, good levels of health care, social support networks and economic opportunities are less susceptible to hazards and faster to recover from shocks and stressors.”

Technology has transformed how the rest of the world views and responds to crises. After the Haiti earthquake in 2010, NGOs and humanitarian agencies turned to crowd sourcing information to reach survivors: the mapping platform Ushahidi was used to map SMS requests for help. Since then, Google’s Person Finder has been used to help reconnect families after floods in Pakistan, the 2013 Japan earthquake, and more.

Disaster Management comprises of activities like

Preparedness – activities prior to a disaster. Examples: preparedness plans; emergency exercises/training; warning systems.
Response – activities during a disaster. Examples: public

warning systems;
emergency operations; search and rescue.
Recovery – activities following a disaster. Examples: temporary housing; claims
processing and grants; long-term medical
care and counseling.
Mitigation – activities that reduce the effects of disasters. Examples: building codes and zoning; vulnerability analyses; public education.

In 2013, the Red Cross and Red Crescent published its standout report, “World Disasters Report: Focus on Technology and the Future of Humanitarian Action”, in collaboration with the Harvard Humanitarian Initiative.

As the Red Cross and Red Crescent and its coalition of partners strive to make 1 billion people safer by 2025, emerging technologies will play a particularly important role in amplifying efforts to facilitate community-level knowledge and health, connection, organization, economic opportunities, access to infrastructure and services, and management of natural resources.

Role of technology in disaster management and Response

The dialogue revealed that emerging technology solutions must possess eight of its own criteria to effectively improve and expand a community’s ability to prepare for emergencies, help people respond to increasing risks, and assist their recovery.

Smart phones, social media, sharing economies and other tools are already helping to redesign emergency preparedness and response operations by:

- Facilitating community participation.
- Spreading lifesaving messages.
- Expediting service delivery even where power, connectivity, infrastructure and local training are lacking or limited.

“We also noted the importance of including different forms of technology beyond information and communications technology (ICT), such as robotics, manufacturing, medical and transport technologies.

The emerging technologies of focus ultimately included 3D printers, augmented reality software, biometric scanners, robots, smart cars, smart home sensor networks, unmanned aerial vehicles and wearable devices as well as the increasingly diverse methods to power them and the applications tied to their effective use.”

The participants in summit organized by Red Cross and Red Crescent in January 2015 at Nyenrode Business University outside Amsterdam, Netherlands, agreed upon four emerging technology use cases:

- Wearable devices for providing early warning, supporting search and rescue, and reconnecting families
- Unmanned aerial vehicles for temporarily restoring communications networks and delivering critical relief items, such as medicines, post disaster
- Smart home sensor networks for sensing and reporting

fires in informal settlements/slums
- Biometric scanners in ATM-like kiosks for restoring lost documentation to prove identity, access assistance and reconnect families.

Wearable Devices

Community members and experts all recognized the value of wearable technology transmitting location information, which could be used by first responders to find people and accelerate family reunification after an incident. They also envisioned wearable technologies assisting with medical triage and diagnosis; this use could also help prevent disease transmission if healthcare professionals can access the patient's information remotely.

Participants noted that both glasses and trackers currently require smartphones and Internet access, which limits their disaster use

New device brings military tech to heart health

Local doctors are making use of military technology to help heart failure patients. The Sensible Medical Vest was developed from technology created in Israel which uses radar to find and help rescue people buried in rubble and debris.

In as little as 90-seconds, the device detects how much fluid is in the lungs and if a patient has too much fluid in their lungs that could indicate heart failure.

“It allows us to make medical decisions about whether they need more diuretics which are water pills to help get fluid off or whether we need to adjust other medications to help keep them clinically out of heart failure,” said Dr. Scott Feitell, director of heart failure at Rochester General Hospital. More than 6 million people suffer from heart failure in the U.S. which accounts for about 25% of readmission’s at hospitals.

3D printers

The most interesting use cases for 3D printers, according to dialogue participants, included the production of medical supplies, disaster-resistant structures and building materials; replacement of important items such as heirlooms, cosmetic and functional modifications to their homes; and making spare parts to maintain the other emerging technologies.

In addition to speed and economic impacts, participants noted several other issues that may prevent 3D printer adoption unless resolved in the next generation of products. Today’s machines are difficult to operate outdoors, especially when exposed to water, dust and winds, and they require regular maintenance and significant power. Participants also questioned the waste generated by the printers as well as their potential toxicity. These barriers must be resolved before their benefits can be fully realized by communities in disaster-prone, urban settings.

Augmented Reality Software

Augmented reality software adds a layer of computer-generated data, which cannot be seen or heard with human senses, into reality through smart glasses and other Internet-connected devices.

The experts noted how mobile devices equipped with augmented reality software could be held in the user’s line of sight (similar to taking a picture) and display computer-generated billboards and bubbles on the screen that correspond with people’s homes and businesses, indicating those who are offering food, water, first aid and other services. This, they said, can be particularly helpful if the user is unfamiliar with the area, cannot see around the corner or is surrounded by high-rise buildings. This emerging technology could also help community members locate available resources post disaster and pinpoint people buried by a landslide or earthquake, saving lives and increasing the speed of recovery.

The software would need to be updated regularly and provide near real-time information (generated by users) about fixed and mobile services as they become available and expire.

Biometric Scanners

Biometric scanners are authentication devices using distinctive, measurable human characteristics and traits such as fingerprints, facial contours, DNA, palm prints, iris or retina patterns, and voice patterns, to identify individuals through a verification process

Participants agreed biometric scanners would be useful tools to manage relief distributions and cash grants, find and reconnect separated families, and restore lost documentation. Community members appreciated that biometrics could help them fight false criminal accusations and prove their identity more immediately than DNA testing.

That said, community members also noted some drawbacks to the technology, including potential abuses of power, privacy breaches and fraud.

Robots

Responding to epidemics also puts healthcare workers at significant risk of infection. Robots, with video screens to display the faces and voices of human healthcare workers, can provide diagnostic support, treatment and monitoring of medical patients.

They can also assist nurses and doctors in removing their personal protective equipment, in burying the deceased, and in comforting people who are suffering from stress and trauma. While people are in quarantine, robots may also deliver medicines, basic necessities and video communications from loved ones.

The most common use cases for robots to assist with strengthening urban resilience, according to the dialogue participants, included supporting telepresence, psychosocial counseling, medical treatment, search and rescue, and clean-up assistance.

However barriers—ranging from perception and trust to technical abilities—will need to be addressed by developers before the average consumers will embrace them as helpful resources.

Smart Cars

Smart cars are generally understood to be autonomous and semi-autonomous human transportation vehicles, but they can also include routine enhancements that make the vehicles safer and more connected.

Smart cars hold interesting potential for strengthening urban resilience, in that they can also operate on sustainable fuel sources leading to positive environmental implications, expedite safe evacuations before and after emergencies, and receive messages and alerts based on risks in its surroundings. Dialogue participants also noted their ability to float in flooding disasters.

Participants noted that after a disaster, when the landscape changes dramatically, updated maps would need to be available immediately to effectively utilize smart cars for a response.

Smart Home Sensor Networks

Community members were significantly more excited by the idea of a home or office building with sensors for fire, earthquake, gas leaks and even pollution, as opposed to the more convenience or entertainment-related use cases. They also preferred the use cases that involved disaster-resistant

technologies, such as computer-controlled wind and water barriers that would protect a home’s interior from damage.

They also desired the smart homes to automatically take time-sensitive action, such as turning off the gas or bracing the roof for high winds.

Unmanned Aerial Vehicles

In recent years, several humanitarian organizations and governments have used UAVs in disaster management, most notably for assessing vulnerabilities before an emergency and damage after the disaster.

Both community members and experts involved in the dialogue agreed on their value as quick delivery agents for high-value supplies, such as medicines, and the sky as a temporary supply route in early response activities, as UAVs could traverse terrain that might be impassable otherwise. They also appreciated their potential to supply lighting, power and connectively from the air until more permanent solutions on the ground can be restored post-disaster.

References and Resources also include:

https://www.theguardian.com/global-development-professionals-network/2017/jan/12/live-qa-how-can-technology-improve-

humanitarian-response

http://thoughtleadership.aonbenfield.com/Documents/20170117-ab-if-annual-climate-catastrophe-report.pdf

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