Technological Development and Dependency

Long-term Trends and Drivers and Their Implications for Emergency Management

May 2011

Overview

Rapid technological growth is expected to continue in the coming decades. The following technological trends and drivers have the potential to impact emergency management dramatically. They are:

- Increase in use and capability of mobile devices
- Development of the "internet of things"
- Increase in use of telemedicine and electronic health records
- Advances in biotechnology

This document contains preliminary research conducted on behalf of the Strategic Foresight Initiative (SFI) on the Technological Development and Dependency driver. This research is intended to serve as a discussion point for further discussions, and does not represent a forecast by the Federal Emergency Management Agency (FEMA). This paper is a starting point for conversations around a highly complex topic, and SFI encourages feedback about this paper from the emergency management community.

SFI is a collaborative effort of the emergency management community that is being facilitated by FEMA. SFI was launched so the emergency management community can seek to understand how the world is changing, and how those changes may affect the future of emergency management. It will do so by encouraging members of the community to think about how the world may look over the next 15 years, and what steps the community should begin taking to thrive in that world. Participants in SFI include emergency managers at the Federal, state, and local level, subject matter experts on relevant topics, and other stakeholders.

Anybody who would like more information about SFI should contact the team at FEMA-OPPA-SFI@fema.gov.

Key Trends and Drivers

Worldwide, mobile devices have become the preferred choice for communication and internet access. There were 4.6 billion mobile phone subscribers in 2009 up from 1.8 billion in 2004 (39% increase). If trends continue, it is predicted there will be 6.9 billion mobile phone subscribers worldwide by 2020 (67% increase).[1] In 2009, half a billion mobile phone subscribers used their device to connect to the internet. This number is expected to double to one billion by 2015.[2] Information searches, mapping/location, messaging, social networking, and music downloads are among the current and projected most popular mobile internet sites accessed by mobile device users.[3] Facebook, the world's most popular social networking site, currently has 500 million users of which 200 million (40%) access the system through mobile devices.[4] By 2020, mobile devices will be a primary connection tool to the internet for most people in the world.[5]

A future of opportunities and risks will arise as people can remotely control, locate, and monitor everyday things – "The Internet of Things." "The Internet of Things" refers to the general idea of things, especially everyday objects, which are readable, recognizable, locatable, addressable, and/or controllable via the internet. These everyday objects include not only electronic devices and the products of higher technological development such as vehicles and high-tech equipment, but things that many people do not ordinarily think of as electronic at all—such as food, clothing, and shelter; materials, parts, and subassemblies; commodities and luxury items; landmarks, boundaries, and monuments; and all the miscellany of commerce and culture. There are several rapidly developing technologies that are enabling the Internet of Things including sensor networks, positioning technologies, and biometrics.[6]

Telemedicine and Electronic Health Records will change patient care and treatment. The Department of Health and Human Services defines telemedicine as "the use of medical information exchanged from one site to another via electronic communications to improve a patient's health." This includes using audio and video technologies to provide real time, two-way communication between patients and health care providers.[7] EHR consist of an electronic version of a patient's medical history (i.e. an electronic medical record) and the technology used by clinicians and patients to access that record. EHR can be used in conjunction with telemedicine to improve health care outcomes and reduce errors.[8] The American Telemedicine Association's current inventory of telemedicine-equipped facilities in the United States shows approximately 200 telemedicine networks linking 2500 medical centers nationwide.[9]

Advances in biotechnology will fundamentally change human health, particularly related to aging. Biotechnology offers the means to accomplish control over and improvement in the human condition, and promises improvements in lifespan. The advancement of the science and technology underlying the biological aging process has the potential to not only extend the average lifespan, but also to simultaneously postpone many if not all of the costly and disabling conditions that humans experience in later life, thereby creating a longevity dividend that will be economic, social and medical in nature.[10]

Implications for Emergency Management

There are several implications for emergency management from the growth in use and capabilities of mobile devices. With constant access to information available at people's fingertips, the public will expect that government will be able to provide open and ongoing access to information that society values and responders will use the internet and social media to communicate information to the public in emergency response situations. This access also could lead to a significant increase in transparency and accountability for government officials, including emergency managers.

Emerging technologies will continue to transform the overall communications environment forcing government officials to understand and embrace new methods of communication. Recent disaster events have shown the value of such innovations. During the September 2010 Fourmile Canyon wildfires near Boulder, Colorado, residents created Google maps showing evacuation zones and structural damage, and shared information and photographs via Twitter. The city of Boulder passed wildfire updates to residents via Facebook.[11] In the aftermath of a series of snowstorms in the Northeastern United States, residents in New York and Boston created "snowmageddon" websites to "view and report blocked streets, stuck cars, and even organize a cleanup party." The Mayor of Newark, New Jersey asked residents to send messages to his Twitter account if they required assistance, and "tweeted" updates on the city's snow cleanup effort back out to residents.[12] This "crowdsourcing" of information and two-way communication between government and the public creates situational awareness for both the public and emergency responders. It also could lead to people relying more on themselves and their virtual communities and less on government. Many people now seek affirmation from multiple sources, especially those in their own virtual communities, before accepting any type of official government information.

There also are risks associated with new communication and information sharing methods. The large amount of data now pumped into the information stream from the public, the media and government sources leads to questions of its accuracy and reliability. In November 2010, a hacker accessed the Twitter account of the disaster management advisor to the Indonesian president and sent out fake tsunami warning messages.[13] During Haiti earthquake response efforts, aid workers needed to verify (subsequently false) media reports of violence in affected areas which delayed aid delivery to survivors.[14]

With the growth in use of mobile devices, mobile networks are becoming overcrowded, especially in cities. If mobile phone sales and use continue to grow at present rates, mobile phone traffic "will more than double every year for the next four years." These strains on cellular networks could cause a "mobile meltdown" by 2013.[15] Since emergency managers depend on cellular networks, strained networks could present numerous response and recovery communication and coordination challenges.

The "Internet of Things," will bring tremendous opportunities to build resilient infrastructure and communities while aiding response and recovery efforts. The ability to more effectively monitor infrastructure real-time will increase both efficiency and safety. Sensors implanted in roads and bridges monitoring traffic flow and deterioration could aid in studies of traffic patterns and

trigger maintenance actions. Sensors embedded in everyday objects could be used to locate persons during search and rescue efforts. Mobile phone, clothing and bracelet sensors could help track evacuees' status and locations. This increase in connectivity also brings an increase in vulnerability. The "Internet of Things" could make it easier to conduct cyber attacks on the Supervisory Control and Data Acquisition systems that monitor and control electrical and water utilities. Pervasive sensory devices also can add concerns about individuals' privacy. The spread of certain sensory devices may be limited or slowed due to concerns about civil liberties.

Telemedicine and electronic health records will provide dramatic improvements in patient care and treatment while potentially reducing overall health care costs. In addition, by providing responders with quick, easy access to medical information, these capabilities could also assist in treatment and tracking of patients and the elderly evacuated from hospitals and nursing homes. However, as dependence on access to telemedicine technology and electronic records increases, it will create vulnerability should power be lost.

Biotechnology has the potential to transform human health by increasing life expectancy and minimizing the threat of disease. Individuals will live longer, healthier lives allowing them to work much later into life. The increased health and mobility of the elderly will facilitate their evacuation during disasters. The challenge arising from longer life spans stems from the increase in overall population growth and the ability of the environment and global markets to sustain the larger population. Emergency managers will have to plan and budget for responding to the needs of a larger and older population. Developments in biotechnology will also provide bad actors increased capacity to build and deploy more dangerous biological weapons.

Correlation to Other Drivers

- **Changing Role of the Individual**: Public interest and expectation of transparency and 24/7 access to information from and about government activities will increase. Technology will continue to alter the relationships and communications between individuals and their government. The public may become more involved in response and recovery efforts by helping authorities sift through large amounts of data provided by sensory devices. People may seek guidance and assistance from their virtual communities rather than from the government.

- **Critical Infrastructure**: Technological dependence built into our infrastructure will provide new benefits while potentially increasing vulnerabilities. More effective control and monitoring of could make infrastructure more efficient and resilient. However, the reliance on technology may also make infrastructure more vulnerable to cyber attacks, natural disasters, Electromagnetic Pulse events and solar flares. These types of events can knock out the power grid and disable electric/electronic devices.

- **Evolving Terrorist Threat**: Cyber and physical attacks on power and water infrastructure could be employed as a main incident or as part of a multi-step attacked designed to create an initial incident then magnify confusion and hamper response through a secondary attack on power and water utilities. As reliance on the internet and mobile devices continues to grow,

terrorists may conduct denial-of-service attacks to disrupt or take down internet and cell phone network access.

- **Government Budgets**: Governments at all levels must consider budgeting for the growth, maintenance and protection of electronic infrastructure as well as traditional infrastructure (e.g. roads, bridges, dams, levees). This will pose a challenge since Federal, state and local government spending on infrastructure has remained steady since the 1980s at about 3 percent of national GDP.[16]

- **Universal Access to the Use of Information**: Technological advances and public preference for and dependence on the internet may increase present expectations that responders will use the internet, social media and mobile phones in emergency response situations. Technology and preferences may also make the public less dependent on government as people turn to their virtual communities for information and assistance.

- **U.S. Demographic Shifts**: Biotechnology could significantly increase the United States' population growth trend as there could be an increase in life expectancy and a reduction in terminal disease. Since the elderly population is the least likely to use new, emerging technologies, emergency managers must continue to use more traditional technology such as radio and television to reach out to seniors while capitalizing on the popularity of the new technologies to reach all Americans, especially minority populations.

Conclusions & Questions

- **Public preference for and dependence on the internet and mobile devices will continue to grow.** How will emergency managers address the internet, particularly social media, and mobile device use in their plans, policies and procedures for disaster response? How will emergency managers pay for investments in technology, training and personnel to meet public expectations and produce operational efficiencies?

- **Some segments of the population will continue to rely on "old media" (i.e. radio, television) during emergency situations.** How will this segment be supported as emergency managers go forward with newer technologies?

- **Growth, operation, maintenance and protection of internet and mobile network infrastructure must be factored into government and private sector budgets.** Will governments buck the trend of relatively flat infrastructure spending to support new technologies? How can decision makers in government and the private sector be convinced of the importance of budgeting for these technologies in an age of constrained budgets?

- **Telemedicine will change the patient treatment model.** How will this affect the availability of medical resources in rural areas? How can this improve patient care and triage in mass care situations? What are the implications of an extended loss of power?

[1] "Mapping global mobile telephone subscriptions: the world's biggest markets," Euromonitor International, May 18, 2010. Available at: http://blog.euromonitor.com/2010/05/mapping-global-mobile-telephone-subscriptions-the-worlds-biggest-markets.html.

[2] "1 Billion mobile Internet users in 2015," Enterpriseinnovation.net, March 2, 2011. Available at: http://www.enterpriseinnovation.net/content/1b-mobile-internet-users-2015 and "Global mobile statistics 2011," mobiThinking, February 2011. Available at: http://mobithinking.com/mobile-marketing-tools/latest-mobile-stats.

[3] "Global mobile statistics 2011," mobiThinking, February 2011.

[4] Facebook Press Room, "Statistics," Facebook, January 2011. Available at: http://www.facebook.com/press/info.php?statistics and Sorav Jain, "40 Most Popular Social Networking Sites of the World," Social Media Today, October 6, 2010. Available at: http://socialmediatoday.com/soravjain/195917/40-most-popular-social-networking-sites-world.

[5] Janna Quitney Anderson and Lee Rainie, *The Future of the Internet III*, Pew Internet & American Life Project, December 14, 2008, p. 2. Available at: http://www.pewinternet.org/~/media//Files/Reports/2008/PIP_FutureInternet3.pdf.pdf.

[6] "Disruptive Civil Technologies: Six Technologies With Potential Impacts on US Interests Out to 2025," National Intelligence Council, April 2008.

[7] Department of Health and Human Services, Centers for Medicare & Medicaid Services, "Telemedicine Overview." Available at: https://www.cms.gov/Telemedicine/.

[8] Department of Health and Human Services, Centers for Medicare & Medicaid Services, "Electronic Health Records Overview." Available at: http://www.cms.gov/EHealthRecords/.

[9] American Telemedicine Association, "About Telemedicine." Available at: http://www.americantelemed.org/i4a/pages/index.cfm?pageID=3308.

[10] "Disruptive Civil Technologies: Six Technologies With Potential Impacts on US Interests Out to 2025," National Intelligence Council, April 2008

[11] Daniel Petty, "Evacuees use social media to keep up on Boulder wildfire disaster developments," *The Denver Post*, September 9, 2010. Available at: http://www.denverpost.com/news/ci_16027417.

[12] Lindsey Siegriest, "Apps become safety tools in blizzard," *PRWeek*, December 29, 2010. Available at: http://www.prweekus.com/apps-become-safety-tools-in-blizzard/article/193429/.

[13] Olivia Solon, "Hacker sends hoax tsunami warning," *Wired UK*, November 26, 2010. Available at: http://www.wired.co.uk/news/archive/2010-11-26/indonesia-tweet-tsunami.

[14] Jessica Heinzelman and Carol Water, "Crowdsourcing Crisis Information in Disaster-Affected Haiti," United States Institute of Peace, Special Report 252, October 2010, pg. 4. Available at: http://www.usip.org/publications/crowdsourcing-crisis-information-in-disaster-affected-haiti.

[15] Jim Giles, "Smartphone use makes cellular networks' collapse a real possibility," *The Washington Post*, November 30, 2010. Available online at: http://www.washingtonpost.com/wp-dyn/content/article/2010/11/29/AR2010112904854.html.

[16] *Trends in Public Spending on Transportation and Water Infrastructure, 1956-2004*, Congressional Budget Office, August 2007.