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**Improving Disaster Management: the Role of IT in Mitigation,
Preparedness, Response, and Recovery**

COMPUTER SCIENCE AND TELECOMMUNICATIONS BOARD

Background

Information technology (IT) has the potential to improve how communities and the nation handle natural and human made disasters. To assist government planning in this area, the Congress, in the E-government Act of 2002, directed the Federal Emergency Management Agency (FEMA) to conduct a study on the application of IT to disaster management. In 2005, FEMA requested the National Research Council carry out that study. This report characterizes disaster management providing a framework for considering the range and nature of information and communication needs; presents a vision of the potential for IT to improve disaster management; provides an analysis of structural, organizational, and other non-technical barriers to the acquisition, adoption, and effective use of IT in disaster; and offers an outline of a research program aimed at strengthening IT-enabled capabilities for disaster management.

Findings and Recommendations

There are six key areas in which shorter-term development and longer-term research offer the potential for significant benefits: (1) more robust, interoperable, and priority-sensitive communications; (2) better situational awareness and a common operating picture; (3) improved decision support and resource tracking and allocation; (4) greater organizational agility for disaster management; (5) better engagement of the public; and (6) enhanced infrastructure survivability and continuity of societal functions.

Both short- and long-term opportunities exist in each of these areas for enhancing responsiveness and increasing resilience by using IT to enhance all phases of disaster management. In the short term, there are a number of specific opportunities. Some, such as laptops with wireless local area network cards, may already be in the hands of users but are not fully exploited because they may not have been identified as useful tools. Policies and procedures for their use have not been established, and they have not been incorporated into training and exercises.

Significant investment in a long-term research program also will be needed. Development of roadmaps is recommended as a tool to engage diverse stakeholders and inform R&D investments. Such R&D activities must be well coupled to the parts of the

Department of Homeland Security (DHS) and state and local agencies that are responsible for mitigation, preparedness, response, and recovery activities to ensure that requirements are grounded in operational needs and to ensure that solutions can be transferred into operations. R&D planning also should be a vital element of policy formulation so that technological and organizational questions are considered together.

Acquisition and adoption of IT for disaster management is challenging for several reasons including the distributed responsibility for disaster management within the U.S. federal system. The intrinsically uncertain and unstable nature of disasters, and their infrequency and relative unpredictability also make planning for investment decisions, collaboration, and skills development difficult.

There are a number of ways disaster management organizations could address these challenges. For example, a diversified acquisition strategy that includes increased use of commercial information technology and greater use of open source software and open standards development is one means of overcoming existing barriers. This approach will require many organizations to improve their technical and technology management capabilities and to work more closely with technology providers to define, shape, and integrate new technologies into their overall IT system.

IT acquisition can also be enhanced through a set of best practices and design principles. These include an emphasis on iterative development, increased opportunities to test and evaluate technology, and design and evaluation processes that allow for strong coupling among practitioners, researchers, and industry. Four design principles have particular importance: effective scaling from routine to disaster operation; exploitation of redundancy and diversity; flexibility, composability, and interoperability; and distinguishing between the user interface and the underlying technologies.

Another important aspect of effective use of IT in disasters is training and routine use. Too much IT in place today for disaster management is not integrated into day-to-day operations, with the result that it is underutilized when a disaster strikes.

The introduction of new IT often presents opportunities for new organizational approaches, which should be considered in any reorganization efforts. Successful technology development also requires consideration of organizational context. Co-development of technology and organizational practice seems especially important at present. A number of relevant technologies have reached a sufficient level of maturity to allow innovative organizational approaches.

Multidisciplinary research centers would be an especially useful mechanism for (1) developing a shared understanding of the challenges in all phases of disaster management, (2) evaluating the application of technology advances to disaster management practice, (3) developing a culture and processes for moving knowledge and technology to the operational communities, (4) building human capital at the intersection of IT and disaster management, (5) serving as repositories for data and lessons learned, and (6) providing analysis to inform the development of technology capabilities,

associated organizational processes, and roadmap development.

Such centers should include a variety of disciplines, including scientists, engineers, and hazard and disaster researchers, and should include partnerships with federal, state, and local disaster management agencies. Experienced and capable disaster management organizations should be deeply involved in the work of these centers. They could assist agencies seeking to implement a diversified acquisition strategy and incorporate best practices, and serve as a means for disaster managers and responders to share experiences and communicate requirements to guide further technology developments.

Finally, systematic collection of data, measurement, and assessment are needed to drive improvements in disaster management. The emphasis should be on measuring the effectiveness of disaster management activities, not the performance of the IT per se. Moreover, independent mechanisms for assessing the effectiveness of disaster management operations, including the use of IT, and for disseminating lessons learned and best practices, could prove valuable for improving IT use in disaster management.

For additional information:

Copies of, *Improving Disaster Management: the Role of IT in Mitigation, Preparedness, Response, and Recovery*, are available from the National Academies Press; call (800) 624-6242 or (202) 334-3314, or visit the NAP Web site at < http://books.nap.edu/catalog.php?record_id=11824 >. The entire report can be downloaded in PDF format from this web site at no cost.

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