ATP-Funded Technologies for Disaster Detection and Recovery

Background

Technology cannot stop natural disasters, but it can provide an early warning and contribute to recovery and rebuilding efforts. In partnership with industry, ATP has invested in technologies that may play a role in early warning systems and contribute to faster rates of recovery.

Since 1990 ATP has funded several projects addressing issues related to disasters both natural and manmade. ATP projects include technologies that sense seismic movements in structures, offer new materials that enable disaster survivors to recover faster, and develop software to enable better interaction among the varied communication devices of first responders.

Unprecedented damage from hurricanes and a barrage of natural disasters resulted in the declaration of 68 major disasters by President Bush in 2004, the most for a single year since 1998. [1] Between 1995 and 2004, there have been 529 declared disasters, ranging from 32 in 1995 to 75 in 1996 and 68 in 2004. The Federal Emergency and Management Agency (FEMA) has spent $34 billion on recovery from these disasters. (See Table 1.)

Table 1: FEMA Disaster Expenditures by Year and Number of Declared Disasters.[2]

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	10 year total
Number	32	75	44	65	50	45	45	49	56	68	529
Expenditures	$1.5B	$2.4B	$1.9B	$4.1B	$1.9B	$1.7B	$11.2B	$1.8B	$2.0B	$5.5B	$34.0B

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- **Technology for deep sea oil and gas exploration.** A potential application of the technology could be use in detecting potential for a number of natural disasters including tsunamis and earthquakes *3D Geo Development, Santa Clara, CA* **(awarded in 2004)**
  - The use of 3-D seismic images facilitates the discovery of oil and gas deposits in difficult regions such as deep marine deposits.
  - The same technology can be used to develop a digital image of the submarine geology to map potentially hazardous features such as:
    - faults which can rupture causing earthquakes and tsunamis,
    - submarine avalanche hazards on the continental shelf, which can cause tsunamis, and
    - gas hydrate deposits which can cause tsunamis and other natural disasters.

- Variants of the same technology can be used on land to help detect and map subsurface features such as caves and subsurface military installations.

❖ **Wireless sensing networks** will be able to monitor the status of structures in extreme-load conditions such as earthquakes, hurricanes or explosions. Such networks will be capable of: *Sensametrics Inc., Los Altos Hills, CA*

(awarded in 2004)

- Analyzing the health and safety of buildings, bridges and other civil structures and providing early warning of potential hazards; and
- Presenting information relevant to necessary updates and repairs.

❖ **A portable microwave imaging technology** will monitor the condition of structures such as bridge columns, buildings, port facilities, and pipelines. *Newport Sensors, Inc., Irvine, CA* **(prototype in development)**

- This device will make use of microwave imaging technology with antenna arrays to assess the condition of fiber-reinforced polymer (FRP) composites and reinforced-concrete (RC) structures or those structures that have been repaired with FRP composite materials.

❖ **Structures of metal and composite materials can incorporate "smart" sensor systems** for continuous structural integrity monitoring, *Acellent Technologies, Inc., Sunnyvale, CA* **(awarded in 2004)**

- "Smart Layer" sensor technologies will be the first of a generation of "structural health monitoring" signaling devices that use an structurally integrated network of sensors to automatically transmit diagnostic data about structural changes due to loads, damage, or changes in material properties. The structural health monitoring systems are currently being beta-tested for use in military and commercial aircraft, missiles and space vehicles.

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❖ **An interoperable hardware and software platform** facilitates communication between public safety personnel using different equipment. *Innovative Wireless Technologies, Inc., Forest, VA* **(completed system requirements)**

- Lack of interoperability between two-way radios and other wireless devices hampers the abilities of first responders to communicate with each other. "Cognitive radio" platforms will use existing commercial and public safety wireless services to ensure communications between a variety of law enforcement and military personnel who currently carry different wireless devices.

❖ **Damaged phone systems can be restored quickly using "shoelace" technologies** to maintain telecommunications continuity during and following

terror attack, natural disaster, equipment failure, or human error. *TeleContinuity, Inc., Rockville, MD* **(awarded in 2004)**

- Making use of a technique referred to as "shoelacing," surviving phone lines can be quickly patched together providing an emergency telephone system back-up network that seamlessly merges conventional phone lines and the Internet to keep individuals, companies, and government agencies in touch during disasters.

❖ **Large structures, such as power transmission towers,** can be quickly assembled using "snap-and-build" systems. *Ebert Composites Corporation, Chula Vista, CA* **(in commercialization)**

- Following a disaster, utility poles can be put back in service to assist with any recovery efforts.
- Using fiber-reinforced composites created through a pultrusion process, coupled with an in-line computer-numerical-controlled (CNC) process, large, lighter weight, corrosion-resistant, composite structures can quickly replace any damaged structures.

❖ **High-performance composite shapes** that are stronger and longer lasting than concrete and steel can better withstand structural disasters. *Strongwell Corporation, Bristol, VA* **(in commercialization)**

- Using a process called pultrusion, the national aging and deteriorating civil infrastructure can be replaced with stronger, lighter, corrosion-resistant, fiber-reinforced polymer composite structures developed by Strongwell.
- New composite materials, with high mechanical and structural performance capabilities, will enable the development of shapes needed for bridges, buildings, and other large-scale structures that can be manufactured quickly and cost-effectively manufactured.

❖ **Three-dimensional (3-D) software** will be used to create accurate, realistic, models of buildings and other large-scale environments for rapid disaster recovery. *BRAINSTORM Technology LLC, New York, NY* **(in prototype)**

- Reconstruction efforts will be accelerated by the preexistence of detailed building plans and the latest safety devices can be incorporated into the design of new structures. First responders will be better able to acquaint themselves with structures prior to entry.

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[1] FEMA. U.S. Department of Homeland Security. "2004 Hurricanes Lead Record Disaster Year For FEMA" http://www.fema.gov/news/newsrelease.fema?id=15967 Updated Jan. 7, 2005, Accessed Jan. 11, 2005.
[2] FEMA . U.S. Department of Homeland Security. "Disaster Expenditures" [web page] http://www.fema.gov/library/df_6.shtm Created Oct 22, 2004. Accessed Jan 11, 2005.