Far, far beyond wrist radios

Eurekalert!

To believe that technologies once dreamed of in science fiction novels, television shows, and comic strips may one day be a reality, or that real-world technologies might make the fantastic devices of fiction obsolete, you'd need to be either an optimist…or a futurist in the Department of Homeland Security (DHS)'s Science and Technology Directorate (S&T).

To keep dreams grounded, S&T maintains a team of futurists in Arlington, Va., at the Homeland Security Studies & Analysis Institute (HSSAI). There, in the Resilience and Emergency Preparedness / Response Branch, analysts explore the art of the possible, helping DHS shape dreams into a lucid, viable vision. "Revolutionary ways of working are often invented because visionaries saw a need and a novel way to meet it," said Deputy Director Bob Tuohy, who is an admitted sci-fi enthusiast.

In 2011, S&T's First Responders Group and FEMA's National Preparedness Directorate turned to Tuohy's team for assistance in forecasting first responder needs. The result was Project Responder 3: Toward the First Responder of the Future (PR3). The third in a series, PR3 identified the capabilities most critically needed to ensure that responders could meet disasters swiftly, surely, and safely in three to five years. "Faced with difficult budget choices, it's vital that the Department get it right so researchers explore the most pressing problems and companies develop the most wished-for tools," said Patrick Spahn, director of S&T's Operations Analysis / FFRDC Management Branch.

While PRs 1 and 2 (2004 and 2008) viewed technologies as a goal, the new report imagines how technologies will become workaday tools that are easily carried and used. Going further, it singles out technologies that will be needed by responders in multiple disciplines—for example, by firefighters and medics, or by emergency managers and police. In this way, DHS and its partners can make the most of limited resources by solving several challenges at once.

Beyond today's fiscal constraints, state and local responders needed to envision a future when budgets may be more solvent. "They asked us to forget that, today, everyone's broke," recalls Tuohy, "and imagine a 'blue sky' scenario, where anything might be possible."

The researchers were also asked to remember that people, places, and industries were becoming ever-more connected and interdependent. How might these dependencies make energy, water, food, and cyberspace itself more vulnerable to attack?

PR3 wasn't the first time the Department gazed a full generation into the future. For FEMA's Strategic Foresight Initiative (2011), DHS futurists flashed-forward to 2026 to help emergency managers understand how their role would be redefined by

changes in climate, technology, and society. Every four years, the U.S. Coast Guard conducts its Evergreen process. And the Defense Department, through DARPA, routinely looks far into the future. The HSSAI researchers pored over similar studies from government, academia, responder groups, and industry. It was time well-spent. "We used Evergreen as a model for mapping scenarios against potential capabilities," says Tuohy.

PR3's data came primarily from comments and priorities voiced in 2011 by four focus groups, each composed of law enforcement officers, firefighters, paramedics, and emergency managers. The responders discussed and debated how their jobs would be transformed by changes in the economy, technology, and society, as well as by future calamities rivaling 9/11 or Japan's 2011 nuclear meltdown. How would these changes alter the role of the responder as an individual, on a small team? In a vast network? During a typical day or an anything-but-typical disaster?

If you're versed in network crime dramas—or Star Trek—PR3's findings will bear a familiar ring. If you're not, brace yourself for future shock:

Start with Dick Tracy's 2-Way Wrist TV of 1964, fast-forward several decades, and you're on your way to envisioning the law enforcement officer / deputy of the future. In 2031, when an officer needs information, he'll have it, as swiftly and surely as the good guys on Criminal Minds and CSI.

In fact, our future cop will seem blessed with a sixth sense. Donning "augmented reality" eyeglasses or a wristphone, he'll be able to ID a shady character while approaching him, pick out (and zoom in on) a terrorist, and find a weapon before it finds its victims. Armed with assistive technologies like data visualization, the law enforcer will also be fighting new forms of cyber crime. Wirelessly "plugged in" to a homeland-security network, he'll spend less time responding to crime, and more time thwarting it.

Using telemedicine, the paramedic of the future will make tough calls and perform advanced procedures onsite, aided by expert systems and doctors watching from afar. Much as OnStar or Sirius can dial 9-1-1 when a car's airbags deploy, a victim's smartphone (or whatever might replace it) will summon an ambulance if its owner is unconscious. The ambulance can then arrive swiftly and safely, using a jammer that can mute loud music in nearby cars and turn a red light green. Reaching the victim, the paramedic relieves the good Samaritan who has been coached by her phone's virtual physician. As the paramedic's own phone downloads the patient's medical history, a tiny "tricorder" will read the patient's vitals and scan for injuries. It's all in a routine day.

But "routine" will not exist if a city is struck by an earthquake, a radiological ("dirty") bomb, or a chemical or biological weapon. The paramedic of the future will carry or wear a suite of sensors to detect victims, reveal which of them needs the most urgent care, and warn him if he can't reach them safely. Together with stationary sensors, these mobile sensors will feed an intelligent triage system that grows smarter with experience.

In the paramedic's "medical bag," you'll find artificial red blood cells, perhaps artificial blood itself. When disaster strikes, the paramedic will be aided by 3D tracking, a lightweight protective suit, and a long-lasting oxygen supply that's trim and lightweight. Victims won't weigh down our paramedic: He'll get a boost from a robotic cot, a stair-chair, or perhaps an "Iron Man lite" exoskeleton.

Lighter gear, sensors that warn when to clear out, and smoke-penetrating goggles ranked high on the wish list of responders envisioning the firefighter of the future.

Like tomorrow's paramedic, the future firefighter may rely on robots to do heavy lifting or scope out a hostile environment. But mostly, he'll rely on headgear that streams "situational awareness" from a symphony of sensors. Warnings, maps, and other vital data will be beamed to a firefighter's eyes and ears, keeping hands free as they guide him into a fire and back out before the ceiling caves, his oxygen empties, or his body succumbs to heat.

Software will help the emergency manager (EM) of the future make urgent decisions, undistracted by logistics. When a hurricane in Florida creates hundreds of calls for portable generators, fresh water, and food, an expert system will sort them out, sending supplies—public and private—where they'll do the most good. And after an earthquake, smart sensors will "phone in" injuries and damage; the results will be color-coded onto high-resolution maps.

The EM, the cop, the fireman, and the medic share a need for game-changers such as multithreat protective suits that are comfortable, light, and slim; intelligent avatars that understand the spoken word; universal translators to let them converse with nervous immigrants; and new learning tools to help them master the new technologies. And responders will need smarter ways to work, team, enlist savvy citizens, and do their jobs if technology fails.

If you think S&T's researchers reached these conclusions by taking notes and tallying votes, think again. Since focus groups are small, findings can be unreliable. To firm up their findings, the HSSAI researchers turned to a survey technique called the Q Methodology—an intensive exercise that revealed, in nuanced detail, how respondents felt about their various needs. Each responder studied a long list of needs, ranking each need's priority from +3 to -3. Then, the researchers used factor analysis—a technique for describing how dramatically correlations vary—to reveal clusters of like priorities farther down the responders' wish lists.

Through factor analysis, an also-ran technology—much like an also-ran talent-show contender—may emerge as an unlikely favorite. When voters merely vote for their favorite contender, the nerd will lose—the fallback of millions, the favorite of few. But when voters voice how strongly they feel about each contender, their new idol may turn out to be the improbable, unglamorous nerd.

Meanwhile, responder agencies must face greater challenges imposed by budgetary belt-tightening, fiscal shortfalls, out-of-reach costs, out-of-touch policies, and out-of-date procedures.

Perhaps the pop-culture accounts of responder technologies are part of that problem. "Everything people see on TV, they think we have," one first responder remarked, adding that this delusion complicates matters when responder agencies are appealing for funds. Talent-show viewers can vote with their phones, but responders must vote with their wallets. That's why S&T is appealing to private industry to provide affordable answers.

Some answers will raise legal or ethical questions. For example, will a paramedic be free to view a patient's entire medical history, or view only the parts that can help her save a life? If a surgeon in Scranton is guiding a paramedic in Pittsburgh, what happens if the link fails?

And how do you sue an avatar for malpractice? Before telemedicine makes its debut, responders will need to hear from experts in medical malpractice and privacy.

That's fine with Spahn, who noted, "Anytime you deploy a new technology, life gets in the way. That's one reason we look so far into the future."

"It's tough to make predictions, especially about the future," said the late Yogi Berra. Project Responder 3 marked the first time S&T tuned its crystal ball 20 years out. But it won't be the last. In 2014, the digital ink will dry on PR4. What new capabilities, and new challenges, might that report describe? It's a tough job, but someone's got to do it. And for DHS, HSSAI will do it right.

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