Defense Horizons
Number 70
A publication of the
Center for Technology and National Security Policy
National Defense University
December 2009

STAR–TIDES and Starfish Networks: Supporting Stressed Populations with Distributed Talent

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Overview

The Department of Defense increasingly is involved in postwar stabilization and reconstruction, humanitarian assistance and disaster relief missions, capacity-building of partner nations at home and abroad, and other such complex operations. To provide sustainable support to stressed populations in these environments, an international, networked, knowledge-sharing research project called Sustainable Technologies, Accelerated Research–Transformative Innovation for Development and Emergency Support (STAR–TIDES)[1] encourages innovative approaches to public-private collaboration, whole-of-government solutions, and transnational engagement. It leverages a distributed network of people and organizations to conduct research, support real world contingencies, and bridge gaps among disparate communities.

The three main goals of STAR–TIDES are to enhance the ability of civilian coalitions (business, government, and civil society) to operate in stressed environments, extend the military's ability to work with civilians in such situations, and economize by identifying cost-effective logistic solutions and rationalizing supply chains.

STAR–TIDES fosters unity of effort among diverse organizations when there is no unity of command. The project is building a repository of information about potential solutions to provide "knowledge on demand" to support decisionmakers and those working in the field, rather than act as an operating agency. Information collected is made available in the public domain via a Web site,[2] and feedback, opinions, and recommendations from users are encouraged.

A Starfish Organization

In *The Starfish and the Spider*, Ori Brafman and Rod Beckstrom explore two competing methods of organization. The spider represents a traditional, hierarchical organization with one leader having centralized responsibilities not replicated in the rest of the organization. Destroy the head and the spider dies. A starfish organization is distributed; members' roles and responsibilities (including leadership selection and refinement) can adapt rapidly to changing circumstances.[3]

Sustainable Technologies, Accelerated Research–Transformative Innovation for Development and Emergency Support (STAR–TIDES) is a networked effort that combines centralized and decentralized types of organizations. Its greatest strength is an extended network of interested individuals, businesses, government offices (civil and military), universities, and other entities from Australia to Singapore to northern Europe.[4] Within this extended network, a steering team of 7 to 10 people is being formed to set broad priorities for outreach, research, event coordination, and technology integration. The team is supported by a small core to execute guidance and oversee engagement with particular TIDES projects. Most importantly, the steering and core teams act together as a catalyst to engage the exceptional energies and talents that reside in the extended network. Some people are dedicated full-time by their organizations to support the project, some are part-time, and most are volunteers.

The broad scope of available expertise has helped STAR–TIDES investigate such diverse areas as stability, security, transition, and reconstruction (SSTR) in Afghanistan, humanitarian assistance/disaster relief (HADR) in tropical regions, building partner capacity (BPC), and defense support to civil authorities (DSCA) in the United States. The network has supported responses to real world events—including wildfires in southern California, Federal Emergency Management Agency (FEMA) trailer replacement, shelter solutions for

the Canadian Arctic, Cyclone Nargis relief in Burma, and election-monitoring in Afghanistan.

While the STAR–TIDES core facilitates interactions among people, processes, organizations, and technology, many of the most valuable ideas have come from the extended network. The Web site, email threads, blogs, Twitter streams, and other fora encourage collaboration among participants. The project is building a knowledge repository containing ideas for potential solutions and best practices in support of stressed populations, arranged to encourage use and feedback by as many people as possible. The long-term goal is to have the repository be updated remotely and continuously by credible, dispersed contributors and accessible by interested parties through natural language queries with minimum involvement from the core.

STAR–TIDES does not provide assistance directly to stressed populations. Its main products are information and reachback capabilities to support decisionmakers and those working in the field. Rapid updates are important as field experience provides new insights, which reinforce the distributed nature of the STAR–TIDES approach.

Policy Background

Since 2004, U.S. policy and national security organizations have changed significantly in ways that promote engagement with civil-military mission partners in complex operations.[5] Collectively, these reflect major policy and doctrine changes for the U.S. military, increasing emphasis on preconflict peacekeeping, capacity-building in partner nations, postwar stabilization and reconstruction, and humanitarian assistance and disaster relief. The implications of these changes are still evolving, and the new guidance recognizes that the sorts of problems that generate complex operations[6] cannot be solved by military means alone.

STAR–TIDES thus supports U.S. national strategy, policy, and military doctrine, and is consistent with recent statements by the Secretaries of Defense and State calling for increased use of smart power[7] initiatives, greater interagency cooperation,[8] and the "3D" approach of diplomacy, defense, and development.

Methodologies

Effective strategies for supporting stressed populations must consider short-term and long-term situations (from multiweek disaster relief to multiyear refugee camps), in domestic and foreign venues, with or without military involvement. In some cases, such as disasters, responses must be rapid and flexible. In other cases, such as capacity-building and stability operations, solutions need implementation systematically in the near and long term. The average stay in a refugee camp is over 7 years, a situation that requires completely different solutions and resourcing approaches than immediate responses. Strategies in nearly all of these cases should be bottom-up, focusing on the needs of the stressed population rather than the interests of aid providers, and strategies should link, where possible, to top-down frameworks. Solutions must be sustainable by those who will have to live with them.

Consequently, STAR–TIDES approaches focus on the needs of a stressed population for shelter, water, power, and other essential infrastructures and services. Military logisticians have noted that the deployable equipment that the Department of Defense (DOD) can bring to support such situations often is expensive, committed to operations plans, and signed for on custody cards—so it cannot be left behind to help build the capacity of the partner nation. At the same time, the capital-intensive infrastructures of the developed world are not likely available, either because they have been disrupted or were not operating in the first place. The TIDES part of STAR–TIDES began by addressing "transportable infrastructures" to encourage cost-effective, nimble, and efficient approaches over a wide range of circumstances (development and emergency support) that do not depend on deployable, costly military systems or fixed terrestrial facilities. A key element is a "whole-systems" concept that looks at cross-cutting links among different infrastructures.

STAR–TIDES approaches focus on the needs of a stressed population for shelter, water, power, and other essential infrastructures and services

STAR–TIDES does not try to provide solutions to all problems of stressed populations. For example, security, food supplies, and medical care are considered "associated activities" at present. The STAR–TIDES distributed approach allows the network to reach out to people with various skills for assistance, and the integrated planning process (described below) can adapt these considerations for particular circumstances.

Infrastructure

The underlying model for STAR–TIDES and its whole-systems approach to infrastructure solutions is based on the Hexayurt Project's "six ways people die" model.[9] These are *too hot*, *too cold*, *thirst*, *hunger*, *illness*, and *injury*. Shelters can help mitigate the first two risks, supply chains can address thirst and hunger, public health and medicine can mitigate many illnesses, and safety and security can reduce the likelihood of injury.

An example of the whole-systems approach is integrated cooking. A combination of solar ovens and high-efficiency stoves, plus retained heat baskets containing stones or bricks, can significantly reduce fuel use compared to open-pit fires. If properly tied to other infrastructures, the heat used for cooking could sterilize water, and use of hot stones and bricks for heating could reduce public health risks from smoke inhalation from open fires, especially in shelters. Lowered fuel demand could mitigate deforestation, give people more time for non–fuel-gathering activities, and reduce security risks to gatherers.

Effective information-sharing can help with early detection and treatment or isolation of some infectious diseases. Information and communications technology (ICT) can help outside partici-

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Table. Examples of STAR–TIDES Infrastructures

Type	Example
Shelter	Indigenously based systems wherever possible: hexayurts, ShelterBox (Rotary Club's integrated support system), cost-efficient commercial shelters, etc. Some 75 types of relatively inexpensive shelters have been identified so far.
Water	Solar water pasteurization, low-power filtration, reverse osmosis units. The Dutch nongovernmental organization Akvo (www.akvo.org) has developed integrated approaches to analyzing water issues that STAR–TIDES is leveraging.
Power	Solar panels, wind turbines, and micro-hydro, with integrating power controllers where applicable. Indigenous manufacturing, or at least assembly, is preferred.
Integrated cooking	Combinations of solar, combustion stoves, and retained heat
Heating/lighting/cooling	LED lighting, low-wattage cooling fans, insulation, whole-systems approaches to reuse heat from integrated cooking
Sanitation	Chemicals that neutralize harmful bacteria, but are environmentally safe. Innovative research in flooded area sanitation is being done in Singapore, and Akvo has comprehensive information on sanitation.
Information and communication technologies	Information transport mechanisms such as portable satellite dishes, microwave links, and mesh networks; bridging equipment to link to local communication systems; robust, low-power computers, such as One Laptop Per Child, geospatial information systems, and related products

pants and indigenous populations mitigate consequences through resource management, security, enhanced situational awareness, and advanced planning for future crises. ICT applications can be designed to provide useful services even when bandwidth is limited. Human interoperability research could help to establish trust within the social networks involved.

Based on the initial expertise of the project's participants, the six ways to die model, and interest expressed by participants in related projects, STAR–TIDES initially focused on seven infrastructures: shelter, water, power, integrated cooking (solar, combustion, retained heat), heating/lighting/cooling, sanitation, and ICT (see table). STAR–TIDES evaluates potential solutions in these categories according to principles of whole-systems integration, plus three additional constraints:

- The solution must be suitable (inexpensive, available, culturally appropriate) and owned, operated, and sustained by the local population, or provisioned from relatively limited budgets.
- Depending on the situation, individual components might need to be small and light, so that a family can travel with its own infrastructure.
- The components should be common, off-the-shelf items to help meet the demand spike in a crisis. Indigenous and/or environmentally friendly materials should be used wherever possible.

An early effort to build an integrated, transportable infrastructure system was the Hexayurt Project.[10] The system is designed for a long-stay refugee camp scenario in dry climates. The system represents an existence proof of the project's goals; on paper, this system could provide all basic services to a stressed population, other than food supplies and medical care.

The hexayurt infrastructure package met the first two conditions but fell short on the third because it required exotic items such as wood-gasification stoves and building materials that might be unavailable in some areas. However, it did demonstrate the feasibility of providing all basic services—drinking water, a safe toilet, cooking, even lighting and recharging of a cell phone—from simple items.

Improving the fit of infrastructures to prevent death and enhance welfare in specific scenarios is a core goal of the STAR–TIDES network. One of the lessons learned to date from research and field activities is that almost no solution is suitable for all environments (for example, shelters deployed for winter snows may not be useful in tropical floods). The single exception seems to be light-emitting diode (LED) lighting—although it may be too expensive for some users.

Scenario-based Planning and Policy Support

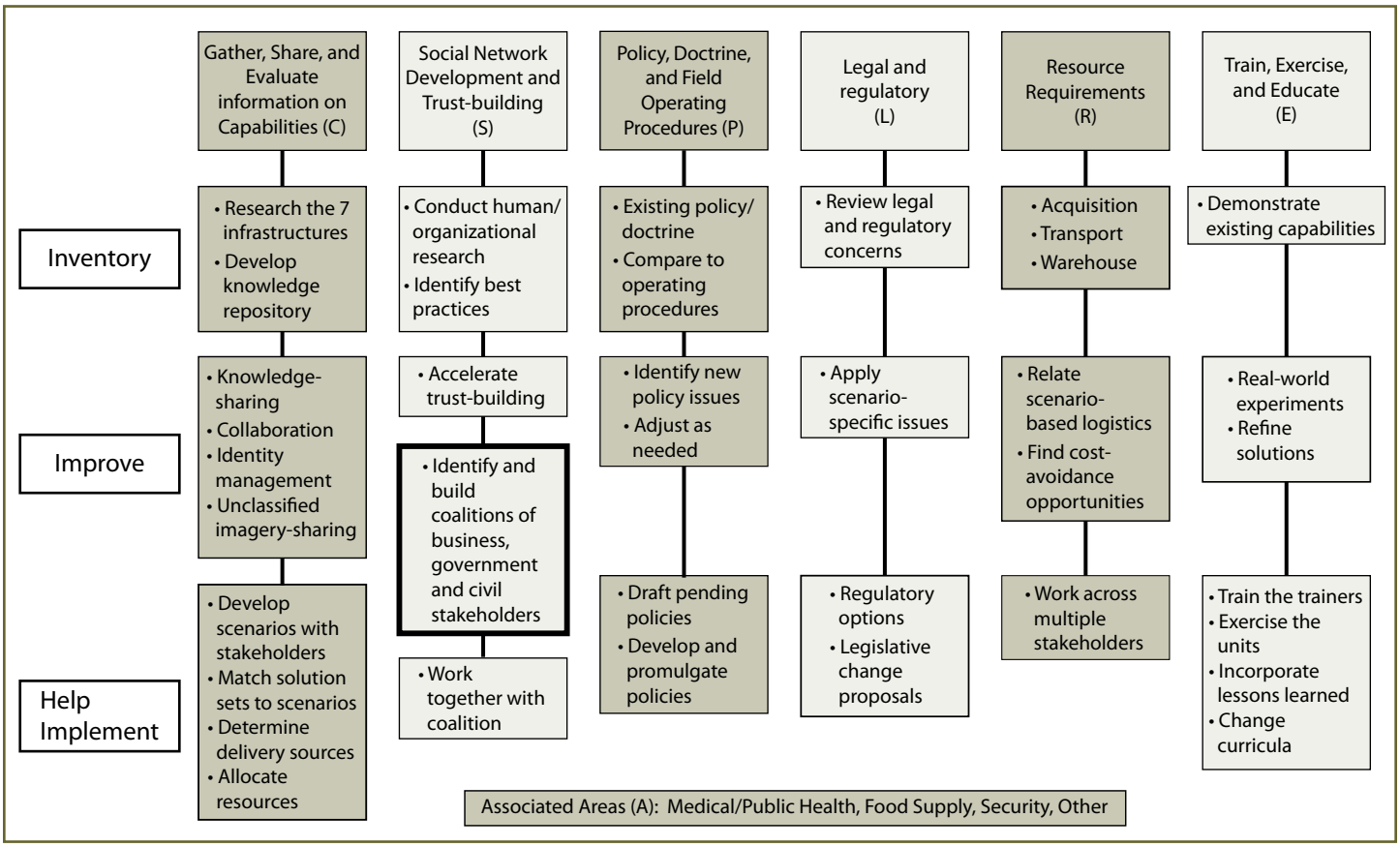
In addition to the infrastructure-based approaches described above, support to stressed populations involves social, policy, operational, legal, regulatory, and financial issues, plus a host of other questions. To address these in an integrated way, focus on problems of interest to stakeholders, and support a planning process that might help mitigate needs in advance of a crisis, STAR–TIDES often examines problems in the context of scenarios. Specific research depends on available resources, but based on inputs from combatant commanders, civilian government organizations, nongovernmental organizations (NGOs), academics, and others, STAR–TIDES is looking at four scenarios:

- SSTR in Afghanistan, particularly renewable energy in remote villages and ICT in the eastern province of Nangarhar around the city of Jalalabad
- HADR in tropical regions, such as western Central America, the Caribbean, or the western Pacific
- DSCA in and around Washington, DC. This would involve natural or manmade disasters, and would focus on improving coordination among Federal, state, and local authorities, businesses, and the populace
- BPC in sub-Saharan Africa, especially focused on refugees.

Each scenario is examined through a 10-step process. For illustrative purposes, the examples given below are built around the Central American HADR scenario.

1. Postulate a desired endstate and success metrics, and build paths to them from the initial scenario condition. When should people be out of temporary shelters and back into permanent housing? Should people be relocated to less vulnerable areas? How will first responders reach the victims? What services need to be provided to meet critical needs?

Figure. Integrated Research Areas



2. Postulate solution sets appropriate to the scenario's circumstances. Which combinations of shelter, water, power, cooking, sanitation, communications, and information services would likely work best in Central American environments in the rainy season and afterward?

3. Identify the coalition of business, government, and civil society needed to implement the solutions on the ground. What part of the local government provides FEMA-like functions? What local languages are involved? Will indigenous NGOs be engaged? Are there local businesses that can be leveraged? How do U.S. Southern Command (USSOUTHCOM), U.S. Agency for International Development (USAID)/Office of U.S. Foreign Disaster Assistance (OFDA), the United Nations (UN), and others interact with them?

4. Refine the scenarios, desired endstates, metrics, and solution sets, in concert with the appropriate local coalition leaders, U.S. entities, and international players so the solutions and metrics meet local needs and are executable in the long run. For example, there may have been about 180,000 homeless after Hurricane Mitch in 1998, but a comparable hurricane today would leave possibly 250,000 homeless.

5. Identify sources of supply for the solutions, for which there are four main options:

- government stockpiles or contracts (USAID/OFDA or DOD, plus FEMA/Department of Homeland Security in the United States, host governments, and so forth)
- nongovernmental stockpiles or contracts (UN, NGOs, private volunteer organizations [PVOs])
- commercial supply chain—indigenous and international
- empowered citizens (imagine how different the situation might have been if everyone in New Orleans had stored 3 days' worth of food and water before Katrina). As an example of ways to empower civilians, STAR–TIDES is working with gamers to write scenarios (for cell phones and projects such as One Laptop Per Child) that could teach children how to prepare themselves and their families better for disasters and then how to respond after disaster strikes.

6. Address legal and regulatory issues (such as customs clearance and export controls).

7. Estimate resources needed for each of the above (this might save all parties funds through cost-effective logistics and supply chain alignment). The actual allocation of resources would be done through established budget and acquisition processes.

8. Work through the field operating procedures (including military tactics, techniques, and procedures) to ensure consistency with policies and allow people on the ground to work well together.

9. Develop the training and exercise programs among the various members of the civil-military coalition to sustain progress and capture lessons learned. In the longer term, adjust curricula at appropriate educational institutions. Explore broad training, exercise, and educational partnerships.

10. Assess progress and adjust as needed.

Ideally, these steps would be taken well in advance of a crisis, thus forming the basis for planning and consequence mitigation measures. Since information will be widely shared via the STAR–TIDES

Web site, others can benefit from lessons learned from any scenario and apply them to their own situations.

Research Areas

The 10 steps for investigating scenarios leverage a range of activities conducted within a framework of 6 broad research areas with links to associated activities. Research in some areas may not be done to support a particular scenario (such as improved collaboration tools, or ways to accelerate trust-building). However, as the broad research agenda develops, it can contribute to building a whole-of-government, public-private, transnational process that can help align strategies, goals, objectives, and policies with capabilities and resource requirements. The overall approach is shown in the figure.

The research area categories and some of the related topics are amplified below.

1. Gather, Share, and Evaluate Information on Capabilities:
   - Leveraging the seven STAR–TIDES infrastructures, gather, share, and evaluate information about capabilities that are useful to, and sustainable by, people on the ground in the affected area. Provide opportunities for ongoing feedback from field experiences.
   - Acquisition of these capabilities and delivery to the field are accomplished through local coalitions of business, government (civil and military), and civil society (NGOs, academia, concerned citizens) in conjunction with international organizations. Such acquisition efforts and field operations are outside the STAR–TIDES scope, per se, but STAR–TIDES shares information with such efforts and draws information from them. The focus on local coalitions integrates with social network development and trust-building.
   - Enhance situational awareness by designing, sharing, and evaluating information services to support field operations. Much of recent STAR–TIDES research has focused on improving geospatial information system products and shared situational awareness

2. Social Network Development and Trust-building:
   - Learn how to develop social networks and build trust with nontraditional, civil-military partners before a crisis. Distinguish between approaches that could work anywhere and those specific to particular scenarios. A mix of skills will be needed—the Bahasa Indonesian–speaking, scuba-diving neuroscientist who could be perfect for tsunami relief in Southeast Asia might be of little help in an Andean earthquake, so a diverse, standing network needs to be nurtured continuously.
   - Examine ways to accelerate trust-building, even in stressed environments.
   - Link to research on human interoperability and human, social, cultural, and behavioral efforts.

3. Policy, Doctrine, Operating Procedures:
   - Review high-level policies and doctrine for sufficiency and recommend changes as appropriate.
   - Examine how to convert policy and doctrine into field operating procedures and communicate those procedures in ways that let people on the ground work effectively.
   - Consider what alternatives to traditional command and control in complex contingencies[11] need to be designed and implemented for disparate stakeholders to focus on a problem, put together a suitably agile structure to meet the needs of the situation, and converge the resources to get the job done.[12] To enable diverse organizations to focus on problems and develop a shared situational awareness of what is going on, network-enabled capabilities that link as many participants as possible are essential. Achieving those capabilities requires an underlying data strategy that allows all information on the network to be discoverable, accessible, understandable, and trusted. (This relates to the "improve knowledge-sharing/collaboration/identity management/unclassified imagery sharing" under the first column of the figure.)

4. Legal and Regulatory Issues:
   - Clarify the legal challenges associated with transferring goods and services bought with certain types of funds to other areas under different circumstances—for example, leaving military equipment behind for disaster victims to use.
   - Understand what regulatory and other issues must be addressed in particular scenarios (such as customs and border clearance or export controls).

5. Resource Requirements:
   - Different scenarios will require different resourcing approaches, from immediate crisis response to long-term capacity-building and sustainment.
   - Aligning the four different sources of supply described in step 5 of the scenario can save everyone money.

6. Train, Exercise, and Educate:
   - The trainers must be trained first, and then those who will use the infrastructures in the field. Rotary Clubs do an excellent job supporting distribution of the ShelterBox disaster relief kit[13] by deploying a team of trainers who speak the local language to teach Rotarians in the affected area how to set up the tents and use the ShelterBox equipment, so they in turn can train survivors.
   - Exercise programs must be established to practice, refine, and revisit issues and incorporate lessons learned. Some broadly inclusive exercises can be used as models, including Operation Golden Phoenix and the annual Fuerzas Aliadas Humanitarias disaster management event among more than 20 Central American and Caribbean nations, U.S. Army South, and transnational institutions.
   - Educational curricula need to be changed to capture lessons learned, and behaviors must be adjusted accordingly.

Associated Areas. When STAR–TIDES began, the members of the team had no experience with areas such as public health or agriculture. In addition, security was not included as a core area since it is handled by the military, law enforcement, and others. Hence, these issues are treated as being "associated areas," relying on others' expertise. This focus may evolve in the future.

Starfish Analogy

STAR–TIDES neither needs nor wants to control all the research done across these broad areas. If research funded by other projects is

producing results in some of these areas, and funders are willing to share it, the results will gladly be incorporated. There is no desire to make this a large, centralized project. Such an approach would fail. For example, much work on information-sharing already is being done under the auspices of the Defense Information Systems Agency (DISA). Research into social network development and trust-building is being sponsored by the Under Secretary of Defense for Acquisition, Technology, and Logistics and others. Policies are developed through many different channels. Exercise planning and execution are dispersed.

Eventually, the STAR–TIDES Web site will be populated with information from any source (which will be given full credit), and then used to share information and gather feedback. A goal is to migrate to genuine Web 2.0–type formats that promote interactions, as opposed to just having readable Web pages. In an ideal endstate, STAR–TIDES resources and processes would be distributed to many centers and serve as a catalyst to encourage the ongoing operation of a starfish network based on a distributed information and innovation platform.

A starfish network does not function without sharing information. STAR–TIDES embraces this idea and holds that to engage effectively with a wide variety of entities in these environments, DOD must find ways to share information properly with these players.[14] Such entities include aid organizations, local populations and governments, indigenous security services, NGOs, international organizations, commercial firms, and even individuals. Without the ability to work effectively with these stakeholders, the United States cannot achieve the social, political, and economic goals for which military forces have been committed. Thus, these smart power capabilities must be core elements of national strategy from the beginning of the planning process.

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Origins

STAR–TIDES developed through a series of events that highlighted some of the basic problems as well as the policy and procedural deficits that have become the focus of its research. STAR–TIDES also addresses needs identified by previous work done by the Center for Technology and National Security Policy (CTNSP) at the National Defense University (NDU).[15] It builds on the evolution of policy and doctrine since 2004 and draws on experiences from the tsunami and Katrina relief efforts, three STRONG ANGEL demonstrations (2000–2006),[16] and reconstruction efforts in Iraq and Afghanistan. In each case, difficulties in communication, collaboration, and information-sharing with various partners have been identified as obstacles to mission success.

STRONG ANGEL Demonstrations

Beginning in 2000, the U.S. military sponsored a series of demonstrations known as STRONG ANGEL to improve civil-military interactions in areas such as medical care, language translation, and information-sharing. In 2006, STRONG ANGEL III (SA III) served as an "integrated disaster response demonstration" that included elements of both a global pandemic illness and cyberterrorism. The focus was on a domestic U.S. scenario in which "the citizens of a community are deprived of power, cell phones, and Internet access, and are beyond the immediate reach of Federal assistance."[17] One key objective was to tap the expertise and creativity within an affected community, including public-private partnerships. A second was to develop social tools and techniques to encourage collaborative cooperation between responders and the population they serve during postdisaster reconstruction.

SA III participants included a wide range of public and private organizations.[18] Much progress was made, but the results showed how much work remains to be done. Despite having tremendous resources and knowledge at their disposal, the SA III participants were slow to achieve unity of effort as the situation unfolded. Wireless networks frequently interfered with each other while standing up. After continuing problems with ad hoc, poorly synchronized approaches, leaders stepped forward to help move the recovery process. These were important insights. Fairly straightforward lessons have been repeated from Indonesia to New Orleans, while corrections consistently have proved hard to implement. This experience reinforces the need to define clear operating procedures that are understandable to field personnel and train with them. Highlighting that more attention must be paid to these recurring problems was part of the experimental goals of the STRONG ANGEL series.

Charrette

In 2002, the Rocky Mountain Institute sponsored a *charrette* (brainstorming session) to rethink refugee-and-displaced-persons settlements from scratch.[19] The focus was on UN High Commissioner on Refugees concerns—energy, site, water and sanitation, communications, education, health, economic development, food and nutrition, and construction and shelter. Participants also considered security, light, and refrigeration. A key purpose was to create a settlement design methodology and template for helping displaced people quickly—in short, a primer for aid workers. The charrette also examined ways to improve the international Sphere Project standards for refugee populations.[20] Innovative outcomes included the Hexayurt Project and the Life Box (where packing materials were impregnated with seeds).[21] Equally importantly, the charrette brought together individuals with diverse skills whose interactions continue to make significant contributions to STAR–TIDES.

Tsunami Relief

As part of the intensive U.S. and international relief effort after a tsunami struck the Bay of Bengal on December 26, 2004, the

Office of the Secretary of Defense sent a small assessment team to the region to identify, address when possible, and document issues in civil-military relief efforts.[22] This team included a Navy doctor, civilian doctor, and retired Navy flight officer. They spent several weeks traveling between UN posts in Jakarta and Banda Aceh in Indonesia and U.S. operating centers, the USS *Abraham Lincoln*, the USS *Bonhomme Richard*, and the airfield at Medan on Sumatra. The assessment produced a number of important observations and recommendations that can apply in other areas:

- Social networks need to be developed to help bridge civil-military gaps. The fact that the doctors were known to the UN and aid communities opened many doors, while the former naval aviator facilitated contacts on board the carrier. Their combined networking allowed them to recommend adjustments in the field that led to improved civil-military interactions and to documented lessons learned that have been incorporated into other efforts, including STAR–TIDES.
- Web-based civil-military collaboration can be an important tool, but it needs to be open and accessible to all, and to serve bandwidth-challenged and intermittently disconnected users. DOD should facilitate Internet access by civil-military mission partners, not restrict it. Policies are being developed to support such access.
- In disaster situations, unclassified information and imagery should be made available as quickly as possible with minimal restrictive caveats.
- Provisions should be made to allow sharing of available bandwidth, possibly by creating separate networks independent of any government or military networks.[23]

Expedient Infrastructure for Transient Populations Effort

In April 2007, approximately 20 people, led by Jim Craft, former senior advisor to the Minister of Communications and Information Technology in Afghanistan, met to initiate a project called Expedient Infrastructure for Transient Populations (EITP). Attendees included public and private stakeholders, governmental and nongovernmental organizations, and others with a common interest in improving help to stressed populations. In late summer 2007, EITP was renamed STAR–TIDES,[24] largely to facilitate outreach. Since Mr. Craft by this time had become Deputy Chief Information Officer of the U.S. Marine Corps, coordination of the project moved to CTNSP at NDU.

Early Activities (2007–2008)

Demonstrations and Conferences

CTNSP sponsored a set of phase I demonstrations in fall 2007 at Fort Lesley J. McNair in Washington, DC, and at the Pentagon that focused on the seven core infrastructures mentioned above. These represented a "proof of concept" for STAR–TIDES and concluded with exposure testing of several shelters on a mountaintop in western Virginia from December 2007 to July 2008.

The diverse visitors to the demonstrations taught the STAR–TIDES team much and took away ideas for future collaboration. In the end, less than $20,000 in U.S. Government investment generated more than $800,000 in private sector engagement, even under the ground rules that participation in the demonstrations did not constitute government endorsement of any particular solution.

Phase II activities continued through fiscal year 2008, and focused on outreach, building the network, researching technologies, and refining analytical models. The environmental testing on the shelters showed that they could withstand severe weather, but also highlighted deficiencies—for example, in resistance to ultraviolet radiation.

Real World Events

A few real world examples illustrate the general STAR–TIDES approach. They reinforce that the objective is to link people who have problems with those who have answers in order to support decisionmakers and those working in the field.

Southern California Wildfires. In October 2007, multiple wildfires in southern California severely stressed the area around San Diego and stretched beyond the border into Mexico. The STAR–TIDES core group asked members of the extended network if anyone had any ideas that could help. One suggestion was to use the Predator unmanned aerial systems with multispectral imagers flown by the National Aeronautics and Space Administration (NASA). At this point, the fact that NASA had Predators with such sensors was not widely known in DOD. To make sure STAR–TIDES was supporting decisionmakers, General Victor Renuart, Jr., USAF, commander of U.S. Northern Command (USNORTHCOM), was asked how STAR–TIDES could best support his efforts. He provided a link to his operations directorate, where continued engagement was focused. Members of the directorate expressed appreciation for the STAR–TIDES support after the fires were out.

In addition, many of the groups involved in the emergency response efforts included members of the STAR–TIDES network. As the situation developed, linkages and paths were created among such diverse groups as San Diego State University, NASA, University of Maryland, Bell Canada, Google, the National Institute of Urban Search and Rescue,[25] the Department of Homeland Security, and USNORTHCOM. In sum, as part of an extended team, STAR–TIDES was able to facilitate information-sharing to help decisionmakers and those in the field address problems of interest to them, and then stand aside as appropriate.

Bangladesh Floods. In November 2007, Cyclone Sidr struck Bangladesh. In response to a query, members of the network noted that *Vibrio cholerae* bacteria are carried by small creatures that live in salt water. The ability to map the salt water intrusion boundary after a flood can give medical personnel about a 10-day warning on where cholera outbreaks might occur. A check with the National Geospatial-Intelligence Agency (NGA) revealed that there was no imagery available from U.S. national technical means, but some commercial imaging firms had photos. However, the contract required that these be released only to governments or similar entities, which greatly complicated their use by NGOs and others working on the relief effort. STAR–TIDES checked with Admiral Timothy Keating, USN, commander of U.S. Pacific Command, who concurred with further investigation. In short order, NGA was able to get the commercial imagery companies to agree to release pictures without caveats within 30 days of a disaster to those working on the mission, so long as copyright information was left on the geospatial products. They also honored this in Cyclone Nargis in Burma.

Canadian Arctic. A final example centers on Canadian interest in infrastructures for the Arctic. Their first question was, "What do you have that might work in −40° temperatures, 50-knot winds, and permafrost?" After a somewhat dumbfounded initial response, the network again was queried. Some members had contracts with the Aleuts for green energy solutions in Alaska. Others were working with the government of the Yukon. The contacts were put in touch with the Canadians who had asked the question, thus adhering to the model of linking people with questions with those who have answers, and then stepping aside.

Collectively, these examples show how STAR–TIDES has worked in its early stages. The experiences have stimulated relationships and social networks that have formed the groundwork for more effective information-sharing in a variety of situations. In one sense, the project can serve as a commons to encourage diverse players to come together.

Phase III Activities

The STAR–TIDES focus in phase III (October 1, 2008–September 30, 2009) was on expanding the online knowledge repository, enhancing information-sharing tools, working through scenarios from beginning to end, and building out the network. It placed more emphasis on open field demonstrations, exercises, and testing than on static displays.

The phase III activities began with the second annual demonstration in October 2008, again at Fort McNair and the Pentagon. The demonstration built on phase I and II results and included operational displays of infrastructures that could be used in each of the fiscal year 2009 scenarios (Afghanistan SSTR, tropical disaster relief, African BPC, and DSCA in the Washington, DC, area). The results suggested considerable progress in a year:

- Less than $5,000 of DOD investment at Fort McNair generated over $1.7 million in private sector engagement.
- A day after starting from a "cold, dark, quiet" field with no access to power, water, or communications, the STAR–TIDES participants (business, military, civil government, NGOs, academia) had:
  - seven satellite networks operating, independent of the power grid
  - a third of the site powered by portable solar equipment with wind turbine backup
  - filtered drinking water (appropriately tested) provided by portable units directly out of the Potomac River
  - food being cooked in solar ovens as part of an integrated solar/combustion cooking and heating approach designed to save 75 to 90 percent of fuel use over open fires
  - innovative shelter solutions available at a fraction of the costs of deployable military systems.

Experimentation

As plausible candidate infrastructures are assembled, credible testing will become even more important. The concept of field feedback ("e-pinions," wikis, and so forth) has always been part of STAR–TIDES, but until recently the project has not had access to structured a priori testing. However, some options are becoming available.

The Naval Postgraduate School at Monterey, California, has a sophisticated test range stretching over an extended area from Camp Roberts in central California to Monterey Bay and beyond. The range also is linked to test sites in other states, so experiments can be run in a range of climates. The first STAR–TIDES field experiment at Camp Roberts in early 2009 addressed renewable energy (solar and wind) to drive water purification, lighting, and some other experiments.

A second experiment in August 2009 focused on developing situational awareness (SA) rapidly in stressed environments, and sharing it under various conditions. Using Afghan and Central American–based scenarios, the team experimented with innovative ways of creating SA using short message system/text messages in limited bandwidth situations, and worked to link the updates to useful geospatial products that could be modified in the field. The products were based on a new archive of sub-one-meter imagery that NGA made available in July 2009 for participants in U.S. and coalition operations in Afghanistan. Through collaboration among geographers, software developers, government employees, and NGO/PVO field staff members, using a mix of freely available open source and common commercial tools, effective products were developed, deployed to Afghanistan, and used in election monitoring less than 2 weeks after the experiment started.[26]

Future experiments will expand these lines of research and integrate unmanned air vehicles and human interoperability investigations, along with a wider range of participants.

In addition, USNORTHCOM set up infrastructures at the U.S. Air Force Academy for field testing by cadets in summer 2009.

Scenarios

Completion of the scenario analyses requires input from nearly all of the STAR–TIDES research areas (see figure). In early 2009, participants in the STAR–TIDES project traveled to Afghanistan to develop scenario-related insights, and began working on Caribbean and Central American issues in more depth. These have been supported by the Under Secretary of Defense (Policy), USSOUTHCOM, the State Department Office of the Coordinator for Reconstruction and Stabilization, USAID, and the U.S. Institute for Peace. Other organizations, such as MITRE and the Institute for State Effectiveness, allocated internal resources to support STAR–TIDES projects, and STAR–TIDES is leveraging funding by DISA and Space and Naval Warfare Systems Command for work on ICT in Afghanistan, as well as human interoperability work funded from several sources. These pieces will be brought to bear as the scenario analyses mature.

Support to Policymakers

Besides the infrastructure and scenario research, STAR–TIDES members have proposed three policy refinements to improve information-sharing and provide needed services to the field faster. The first would allow civil-military mission participants[27] to share DOD radio frequency bandwidth under appropriate circumstances, while preserving adequate security. A second promotes the sharing of unclassified imagery with such partners without restrictive caveats. A third makes information about SSTR/HADR/BPC contingencies more readily discoverable, accessible, and understandable across the participating networks through the use of metadata tagging.

Bandwidth Sharing. As noted earlier, during the 2004 tsunami relief efforts and other contingencies, DOD was limited in its ability

to support NGOs with radio frequency bandwidth, even when it might have been mutually beneficial. Accordingly, STAR–TIDES worked with the Office of the Secretary of Defense, military Services, and combatant commanders to improve this process, using demonstrations, real world activities, and related projects. In April 2009, the Assistant Secretary of Defense (Networks and Information Integration)/DOD Chief Information Officer issued a DOD Instruction that states:[28]

It is DOD policy . . . that:

a. [. . .] *information-sharing activities that facilitate coordination and cooperation between DOD and non-DOD partners will be established to enable common understanding of the stabilization and reconstruction, disaster relief, and humanitarian and civic assistance environment; and to support an integrated Whole-of-Government response capability.*

b. In response to . . . validated requirements, the Department of Defense or Military Department Headquarters may resource ICT capabilities to share spectrum or bandwidth, and to provide associated ICT infrastructure services.

Of course, caveats such as "to the extent authorized by law, and subject to applicable statutory and regulatory restrictions and limitations" have to be addressed as proposals are translated into field operating procedures. Nonetheless, this instruction represents a significant advance in DOD information-sharing policy. Converting it into effective field operating procedures is the next step.

Unclassified Imagery. The second policy deals with sharing of unclassified imagery. The ability to share imagery and other geospatial information systems with other military and civilian entities can make important contributions to success in SSTR, HADR, and BPC operations, as shown in the example of the Bangladesh floods. Ways exist to share such information,[29] but recent real world experiences offer insights into ways to improve these mechanisms. Consider five categories of imagery:

1. products collected on a regular basis, but where additional coverage may be required for mission partners
2. existing products collected but not publicly released
3. publicly released materials, whose location may not be known
4. near real time imagery, which often is the most important for NGOs
5. new products that contain information such as soil pH and moisture information that would be useful to farmers.

NGA innovation in providing imagery in support of disaster relief has been discussed above. The agency also has been extraordinarily forward-leaning in supporting imagery sharing in Afghanistan. Future STAR–TIDES work will focus on integrating categories 4 and 5 with geospatial products and on building cooperative relationships.

Metadata Tagging. Development and emergency support environments require that relevant information be found quickly to address mission needs. A way to do this is to make better use of *metadata*, which is data about data. For example, when an article or photo is tagged with the key word *Bangladesh*, it allows that material to be found more easily by someone searching for that topic. Communities of interest in a particular field will typically reach agreement about the standards and terminology by which they will tag their information and make it discoverable. Early work by members of the STAR–TIDES network found extensive compatibility between the internationally used Dublin Core metadata standards and the DOD Discovery Metadata Specification. Similar definitions of terms within these standards would allow information to be discoverable across communities. This should be formalized by establishing a community of interest for SSTR, HADR, and BPC environments.

Data-sharing. A key objective of STAR–TIDES is to promote the sharing of not only processed information, but also of underlying data so that others can create value in ways that may not have occurred to the original data owners.[30] After the August 2009 Camp Roberts experiments and experiences in Afghanistan, one of the participants outlined three principles for data-sharing:[31]

a key objective of STAR–TIDES is to promote the sharing of not only processed information, but also of underlying data so that others can create value in ways that may not have occurred to the original data owners

- Create immediate value for anyone contributing data; when users contribute data, they should get an immediate return on that investment.
- Make contributor data available with improvements; any data that goes in should be available to download back out again. Furthermore, data should come back better than when entered.
- Share derivative works back with the data-sharing community; urge users who create derivative works from shared data to contribute their products back to the group.

These simple principles often are not followed, which blunts effective data-sharing. Too often data contributions—especially to government and corporations—are not returned or reciprocated, which has led to a pervasive wariness in the private sector and the NGO/PVO community. Researchers need to share their work to create positive feedback loops with the data-sharing community. Such iterations can offer huge benefits in improved accuracy and credibility. There always will be security concerns, often legitimate, but the benefits of a responsible sharing environment need to be weighted heavily over inclinations to protect products as proprietary or sensitive. STAR–TIDES experiments and field activities will continue to look for opportunities to implement these principles.

The Way Ahead

STAR–TIDES has evolved from the infrastructure-focused EITP project to include integrated planning, enhanced situational awareness, and knowledge-sharing processes that offer significant opportunities to whole-of-government, public-private, and transnational stakeholders. As such, it is well suited to reducing stovepipes in smart power projects and to support approaches such as diplomacy, defense, and development and the Civilian Response Corps. This expanded scope is why the project's title was changed to "Transformative Innovation" during phase IV. Since a key objective of STAR–TIDES is to provide information about solutions suited to people "on the ground" who will have to live with and sustain them, this knowledge often can best come from bottom-up, real world approaches that are addressing the problems of "relevant populations"—for example, the National Solidarity Program in Afghanistan. Over time, experience gained from working through diverse scenarios should provide insights that can be applied generally in emergent cases. The preference now is to do a few scenarios thoroughly and document them well, and then expand as resources allow.

Education

STAR–TIDES inherently is an educational vehicle. It seeks to generate and share knowledge and to change behavior based on lessons learned. It also is exciting for young people, and a number of secondary schools and colleges have shown an interest in incorporating it into their curricula. STAR–TIDES also could be the basis for student engineering competitions. More dedicated educational engagement is planned for phase IV.

STAR–TIDES is a multidisciplinary, international research project that already is making contributions to real world situations

Information-sharing

Improving the ability to share information responsibly, especially with civil-military mission partners, is not only a key part of STAR–TIDES but also an essential skill for the U.S. Government. STAR–TIDES efforts to date have focused mainly on building the knowledge repository and improving the Web presence and contact management capabilities. Once these reach an adequate level of sophistication, nearly limitless opportunities are available, such as leveraging the Social Software and National Security initiative,[32] to find innovative yet responsible ways to let the government use emerging Web 2.0 capabilities. Links are being forged to the interagency Center for Complex Operations and others to maximize education and lessons learned.[33] The State Department's Humanitarian Information Unit and CTNSP recently cohosted a conference on civil-military knowledge management in complex emergencies, which drew on STAR–TIDES experiences.[34] Other approaches could focus on virtual planning fora and the use of mobile devices for collaboration and public health in stressed environments.[35] There also are chances to capture "human interoperability" processes for training and implementation.

"Shared Responsibility" Relationships

The distributed nature of knowledge-based approaches raises a fundamental question that will have to be answered by governments and many other organizations in the next few years. The question concerns the oversight and execution of unconventional, relatively imprecise relationships—so-called shared responsibility or covenantial arrangements. For example, there are well-established procedures for managing oversight and accountability in command or contractual relationships, but there are few models for inspectors general and accountability offices to use when the arrangements are made by "covenant" (handshakes; distributed data storage outside a firewall, such as Google Docs; agreements among disparate cultures—"three cups of tea" versus "Texas handshake"; and so forth).[36] Many activities in complex operations, Web 2.0 environments, and other situations where there is no unity of command will have to rely on shared responsibilities. This is an important issue that will have to be addressed from many standpoints—managerial, policy, legal, and accounting. Trying to understand such interactions and their operational implications are inherent parts of the STAR–TIDES objectives and approaches.

Operations in Distributed Environments

STAR–TIDES has operated to date as a porous network with little structure.[37] But as the effort grows and becomes involved in more diverse tasks, it will need more structured approaches, even while preserving the distributed starfish nature of the project. Much of the structure will be instantiated through the new Web site and, eventually, distributed interaction and innovation platforms. These will allow the creation of working groups and provide basic categories for information, but STAR–TIDES will remain a distributed network to facilitate access and the posting of questions or solutions and also allow users to choose their level of involvement.

This decentralized approach works since STAR–TIDES is primarily a knowledge provider to organizations that already work in HADR/SSTR/BPC/DSCA. STAR–TIDES processes and technologies may improve the effectiveness and transparency of these activities, and perhaps reduce their cost, but the project itself serves mainly as a catalyst.

Nonetheless, some structure will be needed to handle increasing activity levels and to engage more professionally as solutions move from small-scale prototypes into large-scale responses suitable for rapid reactions in highly stressed environments. The steering team, core team, extended network construct described earlier should maintain access to diverse ideas and approaches while providing more rigor in coordinating activities, evaluating new ideas, and executing budgets. As skills are developed and distributed across the extended network, the diversity of talent and the strength of the starfish structure are increased.

Summary

STAR–TIDES is a multidisciplinary, international research project that already is making contributions to real world situations. Its distributed structure has much in common with starfish organizations. STAR–TIDES can facilitate public-private, whole-of-government, and transnational planning processes to improve performance in complex environments by reducing stovepiping and encouraging information flows regarding high-impact infrastructures, enhanced situational awareness, and essential services. Activities to date have shown the value of the approach, and the way ahead will expand STAR–TIDES' ability to address more complex problems.

Notes

[1] Until October 2009, the TIDES acronym stood for "Transportable Infrastructures for Development and Emergency Support." Transportable infrastructures still are a key part of TIDES, but the growing scope of the project as described in this paper necessitated expanding the construct to "Transformative Innovation." TIDES is part of the broader STAR effort. As a rule, TIDES projects apply to specific scenarios, but they also draw on, and contribute to, the distributed knowledge and skill sets of the global STAR–TIDES network.

[2] The Web site <www.star-tides.net> includes an infrastructure directory, sections on news and events and working groups, and a reference library.

[3] Ori Brafman and Rod A. Beckstrom, *The Starfish and the Spider: The Unstoppable Power of Leaderless Organizations* (New York: Portfolio, 2006).

[4] Participants include the American Red Cross; Center for Technology and National Security Policy at National Defense University; Engineers without Borders; Hexayurt Project in the Netherlands; Innovative Support to Emergencies, Diseases, and Disasters; Institute for State Effectiveness; The Johns Hopkins University; Nanyang Technological University—Lien Institute for the Environment in Singapore; MITRE; National Institute for Urban Search and Rescue, Readiness, Response, Resilience, Recovery (NIUSR5); San Diego State University; and the U.S. Marine Corps.

[5] See Hans Binnendijk and Patrick M. Cronin, *Civilian Surge: Key to Complex Operations*, A Preliminary Report, National Defense University, December 2008. The changes are discussed throughout the book and summarized on page 220, note 6. Many nongovernmental organizations (NGOs) object to being referred to as "mission partners," preferring less aligned terms like "participants."

[6] The Center for Complex Operations, an interagency effort among the State Department, Department of Defense, and the U.S. Agency for International Development (USAID), includes stability operations, counterinsurgency, and irregular warfare under the umbrella of complex operations. See <www.ccoportal.org>.

[7] Richard L. Armitage and Joseph S. Nye, Jr., *CSIS Commission on Smart Power: A Smarter, More Secure America* (Washington, DC: Center for Strategic and International Studies, 2007).

[8] For example, Robert M. Gates, speech to Kansas State University, November 26, 2007, available at <www.defenselink.mil/speeches/speech.aspx?speechid=1199>; and Hillary Clinton, testimony to Senate Foreign Relations Committee, January 13, 2009, available at <www.state.gov/secretary/rm/2009a/01/115196.htm>.

[9] A useful diagram of the "six ways people die in a crisis" model and additional infrastructure mapping tools from the Simple Critical Infrastructure Maps system is available at <http://butteredsidedown.co.uk/scim.html>. A TIDES variant of the diagram is available at <http://files.howtolivewiki.com/six_ways_to_die/The%20General%20Survival%20Systems%20Model.pdf>. A 1-hour briefing on the topic is available at <http://files.howtolivewiki.com/reykjavik_briefing/>.

[10] The hexayurt is a refugee shelter system based on work done at the Rocky Mountain Institute. It uses an approach based on "autonomous building" to provide not just a shelter, but also a comprehensive family support unit that includes drinking water purification, composting toilets, fuel-efficient stoves, and solar electric lighting. Other systems can be added as modules. For a photograph of a hexayurt and additional information, see <www.appropedia.org/Hexayurt_Project>. The STAR–TIDES whole-systems design integrates tightly with the hexayurt refugee shelter.

[11] Traditional military command and control typically will not work with civil-military mission partners in complex operations, since NGOs, civilian agencies, police forces, and others usually will not subordinate themselves to military command. This is one reason why it is important to focus on how to achieve unity of effort when there is no unity of command.

[12] David S. Alberts, "Agility, Focus, and Convergence: The Future of Command and Control," *The International C2 Journal* (November 2007).

[13] See <www.shelterbox.org/home.htm>. The ShelterBox Trust is a registered United Kingdom charity that provides emergency aid for victims of natural and other disasters anywhere in the world. Since operations began in January 2001, it has helped over 800,000 people and worked in 52 countries, responding to earthquakes, floods, hurricanes, tsunamis, wars, volcanic eruptions, and other disasters.

[14] Binnendijk and Cronin.

[15] Larry Wentz, *An ICT Primer: Information and Communications Technology for Civil-Military Coordination in Disaster Relief and Stabilization and Reconstruction*, Defense and Technology Paper 31 (Washington, DC: Center for Technology and National Security Policy, July 2006), available at <www.ndu.edu/ctnsp/Defense_Tech_Papers.htm>.

[16] Information about STRONG ANGEL is available at <www.strongangel3.net>.

[17] Ibid.

[18] These included Mercy Corps, Naval Postgraduate School, Google, Microsoft, Highlands Forum, and many others. The Highlands Forum is a multidisciplinary knowledge-development and sharing effort that has been sponsored by the Assistant Secretary of Defense, Networks and Information Integration.

[19] A summary of the charrette is available at <www.carebridge.info/carebridge/community/charrette2.html>.

[20] More information about Sphere standards is available at <www.sphereproject.org>.

[21] This idea has since been developed into the Life Box Company. See <www.lifeboxcompany.com/>.

[22] Eric Rasmussen, "Assessing Information Support at the Civil-Military Boundary: Operation Unified Assistance in Indonesia," 2005, available at <www.strongangel3.net/files/crisis/Indonesia_Trip_Report.pdf>.

[23] Many of these points were incorporated into policy in 2007–2009.

[24] TIDES at this point stood for "Transportable Infrastructures for Development and Emergency Support," reflecting its lineage from Expedient Infrastructure for Transient Populations.

[25] An important thread running through most of the activities in this section has been the emergency preparedness focus of NIUSR. Members of this organization and its remarkable leader, Lois Clark McCoy, have connected many of the ideas that underpin STRONG ANGEL, STAR–TIDES, the Synergy Strike Force, and related activities.

[26] The USAID Global Development Commons Web site reported the new partnership to monitor Afghan elections on August 19, 2009. See <www.usaid.gov/about_usaid/gdc/>.

[27] Civil-military mission partners include other U.S. Government agencies, international organizations, NGOs, state, local, territorial, and tribal governments, indigenous security services, and others (including commercial firms and individuals as appropriate) who are directly contributing to the ongoing mission.

[28] Department of Defense Instruction 8220.02, "Information and Communications Technology (ICT) Capabilities for Support of Stabilization and Reconstruction, Disaster Relief, and Humanitarian and Civic Assistance Operations," April 30, 2009, available at <www.dtic.mil/whs/directives/corres/pdf/822002p.pdf>.

[29] NextView licenses provide one channel to share imagery in support of disaster relief. The National Geospatial-Intelligence Agency recently has extended interpretations of these licensing provisions to support government objectives in Afghanistan.

[30] These themes ran throughout the Gov2.0 Summit, held in Washington, DC, September 9–10, 2009; see <www.gov2.0summit.com>.

[31] These principles are from Todd Huffman of the Synergy Strike Force.

[32] Mark D. Drapeau and Linton Wells II, *Social Software and National Security: An Initial Net Assessment*, Defense and Technology Paper 61 (Washington, DC: Center for Technology and National Security Policy, May 2009).

[33] A full description is at <ccoportal.org>.

[34] "Civilian-Military Coordination in Complex Emergencies: Best Practices in Knowledge Management," September 14–15, 2009, Washington, DC.

[35] See the U.S. Institute for Peace "Smart Tools for Smart Power" initiative at <www.usip.org/search/google_appliance/smart+tools>.

[36] The authors are indebted to Ken Hamilton of the KENTIA Management Group for this insight.

[37] See, for example, Paul T. Bartone and Linton Wells II, *Understanding and Leading Porous Network Organizations,* Defense and Technology Paper 70 (Washington, DC: Center for Technology and National Security Policy, October 2009), available at <www.ndu.edu/ctnsp/Defense_Tech_Papers.htm>.

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