DARPA SBIR/STTR
SUCCESS STORIES

2010

ADVANCING STATE-OF-THE-ART DEFENSE TECHNOLOGY

DARPA

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I am pleased to share the following success reports that illustrate how small businesses across the United States—through the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs—have worked to support the Defense Advanced Research Projects Agency (DARPA).

DARPA challenges existing perspectives by taking what was once thought to be impossible, then improbable, and making it inevitable. This progression makes DARPA, and it speaks to the agency's mission of creating and preventing technological surprise for our nation's defense.

The agency's rich history of innovation led to the development of entire new industries and sources of economic growth in the United States. Small businesses have played a significant role in characterizing and solving complex problems related to defending our nation and generating ideas for cutting-edge technologies.

Fostering innovation and entrepreneurship goes hand-in-hand with innovative approaches to awarding contracts to small businesses. DARPA recently initiated a pilot program using Other Transaction Agreements to facilitate faster and more efficient options for awarding contracts to nontraditional small businesses. To date, the contracts processed using this mechanism were awarded in less than 30 days, compared to the traditional cost reimbursable mechanism that typically takes six months to one year.

The companies featured in this publication have developed technologies, products, and solutions that successfully address specific end-user needs while meeting many different challenges across a wide variety of disciplines. I congratulate these small businesses on their successes and look forward to their future contributions in solving important problems for the United States.

Dr. Kaigham J. Gabriel
Deputy Director, DARPA

I am proud to present this publication featuring the transition success stories of 12 small businesses funded through the Defense Advanced Research Projects Agency (DARPA) Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. I share these stories to increase your awareness of the breadth of our country's intellectual capital that is working to solve important problems across a wide variety of industries, including national defense, healthcare, information technology, communications, manufacturing, and energy.

I hope these stories encourage small businesses and their industry and academic partners to explore the opportunities available through the SBIR and STTR programs to fund new ideas. The stories provide valuable insights into how innovation progresses—from an idea, to the lab for proof-of-concept demonstration, through development and testing, and to the field—and can be used in operational environments or commercialized into the private sector.

You may notice that several companies received funding more than 10 years ago. That's intentional. During the development of these stories, I specifically wanted to highlight the key factors that made a difference for these companies over the long term, and the subsequent advancement of the technologies into products and product lines.

I extend my sincere appreciation to all the companies showcased in this booklet for their cooperation and willingness to share their stories with others. I also thank the Foundation for Enterprise Development for creating this publication as part of its effort to inspire innovation and entrepreneurship aimed at solving problems of national and global importance.

Susan Nichols
Program Director, Small Business Programs Office
SBIR and STTR Program Manager

Technology Transition: Learning From Experience

DARPA's SBIR and STTR programs provide seed funding for small businesses to conduct advanced research required to prove the efficacy of innovative concepts and develop prototypes that can be benchmarked, tested and evaluated by potential integration partners and end users.

Successful transition and commercialization of technology requires a thoughtfully constructed transition plan aligned to the needs and requirements of military, federal and commercial markets, which can be a long and complex process. A company's business readiness, adaptability, access to financial and human capital, ability to collaborate with partners and end users, as well as perseverance and patience are essential elements needed to succeed.

Lessons shared in this publication provide insight for other small businesses currently involved in transitioning technology or on the verge of exploring an innovative idea with a DARPA program manager.

BUSINESS STRATEGY

- Target funding opportunities that map to the company strategy
- Identify potential military and/or commercial applications in proposal submissions
- Develop a hybrid business model to address both commercial and federal markets
- Balance a product's functionality and cost to meet market demand
- Anticipate and prepare for scaling up to sell and distribute products within appropriate markets
- Partner with larger defense contractors to secure access to channels for transition

TECHNOLOGY DEVELOPMENT

- Assess technology capabilities and user feedback during all stages
- Consider and evaluate alternative applications of a technology to expand transition opportunities
- Identify potential users early and enlist them to identify requirements and challenges
- Develop specialized tools to measure and assess the technology
- Partner with larger organizations to access technology and testing resources

THOUGHT LEADERSHIP/MARKETING

- Build awareness of the technology and your company by contributing to publications and presenting at technical conferences
- Create visibility for an idea or product at conferences, principal investigator meetings, and other gatherings of potential end users
- Select a memorable project name that conveys its use

INTELLECTUAL PROPERTY

- Obtain patents to maintain a dominant position in the market
- Protect intellectual property for licensing enabling technology to larger businesses that have production and marketing capabilities supporting transition into operational environments

DARPA seeks the most innovative ideas for creating and preventing technological surprise for our Nation's defense and looks forward to the future contributions of small business to inspire the development of new industries and sources of economic growth in the United States.

ADAPX™
TURNING INK INTO ACTION

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Topic Name:	**Multimodal Command Interaction**
Topic Number:	**SB012-007**
Contract Number:	**DAAH01-03-C-R199**
DARPA Office:	**STO (formerly with IXO)**

ABOUT THE COMPANY

Adapx, Inc.
Founded 1999 -
CEO, Ken Schneider.
Adapx is a natural interface software company whose Capturx™ products improve field data collection, decision making, and collaboration. The company is transforming the way mobile teams collect and use data.

Products used by more than 500 organizations worldwide

VALUE PROPOSITION

Adapx's software and digital pens speed up field data collection and sharing by automatically digitizing handwritten text, symbols, and sketches on forms, maps, and other documents; incorporating voice; and integrating these into standard enterprise and federal applications.

Data is digitized when written on paper plans and forms for instant upload into leading commercial software

TECHNICAL CHALLENGE ADDRESSED

Military teams collect large amounts of field data on paper, and much of it is processed and shared through computer systems for better collaboration and faster decisions. However, the time gap between data collection and sharing can lead to slower, less informed decisions, because mobile computers do not fit the workflow and require excessive cognitive operations and training that distract from job performance. Also, some operators trust their paper-based systems more than the computers.

Adapx overcame this challenge under the DARPA SBIR program by developing software that integrates handwriting with standard digital paper and pen technology into commercial software packages used in the field. The multimodal technology enables soldiers and others to create, analyze, process and share handwritten and voice data through commercial software packages for geospatial, technical drawing, design and spreadsheet/form applications.

TECHNOLOGY DESCRIPTION

DARPA Phase II project integrated Adapx's digital pen/paper, sketch recognition, and multimodal technologies, with several military applications, such as the Command Post of the Future and Maneuver Control System. Users were able to speak and sketch on tablet PCs and touch-sensitive surfaces in order to create courses of action or to enter MIL-STD-2525B symbols onto maps rapidly. This multimodal system demonstrated more than an order of magnitude speed advantage over existing graphical user interface methods for military command and control (C2) data entry. Users were also able to sketch symbols on paper maps in the field, with the "digital ink" being entered into C2 systems automatically.

Handwritten data on paper maps automatically integrated in ArcGIS

DARPA then provided Phase III funding from its Advanced Soldier Sensor Information Systems and Technology (ASSIST) and Personalized Assistant that Learns (PAL) programs, and recently, the Deep Green program, to develop recognition methods for the full set of MIL-STD-2525B sketch symbols through sketch alone or multimodal input.

Adapx has further evolved the digital pen/paper technology in its Capturx™ products used to speed data collection for forms, maps, and building plans. Users can:

- Annotate digital paper maps in the field with digital pens that automatically record the data and integrate it into ArcGIS.
- Integrate data collected on paper into commercial software
- Automatically integrate markups on building plans, maps, and other documents in PDF format back into the original PDF files.

LESSONS LEARNED & BEST PRACTICES

- Develop a hybrid business model that addresses both commercial and federal markets.
- Use SBIR funds to develop intellectual property and early prototypes, to support further fundraising and commercial product development.
- Identify and understand all the players in the procurement of new technology.
- Align with prime contractors to be included in programs of record.
- Anticipate the challenge of scaling up to market, sell, and distribute multiple products to enterprises in many geographic locations.
- Align incentives among partners and their employees.

ECONOMIC IMPACT

SBIR funding from DARPA in Phases I, II and III enabled Adapx to develop and patent software technology and adapt it for initial military applications, thus providing the foundation needed for commercialization. With its software proven, Adapx obtained $20 million in venture capital backing from several firms and additional support from strategic partners, such as ESRI, In-Q-Tel, Lockheed Martin, Microsoft and Trimble. The company now has a robust, growing volume of business, with 45 employees as of November, 2009.

APPLICATIONS

The Capturx™ platform is used in numerous applications by more than 500 military; federal, state, and local government; and commercial organizations. Current application areas include defense, intelligence, public safety, retail, energy and mining, healthcare, transportation, utilities and pipelines, and engineering and construction. Examples include in-processing of soldiers; triage, diagnosis, and treatment of injuries; capture of geographic information system (GIS) features automatically into ArcGIS; and completion of forms in Microsoft Excel.

The U.S. Army's Network Enterprise Technology Command (NETCOM) issued a *Certificate of Networthiness* for medical applications of Capturx™ technology, signifying that the software is secure, supportable, sustainable and compatible with the Army enterprise infrastructure.

PARTNERING & COLLABORATION

Recently, in the Deep Green program, Adapx, working with Science Applications International Corporation (SAIC), developed advanced course-of-action generation methods that improve command and control planning and execution. Adapx is now on the BAE team for Deep Green.

Adapx has established important strategic partnerships with a number of large companies. For example, the company is a *Gold Certified Partner* of Microsoft; ESRI awarded Adapx its *New Partner of the Year* award in 2007; and Adapx is an Original Equipment Manufacturer (OEM) provider of digital pen/paper technology to Trimble Navigation. Other partners include In-Q-Tel, which also provided Phase III funding for intelligence applications; Lockheed Martin for military applications; ESRI for ArcGIS; Anoto Group AB for digital pen and paper technology; Oki Data for workflow printing; J.L. Darling for its use of Rite in the Rain all-weather writing paper; and VisionObjects for accurate handwriting recognition technology.

TECHNOLOGY DESCRIPTION

The compact acoustic-seismic unattended ground sensors are able to detect, track, and identify ground vehicles and dismounted personnel. An autonomous geo-location capability (global positioning system [GPS] and compass) was incorporated into the sensors to autonomously record their location, so that they could be easily emplaced without adding to the soldier's burden.
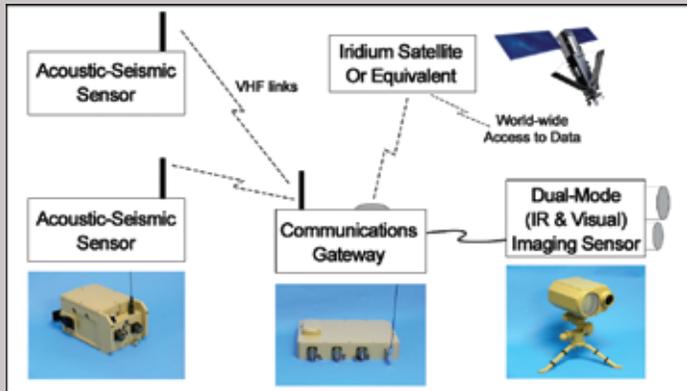
Sentech's acoustic-seismic sensors as part of a militarized sensor suite and communication system

The sensors and signal processing methods addressed several essential functions, including target localization using a small conformal microphone array, seismic detection and localization using a three-axis geophone; and target tracking and identification using an embedded digital signal processor and neural networks trained with the spectral features of the target emissions.

Knowledge-based classification algorithms identify and differentiate targets and interpret field activity based on the characteristics of vehicle acoustical noise emissions. Advanced seismic processing techniques eliminate the contribution of acoustically coupled seismic noise and determine the location of the vehicle. Seismic signature processing methods are employed to obtain target bearing, determine absolute velocity, and estimate target range.

LESSONS LEARNED & BEST PRACTICES

- Use higher levels of integration in electronics components. This allowed SenTech to provide smaller sensors with increased processing capabilities at a reasonable price.
- Develop new components, if necessary, to meet customer needs.
- Use a multi-level processing scheme to reduce overall power consumption and achieve longer deployment times.
- Balance the right level of functionality vs. cost to generate the level of demand required to set up a production line.
- Partner with larger defense contractors to achieve the level of financial backing necessary to maintain a profitable product line.

ECONOMIC IMPACT

Developing a more advanced sensor technology than competitors allowed SenTech to partner with larger defense contractors and participate in many defense programs. SenTech found that it could not acquire orders large enough to merit a full-scale production line; sensors had to be manufactured in small lots with large amounts of manual labor, thus lowering profitability.

APPLICATIONS

SenTech has successfully applied its sensor and signal processing technology developed under DARPA and Sandia National Laboratories funding for a variety of military applications. For the U.S. Army Tank-automotive and Armaments Command, the company developed an acoustic sensor to detect and track combat vehicles at extended ranges. For the U.S. Army Armament Research, Development and Engineering Center, they developed a new approach for target classification and identification that combines artificial intelligence techniques with statistical pattern recognition algorithms for high performance target classification and scenario interpretation.

SenTech supported the U.S. Navy Naval Undersea Warfare Center in two field trials involving the design and test of a planar hydrophone array used to track towed acoustic sources and targets of opportunity. Other military applications include the Acoustic Warning System, an easy-to-deploy, highly accurate sniper location system. In addition to military use, the sensors and processing methods have potential for use in border protection and drug interdiction.

PARTNERING & COLLABORATION

SenTech teamed with General Dynamics to develop the Intelligent Munitions System, a networked target-tracking and fire-control system. The companies also partnered on the Massively Deployed Unattended Ground Sensor System. Both of these systems used the main processor of SenTech's sensor.

For Harris RF Communications, the company developed a new dual mode imager (infrared [IR] and visual) and licensed the design of its acoustic-seismic sensor. The imaging sensor combines IR and visual cameras and built-in image processing capabilities in a compact militarized package.

The Acoustic Warning System was a joint development project with Lockheed Martin's Infrared and Imaging Systems. It gained high marks for accuracy during government-sponsored tests at the United States Marine Corps Camp Pendleton Military Operations.

DARPA SBPO web site

For more information visit: www.darpa.mil/sbpo

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