DARPA/SBIR Success Reports

Advancing state-of-the-art defense technology

www.darpa.mil/sbir

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Acknowledgement

A big thank you goes out to all of the DARPA SBIR companies described in this publication for contributing their information, time and experiences to these success reports. Their willingness to share their first-hand knowledge will help other companies navigate the innovation and commercialization processes that contribute to a stronger military and a more dynamic economy for our country.

This publication was written and developed by the Foundation for Enterprise Development, La Jolla, CA *(www.fed.org)*.

Introduction

The SBIR Program was created by Congress in 1982 to help small businesses more actively participate in federal research and development, stimulate technological innovation, and increase private sector commercialization of innovations derived from Federal research and development, thereby increasing competition, productivity and economic growth. DARPA encourages the submission of SBIR proposals whose technology development will support its mission of advancing state-of-the-art defense technology, have a strong likelihood of being successfully transitioned into a military application, and have a potential civilian application.

The modern warfighter, whether on land, air or sea, must constantly innovate to keep one step ahead of the changing twenty-first century battlefield. Innovative research projects provide cutting-edge technology to U.S. military personnel. The companies described in this publication have successfully created new approaches and solutions resulting in improved capabilities not only for the military but also for commercial markets.

There are real benefits for businesses to apply to the SBIR/STTR programs. In addition to funding for research and development, DARPA program managers offer guidance and counsel to assist companies in meeting the needs of the military.

The 2007 DoD budget for the SBIR/STTR programs is approximately $1.2 billion dollars. Under these programs, the Department of Defense (DoD) develops and publishes topics specific to soldiers' needs. The SBIR program publishes solicitations three times a year.

- In Phase I, small businesses—mostly with twenty-five or fewer employees—take about six months to research a selected topic and develop a 20 to 25 page feasibility study.
- If successful in Phase I, the DoD topic program manager invites a proposal for Phase II. In phase two, the awardees develop a prototype as "proof-of-principle."
- The ultimate objective of all SBIR initiatives is product commercialization, and that's Phase III.

The Air Force, Army, Navy, Missile Defense Agency, Office of the Secretary of Defense and DARPA participate in the STTR Solicitation and they only publish once each year. STTR is also a three-phase program.

As you read the success stories of the following companies, remember that America was built by entrepreneurs, and small businesses are still the backbone of our nation's economy today. Small businesses are encouraged to apply for the SBIR/STTR programs. When small businesses successfully complete DARPA contracts, it's good for everyone—our military, our companies and the economy.

Consolidated Undersea Situational Awareness System (CUSAS)

Agent-Based Software Significantly Improves Awareness and Decision Making

Technology and Innovation

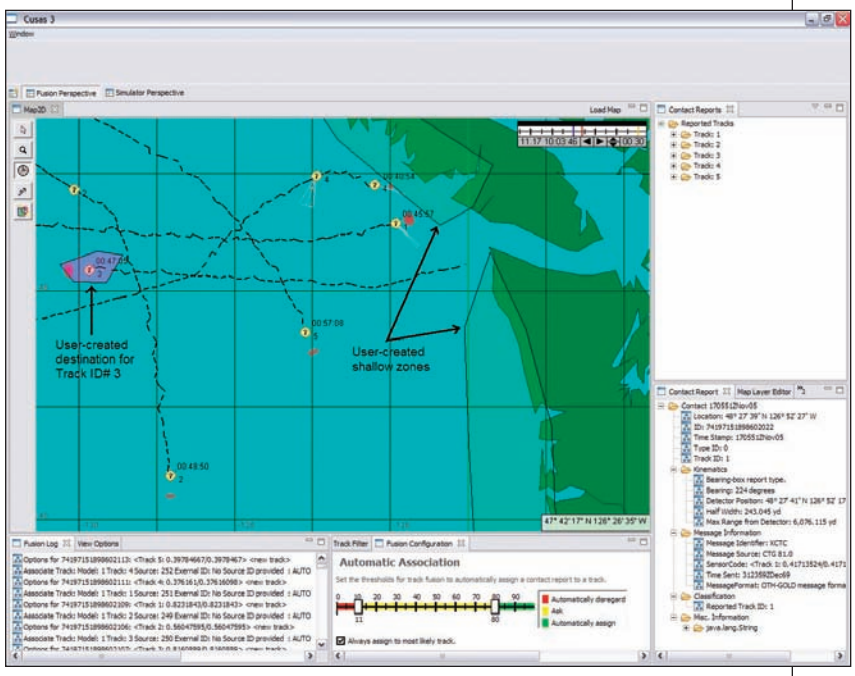
The ability to exercise good judgment requires a keen sense of what's going on around you – situational awareness – coupled with enough information to process, evaluate and choose among alternatives – decision-making.

Under a DARPA SBIR, 21st Century Systems, Inc.® (21CSI®) has developed the Consolidated Undersea Situational Awareness System (CUSAS). This software program monitors and analyzes the environment, and helps users focus on the most important information.

21CSI based this new technology on their own commercial off-the-shelf decision-support software technology, which uses "intelligent agents" that adapt to, respond to, and learn from individual users. It processes and correlates information that originates from multiple sources in multiple formats. CUSAS analyzes data and operator input, alerts the operator of potential dangers, provides notification of specific events, and recommends actions to be taken.

CUSAS provides an integrated, common tactical picture in real time and in the correct format for time- and mission-critical decision-making, incorporating a suite of undersea warfare (USW) tactical decision aid (TDA) toolkits. TDAs under development include:

- A surface track data fusion tool for use by the Pacific Missile Range Facility (PMRF) in merchant vessel range clearing and monitoring
- A modular anti-submarine warfare (ASW) system for use by the Program Executive Office Integrated Warfare System (PEO IWS) Undersea Warfare Decision Support System (USW/DSS) program
- A situational awareness/collision avoidance system for evaluation by the submarine combat system Advanced Processor Build (Tactical) (APB (T)) program.



CUSAS enhances warfighters' awareness and decision-making capabilities by providing real-time, integrated, common tactical pictures

CUSAS is under consideration to become the principal ASW agent decision support tool for emerging PEO IWS Anti-Submarine Warfare Command and Control (ASWCC2) requirements. Also, the system has implemented a robust collision avoidance tool called "QuartermA* (Quarter MaStar)," which computes a safe route for transiting into

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and out of waters of high merchant vessel density and traffic. This tool is being considered for incorporation with emerging submarine collision avoidance radar systems.

Joint Collaborations

21CSI frequently partners with other technology organizations, major universities and government laboratories to augment its in-house know-how and products and to deliver joint solutions to civilian and military customers.

21CSI is working closely with PMRF and PEO IWS as CUSAS transition sponsors for current and future combat systems.

Lessons Learned

- Design flexibility into the systems to be able to adapt to changing requirements. Military applications–especially operational ones–can change rapidly.
- Be knowledgeable about current standards and protocols. The system must be compatible with these yet not irreversibly tied to any one. Systems, protocols and standards may change over the course of a project.

Economic Impact

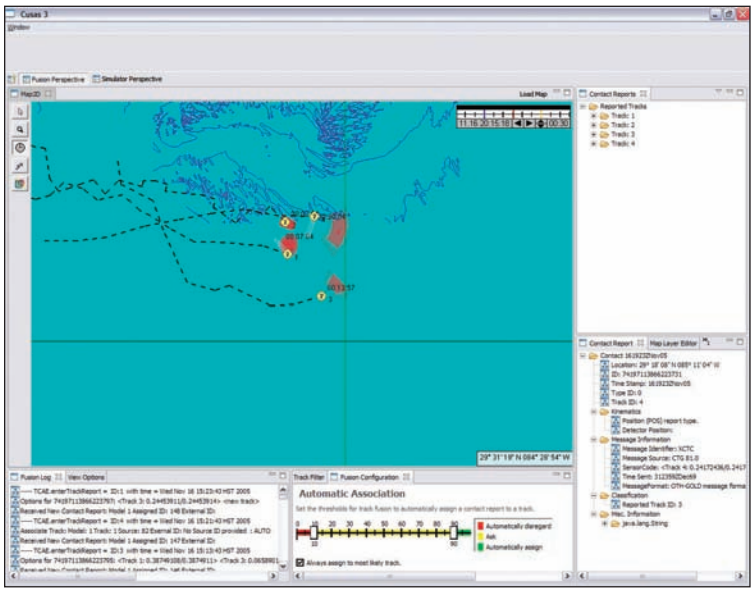
The DARPA SBIR award has opened up a multitude of opportunities for 21CSI, including the ability to expand CUSAS technology beyond its original undersea warfare focus. As a result, 21CSI is participating in the FY06 APB (T), and CUSAS has been awarded another $2.6 million in research and development funds to further refine its current array of TDAs and develop additional TDAs for possible use in other warfare areas.

About the Company

Since 1996, when 21st Century Systems, Inc. was founded by Dr. Alexander D. Stoyen, the Arlington, Virginia-based company's primary focus is developing intelligent systems that enhance human decision making.

21CSI's cutting-edge expert technologies have been successfully applied across many missions and environments, ranging from satellites in space and soldiers in the field to submarines and undersea systems.

Since 2001, 21CSI's revenue has increased by 319 percent, and the company has expanded from three offices in three states to eleven offices in nine states. In 2005, the company was identified in the Inc. 500® list as one of the nation's fastest-growing private companies. ■



CUSAS integrates a variety of tools which aid in collision avoidance and in tracking vessels

Company Information

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Dr. Alexander D. Stoyen, Founder and CEO
Founded: 1996
Number of employees: 144

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Electronic Textile Antenna Technology

E-Textile Antennas Offer Low-Cost, Lightweight Solutions for the U.S. Military

Technology and Innovation

Traditional antennas are often rigid, bulky, and can be a limiting design factor when incorporated into military hardware. Applied Radar, Inc. (Applied Radar) has taken the traditional idea of what an antenna should be and transformed it for new applications. Under a DARPA SBIR, the company has developed innovative conductive fiber technology that allows antennas, feed lines, and other microwave structures to be incorporated into garments, tents, tarps, and composite reinforced laminates such as airframes and vehicle chassis. The idea migrated from a series of experimental benchmark prototypes to useful samples of interest to both military and commercial customers. Specific innovations included the use of nonwoven textile technology—calendering—to produce low-cost microwave structures, and the experimental use of 3-dimensional weaving. The company's technology provides value in two specific ways: 1) lower-cost, high-performance microwave and radar prototypes for conformable applications, and 2) rapid response to customer requests for new microwave products for operational use. They have a range of flexible wireless network antennas that are available for military and commercial applications.

Flexible Conductive Fiber Antenna

Joint Collaborations

The successful development of Applied Radar's technologies required building a team of more than seven other companies, one university, and numerous suppliers. The team included a group of university researchers, industrial embroiderers and weavers, machine suppliers, and manufacturers of composite-based aircraft. DARPA and the U.S. Air Force were instrumental in helping Applied Radar establish collaborative relationships with these and other organizations.

The technology developed under this SBIR is being transitioned to a large military prime contractor where it promises to be a key element in a new generation of Air Force composite airframes for reconnaissance aircraft. Applied Radar's work on this project has also helped them secure new contracts for more conventional radar projects.

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Lessons Learned

- Be sure the customer knows that the company is serious about the work and capable of getting it done.
- Develop usable technology in addition to performing innovative research. Experiments and prototypes must lead to real applications.
- Even though a particular application may not be "in favor," keep it close by. It may have future potential.
- Demonstrate a high level of technical competence, especially to DARPA, and have an innovative idea that can be applied to a near-term military need.

Economic Impact

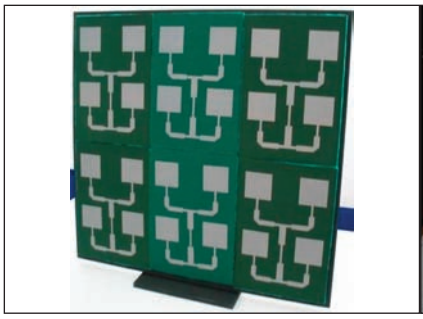
The U.S. textile industry is facing an extraordinary challenge from off-shore competitors. Conductive fiber techniques are a way to leverage the industry into new, high-value product lines that can provide a competitive, time-to-market advantage. The company's unique electronic textile antenna technology has been provided directly to two military customers. It is now being transitioned to a prime contractor under a license agreement.

Having a DARPA SBIR contract helped Applied Radar secure bank loans and additional contracts with the Army and Air Force. The SBIR also indirectly benefited the company's textile industry subcontractors, which are themselves small, U.S.-based businesses facing intense foreign competition. As a direct result of the DARPA SBIR project, Applied Radar has filed four provisional patent applications and is currently working on its fourth regular patent application.

About the Company

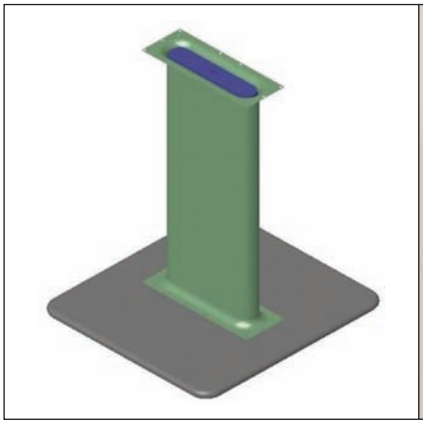
Applied Radar, Inc.—founded in 1998 by Dr. William Weedon—is headquartered in North Kingstown, Rhode Island. The company serves the U.S. Army, Navy, Air Force, and U.S. Special Operations Command (SOCOM).

Applied Radar was originally a consulting company focused on delivering technical services in microwave systems development. This initial consulting work was later augmented with SBIR funding, and since then the focus has shifted more to product development. ■



Lightweight Scalable Arrays

Composite Airframe Microwave Test Panel



A-160 Antenna

Vest with liner patch antenna

Company Information

Applied Radar, Inc.
210 Airport Street
N. Kingstown, RI 02852
Phone: 401-295-0062
www.appliedradar.com

Dr. William H. Weedon III, President
Founded: 1998
Number of employees: 23

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Portable Micro Air Vehicles

Micro Air Vehicle Protects Warfighters with Fast, Far-Sight Security

Technology and Innovation

Realizing that a smaller, lighter unmanned arial vehicle (UAV) would help maximize its military use and effectiveness, AeroVironment set out to create the first operating micro air vehicle (MAV). Completed in 2001 under a DARPA SBIR, AeroVironment's Black Widow, weighing just three ounces and measuring six inches across, was able to fly for over 30 minutes with a range of 1.1 miles at altitudes up to 800 feet. The small size responded to the issues of portability and covert operation, which helped to maximize the MAV's use to the military. The Black Widow carried a color video camera and download link, plus stability augmentation and flight data sensors.

At the time the Black Widow was conceived, the smallest state-of-the-art UAVs were about 12 times larger and 50 times heavier. With the MAV, AeroVironment immediately faced the problem of cramming all the avionics, propulsion, and payload systems required by a military UAV into a parcel that would fit into the palm of the hand.

The development team solved this problem by reducing the packaging sizes of all the components, using multi-functional components, and removing any excess capability from the system that was not absolutely necessary.

In recognition of this work, DARPA presented AeroVironment with its prestigious *Award for Outstanding Performance by a SBIR Contractor* in June of 1999. The Black Widow also won the 1999 Shephard's Press, *Unmanned Vehicles Magazine Readership Design Award* in Paris, France.

With a wingspan of 4.5 feet and a weight of 4.2 pounds, the hand-launched Raven provides aerial observation at line-of-sight ranges up to 10 kilometers

Rather than being implemented into a stand-alone product, the Black Widow served as proof-of-concept for a palm-sized aircraft capable of performing "over the hill" reconnaissance. Components developed for the Black Widow became enabling technologies for the extremely successful AeroVironment Raven UAV, which can fly for 90 minutes with a range of 10 kilometers. Raven UAVs have saved countless lives in various military conflicts around the world by providing fast far sight security against threats. The Black Widow program also evolved into another DARPA-funded program, the AeroVironment Wasp MAV.

Joint Collaborations

AeroVironment has been working closely with the U.S. Army in developing the Raven UAV. The slightly smaller

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Wasp air vehicle has been field tested by various military customers, including the U.S. Navy and Marines.

Lessons Learned

- Instead of following today's trends and duplicating other products on the market, look well into the future for solving tomorrow's challenges with today's resources.
- To facilitate transitioning products to the military, make sure the product fulfills all of the customer's critical needs. Concentrate on the important aspects of the design and leave other features out until the technology matures. Delivering a solution that meets 80% of the technical criteria but works well is much better than delivering a solution that meets 100% percent of the technical criteria but is unreliable or cost prohibitive to produce.
- Understand the goals of the program and do not get distracted by challenges that tend to derail or change the course of the program, even if those "side" research studies are more interesting than the principal development task.
- Don't hesitate to submit a DARPA SBIR proposal. It's a great way to jump start a new company or a new division of a company in an area of future technology. The entrepreneur will then be in a good position to fulfill military needs relating to the product developed under the DARPA SBIR.

Economic Impact

The Black Widow program provided monies for cutting-edge technology research that would not otherwise have been funded and promoted internally at AeroVironment. The resulting technologies allowed AeroVironment to produce other UAVs more quickly, saved money on their development, and ultimately led to large production orders by the U.S. military. The success of the Raven UAV resulted in a significant increase in the number of employees at AeroVironment Inc. In addition, DARPA funding allowed AeroVironment to demonstrate its capability to produce very micro-scale air vehicle systems, which has led to subsequent contracts.

AeroVironment Senior Engineer Matt Keennon with the Black Widow, a tiny reconnaissance tool which can fly for over 30 minutes at a range of 1.1 miles at altitudes up to 800 feet.

About the Company

AeroVironment designs, develops, produces and supports a family of unmanned aircraft systems (UASs), from micro air vehicles to high-altitude long endurance platforms. The company's small UAS products are used to deliver real-time intelligence, surveillance and reconnaissance. ■

Company Information

AeroVironment
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Paul MacCready, Founder and Chairman
Founded: 1971
Number of employees: 300

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Scramjet Flight Testing Techniques

Innovative Testing Techniques Accelerate Hypersonic Technology Development

Technology and Innovation

Imagine economical air travel and propulsion at hypersonic speeds. This has long been a common goal for military and commercial applications. Scramjet (supersonic combustion ramjet) propulsion technology—currently in development and testing by the military and a variety of contractors—offers the promise of hypersonic (i.e., highly supersonic) flight (including rockets and projectiles) at speeds beyond Mach 7, or seven times the speed of sound. One of the difficulties in developing and testing scramjet technology, however, is the fact that test vehicles must themselves be accelerated to a minimum speed of Mach 5 before the scramjet engine will ignite. This makes flight testing both a logistical and a financial challenge.

Under this DARPA SBIR, ATK GASL pioneered two new approaches to scramjet flight testing, ScramFire and FASTT (Freeflight Atmospheric Scramjet Test Technique). With ScramFire, the company developed a gun-launching system for Scramjet projectiles that advanced technology performance beyond what had been previously achieved. FASTT uses an unguided ballistic launch trajectory that is nearly as effective but significantly less expensive than a traditional guided flight.

The net result is that these two technologies move scramjet prototypes to flight testing earlier in the development process, shortening the path to military transition and saving money. According to the company, these savings typically amount to a 10- to 100-times reduction in flight test costs.

Current customers include:

- DARPA
- Air Force Research Laboratory
- Office of Naval Research
- NASA

ATK GASL also built the first airframe-integrated scramjet engines to be flight tested at hypersonic speeds in 2004, on NASA's X-43A experimental aircraft.

Two ATK GASL applications aid the development of hypersonic propulsion technology

Joint Collaborations

This DARPA SBIR allowed ATK GASL to transition from its ground test technology roots to a hypersonic propulsion development and flight test organization, raising its profile in the industry. This increased profile led to a recent invitation for ATK GASL to bid

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Testing the Scramjet technology

as a propulsion prime contractor by major airframe companies.

For its ScramFire gun-firing development effort, the company signed a cooperative research and development agreement with the U.S. Army Armament Research, Development and Engineering Center (ARDEC) to co-develop a hardened, stable projectile design.

Lessons Learned

- Be aware that transitioning innovations to the customer may be more difficult than anticipated.
- To ensure a commercially viable solution at the end of the project, have a vision for the company that includes transition to a military product.
- Start the process of getting end-user sponsorship early—a sponsor is necessary for ultimate success.

Economic Impact

GASL was purchased by Allied Aerospace in 1999, and subsequently purchased by ATK in 2003. The valuation of GASL in both acquisitions was significantly enhanced by the work completed under this DARPA SBIR program. In addition, the SBIR attracted sponsor funding from ARDEC and the Office of Naval Research.

Phase III funding has been obtained from ONR, ARDEC, and DARPA. During this phase, requirements will be developed for scramjet technology in the military, thus helping the further transition to product.

About the Company

ATK GASL is located in Ronkonkoma, New York, and it currently employs 170 people. The company is a provider of research, development, test and evaluation services to the aerospace industry, specializing in development of advanced high speed aeropropulsion systems and low emission gas turbine engines.

The company operates six wind tunnels and two shock tunnels on its premises, capable of simulating atmospheric flight environments at speeds from approximately 2,000 mph to 17,500 mph, as well as static engine test stands. It also provides CAD design services, machining and assembly on-site for engine test rigs and related prototype hardware. ■

From left, Eugene Day, Ed Poole and Greg Wurst prepare for a scramjet flight test

Company Information

ATK GASL
77 Raynor Ave.
Ronkonkoma, NY 11779
Phone: (631) 737-6100
www.atk.com

GASL Operations
Robert Bakos, VP/General Manager
Founded: 1956
Number of employees: 170

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Ducted-Fan Unmanned Aircraft Systems (UAS)

Hovering UAVs Provide Better Access in Difficult Situations

Technology and Innovation

Unmanned aerial vehicles need to be designed to meet the diverse, often clandestine needs of military, law enforcement, and homeland security personnel. Historically, UASs designed with ducted-fan technology have had problems with control, noise and mechanical reliability. Aurora Flight Sciences, in their most significant SBIR-funded work, set out to overcome these problems with the development of ducted-fan UASs that can take off vertically, hover like a helicopter, and transition to horizontal wing-borne flight that is faster and more fuel-efficient. The ducted-fan's enclosed propeller increases soldier safety and aircraft survivability during operations in urban environments.

The company's UASs include the GoldenEye-50, the GoldenEye-80 and the Excalibur. The backpackable GoldenEye-50 is a versatile platform designed for tactical surveillance and chemical agent detection missions in restricted, hard to reach or dangerous locations. The GoldenEye-80 is targeted for low-cost, tactical reconnaissance, surveillance, and target designation missions. Excalibur is an armed, tactical UAS that fills the gap between current weaponized UASs and manned strike platforms to provide tactical air support.

Joint Collaborations

Aurora's success on more than 20 DARPA SBIRs has enhanced their collaborative and contract opportunities. In addition, the company has developed strategic relationships with major defense companies including Northrop Grumman, Boeing, Raytheon, and Sikorsky. Aurora is in discussion with the U.S. Army, U.S. Special Operations Command, allied military services, and law enforcement organizations about their interests and applications of the ducted-fan UAS technology.

Aurora's unmanned aerial vehicles transition from horizontal to vertical flight, hovering in specified areas

Lessons Learned

- Be prepared to make course adjustments to move the technology on to the next SBIR phase.
- Identify government restrictions that may affect transitioning technologies developed under DARPA to the private sector.
- Use the SBIR process to start a business around a novel idea, and then leverage

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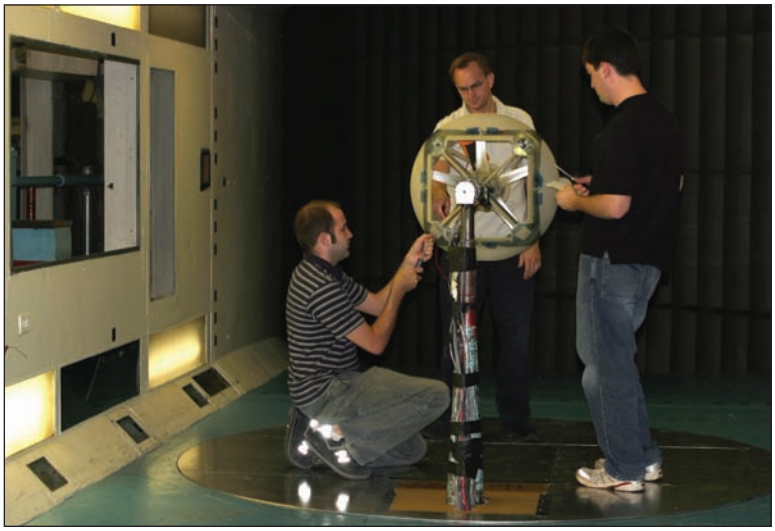
other financial sources including non-SBIR contracts and corporate investment.

- To transition into Phase III, focus on developing a technology that will mesh with end-user operational requirements. Without this focus, there is a danger of creating outstanding technology that will not be procured because it does not align with requirements.

Economic Impact

All of Aurora's vertical takeoff and landing UAS technology had its genesis in DARPA SBIR work. An SBIR helped Aurora develop the ducted-fan technology that enables it to compete for the U.S. Navy Small Tactical Unmanned Aircraft Systems (STUAS)/U.S. Marine Corps Tier II UAS program.

Since 2000, Aurora has maintained an average compound annual growth rate in excess of 40 percent. Much of that growth has been driven by SBIR projects, resulting technologies, and the reputation the company built during the performance of SBIR contracts. Aurora also holds several patents directly traceable to work performed with SBIR support.



Testing the ducted-fan technology

About the Company

Aurora Flight Sciences, founded in 1989, is one of the leaders in UAV technology for research, defense, and homeland security organizations. For more than 17 years, Aurora has expanded the limits of unmanned flight through the design and manufacture of innovative aircraft. The company also specializes in the manufacture of composite and metal aerostructures for manned and unmanned aircraft. ■

Company Information

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Dr. John Langford, Founder, President, and CEO
Founded: 1989
Number of employees: 300

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On-Chip Transport of Biological Fluids in MEMS Devices

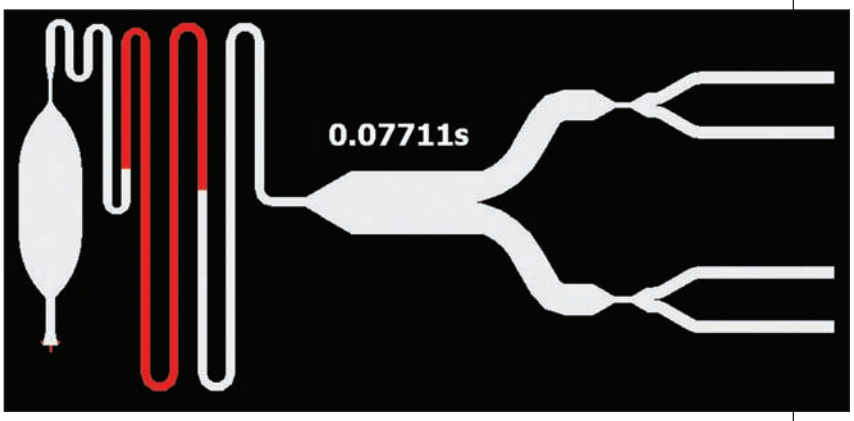
Advanced Simulations for Field Screening of Chemical and Biological Agents

Technology and Innovation

In this DARPA SBIR project, CFD Research Corporation (CFDRC) developed novel simulation methods and software for the design of microfluidics and BioMEMS (Biological MicroElectroMechanical Systems) that miniaturize and automate complex laboratory procedures. The end results include the ability to deploy sophisticated bioanalytical tests in the field for purposes ranging from sensing chemical and biological agents to monitoring soldier health and performance.

CFDRC's simulations provide a cost-effective approach for screening competing concepts for different BioMEMS applications, and then optimizing selected designs. These advanced physical models for novel microscale phenomena—particularly in a general-use format—were not readily available prior to this SBIR project.

Primary end users include researchers in government laboratories focused on developing miniaturized automated detection systems for chemical and biological defense (including Los Alamos National Laboratory and Sandia National Laboratories). Additional end users include the life sciences instrumentation sector specializing in the development of new devices for genomic and proteomic applications in drug discovery and diagnostics (including Applied Biosystems, Becton Dickenson, Caliper Life Sciences, and others), and government prime contractors (such as Lockheed Martin, Honeywell, Motorola, and others).



Dispensing of a liquid plug under the action of on-chip pneumatic actuation (Experimental data from Prof. Chong Ahn, U. Cincinnati)

Joint Collaborations

CFDRC's SBIR work has led to a number of collaborations, providing the company with an introduction to a broader community focused on developing MEMS-based Microsystems to address various government and commercial needs. These collaborations aided CFDRC's overall effort in two key ways: (1) relationships with academic investigators (such as U.C. Berkeley, Stanford, and CalTech) allowed the company to tap into the investigators' fundamental knowledge in the quest to develop general purpose models and (2) contact with lead organizations such as Motorola, Honeywell, Science Applications International Corporation (SAIC), and others helped prioritize the company's various model development efforts.

Lessons Learned

- Focus on user convenience and workflow integration. These are

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frequently more important than technological features. In the company's experience, simple features such as databases and the import of CAD geometry were as important to the end-user point of view as were advanced physical models.

- Prioritize technology efforts based on end-user value creation rather than on technological desires. Be sure that end users serve on advisory panels that set requirements and assess performance.
- If planning to submit a proposal for a DARPA SBIR, be sure to take time to understand DARPA's needs as specifically as possible by talking to the SBIR topic author during the pre-solicitation period.

Economic Impact

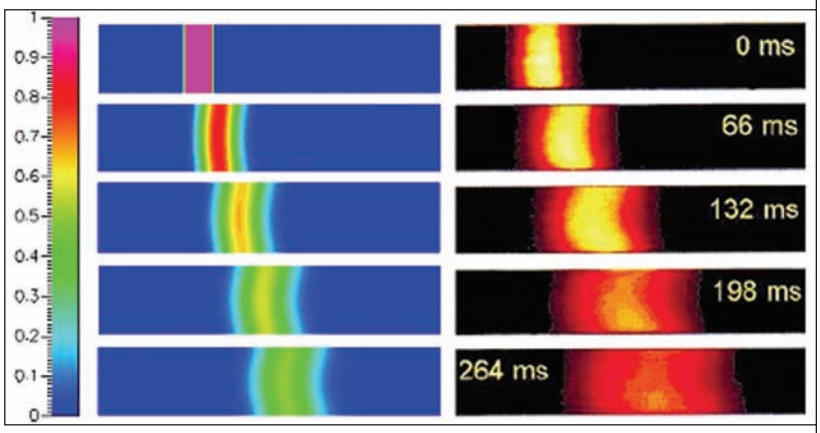
The foundation laid by the DARPA SBIR was instrumental in developing CFDRC's expertise and software products, and enabling subsequent revenue generation via a variety of sources. These sources included government Broad Agency Announcements, National Institute of Standards and Technology's Advanced Technology Program contracts, and commercial software licensing and application contracts.

SBIRs have been a significant source of funding for new technology development for the company. These new technologies—which each have taken several years and several million dollars from non-SBIR sources to further develop--are vital to the company's future.

About the Company

CFD Research Corporation—founded in 1987, and located in Huntsville, Alabama—specializes in innovative engineering simulations and designs. CFDRC offers unique capabilities for multiphysics, multiscale, coupled simulations of fluid, thermal, chemical, biological, electrical, and mechanical phenomena for real-world applications.

The company has grown steadily and profitably since its founding, and its software products and services are used by more than 500 organizations, including over fifty Fortune 500 companies. CFDRC currently has 85 employees at its Huntsville offices and—in recognition of its successes in commercializing its products—the company received the Tibbetts Award by the U.S. Small Business Administration. ■



Sample dispersion in an electrophoretic chip (Experimental data from Prof. J. Santiago, Stanford University)

Company Information

CFD Research Corporation
215 Wynn Drive
Huntsville, AL 35805
Phone: 256-726-4800
Fax: 256-726-4806
www.cfdrc.com

Founded: 1987
Number of employees: >85

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Multiscale Model of Lung Injury and Personnel Protection

Software Simulates Explosive Impacts on Virtual Humans in order to Save Lives

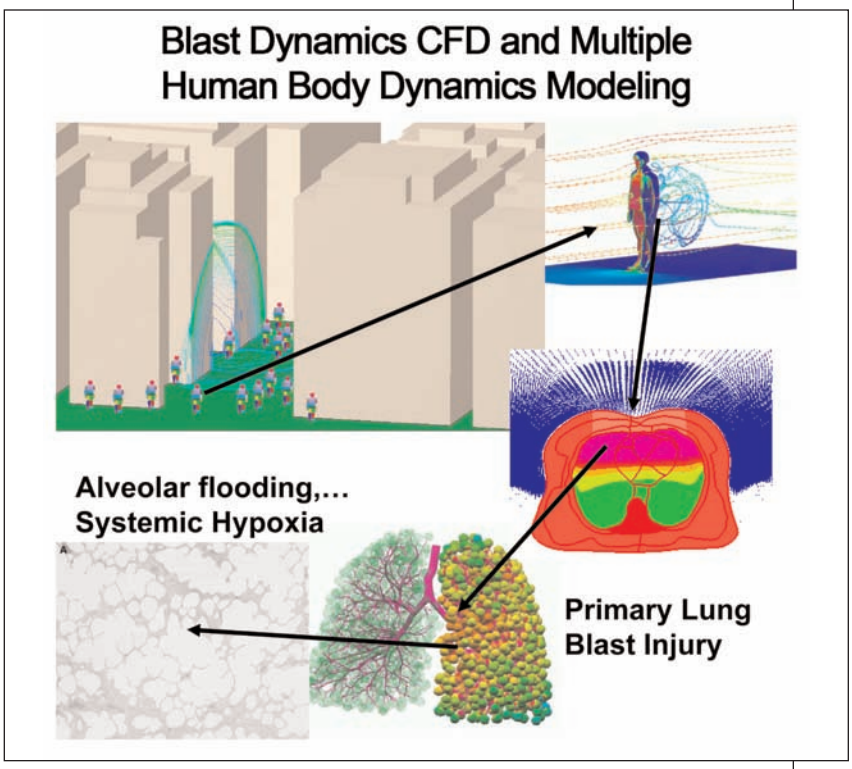
Technology and Innovation

Most terrorist attacks use explosive devices to maximize injuries to soldiers and civilians. CFD Research Corporation (CFDRC) is using DARPA Defense Sciences Office SBIR funds to develop software that simulates the effects of explosions on the human body in order to improve diagnoses, resuscitation, and treatment planning for blast victims.

The multiscale model software under development provides high fidelity, physiology-based modeling of blast injuries to the brain and lungs. Its integrated view of injury responses at the cellular, organ, and whole body levels simulates how explosion blasts affect the human body, body biodynamics, and biomechanics of vulnerable organs; and predict the pathophysiology of blast-related injuries.

Phase I of the project focused on lung injuries. CFDRC adapted exiting fluid- and structure-dynamics modeling tools and integrated them into a framework to model blast explosion events, human body injury mechanics, and the body's systemic cardiovascular response. The software simulates wave pressure propagation in microseconds; tissue viscoelastic responses in seconds, and metabolic and neurophysiologic responses in minutes, hours, and days.

Phase II concentrates on modeling blast-induced brain injuries in a similar manner. For example, simulation will include the biomechanics of brain tissue and skull interaction, vascular hemorrhage and hematoma formation, and secondary injury events such as hypoxia (oxygen depletion in the body) and ischemia (restriction of blood supply).



Multiscale model of blast lung injury

The software toolkit has many potential applications, including:

- Assessment of injury potential from explosive blasts
- Medical diagnoses, resuscitation, and treatment planning for blast victims
- Training of military medics and first responders
- Forensic study of terrorist incidents
- Development of personal protection armor, including novel helmets and vests

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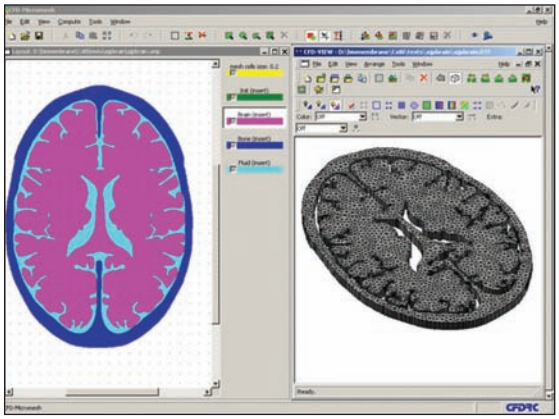

CFD Research Corporation's multiscale model software helps determine medical needs after blast injuries

- Study of drug delivery methods
- Pharmacological treatment planning
- Medical imaging
- Tissue engineering

Joint Collaborations

CFDRC has established partnerships with technology end users, lead research organizations, prime contractors, and system integrators for various purposes, including product development, software customization, research and development collaboration, technology advice, and strategic business alliances.

During Phase II of this project, CFDRC will be establishing partnerships with US Department-of-Defense-sponsored labs to conduct modeling experimental studies and with U.S. biomedical and pharmaceutical industries to commercialize the software developed under the SBIR program.

Lessons Learned

- Prioritize technology efforts based on end-user value creation rather than on technological desires. Be sure that end users serve on advisory panels that set requirements and assess performance.
- If planning to submit a proposal for a DARPA SBIR, be sure to take time to understand DARPA's needs as specifically as possible by talking to the SBIR topic author during the pre-solicitation period.

Economic Impact

CFDRC is a several-time beneficiary of the SBIR program. Previous awards provided momentum for continued implementation, validation, and application of various modeling techniques and technologies, which contributed substantially to CFDRC's position as a leader in the use of computational fluid dynamics to model and simulate complex physical processes. The current SBIR award will result in commercial quality software tools for solving biomedical and biotechnology problems.

About the Company

Founded in 1987, this Huntsville, Alabama-based company specializes in engineering models that integrate multiphysics, multiscale simulations of fluid, thermal, chemical, biological, electrical, and mechanical phenomena for real-world applications. CFDRC's products and services are used by over 500 organizations, including more than 50 Fortune 500 companies, worldwide. Major industries include aerospace, biomedical, defense, electronics, materials, and power. The company holds many patents and has received numerous awards in recognition of its successes in technology transfer, technology commercialization, and contributions to various organizations. ■

Company Information

CFD Research Corporation
215 Wynn Drive
Huntsville, AL 35805
Phone: 256-726-4800
Fax: 256-726-4806
www.cfdrc.com

Founded: 1987
Number of employees: >85

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Enabling Modeling and Training through Knowledge Acquisition

Innovative Software Tools Enable Organizations to Learn from Their Experts

Discovery Machine™ Inc.
Accelerating Innovation

Technology and Innovation

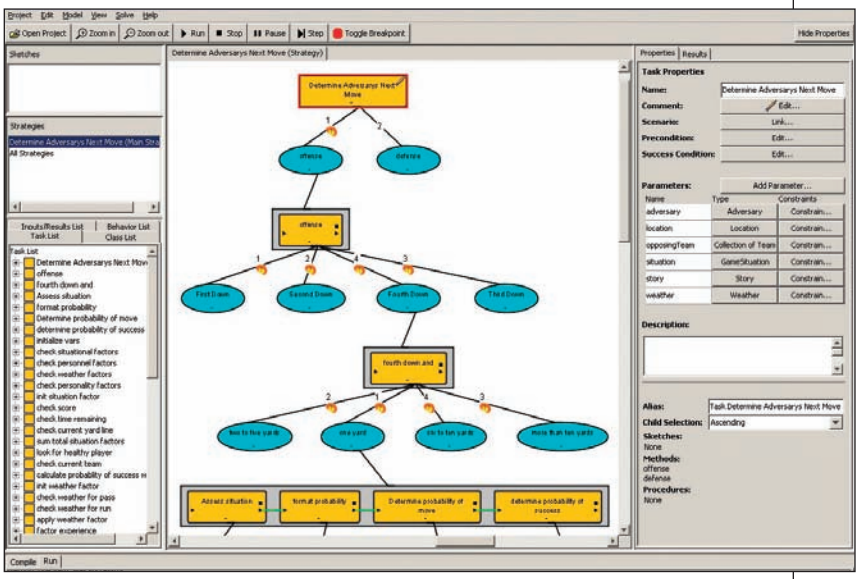
The task of acquiring, assessing, cataloging, and making knowledge available to those who need it when they need it is becoming increasingly difficult. Today, the sheer amount of data often overwhelms an organization's ability to make effective use of it.

In response to this challenge, Discovery Machine, Inc. developed Expertise Encoding and Execution Workshop (E^3W) software specifically designed to enable experts to computerize their own strategies for solving complex problems, thereby making them readily available to others at a future point in time.

Discovery Machine's approach is unique in that it is focused on keeping subject matter experts engaged in the knowledge acquisition process from beginning to end, allowing them to fully participate in the creation of expert models for decision making, diagnosis, planning, and more. Once expert models are captured by E^3W, the company's software allows these models to execute on a variety of platforms.

Discovery Machine's technology is being used by the Naval Air Systems Command (NAVAIR) as part of the Affordable Human Behavior Modeling (AHBM) Mission Builder, which provides human behavior models for application as computer-generated forces or intelligent agents in simulations for military training and analysis.

A tailored version of the E^3W called the mission builder enables trainers of Naval Aviators to quickly build entity missions into intelligent planes, ships, and submarines for training. The company has also sold its products and services to a number of commercial customers, including Concurrent Technology Corporation, 3DSolve, Inc., Global Infotek, QuantumBio, Inc., and Lockheed Martin Advanced Technology Labs.



E^3W software computerizes experts' problem-solving strategies, giving users the ability to choose each step wisely

Joint Collaborations

In addition to this DARPA SBIR, Discovery Machine has participated in SBIRs from NASA, the National Science Foundation (NSF), Naval Surface Warfare Center, Dahlgren Division (NSWCDD), and has subcontracted to other businesses on Navy projects. The company attributes its DARPA SBIR with giving it the credibility and additional technology needed to participate in these projects. According to Discovery Machine, these collaborations allowed the company to use its technology and

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methodology to provide and demonstrate real-world solutions for commercialization.

Lessons Learned

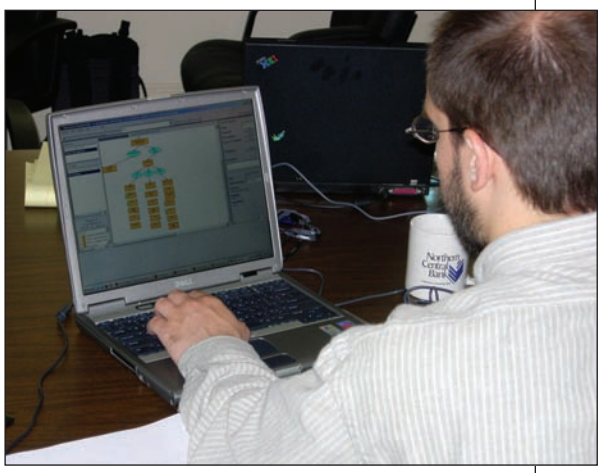
- When acting as a subcontractor, quickly assess where the company can make the biggest impact, and then focus on that area rather than attempting to solve every problem.
- When transitioning a new technology to the military, patience is a virtue. The length of time required is usually far greater than can be anticipated.
- The military is less interested in licensing software and more interested in obtaining services. The software, therefore, is not the focus. Instead, the training and methodology that accompany the software is the focus.
- Do not focus solely on impressing the DARPA program manager, but rather on producing a sellable product. The R&D world of the DARPA program manager may not place as much value on well-developed products as does the commercial world. It is important to satisfy both.
- It's imperative to communicate effectively with the program manager. If it becomes clear that a change in direction will lead to a better solution, it is important to present this new idea to the project manager and get it approved.

Economic Impact

This DARPA SBIR has allowed Discovery Machine to hire and retain people while providing significant funds for development of core products and significant opportunities to connect with Department of Defense and other government offices. The company's management team has grown the company organically, with limited angel equity investment. Approximately 72 percent of the company's technology development funding has derived from the SBIR program. The company has had four SBIR Phase II projects since April 2000.

Discovery Machine has three patents pending, two in progress, and more than 150 patent idea sheets logged and witnessed.

The company's revenue will greatly increase with the recent NAVAIR Orlando award of a $7.9M, five-year contract for operational work with the knowledge capture technology.



An end user training session

About the Company

Discovery Machine, Inc. is a privately held, woman-owned small business with headquarters in Williamsport, Pennsylvania, and offices in Raleigh, North Carolina. The company provides custom solutions, software tools, comprehensive services and training to a broad range of industries that include national defense, homeland security, aerospace and life sciences. ■

Company Information

Discovery Machine, Inc.
454 Pine St, Suite 1A
Williamsport, PA 17701
Phone: 570-329-5661
Fax: 570-329-5662
\www.discoverymachine.com

Howard H. Lewis,
President & CEO
Founded: 1999
Number of employees: 10

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Ocular Scanning Imaging-Based Device

Eye Scans Quickly Screen for Exposure to Chemical Agents and Toxins

Technology and Innovation

A very frightening aspect of modern warfare is the possible use of chemical and biological agents, which can have quick and deadly effects on exposed troops and civilians. Currently, when such exposure is suspected, invasive blood tests are required to identify the agent, determine health status, and begin treatment. But these tests must be performed by trained individuals who are not always available on-site. By the time the individual can be diagnosed and treated, irreversible injury or death may have occurred.

With DARPA SBIR funding, EyeMarker Systems, Inc. is developing an ocular scanning instrument (OSI)-based imaging technology capable of determining an individual's exposure status with respect to a variety of toxic agents. Since the eyes are directly connected to multiple physiological systems (central nervous, cardiovascular, lymphatic, etc.) in the body, they can be scanned for primary and secondary ocular effects of exposure. This technology can:

- Rapidly and non-invasively identify exposure to toxic agents and the extent of exposure by scanning for specific biomarkers in the eye, including pupil size, pupillary reactivity and blood vessel oxygenation.
- Quantify and analyze these biomarkers without the need for human expertise.
- Far exceed the through-put of other toxic exposure testing methods, allowing quicker triage and medical intervention for those in need.
- Be packaged into a portable, hand-held device that makes the OSI technology highly adaptive and mobile.

Side view of the Ocular Scanning Instrument (OSI)

Currently, the imaging device can determine exposure to four specific agents: organophosphorous nerve agents, botulinum toxin, cyanide, and carbon monoxide. The device does not identify the agent itself but rather identifies the early physiological ocular consequences of exposure to the agent prior to the presence of normal clinical symptoms of exposure.

Alternative applications for the device include identifying and monitoring health concerns such as systemic hypertension, diabetic retinopathy, and cerebral malaria.

EyeMarker Systems developed a working prototype in 2006 and plans to have a marketable scanning device by mid to late FY07. To date, the company's focus has been on identifying which ocular biomarkers are best suited for identifying and quantifying toxic agent exposure.

Joint Collaborations

EyeMarker Systems has established ongoing collaborations with military and non-military government laboratories along with academic and

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private research and development entities. Collaborators include Walter Reed Army Institute of Research, Armed Forces Radiobiology Research Institute, Army Institute of Scientific Research, Air Force Medical Evaluation Support Activity, West Virginia University, University of Pittsburgh Medical Center, West Virginia High Technology Consortium Foundation, and National Institute of Justice Office of Law Enforcement Technology. The development of the prototype OSI technology has taken place via a current commercial contract with Summa Design, Los Altos, CA and a previous one with Integrated Defense Systems, Austin TX (a division of BAE).

Lessons Learned

- When submitting a DARPA SBIR proposal, make sure there is a clear project goal that meets a critical military need, benefits warfighters, and can be commercialized.
- Develop a sound corporate structure with a commercialization strategy that will lead to success.
- Always have clear project milestones with specific "go" and "no go" approval gates. Remember that good project management is essential.
- Have the company's strongest entrepreneurs develop and cultivate end-user sponsorships. Sponsorship is critical for success.

Economic Impact

The DARPA SBIR program has enabled the company to advance the idea through proof-of-concept and initial prototype stages. The DARPA SBIR also facilitated acquisition of additional funding for Phase III commercialization of a hand-held device based on the OSI technology with the Technical Support Working Group. To date, the DARPA SBIR has supported about 50 percent of the project.

EyeMarker's OSI technology rapidly and non-invasively identifies exposure to toxic agents

This DARPA SBIR project has benefited EyeMarker Systems in many other ways as well. The company has obtained two patents and has three additional patents pending. Due to the success of the project, the company has focused development efforts exclusively on the OSI technology and changed its name (from MD Biotech) to reflect the new focus.

About the Company

Founded in 2001, EyeMarker Systems is an emerging company committed to the commercialization of innovative ocular screening technology. Company headquarters are in Morgantown, West Virginia, in close proximity to West Virginia University and the WVU Eye Institute. ■

Company Information

EyeMarker Systems, Inc.
886 Chestnut Ridge Road,
6th Floor, PO Box 6884
Morgantown, WV 26506-6884
Phone: 304.598.1101
Fax: 304.598.1183
www.eyemarkersystems.com

Dr. Christopher Kolanko,
Founder and Chief
Scientific Officer
Founded: 2001
Number of employees: 5

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Inverse Inference Engine for High-Precision Web Search

Enhanced Search Engine Provides Better Intelligence Faster

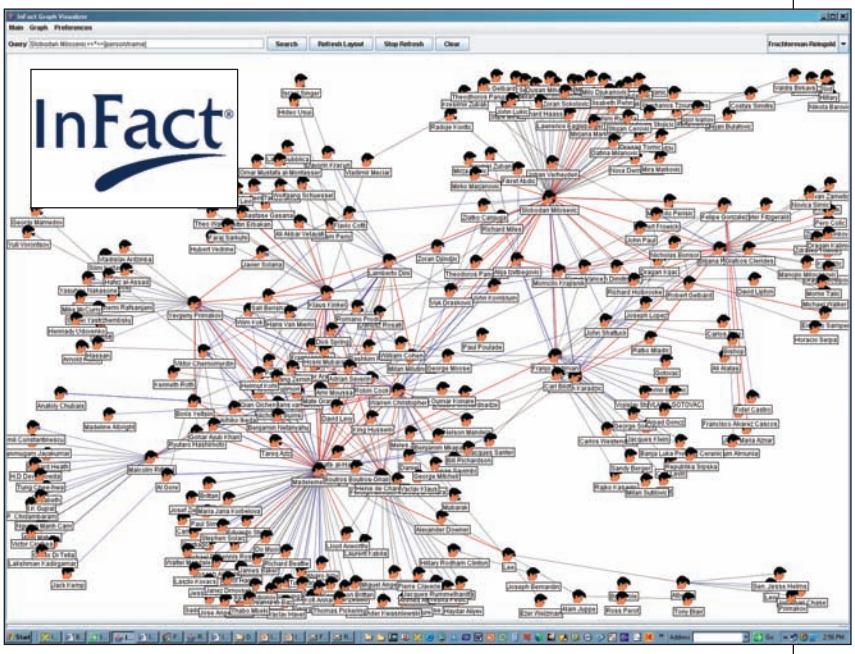
Technology and Innovation

The technology developed by Insightful Corporation (Insightful) under DARPA's SBIR program helps analysts work through documentation more quickly and efficiently than traditional technologies, such as keyword search or simple entity extraction software. The program comprises two distinct parts: 1) a new algorithm for latent semantic analysis, and 2) deep parsing technology for relationship extraction from unstructured information.

Latent semantic analysis is a promising technique with applications to enhanced keyword retrieval and cross-lingual retrieval. Insightful's development of a new algorithm, labeled Latent Semantic Regression (LSR), is scalable to large data sets and forms the basis of the company's InFact® product line. InFact® is a production quality, end-to-end deployable software system that performs relationship extraction, text mining, and search.

InFact® understands far more than keyword searches—it understands facts and actions. In a search for 'blackhawk,' a type of military helicopter, InFact® generates an aggregated list of all combat situations where the Blackhawk helicopter was deployed in the recent past, including all locations and military units that employ it, along with information about acquisition and maintenance costs and much more.

The company's technology is being used by the U.S. Army Corps of Engineers, Air Force Research Labs, major pharmaceutical companies, and a major food manufacturer.



The results of an InFact® query showing relationships between individuals

Joint Collaborations

The work Insightful has done on its LSR algorithm and InFact® product has spawned a number of SBIRs, including:

- U.S. Air Force
- National Institutes of Health
- U.S. Army Corps of Engineers
- Office of the Secretary of Defense/Army Research Institute

Additionally, Insightful is collaborating with several major systems integrators, including Science Applications International Corporation (SAIC), Mantech, and Booz Allen Hamilton.

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Lessons Learned

- Do market research and validation to ensure that there is a viable commercial outlet for the company's innovative technology, once all the technical hurdles have been overcome.
- Be able to deploy to a large community of end users and gather their feedback from the very beginning. Validation with the end user must drive all product development.
- Communicate changes in direction to the DARPA project manager promptly. Changes in direction often are motivated by lessons learned from end-user feedback. Changes can be straightforward to justify to the program manager, but still require advance notice.

Economic Impact

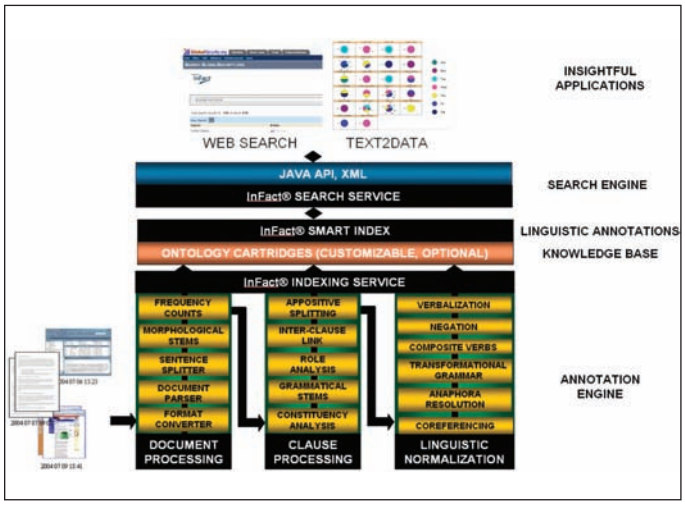
The funding received by Insightful under this DARPA SBIR has had a significant and positive impact on the company's research efforts. Besides being Insightful's initial key contract in this research area, the DARPA SBIR offset approximately 25 percent of the company's development costs during the period 2000–2002. The InFact® product line has contributed to the company's revenues—approximately $900,000 in 2004, and $1.5 million in 2005.

After the successful debut of InFact®, Insightful created a separate business unit for text analysis and search, and hired additional business development and sales personnel. The DARPA SBIR also led to three U.S. Patents: 6,510, 406; 6,757,646; and 6,862,710.

About the Company

Insightful Corporation—based in Seattle, Washington—has 120 employees and annual revenues of $22.3 million, representing a 18-percent increase over revenues for the previous year. Insightful also has offices in New York City, North Carolina, France, Switzerland, and the United Kingdom, with distributors around the world.

Insightful develops and delivers software and solutions for predictive analytics that have enabled thousands of companies to discern the patterns, trends, and relationships hidden in the data they collect. Insightful solutions are used by companies and organizations where analytics are critical to success, including financial services, pharmaceuticals, biotechnology, telecommunications, energy, and manufacturing, as well as research institutions and military and non-military government organizations. ■



The ingestion engine's map for understanding semantic and syntactic relationships

Company Information

Insightful Corporation
1700 Westlake Avenue N., Suite 500
Seattle, WA 9810-3044
Phone: 206-283-8802
Fax: 206-283-8691
www.insightful.com

Jeff Coombs, President
Founded: 1984
Number of employees: 120

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Cognition-Based Simulation Training System

Realistic Training Solutions Better Prepare Military Personnel for Combat

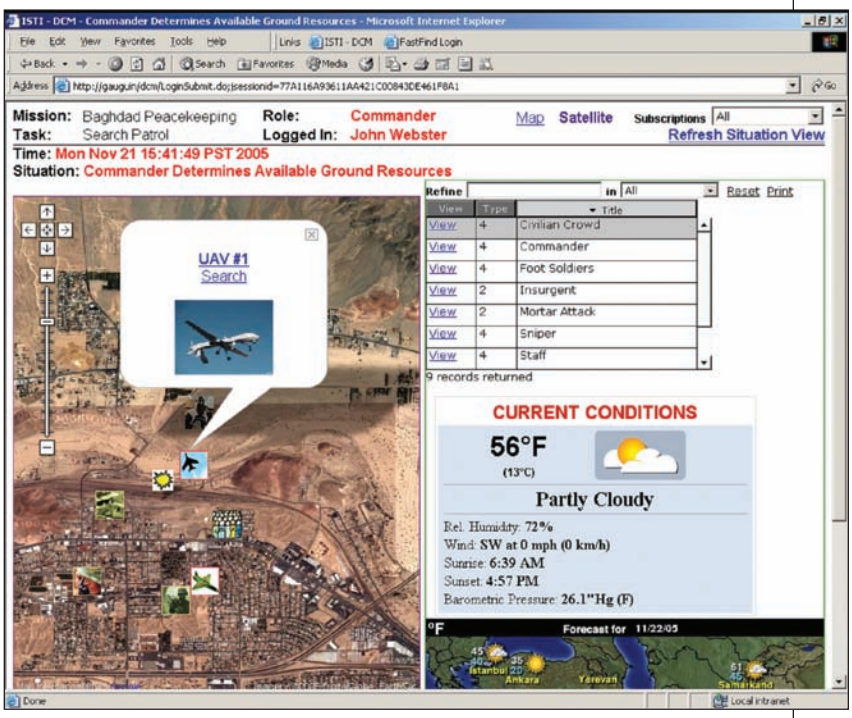
Intelligent Systems Technology Incorporated

Technology and Innovation

Training teams of warfighters is an expensive proposition, considering the costs of labor, travel, equipment, and related costs. Consequently, much training has migrated to computer modeling and simulation, which cost far less than training using real equipment in the field. Until recently, however, computer-based team training—using synthetic role players—has suffered from a distinct lack of realism, with characters appearing robotic and obviously simulated.

Under this DARPA SBIR, Intelligent Systems Technology, Inc. has made great strides in overcoming this long-standing problem by developing a next-generation unified agent architecture (NGUAA) for use in distributed simulation environments for mission rehearsal and team training. Using innovative combinations of cognitive science for realistic human behavior representation and advanced computing for team behavior evolution, the company developed a NGUAA to provide cost-effective and realistic human behavior simulation models for use in distributed simulation and game environments.

Intelligent Systems Technology serves the Department of Defense, Homeland Security, aerospace, and state organizations engaged in emergency preparedness and disaster response planning.



A set of complementary views based on contextual knowledge

Joint Collaborations

Development of the technology under this SBIR involved collaboration with a number of organizations, including George Mason University's Krasnow Institute for Advanced Study and the University of Central Florida's Institute for Simulation and Training. In addition, Intelligent Systems Technology has shared its research findings with a variety of major aerospace prime contractors with the expectation of bringing one or more on board as an SBIR Phase III commercialization partner when the technology has reached the appropriate level of maturity.

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Lessons Learned

- Bid on a focused set of SBIRs that fit the company's business plan and vision of becoming a viable commercial enterprise.
- Keep open lines of communication with the sponsor, end user and collaborators.
- Persuade investors and evaluators of the company's ability to execute from a business perspective by defining and clearly communicating the technology's commercial potential and positioning, and the company's commercialization strategy.
- To get the technology into the hands of the warfighter:

  (1) Actively pursue its insertion into an acquisition program, advanced concept technology demonstration (ACTD) or advanced technology demonstration (ATD),

  (2) Secure a role as a subcontractor to primes to find a home for the technology on a nationally significant initiative, and

  (3) Work with project managers and project engineering offices to identify relevant transitions to pursue in Phase III with non-SBIR funds.

Economic Impact

Approximately 80 percent of Intelligent Systems Technology's annual revenues derive from SBIR programs, and 20 percent from commercial product and service sales. The DARPA SBIR project was instrumental in the company's ability to obtain several million dollars of funding from other sources, including additional SBIRs and non-SBIR funds from the Navy and prime contractors on Distance Support and Engineering Planning Operator's Course programs. Having this DARPA SBIR enabled the company to hire a game designer and man-machine interface expert, and added 15 percent to the company's sales growth. Intelligent Systems Technology is in the process of filing for provisional patents on technology developed under this SBIR.

About the Company

Intelligent Systems Technology, Inc.—founded in 1994—is headquartered in Santa Monica, California. The company currently employs more than 20 people.

The company is a two-time winner of the Developer of the Year Award from the Software Council of Southern California, was the recipient of the SBA's 1999 National Tibbetts Award in California for excellence in technology, research, and innovation, and was selected as one of *Computerworld* magazine's 100 Top Emerging Companies to Watch in 2000. ■

Insurgent engaged in eluding capture

Company Information

Intelligent Systems Technology, Inc.
3250 Ocean Park Blvd
Suite 100
Santa Monica, CA 90405
Phone: 310-581-5440
Fax: 310-581-5430
www.intelsystech.com

Azad M. Madni, Ph.D.
Chairman and CEO
Founded: 1994
Number of employees: 20+

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Stacked Memory Chip Technology

Advanced Memory Technology Reduces Vulnerabilities of Integrated Circuits

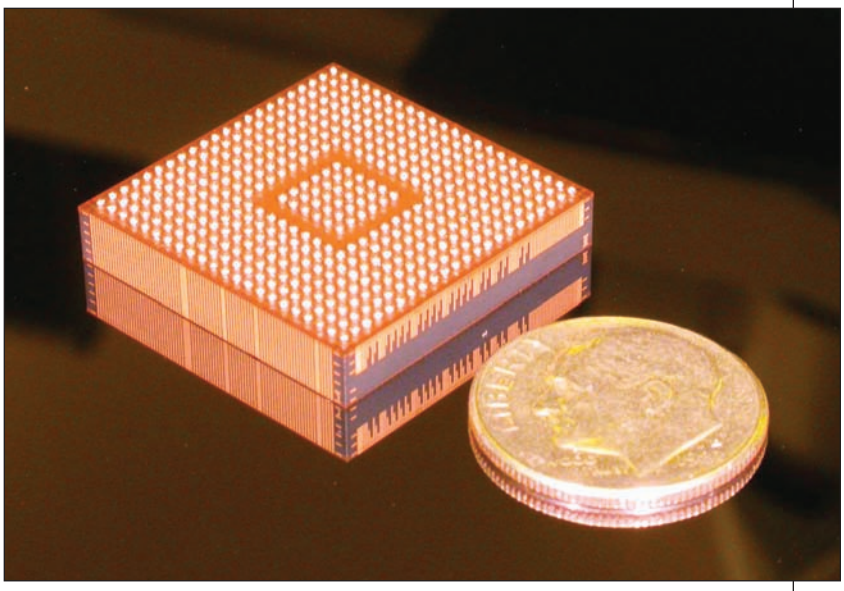
Technology and Innovation

Under this DARPA SBIR, Irvine Sensors Corporation (Irvine Sensors) developed a stacked-chip solution to ensure correctness, reliability, and functionality of designed integrated circuits (IC's). These circuits are critical parts of future weapons and defense systems. Based on a novel assembly of subcomponents, the stacked technology prevents determined adversaries from potentially intercepting and altering designs. The company's approach utilizes a "trust-enabler" stacked module, parts of which are designed and fabricated in a trusted foundry that monitors every activity of the non-trusted component and provides a safety agent for the surrounding critical system.

The DARPA solicitation and previous interactions with military users—particularly for anti-tamper uses of stacking technologies—prompted the idea, which is now in the feasibility stage.

Joint Collaborations

As a small business, Irvine Sensors has a limited ability to fund significant advances in the basic technologies related to direct stacking of integrated circuits. Accordingly, the company has a long history of end-user sponsorship of its innovative technology uses. The company has successfully moved many Phase I SBIR programs into Phase II and beyond. Sponsorship throughout various military organizations has been essential. Irvine Sensors has strong working ties with a number of educational and government research and development institutions, including UC-Irvine, UCLA, JPL, UC San Diego and CalTech. The company plans to collaborate with a leading three-dimensional (3-D) electronics design provider and a leading university for the later phases of the SBIR program.



A system-in-stack module with programmable logic and multiple memory layers

Lessons Learned

- During the open dialogue period, focus on the real needs of the program manager, who typically has the best appreciation of the service user's unstated requirements.
- Work with tier I and tier II DoD suppliers such as Raytheon, Lockheed Martin, and others. They have important insights on funding, customer needs, and technology development.

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- Be prepared for the funding gap during the transition between Phase II concept demonstrations and program insertion of the resulting technology.
- Embrace the fiscal discipline required by the DoD's audit process. It helps a small company meet the demands of being publicly held.

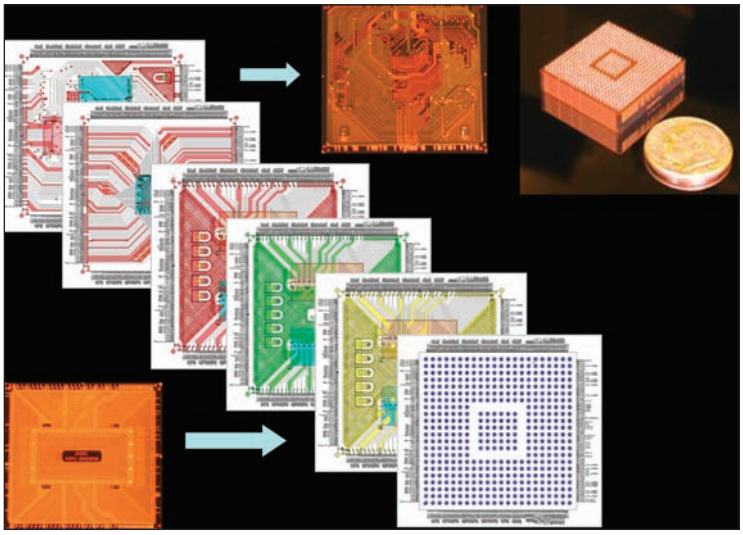
Economic Impact

DARPA SBIR programs have provided a direct and positive impact on Irvine Sensors' revenue stream, accounting for 26 percent of its external development funding. This funding and other DARPA funding obtained through Broad Agency Announcements have enabled Irvine Sensors to develop a competitive technology and establish a related patent base and evolving product catalog. More than 20 of the company's patents are a direct result of SBIR-funded technology innovations.

About the Company

Irvine Sensors Corporation, located in Costa Mesa, California, designs, develops, manufactures, and sells extremely compact 3-D electronic and imaging systems and modules. Since commencing operations in 1980, Irvine Sensors has pioneered 3-D semiconductor technologies related to advanced signal processing and image stabilization technologies for surveillance system focal planes.

Irvine Sensors sells products and prototypes from ultra high speed image processing, miniature infrared cameras, 3-D laser imaging, embedded computing, image enhancement and stabilization, stacked memory, and infrared data communications. The company offers standard and custom stacked memory products for military and commercial markets. ■



Details of the stack layers for the heterogeneous system-in-stack module

Company Information

Irvine Sensors Corporation
3001 Red Hill Avenue
Costa Mesa, CA 92626
Phone: 714-444-8715
www.irvine-sensors.com

John Carson, President
Founded: 1980
Number of employees: 152

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Forward-Looking Collision Avoidance and Sub-Bottom Sensor for Conceptual High-Speed Submersibles

E-Field Technology Helps the Navy Avoid Costly Accidents

Technology and Innovation

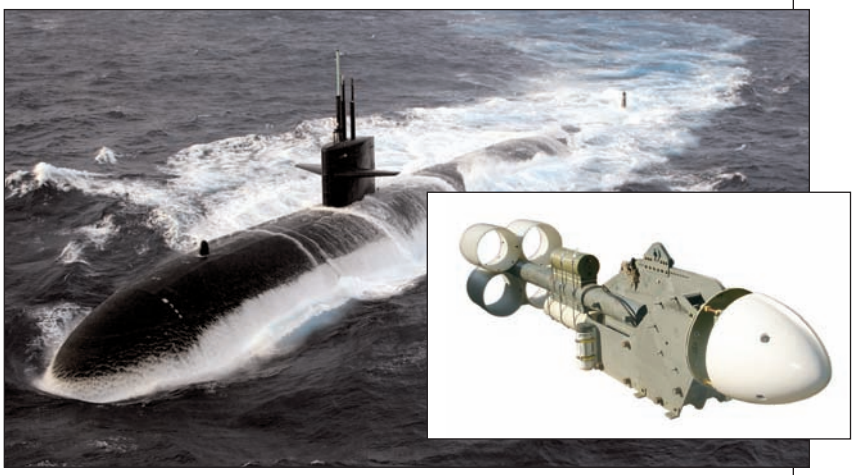
Information System Laboratories' (ISL) DARPA SBIR project explored using electric-field (e-field) sensors and advanced processing technology to provide submarine commanders with early warning information necessary to avoid collisions when proceeding to periscope depth. This is a major leap beyond traditional acoustic technology, which has a number of flaws that leave submarines open to an increased probability of collision. Although e-field sensor technology is in wide use for a variety of other applications—including monitoring of electrical equipment and measurement of high-voltage outputs from transmission lines—ISL's exploitation of this technology for anti-submarine warfare and submarine collision avoidance is unique.

This innovative technology—developed under a DARPA SBIR contract—has attracted the interest of a number of U.S. Navy organizations, and shows promise in homeland security applications such as coastal and harbor defense.

Joint Collaborations

The DARPA SBIR project has attracted the attention of a number of organizations, leading to a variety of important collaborations, including:

- University of Washington, Applied Physics Laboratory
- Office of Naval Research
- SPAWAR Systems Center, San Diego
- NAVSEA Program Executive Office – Integrated Warfare Systems 5 (PEO-IWS 5)
- Sparton Electronics



The Enhanced Collision Avoidance System reduces a submarine's risk of colliding with other vessels in acoustically unfriendly environments.

Lessons Learned

During the course of its DARPA SBIR program, Information Systems Laboratories has developed a number of best practices that have helped ensure the project's ultimate success, including:

- Since military organizations and warfighters are your ultimate customers, their needs must be kept front and center.
- The best way to ensure that customers are satisfied with your efforts is to keep them well informed and up to date.

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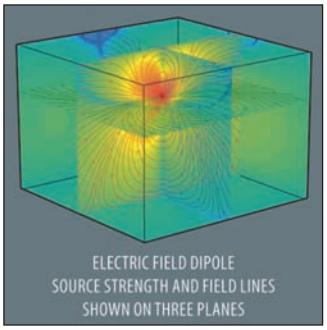
- Advances in technology are the result of creating a business culture that encourages employees to follow their dreams. Successful products merge the best technology with cost-effective solutions for customers.

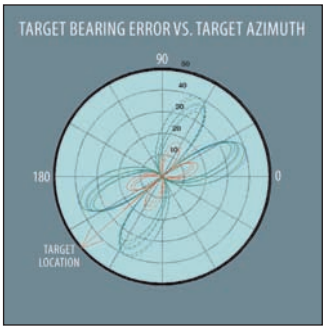
Economic Impact

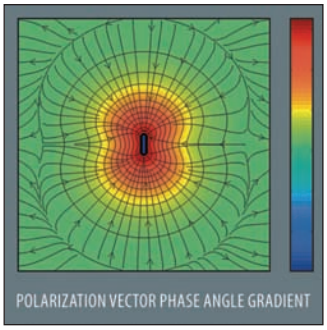
Participation in the DARPA SBIR program has opened the door to new business opportunities for Information Systems Laboratory, leading to significant personnel and financial growth for the company. Successful performance under the DARPA SBIR enabled the company to win a similar U.S. Navy SBIR to transition the technology to the fleet. The DARPA SBIR is one of several building block initiatives the company has undertaken to win larger programs that command the capabilities of multiple divisions within Information Systems Laboratory, helping the company attain revenue growth in excess of 20 percent.

About the Company

Information Systems Laboratories, Inc. (ISL)—founded in 1982—has headquarters in San Diego, California, and additional offices in Maryland, Virginia, Idaho, Washington, and Alabama. The company provides technical solutions to critical defense, intelligence and commercial problems, including signal processing, nuclear systems analysis, advanced sensor platforms, and sophisticated algorithm development. In 1996, ISL embarked on a major expansion plan which included conversion from a sole proprietorship (95 percent owned by the founder) to an employee-owned company with stock distributed among all employees. ■







Company Information

Information Systems Laboratories, Inc.
10070 Barnes Canyon Road
San Diego, CA 92121
Phone: (858) 535-9680
Fax: (858) 535-9848
http://www.islinc.com

Dr. R. Michael Dowe, Jr., President and CEO
Founded: 1982
Number of employees: 150

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High-Speed Multi-Axis Nanopositioning Systems for Next-Generation Metrology and Lithography

More Accurate and Reliable Tools Aid the Development of New Nanotechnology Applications

Technology and Innovation

The explosive growth of nanotechnology, which continues to shrink military and commercial system components to infinitesimal sizes, has led to a pressing need for tools that can function in this extremely challenging environment. nPoint, Inc. was founded on the premise that advanced measurement tools would be essential for the continued development of nanotechnology, and the belief that existing motion-control products did not have the capability to perform reliably and quickly on the nanoscale.

Under this DARPA SBIR, nPoint developed a three-dimensional (3-D) nanopositioning system for a surface metrology tool that has significant advantages over existing products, in terms of improved precision, accuracy, repeatability, speed, and ease of use.

The primary military application of nPoint's technology is in the area of infrared imaging. In one such application, FLIR—a defense contractor—manufactures infrared imaging systems for airborne vehicles for purposes such as reconnaissance, surveillance, and search and rescue. FLIR achieved significant improvement in its image resolution, which can be accomplished by way of small, repeatable motions of the imaging system relative to the detector. Such motions must be provided by a nanomotion system, but such a system must be light, shock-proof, operational over a wide temperature range, and able to withstand enormous force. nPoint designed such a system with expertise gained directly from its SBIR contract.

nPoint's nanopositioning technology facilitates infrared imaging systems used by airborne vehicles in reconnaissance, surveillance, and search and rescue operations

nPoint's end users include both military and commercial customers. The company sells directly to original equipment manufacturers (OEM), which in turn supply the military. Some of the companies that nPoint supplies include VEECO, ZYGO, FLIR, Toshiba, Hysitron, 3M, and Seagate.

For FEI Company, nPoint designed a closed-loop positioning system for semiconductor surface metrology instruments that allows higher speeds and precision, effectively meeting the needs of the next generation of devices as outlined in the International Roadmap for Semiconductors.

Joint Collaborations

nPoint's strategy is to sell to OEMs. This has been effective for the company and, to date, has not required extensive collaborations. As nPoint grows, the

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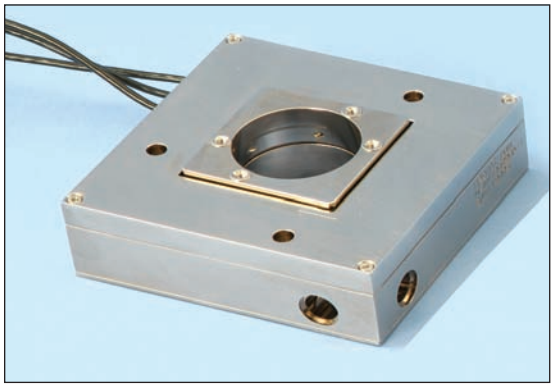

A 3-axis nanopositioner

company is looking forward to many collaborations to support commercialization.

Lessons Learned

- Understand that transitioning product innovations to the military takes much longer than anticipated. One has to first build confidence in the customer that not only is the product something that is needed, but that the company has enough longevity to service it or supply a new version.
- Get to know program officers at DARPA to understand their needs and interests.
- Get in touch with the local SBIR facilitator, who can help guide the company through the process from identifying a program and creating a proposal to contract award and beyond.
- Improve the chances of award by being ready and able to defend the military or societal need for the product.

Economic Impact

DARPA SBIRs funded nearly all of the company's product research and development and—because SBIRs don't demand an equity stake in exchange for funding—nPoint's founders and employees have been able to retain more than 60 percent ownership in the company.

The company has leveraged its DARPA SBIRs to solicit and attract angel funding, state government technology loans, and bank loans. nPoint is beginning research and development to enter the biotechnology, pharmaceutical, and advanced optical imaging markets with unique nanopositioning product designs. Future plans are to expand further and explore subsystem or complete system design and manufacture.

About the Company

nPoint, Inc.—located in Madison, Wisconsin—had its origins in university research. In 2004, nPoint was awarded the MIT Small Technology Company Award.

The company provides enabling technologies in nanopositioning and nanomotion control to some of the world's most advanced laboratories and manufacturers. nPoint nanomotion systems and controllers combine high speed, precision, and accuracy at the sub-nanometer level. nPoint, Inc. serves defense, commercial, and research markets in applications involving imaging, materials and product characterization, nanofabrication, and nanomanipulation. ■

Company Information

nPoint, Inc.
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Marti Smith, President
Founded: 1997
Number of employees: 12

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Intelligent Video Surveillance System

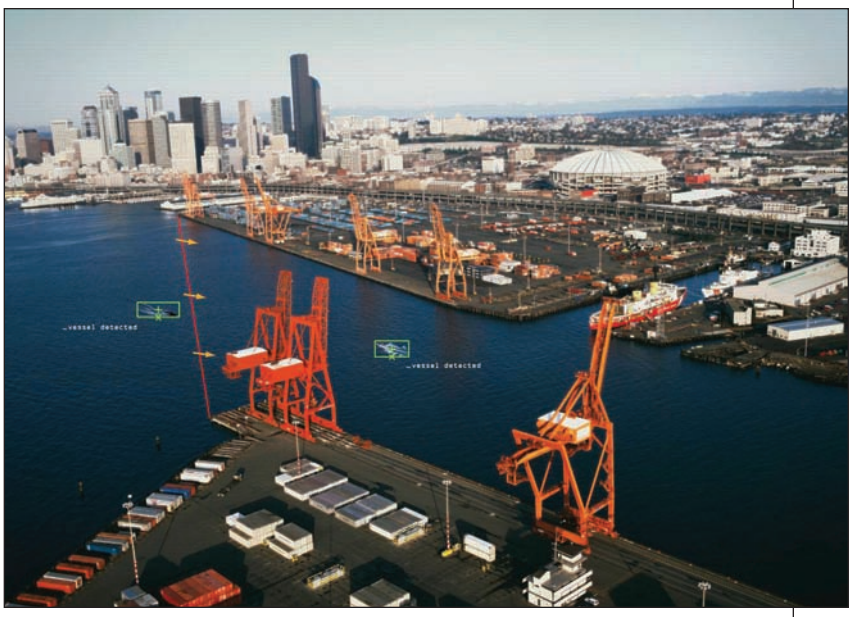
Real-Time Alerts Help Security Personnel Respond Quickly to Possible Threats

Technology and Innovation

Video security systems have been used for years at airports, seaports, government facilities, and many other installations to protect people and prevent property theft or damage. But such systems depend heavily on their human monitors' ability to detect threats, which is not always perfect. The problem relates to chronic inattention of security personnel who are tasked with watching security camera feeds. Sandia National Labs has studied this problem and declared security video monitoring to be a "super-human" task.

ObjectVideo offers a solution to this problem. This company's software products use patented computer vision technology to turn video into data to detect, classify, and track objects of interest according to user-defined rules. Users then receive real-time alerts, which allow them to proactively address possible threats and other concerns within the environment.

ObjectVideo has produced a suite of products that enable users to convert their existing closed-circuit TV installations into proactive intelligent video surveillance (IVS) systems that can be used in challenging environments. These products have been used in over 200 deployments. Markets for the technology include homeland security, transportation, banking, and education, and uses range from protecting U.S. troops in war zones to monitoring schools for student safety and security.



ObjectVideo's Intelligent Video Surveillance System helps to track potentially threatening movements and activities, a task which is usually subject to human error.

Joint Collaborations

ObjectVideo's first large DoD acquisition was the U.S. Air Force Integrated Base Defense Security System and it continues to pursue U.S. Navy, U.S. Coast Guard and U.S. Army adoption. Products have been used in five mobile combat deployments in Iraq, including the First and Second Marine Expeditionary Forces.

ObjectVideo has also established partnerships with an extensive list of companies around the world for the purposes of marketing, sales, and support. The company adopted an Original Equipment Manufacturer (OEM) strategy and is embedding its technology into products like cameras, digital video recorders, routers and video encoders made by companies like FILR, Cisco, CoVi, Lumenera, Verint and more.

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Lessons Learned

- Once an SBIR Phase I contract has been awarded, focus on attracting more of the top people in your field and the best outside investors. The award will help your credibility with both.
- Be prepared to make frequent course corrections to bring a product to market and develop a scalable business model. That model should include a marketing plan ranging from the first sale to a robust sales pipeline and a financial plan that includes baseline estimates with risk mitigation.
- Understand that transitioning innovations to the military has a very long cycle time.
- Do not underestimate the challenges associated with turning technology into a viable commercial product. A new skill set that includes marketing, product management, engineering, quality assurance and customer care is required.
- At the beginning, use SBIR funding to help achieve your current business goals, but design your company plan for growth beyond the SBIR program.

Economic Impact

The hurdles facing ObjectVideo included attracting top talent and outside investors as well as selling to government agencies. The SBIR awards were extremely helpful in all of these endeavors: workers see job security in SBIR-phased projects and private investors view an SBIR success as a strong endorsement of the company and technology. The SBIR Phase III vehicle enabled Federal government agencies to purchase ObjectVideo's products and services without conducting additional competitive reviews, which shortened the sales cycle on key accounts.

The company has worked with more than 150 customers in 16 countries and believes to have more market share than its top IVS competitors combined.

IVS systems help to create clear visual images of movements.

ObjectVideo has grown from a core group of seven technologists into an organization of over 90 personnel. The company has a number of pending and awarded patents that resulted directly or indirectly from SBIR-funded technology.

About the Company

Founded in 1998, ObjectVideo has become a leading provider of intelligent video software for security, public safety, business intelligence gathering, and other applications. The company received the 2005 Wall Street Journal Technology Innovation Award and Frost & Sullivan's 2005 Excellence in Technology Award. ■

Company Information

ObjectVideo
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www.objectvideo.com

Paul Brewer, Co-Founder and Vice President, New Technology
Founded: 1998
Number of employees: 90

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Miniature Robotic Vehicles

Smart Robots Create Value by Increasing Personal Safety

Technology and Innovation

Omnitech Robotics International LLC (Omnitech) has completed Phase I, II, and III DARPA SBIR projects. The company's DARPA SBIR Phase I and II focused on development of a miniature robotic vehicle, which led to the development of TOUGHBOT, a robot being used in Iraq to aid in surveillance, building entry, and clearing operations. Omnitech's Phase III work focused on the development of a larger Mule class of vehicle, referred to as the Experimental Robotic Support Vehicle (XRSV). This effort, in turn, led to the development of a next-generation appliqué robotics kit referred to as NGCM1, that is currently entering into service to counter improvised explosive devices (IEDs) in Iraq. The appliqué robotics kit can convert a variety of vehicles to unmanned operation reducing life cycle cost. All of Omnitech's products create value by providing increased safety for personnel performing hazardous operations.

The original, two-pound miniature robotic vehicle combined the capabilities of a PDA, cell phone, video and still camera with a remote control car. However, the single prototype was mechanically fragile and it offered capabilities that were not needed for the bare-bones, utilitarian missions that military end users actually wanted. Building on this lesson, Omnitech developed a product called TOUGHBOT, a throwable, survivable audio/video reconnaissance tool, to meet the utilitarian mission requirements of ruggedness and reliability. Omnitech's customers ordered 75 units right away.

Omnitech's XRSV allows soldiers control of rescue vehicles from afar

Reliability is a top priority for Omnitech's customers. TOUGHBOT survives 300 g shock repeatedly. It can be thrown or dropped from a three-story building and will continue to work. The company's NGCM1 appliqué robotic kit is flexible and inexpensive, allowing cost-effective use—even for highly dangerous missions such as IED inspection and neutralization.

Omnitech's primary customers and end users include:

- U.S. Army
- U.S. Marine Corps
- Urban search and rescue personnel
- Security personnel

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Joint Collaborations

The company's most important collaboration is with BAE Systems, to which it sold a minority ownership position. BAE Systems has provided significant opportunities to support its larger Future Combat Systems (FCS) programs. BAE has also benefitted from the knowledge Omnitech gained through its DARPA SBIR-funded research. FCS has been a major focus since the company was founded—this SBIR has helped address the maturation of technologies for this major program.

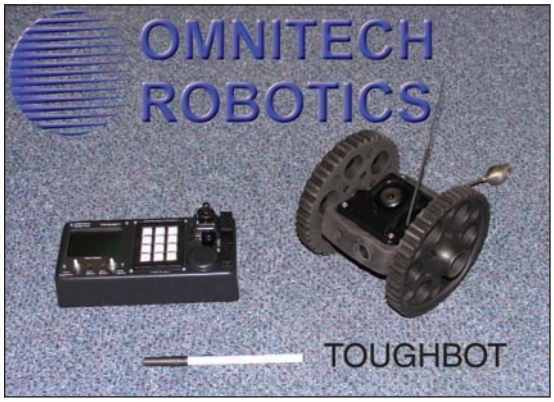
Lessons Learned

- Build a competitive edge at product sales and you will succeed. Product sales is the eventual goal, and R&D is just a means to get there.
- View funding sponsors as customers who have a problem to solve, not just a need for more R&D.
- Use SBIR R&D funds to develop the product, then focus on selling it. Return to R&D only when the product needs improvement. R&D is fun, but recurring gains from product sales is the best reward.

Economic Impact

The DARPA SBIR has had a positive financial impact on Omnitech, specifically by leading to new technology that allowed innovative products to be designed and produced, and profits generated. The DARPA funding was also instrumental in helping the company obtain funding from other sources.

The TOUGHBOT and NGCM1 products came from results and confidence gained during the SBIR-funded efforts. That has resulted in two new product lines, multiple and ongoing sales opportunities, and new hires.



The TOUGHBOT aids in surveillance, building entry, and clearing operations

About the Company

Omnitech Robotics International LLC is headquartered in Englewood, Colorado where it employs 11 people and generates $1.6 million in annual revenues. The company also plans to open a new R&D facility in Maryland that will include a robot vehicle test track. Omnitech is in the business of developing and manufacturing robotic components, controls, and systems for unmanned ground vehicles and broad-based automation. The company focuses on the design, manufacture and support of modular embedded control components for converting any ground vehicle to remote control, teleoperated control, or semi-autonomous control. These components are typically added to existing manned vehicles using robotic conversion kits, or appliqué robotic controls. ■

Company Information

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Fax: 303-922-7775
www.omnitech.com

David Parish, President
Founded: 1999
Number of employees: 11

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Glass Turret Visualization System (GTVS)

Augmented Reality Systems Offer Low-Cost, Safer Training and Navigation Solutions for the Army and Navy

Technology and Innovation

Pathfinder Systems' DARPA SBIR project defined a method to implement a Glass Turret Visualization System (GTVS) for military platforms. The basic GTVS technology is to use Augmented Reality to inject computer-generated entities into real-world, real-time user views. In one example, the U.S. Army Research, Development, and Engineering Command (RDECOM) has used the technology to begin to explore the use of Augmented Reality (AR) to support dismounted soldier training. In this application, AR is used to integrate virtual friendly and opposing force (OPFOR) entities into soldier views to support training and mission rehearsal. The same technique can also be used to inject real-time Command and Control (C2) information into soldier views to support the execution of cooperative tasks and enhance/expedite military decision making.

This innovative technology—developed under a DARPA SBIR contract—has found its way to a number of U.S. Army and U.S. Navy end users, and shows promise for use in commercial applications as well.

Joint Collaborations

Pathfinder Systems has used its DARPA SBIR to create joint collaborations with the U.S. Army Tank-Automation Command (TACOM), U.S. Army Research, Development, and Engineering Command (RDECOM), and U.S. Army Program Executive Office for Simulation, Training, and Instrumentation (PEO-STRI). In addition, the U.S. Air Force will be using Augmented Reality technology to train the loadmasters located in the back of C-130 aircraft. The program begins in early 2007. The knowledge the company gained from its work on the DARPA SBIR program better enabled the company to access additional technology funds—in some cases by pointing out the existence and benefits of streamlined contracting procedures of which customers were unaware.

The seamless integration of virtual targets into real-world view offers a realistic, cost-effective training solution.

Lessons Learned

As a specialist in pursuing and successfully completing SBIR projects, Pathfinder Systems has developed a number of best practices which have served the company well over the years. Some of these best practices include:

- **Technology transition:** To improve the chances for adoption by prospective end-users, begin the process of transitioning technology to the

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Virtual minefield breach markers allow safe ingress and egress through minefields and other hazardous areas.

military when writing the Phase I proposal—not after an award is made.

- **Technology evaluation:** To increase the probability of acceptance by the client, begin planning for customer evaluation of technology at the same time as writing the Phase I proposal.
- **Changing course:** For ultimate project success, keep government technical points of contact fully apprised of such situations, giving them a say in new research directions.

Economic Impact

The DARPA SBIR program has been an economic catalyst for Pathfinder Systems—helping the company find and attract additional funding from a variety of agencies within the Department of Defense. By the company's estimation, its original DARPA SBIR project has been leveraged into more than $1.4 million of additional work in the area of Augmented Reality.

As a direct result of the DARPA SBIR, Pathfinder Systems has secured one patent and is currently working on one more. The company is in the process of establishing a new subsidiary which will provide its proprietary neural net technology—developed under another SBIR effort—to the gaming industry, and exploring the possibility of designing and manufacturing a low-cost Augmented Reality system that could be sold within the toy and entertainment industries.

About the Company

Pathfinder Systems, Inc.—founded in 1985 by Sheila Jaszlics, who also serves as president of the company—is a small, woman-owned business based in Lakewood, Colorado that specializes in developing real-time simulations and executing complex research and development efforts. ■

Company Information

Pathfinder Systems, Inc.
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Sheila Jaszlics, President
Founded: 1985
Number of employees: 7

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High-Bandwidth Data Communication Technology

HoloLink Technology Speeds Up Communications at Lower Cost

Technology and Innovation

In 1993, Physical Optics Corporation (POC) was selling fiber optic components in an extremely competitive market. The company decided to distinguish itself with a unique product solving a critical telecommunication challenge: bandwidth. The company already had a concept when they came across DARPA and a military need that aligned with their idea.

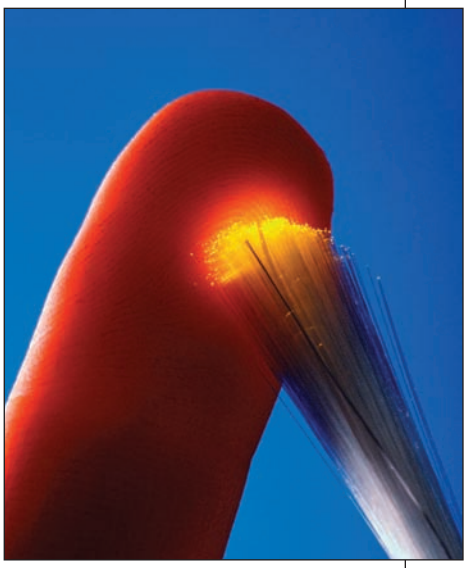
With DARPA SBIR sponsorship, POC optimized their concept to meet military specifications and came up with a fiber optic, unidirectional, multiplexing system called HoloLink. This technology significantly increases bandwidth transmission over existing fiber networks by allowing video transmission of different signal formats through a single fiber for parallel, high-bandwidth data communication.

This solution reduces synchronization constraints, which reduces the cost per bit by adding to the capacity of existing fiber and reducing load on nearly saturated fiber plants.

The HoloLink system is based on POC's patented wavelength division multiplexing (WDM) technology. POC's HoloLink technology was used by the U.S Air Force and the U.S. Army as part of a surveillance system for a U.S./Israeli defense program. The commercial sector embraced the product, particularly in areas of intense bandwidth requirements, such as medical graphics transport, Internet services, multimedia services, and financial transactions.

Joint Collaborations

The company's collaborative successes include strategic partnerships for component manufacturing; technology licensing to original equipment manufacturers; strategic partnerships with research and development institutes, national laboratories, and government and military agencies; and strategic alliances with advanced system integrators of high-end products.



Lessons Learned

- Recognize early in the program what technologies can be commercialized and/or developed to meet military and/or commercial needs. For both types of applications, a solution has to be innovative and mature, which is tremendously difficult to achieve within a short period of time with limited resources. Therefore, prioritize early and make investment decisions based on commercialization needs.
- Transitioning technology from SBIR to military or commercial applications requires a team effort. Bring scientists and engineers together with mechanical/electrical/systems integrators to help work out the transition action plan.
- Compete in a very competitive market by exploiting a market niche based on innovation. The knowledge capital and effective interaction of 48 PhDs has worked well for Physical Optics.

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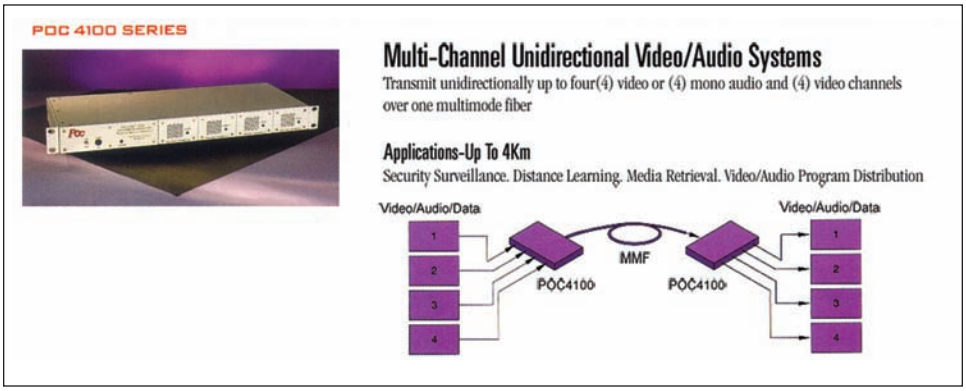

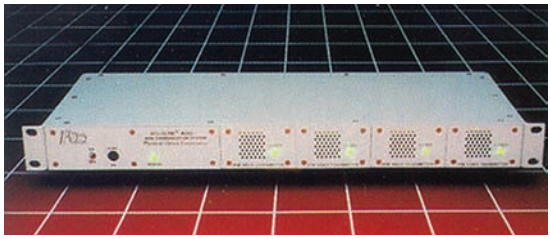

The Hololink system's user interface.

Filing and maintaining patents has helped the company to develop solutions with comparable advantages as well as generating licensing revenues.

Economic Impact

DARPA funding was critical in moving this technology from concept to product. The HoloLink technology contributed significantly to the expansion of one of POC's major divisions, specializing in communication. It has been used in three product families involving passive wavelength division multiplexers and high-speed fiber optic video/audio/data transmission links. This project was also important in establishing a new production line in 2000 that achieved ISO:9000-2001 certification. In addition, it was instrumental in launching a spin-off company, Broadata Communications, and generated several licensing agreements for various applications.

The entire product portfolio at POC can be directly or indirectly traced to the SBIR program, since the company's principal product for many years, Light Shaping Diffuser™—used in cell phone displays and auto dome lights—was also developed under an SBIR. From its inception, POC has grown at a rate of 8 to 25 percent over 20 years. The company currently holds 88 patents and has others pending, most based on research that was originally funded under SBIR.

About the Company

Started in 1985, this private employee-owned Southern California company has emerged as a innovative small systems integrator and value-added components manufacturer in the areas of light shaping displays, information technology, photonic systems, electro-optics, and holography. Recently, Inc. Magazine ranked POC as 24th on their "Innovative 50" list of the most innovative companies in America. ■

Company Information

Physical Optics Corporation
20600 Gramercy Place,
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Torrance, CA 90501
Phone: 310 320-3088
Fax: 310-320-5961
www.poc.com

Gajendra Savant
Founded: 1985
Number of employees: 135

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Integrated Electric and Magnetic Compact Sensors

Compact Sensors Provide Intelligence Gatherers with Better Signals Faster

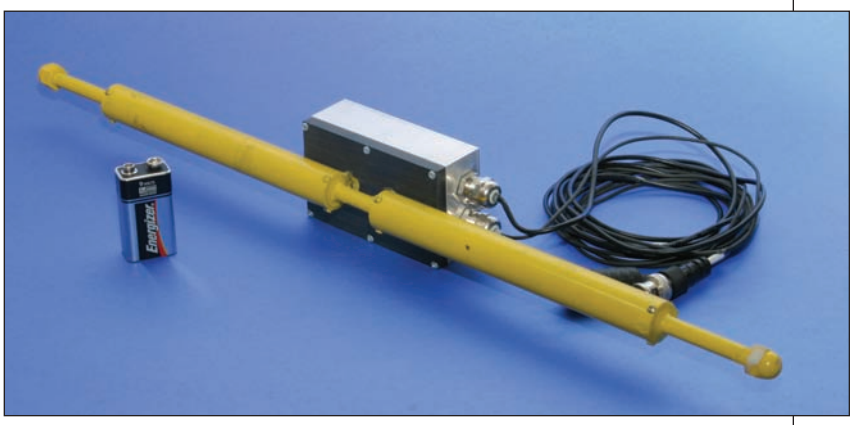
Technology and Innovation

Under the DARPA SBIR program, Quantum Applied Science and Research, Inc. (QUASAR) built and optimized an advanced integrated electric and magnetic sensing device. This device is the first with electric and magnetic sensors integrated into a single unit which can produce a better record of the signal of interest, provide better noise cancellation techniques, and shorten complicated set-up times. Being able to move and hide the device quickly is especially important to military personnel working in hostile territory.

QUASAR's sensors offer the additional advantages of being much more compact and deployable than previous technology, allowing for the construction of unique and convenient sensing systems. The company's expertise in isolating signals of interest from "noise" (other signals picked up by the sensors), in combination with the high-level sensitivity of the devices, allows QUASAR's technology to deliver measurements that were previously unobtainable. Intelligence gatherers are the primary military end users of the technology funded by the DARPA SBIR. The primary commercial end users are expected to be organizations interested in lightning detection technology and Earth resource exploration.

Joint Collaborations

For this sensor technology, QUASAR worked with a major prime contractor involved in DARPA's Counter Underground Facilities (CUGF) program and SBIR customers. QUASAR's main role was to provide the sensors for the CUGF project. Research accomplished under previous DARPA SBIRs enabled QUASAR to win the subcontract. Subsequently, DARPA awarded the current Phase II SBIR which has funded sensor development, construction, and testing.



Magnetic Sensor

Lessons Learned

- Although the SBIR program promotes research, be sure to focus on a specific customer problem so that the technology is transitioned to end users successfully.
- Develop a core technology platform and use appropriate DARPA programs to improve it. Avoid simply responding to solicitations.
- Do your homework. Read solicitations carefully, then connect with the DARPA technical point of contact to be sure that the proposed technology meets the need that prompted the solicitation.

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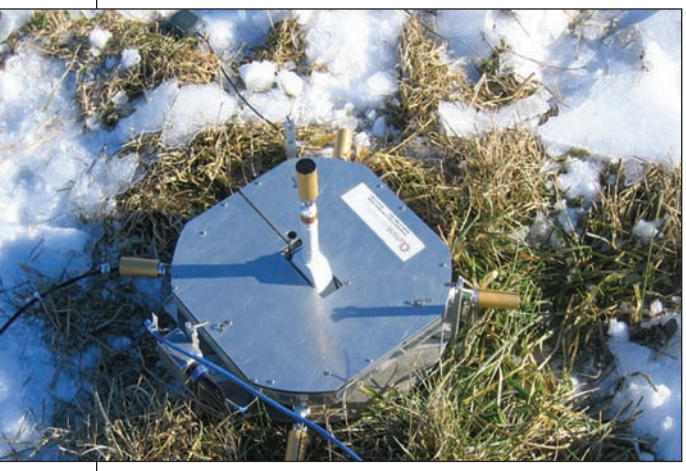

Integrated Sensor in the field

- Continuously investigate new applications for the technology to broaden its appeal, increase the amount of funding available, and assure continuity of funding.

Economic Impact

The original DARPA Phase II SBIR award funded improvements to the company's sensors as well as the integrated prototype. Results achieved with the improved sensors and the existence of the prototype led to increased funding for an airborne sensing version. Both military and commercial airborne sensing applications have potential.

Approximately 50 percent of QUASAR's technology development funding came from DARPA. The compact ground sensors SBIR provided a substantial portion of the company's revenues. QUASAR's management team anticipates that follow-on work from this program will continue to play a major role in the company's growth. The company has a patent pending on its unique integrated electric and magnetic sensing technology, as well as a Continuation-In-Part (CIP) of that application using the technology for lightning detection.

About the Company

Quantum Applied Science and Research, Inc. is located in San Diego, California, and currently employs 28 people. Annual revenues of approximately $4 million represent a 24 percent increase from the previous year.

QUASAR provides noninvasive sensors integrated with precision hardware and sophisticated, robust algorithms to produce systems that output information about cognitive and physiological states. QUASAR plans to offer full sensor systems and services, including all stages of data collection.

QUASAR maintains an 11,500 square foot facility with a comprehensive range of advanced electronic instrumentation, including state-of-the-art electric and magnetic field modeling capabilities, calibration systems, and a double-shielded, climate-controlled, RF-screened room, rated to provide 120 dB of electrostatic shielding at frequencies below 1 kHz. QUASAR performs all of its development, manufacturing, and marketing of complete sensing systems from its San Diego facilities. ■

Company Information

Quantum Applied Science & Research (QUASAR), Inc.
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San Diego, CA 92121
Phone: 858-373-0231
Fax: 858-373-0235
www.quasarusa.com

Dr. Andrew D. Hibbs, CEO
Founded: 1998
Number of employees: 28

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Battery-Powered Ascender

Climbing Device Provides Quick Vertical Access for Search, Rescue, and Repair Operations

Technology and Innovation

If firefighters, emergency personnel, construction workers, and military personnel could choose a superhuman power, it might be Spiderman's ability to cast a web and ascend to hard-to-reach places. Though they may lack this superhero power, an innovative personal lifting device now allows them to quickly and easily scale buildings, access windows or airplane cockpits, and reach tall interior spaces without the need for extensive setup or support on the ground.

Under a DARPA SBIR, Quoin International, Inc. developed the PowerQuick® Powered Ascender, a rechargeable battery-operated lifting device that allows people to quickly access high places by ascending a rope. The technology for this device was conceived when Quoin responded to a DARPA request for a powered, lightweight personal lifting device capable of scaling vertical surfaces to gain entrance to upper stories in situations requiring speed and stealth.

PowerQuick® uses now include high-rise search and rescue, vertical evacuation, inspection and repair of structures such as bridges and ships, and maintenance of telecommunication towers. Recently, the PowerQuick® Powered Ascender was used to repair the 60-foot-high domed ceiling of the historic Proctor Theater in Schenectady, New York without removing the seats, installing scaffolding, or shutting down the theater during repairs.

Three models of the device exist with different lifting capacities (200 to 500 pounds) and climbing rates (6 inches to 2 feet per second) to accommodate military and commercial lifting needs ranging from a single worker with tools or equipment to rescue and industrial applications. A climb of 600–800 feet can be accommodated on a fully charged battery.

Joint Collaborations

As a result of the DARPA research and in response to a U.S. Air Force SBIR topic, Quoin is currently developing a system that provides firefighters and rescue personnel with improved access to cockpits to speed pilot extraction under emergency conditions on the ground. This lightweight Personnel Access Rescue Stand (PARS), a portable climbing base for the Powered Ascender, is designed to allow cockpit access in less than 90 seconds, reduce rescue crew injuries and protect expensive airplane coatings during training. The Air Force featured this new equipment at the NATO conference in Paris in July 2006.

Outside of the military, Quoin has received strong support from the University of Nevada, the Reno Department of Mechanical Engineering, the China Lake Mountain Rescue Group, and the Carson City Fire Department.

When Quoin started development, the company discovered that there were no specific safety or other standards for powered ascender devices. Quoin worked with the Society for Professional Rope

Members of the Carson City Fire Department demonstrate horizontal egress for a Discovery Science *Beyond Tomorrow* segment on the PowerQuick ascender.

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Access Technicians (SPRAT) in the U.S. and the Industrial Rope Access Trade Association (IRATA) in the UK to develop standards for powered ascenders that meet or exceed all U.S. and international standards for rope access equipment.

Lessons Learned

- Decide early whether to manufacture in house or license the technology. Key factors to consider are financial requirements, production capacity, quality control, manufacturers' market channels, and customer service.
- Be ready to hit the road, attend trade shows, give presentations, and use professionally developed brochures and manuals.
- Conduct a thorough risk assessment and develop mitigation strategies. Risks issues include technology performance, intellectual property protection, standards development, product acceptance, key employee retention, supplier management, and product liability.
- Focus on having trainers use the product. Products used in training are likely to become the preferred choice of trainees as they perform their new skills on the job.

Economic Impact

DARPA SBIR funded about 90 percent of the Powered Ascender's development. The fact that the device was developed under a DARPA contract provided instant credibility for Quoin and the product. Additional DARPA funding for personnel rating and safety testing further enhanced credibility and alleviated safety concerns.

DARPA was also a tremendous help in providing valuable military contacts early on, and the DARPA effort was directly responsible for Quoin winning the additional Air Force development program (PARS).

Quoin has applied for international patents for the PowerQuick® Powered Ascender and has filed copyrights to assist in branding. In November of 2004, Quoin established Bonanza Products, Inc. as a separate subsidiary corporation to commercialize the PowerQuick® product line. Bonanza currently has over 20 distributors located in the U.S. and around the world.

(Left) Members of the Fort Bragg, North Carolina U.S. Army Special Operations Command evaluating the PowerQuick for deployment. (Right) Prize Construction uses the PowerQuick Ascender to perform ceiling repairs on a 60-foot domed ceiling in the historic Proctor's Theater in Schenectady NY without removing the seats, installing scaffolding and shutting down the theater during the repairs.

About the Company

Quoin International, Inc. is an engineering, technology development, manufacturing, and service company that specializes in power, control, actuation, and pyrotechnics technology development. The company was founded in December of 2001 and is located in Carson City, Nevada. ■

Company Information

Quoin International, Inc.
3000-B Conestoga Drive
Carson City, NV 89706
Phone: 775.882.8100
Fax: 775.882.8158
www.quointech.com/
www.powerquickascender.com/

Founded: December 2001
Number of employees: 21
(Quoin: 9; Bonanza Products, Inc.: 12)

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Visualization System for Information Security

3-D Images Help Thwart Attacks on Vital Defense Computer Systems

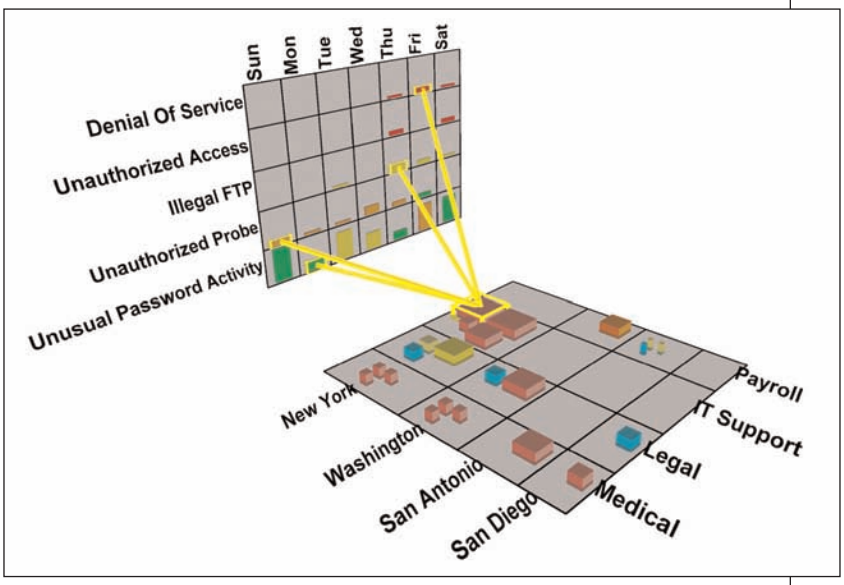
Secure DECISIONS
A Division of Applied Visions, Inc.

Technology and Innovation

As anyone with a computer connected to the Internet knows, there are countless threats from hackers and others who would exploit hardware and software vulnerabilities to their own advantage. Military computer security officers deal with external and internal attempts to compromise their equipment on a daily basis, threatening to degrade or even disrupt vital defense computer systems as well as the military operations and personnel that depend on them.

SecureScope takes security data that comes from many sources and, by way of a data-rich three-dimensional (3-D) presentation, displays it in the proper context to help information security analysts make informed decisions about potential threats and the subsequent impact of information security breaches. By means of 3-D visualization with rotational capability, Secure Decisions technology helps users more easily discover new suspicious activity by displaying multiple and specific threats and impacts across a complicated enterprise network. Particularly innovative and helpful is the presentation of time patterns to end users monitoring security breaches, correlations, and detection events.

Built upon initial concepts developed by Secure Decisions for the Air Force Research Laboratory, SecureScope reached maturity under this DARPA SBIR. Secure Decisions extends its visualization software to other applications including operational environments for test and evaluation, and add-ons to commercial and government off-the-shelf security software packages that have been adopted by the U.S. military, non-military federal agencies, and commercial users. Primary customers under this effort include U.S. Southern Command (SOUTHCOM), U.S. Joint Forces Command (JFCOM) and The Pentagon.



This SecureScope™ association scene illustrates the distribution of attacks and suspicious activity occurring on host workstations in different locations and organizations

Joint Collaborations

Secure Decisions has deployed its SBIR-developed technology in a variety of government environments. Deployments such as to the Fleet Battle Experiment-Kilo provided a significant amount of exposure, helping to open doors for deployment of the technology into other operational environments.

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Lessons Learned

- Identify additional funding sources to help ensure continued pace of technology development through periods with little to no government funding.
- Gain feedback from operational users as quickly as possible to help guide SBIR technology maturity.
- Communicate any changes in direction of the SBIR program clearly and continuously to the contractor community.
- When developing proposals, present both a broad, innovative solution and a plan for incremental development of smaller-scoped interim solutions that can be operationally tested.

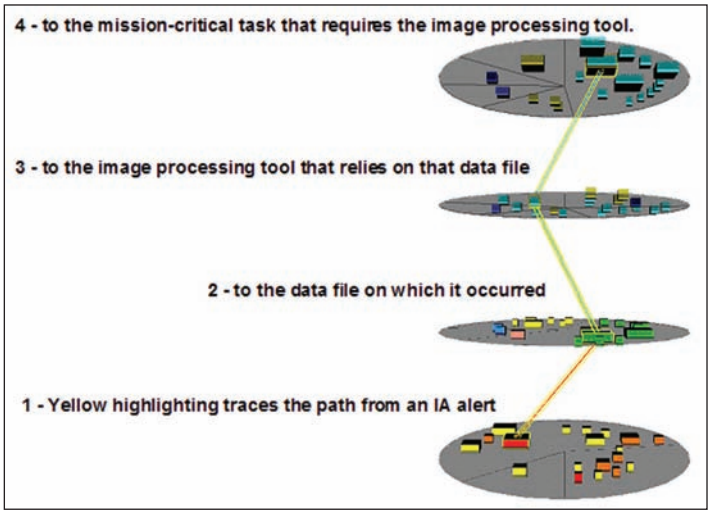
Economic Impact

In addition to serving as an important source of funding, this DARPA SBIR enabled Secure Decisions to acquire substantial funding from other DoD government agencies. The SBIR also enabled the company to substantially change its focus to include federal business and research, as well as providing a basis for pursuing third-party funding for commercial product development.

SecureScope is a valuable asset in helping Secure Decisions pursue relationships with other government agencies, prime contractors, and commercial businesses. This has had a significant impact on growing the company's staff, contributing to overall sales and employment. Secure Decisions received Patent Number 6,906,709 for its work under this SBIR.

About the Company

Secure Decisions—a division of Applied Visions, Inc.—employs 28 at its Northport, New York location. The mission of Secure Decisions is to enhance the decision-making of those responsible for the information security of their organizations and regions. To achieve this, Secure Decisions provides software and consulting services to improve the situational awareness of information security officers, law enforcement and intelligence analysts. Its client list includes the U.S. military, DARPA, law enforcement and intelligence agencies, as well as U.S. and Japanese companies. ■



The SecureScope™ layered wheel scene traces the path from a security alert to its business or mission impact

Company Information

Secure Decisions
A Division of Applied Visions, Inc.
6 Bayview Ave
Northport, NY 11768
Phone: 631-754-4920
Fax: 631-754-1721
www.securedecisions.com

Frank J. Zinghini, Jr., President and CEO
Founded: 2000
Number of employees: 28

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Deep Ultraviolet Light Emitting Diodes

Cost-effective Ultraviolet Light Source Improves Covert Communications, Aids in Medical Processes

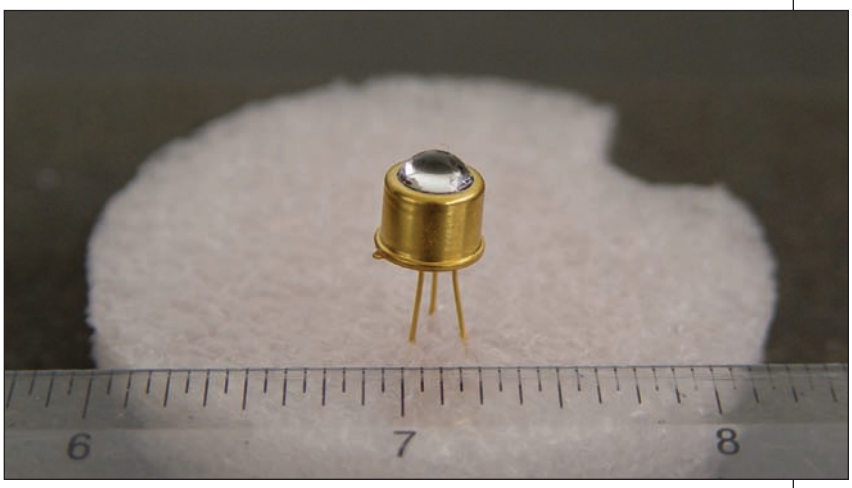
Technology and Innovation

Non-visible (ultraviolet) light sources are increasingly important elements in embedded systems, including bio-agent sensors and covert short-range non-line-of-sight communications systems. Especially important are new types of ultraviolet light sources that are compact, fast to respond, consume little power, last a long time, and are cost effective.

Previous sources of deep ultraviolet (DUV) light were bulky, consumed a lot of power, provided only a limited set of emission wavelengths, and were more expensive.

Under this DARPA SBIR, Sensor Electronic Technology, Inc. (SET) developed proprietary technology to fabricate DUV light emitting diodes (LEDs) based on a wideband gap III-Nitride material system. When an electrical signal (typically between 5 to 7 volts) is applied to these devices, the LEDs emit light in the ultraviolet spectral range. Depending on the application, the wavelength can be tuned to any frequency in the range from 247 to 365 nm. Analyzing fluorescence response from bio-agents using LEDs with various peak emission wavelengths is expected to detect and identify agents. For example, if UV light with 340 nm or 280 nm wavelength (or both) is directed on Anthrax, it will fluoresce blue light.

Compared to other ultraviolet light sources such as lamps and solid state or gas lasers, SET's DUV LED technology provides a number of advantages: small size, high speed, low power consumption, and low cost—all with a power output that is more than 20 times greater than previous technology.



Sensor Electronic Technology's innovative deep ultraviolet light emitting diodes

In addition to its military applications, the company's DUV LEDs are also being used commercially for water/air/surface and tissue disinfection and sterilization, optical sensors, drug discovery and analysis, and more. Customers include:

- U.S. Army
- Department of Homeland Security
- More than 400 commercial customers worldwide using a wide variety of applications

Joint Collaborations

SET has relied on a number of important collaborations to verify the company's technology achievements and foster relationships with future customers. These collaborations include:

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- Army Research Lab, which provided independent testing of SET's devices.
- University of South Carolina, which became a key member of the company's technical team.
- Hydro-Photon, which developed prototypes of portable water purification/disinfection systems based on SET's DUV LEDs.

Lessons Learned

- Ensure that prototypes move smoothly into production by planning in advance for more resources between prototyping and the transition to production of qualified products.
- Avoid too much diversification in your SBIR research and development efforts.
- Try to become the best in bringing innovative products to the marketplace through fast development, sampling and sales of the prototype product.
- Aggressively market through conferences, trade shows, journals, the Internet and personal contact with potential customers.

Economic Impact

SET's technology breakthrough—a direct result of this DARPA SBIR—made SET the first commercial supplier of deep ultraviolet light emitting diodes. The SBIR helped to fund research and development and enabled SET to bring research-grade products to the marketplace. The company currently commands solid technological leadership in the field and remains the world's sole supplier of DUV LEDs with peak emission below 365 nm. SET's sales plan is to increase commercial revenue from nearly zero in 2003 to 50 percent of total revenue by the end of 2006.

The company's current challenge is to transition research and development and pilot production to volume manufacturing of qualified products. To accomplish this goal, the company is using a combination of government funding, strategic partnerships, and commercial sales.

SET's LEDs have 20 times the power of previous technology

About the Company

Sensor Electronic Technology, Inc. was founded in 1999 by Dr. Remis Gaska and Dr. Michael Shur at the Rensselaer Polytechnic Institute Incubator (Troy, NY) after receiving government funding to develop and advance novel III-Nitride based devices and systems. In 2001, the company moved its operations to Columbia, SC to leverage the company's expertise with the newly established Photonics and Microelectronics Laboratory at the University of South Carolina.

These combined resources have allowed SET to expand operations into a 10,000 sq. ft. facility. SET became the first commercial supplier of DUV LEDs and is a leading supplier of high power, high frequency transistor materials. ■

Company Information

Sensor Electronic Technology, Inc.
1195 Atlas Road
Columbia, SC 29209
Phone: 803-647-9757
Fax: 803-647-9770
www.s-et.com

Remis Gaska, President & CEO
Founded: 1999
Number of employees: 20

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Solid-State Pulse Power Technology

Pulse Technology Reduces Vulnerability from Explosion Radiation, Improves Lasers for Semiconductor Chips

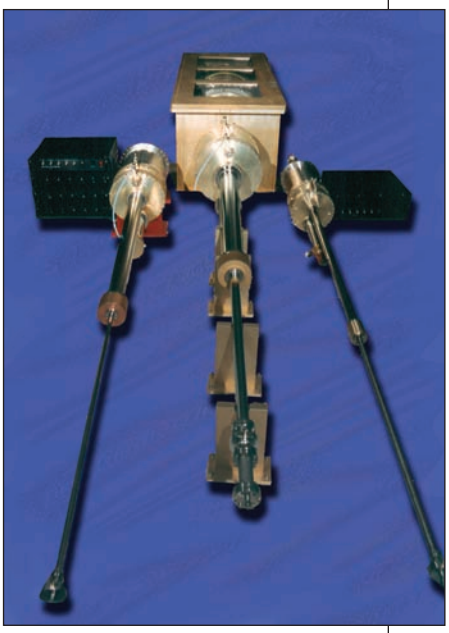
Science Research Laboratory, Inc.

Technology and Innovation

Electromagnetic radiation from an explosion or weapon device has the potential to significantly damage electronic devices, thus making them inoperable for military and/or civilian use. The U.S. military is continuously seeking more effective and affordable ways to test vital electronic assets that might be susceptible to enemy attack or compromise. Of specific concern are assets that incorporate electronic semiconductors potentially vulnerable to the electromagnetic pulses generated by nuclear or directed energy weapons. Certain tests require the production of high-power, wideband microwave radiation pulses. Conventional technology, however, has long relied on Marx banks devices, which are bulky and have difficulty operating under repetitively pulsed operation.

Under this DARPA SBIR, Science Research Laboratory (SRL) developed a new solution to this problem—called the solid-state pulsed power module (SSPPM)—using non-linear magnetic switching to generate very short (1 nSec) high-peak power pulses. SRL's novel approach involved building a unique, all-solid-state shock line, which offers the advantages of being compact and reliable, along with the ability to be repetitively pulsed at the rate of 5000 pulses per second—a significant improvement over existing technology.

As an offshoot of this technology, SRL has developed, commercialized, and licensed their SSPPM for deep ultraviolet (DUV) excimer lasers, a key tool in the sub-0.15 micron lithographic process used for the production of the most advanced semiconductor chips. As a result, SRL has successfully transitioned its technology into large-scale commercial applications.



SRL's solid-state pulsed power module

Joint Collaborations

Over the years, SRL's innovative technologies have spawned a number of SBIRs and STTRs from agencies including:

- Army Research Office
- Missile Defense Agency
- Department of Energy

SRL stays in close contact with the DoD to keep abreast of new requirements and technology needs. At the same time, SRL works with the private sector to determine if government-developed technologies have commercial applications.

Lessons Learned

- Recognize that the company's technology may be more valuable than anticipated and if needed, seek expert help to be able to negotiate the best terms for licensing or selling SBIR-developed technology.

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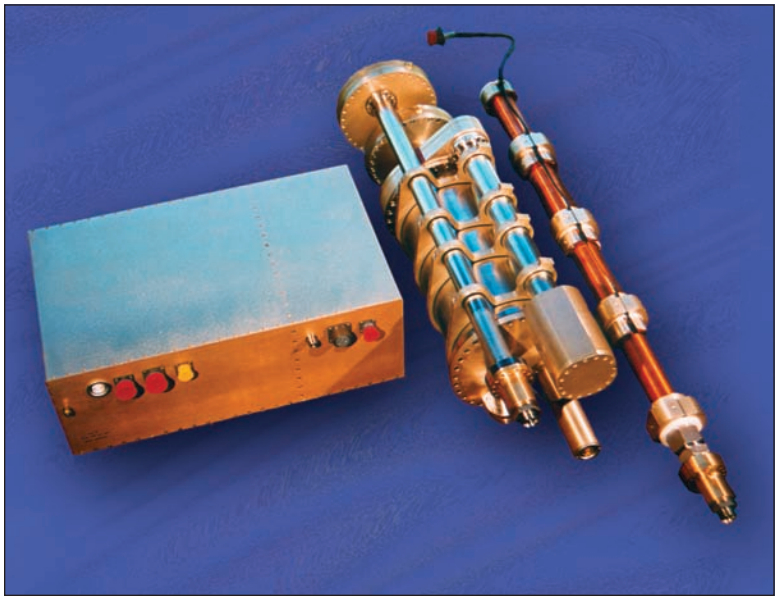
- Consider approaching DARPA as a temporary funding alternative to venture capital. Venture capital can be a tempting avenue to raising funding necessary for growth, but it can mean giving up control of your company, and potentially losing the rights to the technology.

Economic Impact

The company's DARPA SBIR contracts have been instrumental in surmounting the challenge of obtaining funds for technology demonstration. Approximately 30 percent of the company's technology development funds have derived from SBIRs.

SRL's DARPA-developed technology has also found application in commercial uses. Through an exclusive licensing agreement, the company has supplied all-solid-state krypton-fluoride (KrF) laser driver technology to San Diego-based Cymer, Inc. Using its SSPPM, SRL was able to improve the lifetime of the driver from 1 billion shots (two weeks of operation) to 100 billion shots (four years). Coupled with specialized energy-recovery circuits, SRL's technology results in a 50 percent reduction in the operating cost of the excimer laser. These drivers are now used with lithographic tools manufactured by ASML, Canon, and Nikon, which are in turn sold to companies such as Intel and IBM for the production of semiconductors. As a direct result of its license for SRL's SSPPM technology, Cymer, Inc. is the world's top supplier of excimer laser light sources for DUV photolithography systems used in chipmaking, with 85 percent of the excimer laser market.



As an offshoot of the technology developed under the SBIR, SRL commercialized and licensed a device that drives DUV lasers in semiconductors. SRL built the first 50 units before transferring the technology, and now 2,500 of these devices are used in semiconductor facilities around the world.

About the Company

Science Research Laboratory, Inc.—based in Somerville, Massachusetts—is a technological research and development corporation founded in 1983. The company's primary objective is to develop commercial products based upon research programs conducted for the United States government. SRL currently employs 10 individuals, most of whom are scientists holding doctorate degrees from top ranked and distinguished universities. ■

Company Information

Science Research
Laboratory, Inc.
15 Ward St
Somerville MA 02143-4241
Phone: 617-547-1122
Fax: 617-547-4104
www.srl.com

Jonah Jacob, President
Founded: 1983
Number of employees: 10

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Self-Localization of MicroSensors Using Ultra-Wideband RF

Smaller, Better Ground Sensors Make Tracking Less Expensive

TIME DOMAIN®
THE PULSE OF THE FUTURE™

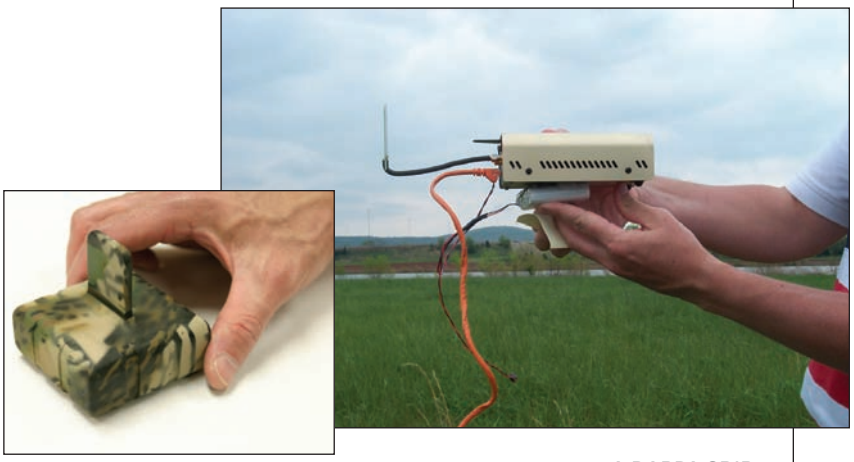
Technology and Innovation

While there are numerous options available to warfighters when selecting ground sensors for detecting the movement of people, these options are often relatively expensive. Under this DARPA SBIR, Time Domain Corporation developed a low-cost, long-endurance unattended ground sensor (UGS) that has a low incidence of false alarms, has its own communications system, and can self-locate.

The primary end product under this project is an ultra-wideband (UWB) chip device that sells for less than $600, weighs less than 150 grams, measures 2.5 by 2.5 by 1.25 inches, and lasts 180 days on AA batteries. The sensor is capable of detecting and tracking people who move through a field of such sensors, and, when completed, will be attractive to military users who need to monitor borders, defend base perimeters, or monitor the flow of people. These same capabilities are of great utility in many different commercial markets.

Time Domain Corporation's technology is unique in using UWB radio frequency (RF) technology combining three functions—radar, communications, and positioning—into one device. Using this technology as a radar sensor is advantageous because the transmissions additionally:

- Are difficult for others to detect
- Can form ad hoc data networks
- Can be used to accurately measure the distance between radios



A DARPA SBIR facilitated the development of an innovative ground sensor (above right), which Time Domain is now refining for further applications (above left)

These functions can be performed simultaneously, offering "fused capability." UWB also makes an outstanding radar and lends itself to low-cost implementations.

Joint Collaborations

Time Domain Corporation actively collaborates with other SBIR programs, governmental departments, companies, and investors. The company has received strong interest from the military aviation community, border security, and organizations interested in perimeter defense. To support the rollout of Time Domain's technology, several of these entities have offered matching funds to trigger the SBIR Enhancement funding. The company has plans to engage experienced partners and systems integrators to produce and deploy UWB products for homeland security, Department of Defense, law enforcement, healthcare, and other markets.

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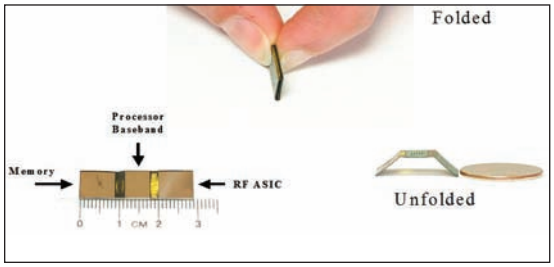

Time Domain plans to develop its ground sensor technology to produce very small sensors, as shown in this prototype

Lessons Learned

- Seek partners early in the course of the SBIR project, especially where the customer demands are high and technology is advancing quickly.
- The process of transitioning innovations to the military takes considerably longer than you would expect. Be prepared for schedule slips and other unexpected events.
- Companies that participate in the SBIR program should avail themselves of all the online tools to understand the process, follow the rules, and expedite their proposal responses.
- End user sponsorship is critical. With sponsorship, you have a legitimate chance of making real products. Without sponsorship, all you have is a $750,000 science fair project.
- Companies should understand what the DARPA project manager wants before submitting a proposal and should continue the interaction after winning the SBIR.

Economic Impact

As a direct result of its work on this DARPA SBIR, Time Domain Corporation was able to capture a $5.1 million DARPA sub-contract for development of camouflaged long-endurance nano-sensors (CLENS).

Time Domain has successfully performed on numerous government contracts. SBIR programs for all government agencies have accounted for more than 25% of the company's revenue since 1998. During the same period, DARPA SBIRs have represented about 8% of the company's revenues. DARPA SBIR contracts have played an important role in the company's ability to generate revenue.

DARPA funding has increased Time Domain's credibility, and the SBIR Enhancement program offers a quick and easy way for them to "get their feet wet" by becoming accustomed to working with potential customers. Time Domain has developed significant intellectual capital through this program and other SBIRs, and has built a broad and deep patent portfolio covering the base technology, which is independent of government funding.

About the Company

Time Domain Corporation of Huntsville, Alabama is a leader in ultra-wideband radio frequency technology. The company holds over 110 patents and has built several development platforms to demonstrate the utility of the technology. Time Domain Corporation creates value by integrating UWB technology into military and commercial applications that benefit from UWB's unique advantages. ■

Company Information

Time Domain Corporation
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Fax: 256.922.0387
www.timedomain.com

William Webb, President and CEO
Founded: 1987
Number of employees: 78

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Piezoelectric Single Crystal Production

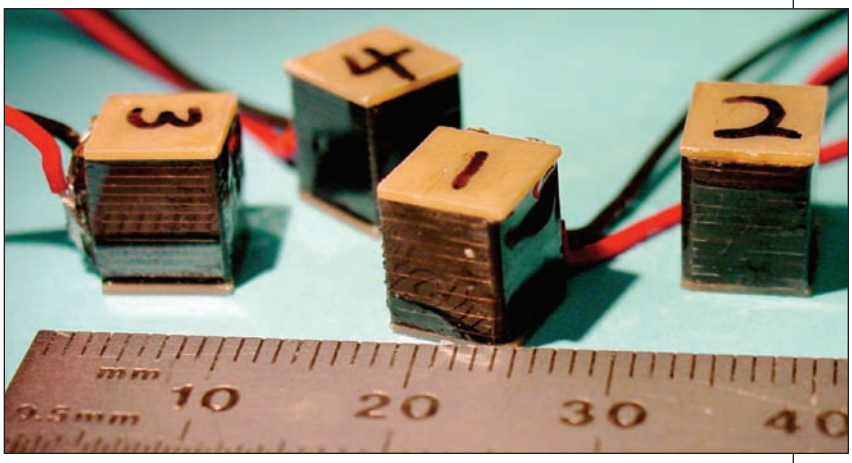
Improving the Acoustics of U.S. Navy SONAR Devices Through Advanced Crystal Technology

Technology and Innovation

With the shift of sea warfare to the littoral environment, where shallow waters, noisy environments, and constricted areas all increase the danger to military vessels and personnel, there is significant need for better detection and countermeasures systems. Effective use of unmanned underwater vehicles requires small systems with minimal energy requirements for sonar components. For this DARPA SBIR program, TRS Technologies, Inc. (TRS) focused on the optimization of the Bridgeman process for the production of PMT-PT crystals greater than 2 inches in diameter, which are used in Naval SONAR devices, military electromechanical actuators, and medical acoustic transducers. The materials technology developed under this SBIR promises to add an additional crystal supply stream. The increased availability of crystals will facilitate development efforts that are dramatically advancing the performance of acoustic transducers and actuators in the form of increased sensitivity, broader bandwidth, higher strains, and higher acoustic power. One advantage is that a single device can be used to both transmit and receive acoustic signals.

Joint Collaborations

TRS collaborates with other companies and universities on most of its government-funded research. The company strives to develop and improve long-term relationships with its customers and collaborators in industry and academia. These close partnerships have resulted in numerous patents and licenses for advanced capacitors and single crystal-based transducers and actuators.



Single crystal piezoelectric-based stacked actuators

DARPA SBIRs have allowed TRS to develop core technology that helps attract partners for developing and commercializing the technology. Through various Navy programs, TRS is addressing the Navy's specific use of the technology, continuing crystal growth development, and evaluating commercialization possibilities. The technology developed under the DARPA SBIR has also garnered interest from large device manufacturers and government prime contractors, to which TRS can license its technology.

TRS is establishing more strategic alliances with prime contractors and medical OEMs (original equipment manufacturers). Working with these organizations helps the company navigate complex regulatory, procurement, and other requirements for new government and commercial applications.

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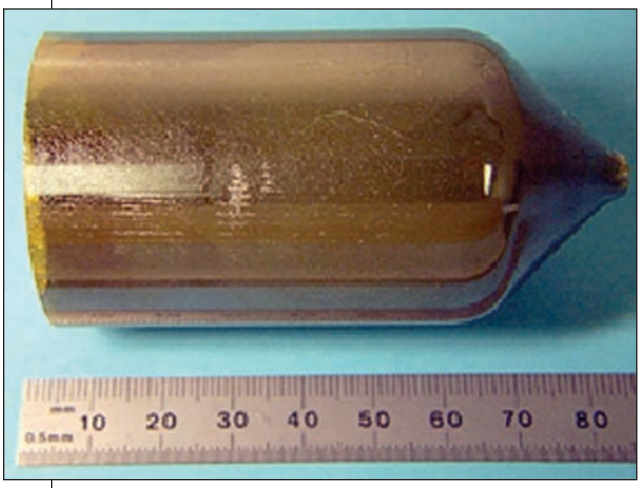

Bridgman-grown boule of piezoelectric PMN-PT single crystal

Lessons Learned

- Maintain good communication with technical monitors, determine your commercialization path as early as possible, and know the potential markets.
- As early as possible, think ahead to subsequent phases (II, III).
- Be sure you understand the rules before you submit your bid. Contracting rules and procedures are complex and agency specific.
- Be aware of International Traffic in Arms Regulation (ITAR) and export control restrictions.
- Although prime contracting is typically preferred, be a subcontractor if that can help increase the probability of award and advance the technology's commercial platform.

Economic Impact

The innovative material being developed under SBIRs is of strategic importance to many potential TRS products currently in the company's development pipeline. Approximately 80 to 90 percent of the company's government funding to date has been from SBIR/STTR programs, of which about 10 percent has been from DARPA.

The DARPA SBIR has produced a high-capacity, reproducible process that has allowed the company to develop more sophisticated, higher-value products. As a result, TRS is transitioning from being a materials company to a device company with higher value-added products.

A variety of high-voltage, high-precision multilayer capacitors

About the Company

TRS Technologies, Inc. is located in State College, Pennsylvania and specializes in the development and application of tailored piezoelectric ceramics, single crystals, and capacitors for high-stress environments. The company's vertical product approach includes offerings ranging from raw powders to devices, in quantities of one or one thousand. TRS currently has 36 employees and annual revenues of $4.5 million. ■

Company Information

TRS Technologies, Inc.
2820 East College Avenue
State College, PA 16801
Phone: 814-238-7485
www.trstechnologies.com

Wesley S. Hackenberger, President
Founded: 1991
Number of employees: 36

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Avatar Behavioral Modeling Tools

Digital Virtual Humans Help the Military Communicate in Different Cultures

Technology and Innovation

The focus of Vcom3D's DARPA SBIR project is to develop technology that simulates the gestures, facial expressions, body language, and other non-verbal behaviors of "digital virtual humans." This technology can be embedded in computer-based training simulations, including simulations based on commercial "game engines" as well as interactive Web-based multimedia. Vcom3D provides animation tools that substantially accelerate the creation of language-based learning scenarios and games. These scenarios use digital virtual humans that can lip-sync automatically to any language.

The company provides libraries of interchangeable characters with different ethnicities and behaviors appropriate to different cultures and a tool for rapidly creating interactive scenarios and games in which students learn by interacting with these characters. Once a scenario or game is created, it can be rapidly modified to teach another language or culture. This provides a much lower lifecycle cost than using live videos of actors, or by using traditional animation techniques.

The technology developed by Vcom3D under this SBIR offers a significant advantage over commonly used technology for creating multimedia instruction for language learning, which relies on making video recordings of live actors who have native proficiency in the target language and know the associated culture. For more specialized languages, such as Persian and Arabic dialects, qualified talent is expensive and hard to locate and typical hourly production costs range from $35,000–$50,000. Animations are less expensive to produce, and offer greater flexibility and adaptability than video-based systems. Primary customers and end users, who will use the software to teach language and culture to military personnel, include the U.S. Army, the Defense Language Institute, U.S. Special Operations Command (SOCOM), and the U.S. Marine Corps. Commercial publishers such as Topics Entertainment are using the software to develop and sell commercial products for second-language learning.

Vcommunicator technology provides training simulations with culturally and regionally appropriate digital characters

Joint Collaborations

Vcom3D is working with a number of universities and corporations to integrate the technology with advanced natural language understanding and

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high-level human behavior simulation. The proven results of the company's DARPA SBIR Phase I and II were instrumental in establishing these relationships.

Lessons Learned

- In transitioning innovations to the military, understand the need of end users and develop collaborative relationships with partners that also sell to them.
- Use the SBIR and company funds to develop the technology initially, then partner with companies to bid Broad Agency Announcements (BAAs) and similar opportunities that develop prototype applications.
- To further expand business, communicate capabilities to potential users and partners and determine how these capabilities match future contract requirements.

Economic Impact

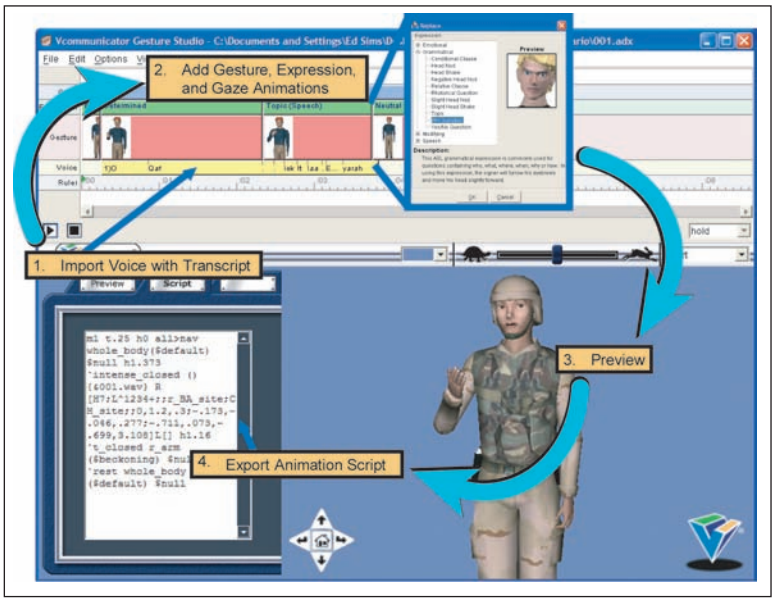
Work done under the DARPA SBIR helped Vcom3D win a contract with the Pentagon's Technical System Working Group (TSWG) and Combating Terrorism Technical Support Group (CTTSO). Approximately 15 percent of the company's technology development has been funded by DARPA, and 50 percent from SBIR programs in general. Intellectual property resulting from the SBIR is being considered for protection under a new patent application.

In December 2006, Vcom3D introduced VCOM Mobile, a language and culture job-aid on an iPod or PDA. VCOM Mobile was created by warfighters for deployed warfighters. This job-aid is used for reference, practice, or one-way translation and provides spoken, written, and animated representations of sentences used in common missions.

About the Company

Vcom3D, Inc. is an Orlando, Florida-based small business co-founded by CEO Carol Wideman and CTO Ed Sims. The basic idea for the technology pursued under the DARPA SBIR program has its origins in two earlier Vcom3D applications of "digital virtual human" simulation:

- Animated characters that help deaf children learn to read, by translating English text into American Sign Language.
- Animated characters that serve as mentors and role-playing actors for teaching foreign language and culture. ■



Vcommunicator Studio tools allow the user to create complex multple character scenarios in any language with behaviors appropriate for any culture or region

Company Information

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Carol Wideman, President
Founded: 1996
Number of employees: 15

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Hand-Held, One-Way Voice Translation System

Real-Time Language Translation Tools Assist Deployed Military Personnel and Law Enforcement

Technology and Innovation

After the events of 9/11 and the military's subsequent initiation of operations in Afghanistan, there was an immediate need for a small handheld device that would provide one-way phrase-based communication capability. VoxTec International, then a division of Marine Acoustics, Inc., developed the Phraselator® handheld translation device and tools to meet this need. Phraselator® translation devices provide fast, accurate translations by matching predetermined English phrases to recorded translations in other languages, enabling the user to provide information, give directions, or ask questions with easily conveyed responses (like yes or no). Use of the technology frees up human translators for more complex interactions. The device is designed for inclement weather and harsh environments, for easy insertion of new languages and dialects, and for addition of new phrase modules into a specific dialect.

Current military customers include U.S. Joint Forces Command (JFCOM), U.S. Special Operations Command (SOCOM), and the U.S. Marine Corps, with end users consisting primarily of deployed military personnel in Iraq, Afghanistan, and the Gulf region. With approximately 5,000 units in the field, the technology is being used by medical personnel, guards at checkpoints, and soldiers involved in civil affairs, patrol, and other duties that require limited but direct communication with the local population. Additional military users of VoxTec's Phraselator® translation tools have included personnel stationed in Kosovo, Korea, and Southeast Asia (in response to the 2004 Tsunami).

The Phraselator® P2 handheld translation device provides fast phrase matching from English into other Languages

According to one Special Forces soldier in Iraq, "I was able to use the device to get exact information on a huge weapons cache. This device was invaluable, and it assisted in protecting the team." Outside of the military community, a number of law enforcement agencies have adopted Phraselator® as a tool to communicate with citizens who speak little or no English. Emergency responders have also shown great interest.

Joint Collaborations

VoxTec has collaborated within the SBIR and STTR programs and various military and other government agencies to develop training and determine desired product features and unique user requirements.

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Col. Jim Bass, former DARPA project manager using the Phraselator® in Afghanistan in 2002.

During Phraselator® prototype development, VoxTec worked with Applied Data Systems for circuit boards, SRI International for application software development and Montalbano for industrial design. For the current P2, Helix Design provided hardware design and InHand Electronics provided the circuit boards. For selling the end product, VoxTec works with a variety of resellers including ADS and Aardvark Tactical, Inc.

Lessons Learned

- Find a customer willing to pay for a practical technology that can be developed and fielded. As fielded prototypes generate positive results, interest in the product will grow.
- Be prepared for a learning curve about who the end users of the technologies will be, and what other tools are available for their use.
- Develop a clear commitment and direction within the company to move beyond research and into developing and implementing products.
- To work effectively, be prepared to learn and understand government accounting, invoicing and auditing practices.

Economic Impact

VoxTec's DARPA SBIR contracts (originated with former parent company, Marine Acoustics) have resulted in nearly $7 million in revenues. Continued support from SBIRs has contributed to the company's ability to conduct ongoing research and development efforts, which help the company to provide better tools for the warfighter and increase its profitability. In addition to the design patent VoxTec holds, it has applied for a utility patent.

About the Company

VoxTec International Inc., a Delaware Corporation based in Annapolis, Maryland has successfully fielded three generations of Phraselator® handheld translation devices since 2002. In addition to manufacturing, selling and improving in its existing products, VoxTec pursues research and development across the spectrum of machine based language translation technologies and is involved in programs such as DARPA TransTac. The Phraselator® P2 is in use by all branches of the military, as well as in civilian law enforcement and limited construction and health care settings. In early 2007, VoxTec introduced a new line of wearable, hands-free, eyes-free translation products. ■

Company Information

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Founded: 2004
Number of employees: 17

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Molecular-Level Self-Assembly Manufacturing

Nanoscale Manufacturing Enables New Material Properties for Military Innovations

Technology and Innovation

Under the auspices of a DARPA SBIR, NanoSonic, Inc. (NanoSonic) has developed molecular-level self-assembly manufacturing processes (not requiring guidance or management from an outside source) that can be used to fabricate materials having properties not previously obtainable using other production methods. The ability to form lightweight, mechanically flexible materials in sheet and fabric form that have electrical conductivities approaching those of bulk metals and metal alloys has been of particular importance for this program. This material, called Metal Rubber™, flexes and stretches like rubber, yet conducts electricity like a solid metal. Such materials have a wide range of possible applications, either as improved replacements over existing materials or in new applications made possible by their unique characteristics.

Conventional self-assembly processing had been limited in both the thickness (typically less than one micron) and the two-dimensional size (typically tens of millimeters square) of materials that may be formed. NanoSonic has developed variations on conventional processing methods allowing thick (millimeters rather than microns) and physically large (sheets up to 4' x 8' so far) free-standing materials to be formed. This is a major advance for the many large military systems such as aircraft, spacecraft, land vehicles, and ships.

A segment of a manufactured Metal Rubber™ sheet.

Joint Collaborations

NanoSonic has developed collaborative relationships with many defense contractors, government laboratories, and research universities. The DARPA SBIR has enabled the company to expand its existing network of contacts in the area of flexible electronic materials and devices, an area in which NanoSonic had little previous exposure or experience.

Additionally, the company has obtained recognition and support from government research laboratories through journals and conference publications, presentations at technical meetings, briefings at specific defense installations, and cooperation with larger defense companies that have direct relationships with end users.

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Lessons Learned

- Understand the requirements of the end user and the implications on the technology to be developed. The end-user requirements are key to guiding development and providing a framework for the transition to military and private sector applications and products.
- To achieve desired collaborations, establish many contacts in military organizations and private sector companies, invest the time to maintain those contacts, and bring them a useful technology.
- Commit early to transitioning into specific military and commercial applications. Transitioning is challenging because it requires allocating resources away from research, hiring new people with broader manufacturing experience versus research, and convincing sponsors that your technology merits other applications.

Economic Impact

This DARPA SBIR has had a significant impact on company growth. Since its founding in 1998, the company has grown from three employees to 62, and annual revenues have grown to $6.5 million. Aside from the direct impact of SBIR contract proceeds, funding received under the DARPA SBIR program helped NanoSonic obtain funds from other government organizations and industry partners.

For specific variations of its technology, 100 percent of its funds came from the DARPA SBIR and, since its founding, approximately 90 percent of the company's technology had its beginnings in SBIR programs. The company expects about 50 percent of its gross income in the current fiscal year to derive from non-SBIR sources. NanoSonic has developed a portfolio of issued patents and patent applications currently in process as a direct result of its SBIR work.

About the Company

NanoSonic, Inc. is headquartered in Blacksburg, Virginia. The company has created a competitive advantage in its industry by developing a set of manufacturing processes that produces unique materials not available from other suppliers. The company's Metal Rubber™ material—with the electrical conductivity of metal, but the mass density and flexibility of polymers—is one example. ■

A component formed in the laboratory using NanoSonic's modified self-assembly process

Company Information

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Dr. Richard O. Claus, President
Founded: 1998
Number of employees: 62

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Conclusion

When the success reports and this publication were being developed, a wide range of companies were asked to participate. Some had only moved through prototype development; most had already moved beyond serving military needs and reached commercial success with their products. The companies were asked to reflect on their experiences in both securing SBIR/STTR awards and preparing for commercialization. Here are some of the important things they learned along the way:

- Get off on the right foot… Consistently monitor what the DoD and DARPA program managers want, identify where the company's new technologies can be best aligned, and write your proposals accordingly.
- Involve end-users early—in Phase I and throughout the subsequent phases to ensure your technology will meet their needs. Your DARPA program manager can put you in contact.
- Embrace how the DoD does business…Learn key government practices including contracting, accounting, invoicing, and auditing so the company is prepared and streamlined in meeting requirements. This can also help with meeting the requirements of public or private ownership.
- Conducting innovative research isn't enough. For success, your research must lead to a technology with practical applications. Approach your work with this intent early, look for incremental applications, and consider multiple markets for your technology.
- Establish military and private sector contacts, and develop strategic alliances with partners who can help you move towards commercialization. Both your DARPA program manager and your SBIR program manager can assist with contacts.

Through the SBIR/STTR programs, companies are able to undertake significant technology development efforts, where risk and payoff are both very high and where success may provide dramatic advances for traditional military roles and missions. Applying these lessons learned to new endeavors will bring greater progress to the cycle of innovation and development for the military and beyond.