

Small Business Innovation Research Program — A Potent DoD Resource

Harnessing the Entrepreneurial Power of Small Technology Companies

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SOLDIERS FROM THE 101ST AIRBORNE AT FORT CAMPBELL, KY, UNLOAD BOXES OF AMMUNITION FROM THEIR C-5 GALAXY TRANSPORT PLANE ON ARRIVAL IN SAUDI ARABIA DURING OPERATION DESERT STORM. OVER HALF OF THE 40,000 CARGO CONTAINERS SHIPPED TO THE DESERT, INCLUDING \$2.7 BILLION WORTH OF SPARE PARTS, WENT UNUSED, ACCORDING TO A GAO REPORT. IN THE AFTERMATH OF DESERT STORM, THE ARMY ESTIMATED THAT IF AN EFFECTIVE WAY OF TRACKING THE LOCATION AND CONTENT OF THE CARGO CONTAINERS — SUCH AS THE SAVITAG — HAD EXISTED AT THAT TIME, DoD WOULD HAVE SAVED ROUGHLY \$2 BILLION.

One of the most remarkable shifts in the U.S. economy over the past 20 years has been the emergence of small technology companies — in Silicon Valley, California; along Route 128 in Massachusetts; and across the country — as a powerful engine of innovation and new technology. The Defense Department's Small Business Innovation Research (SBIR) program provides a unique opportunity for program managers to tap this potent resource for the benefit of the U.S. warfighter. Established in 1983, the SBIR program this year will fund more than \$500 million in early-stage R&D projects at small technology companies — projects that serve a DoD need and have the potential for commercialization in military or private-sector markets. Program managers across DoD can participate in the program in several important ways.



Photo courtesy UPI/Corbis-Bettman

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Small Technology Companies — A Powerful Resource for Innovation

Our nation's small technology companies are the envy of the world, and are widely regarded as one of our country's great economic resources. According to studies sponsored by the National Science Foundation and others, small businesses originate roughly two and a half times as many innovations per employee as large businesses — and also introduce a disproportionately large share of the most significant innovations. Examples include the supercomputer, the small computer, the planar integrated circuit, and the Xerox copier — all developed by companies that were small at the time (Cray, Apple, Fairchild, and Haloid, respectively).

Increasingly, the private sector is recognizing the innovative talents of small technology companies. This is evidenced by the remarkable flow of our nation's scientific and engineering

talent into small technology companies in recent years. Small businesses' share of the nation's research and development (R&D) workforce has grown from 6 percent in 1978 to 18 percent in 1993, and small businesses' share of industrial R&D funding has grown from 4 percent in 1980 to 15 percent in 1993.

SBIR is an Effective Means for DoD to Tap the Small Business Resource

Comprised of eight Component SBIR programs — Army, Navy, Air Force, Ballistic Missile Defense Organization, Defense Advanced Research Projects Agency, Defense Special Weapons Agency, U.S. Special Operations Command, and Office of the Secretary of Defense — the SBIR program enables DoD to harness the talents of small technology companies for U.S. military strength. Twice a year, DoD issues an SBIR solicitation, describing the R&D needs of the eight Component

programs and inviting R&D proposals from small companies. Companies compete first for a six-month Phase I award of up to \$100,000 to test the scientific, technical, and commercial merit and feasibility of a particular concept. If Phase I proves successful, the company may be invited to apply for a two-year Phase II award of up to \$750,000 to further develop the concept, usually to the prototype stage. Proposals are judged competitively by each Component on the basis of scientific, technical, and commercial merit. Following completion of Phase II, DoD then expects small companies to obtain funding from the private sector or non-SBIR government sources to develop the concept into a product for sale to DoD, defense contractors, and/or private sector customers.

During its 14 years of existence, SBIR has built an impressive track record of success. DoD's own careful evaluation of the SBIR program, transmitted to Congress last year by the USD(A&T) [Under Secretary of Defense (Acquisition and Technology)], Dr. Paul Kaminski, found that SBIR-funded technologies have "resulted in significant improvements in U.S. military capabilities and major savings to the taxpayer." Paul Hoeper, the Deputy Under Secretary of Defense for International and Commercial Programs, describes the SBIR program as "a major commitment by the Federal Government to harness one of the great economic resources in this country — our small technology companies." And in congressional testimony earlier this year, Robert Neal, Director of the Office of the Secretary of Defense (OSD), Office of Small and Disadvantaged Business Utilization, expressed the Department's view that "The SBIR program...[has] made a major contribution not only to the small business community in this



THE LIGHTNING CHARGER — AN ENGINE-DRIVEN ALTERNATOR THAT IS ONE-THIRD THE WEIGHT AND TWICE THE POWER OF COMPARABLE ALTERNATORS — IS USED FOR POWERING SUCH EQUIPMENT AS EMERGENCY LIGHTS AND REFRIGERATORS, AND TO START VEHICLES INCLUDING CARS AND AIRPLANES. GENERATING COMMERCIAL/MILITARY SALES OF \$8 MILLION SINCE 1994 (AN ADDITIONAL \$90 MILLION ANTICIPATED BY THE END OF 1998), LIGHTNING CHARGER IS SOLD IN MAJOR HOME APPLIANCE STORES ACROSS THE COUNTRY AND IS CURRENTLY USED BY THE ARMY TO START TANK ENGINES WHEN THE BATTERIES DIE.

Photo courtesy Active Technologies, Inc (Coleman Powermate, Inc.)

country, but more generally to the strength of the U.S. economy and of our armed forces.”

For example, an SBIR-developed technology – the “SaviTag” – recently had a direct, major impact on DoD operations in Bosnia and elsewhere. Developed under the Navy SBIR program by Savi Technology, a start-up company based in Mountain View, California, located in the heart of Silicon Valley, the SaviTag is a miniature radio transceiver with an embedded microcomputer. When attached to military cargo containers, or any other crate or container used for transport, the SaviTag will automatically track the container’s location and contents. Developed with just \$2.5 million in SBIR funding (three awards), the SaviTag is now a central element in the Department’s *Total Asset Visibility* effort: *the capability of pinpointing location and content of every plane, ship, tank, and cargo container in transit around the world.* DoD awarded Savi a \$71 million contract in 1994, and a \$111 million contract earlier this year; the Department now uses the SaviTag in a large segment of its logistical operations, including almost all shipments into Bosnia.

The SaviTag solves a very real problem for DoD. During Desert Storm, over half of the 40,000 cargo containers shipped to the desert, including \$2.7 billion worth of spare parts, went unused, according to a GAO report. In the aftermath of Desert Storm, the Army estimated that if an effective way of tracking the location and content of the cargo containers – such as the SaviTag – had existed at that time, DoD would have saved roughly \$2 billion. That is an enormous savings – far more than DoD’s entire annual SBIR budget. The SaviTag has already resulted in major efficiencies in our logistical operations in Bosnia, although we don’t yet have precise estimates of the savings.

As you can imagine, the SaviTag also has major applications in the private sector – particularly in the commercial trucking, rail, and shipping indus-

tries. Savi’s sales to the private sector totaled approximately \$6 million in 1996, and are increasing rapidly.

The SaviTag is but one of many SBIR-developed technologies, having a direct, major impact on DoD programs. Additional examples follow:

Digital System Resources. Its Commercial Off-the-Shelf-based submarine sonar processor is now being used to upgrade the sonar equipment on most Navy submarines. This processor provides 200 times the computing power of existing, military-specific processors at a fraction of the cost.

American Xtal Technology. AXT’s technology for the production of Galli-

THE SBIR PROGRAM HAS BEEN INSTRUMENTAL IN SUPPORTING LIGHTWAVE ELECTRONICS’ EFFORTS TO DEVELOP ADVANCED TECHNOLOGY AND SERVE A BROAD CUSTOMER BASE IN A VARIETY OF APPLICATION AREAS, SAYS DR. RICHARD WALLACE, VICE PRESIDENT OF ENGINEERING AT LIGHTWAVE ELECTRONICS. LIGHTWAVE HAS BEEN A LEADING INNOVATOR OF NEW SOLID-STATE LASER SYSTEMS BASED ON LASER-DIODE PUMPING. CURRENTLY USED IN A WIDE RANGE OF APPLICATIONS, LIGHTWAVE’S LASER SYSTEMS ENCOMPASS SEVERAL AREAS: BASIC RESEARCH AND DEVELOPMENT, COMMUNICATIONS, FIBER-OPTIC SENSING, SEMICONDUCTOR PROCESSING, GRAPHIC ARTS, AND MEDICAL PROCEDURES.

um Arsenide (GaAs) wafers – a critical component of many integrated circuits – reduces wafer defects by one to two orders of magnitude. On the basis of this technology, AXT has become the leading domestic manufacturer of GaAs for optical and electronic applications, with customers that include TRW, Hewlett-Packard, Lockheed Martin, and many universities and government laboratories. Commercial/military sales in 1996 were \$16 million, representing 15 percent of the world market.

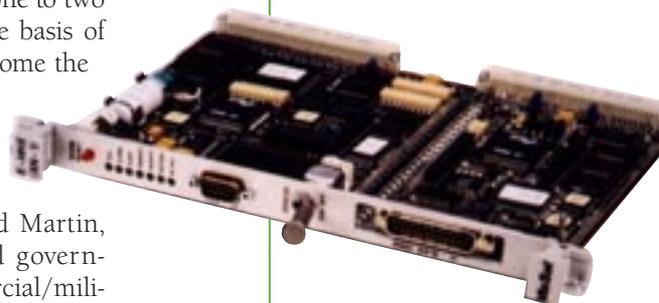
ParaSoft Corporation. Its software-debugging program (Insure++) is now used by most major developers of commercial software (e.g., IBM, Lotus,

SEAKR ENGINEERING, A SMALL FAMILY-OWNED BUSINESS, IS PRIMARILY ENGAGED IN THE DEVELOPMENT, MANUFACTURE, AND SALE OF SOLID STATE MASS MEMORY SYSTEMS FOR SPACE, AEROSPACE, MILITARY, AND RUGGED APPLICATIONS. THEIR ORIGINAL SBIR AWARD IN FISCAL YEAR 1983 RESULTED IN \$1.4 MILLION IN ADDITIONAL SBIR FUNDING AND \$15 MILLION IN OTHER FEDERAL RESEARCH AND DEVELOPMENT FUNDING. THE FLAGSHIP OF THEIR PRODUCT LINE, EMDS (ENHANCED MEMORY DATA STORAGE) SYSTEMS, OFFERS UP TO 512 GIGABYTES OF STORAGE PER SYSTEM AND SUPPORTS UP TO EIGHT SOLID STATE RECORDERS (SSR), WITH EACH SSR OPERATING INDEPENDENTLY.

Photo courtesy Savi Technology



Photo courtesy ViaSat Inc.



Microsoft) and organizations that develop software for in-house use (e.g., Naval Research Laboratory, Lockheed Martin, Hughes Aircraft, Boeing, Pratt-Whitney, the Internal Revenue Service, and the U.S. Postal Service). Commer-

installed in all B-2 bombers, which warns the pilot if the plane is about to produce a trail of condensation that could be detected by enemy radar.

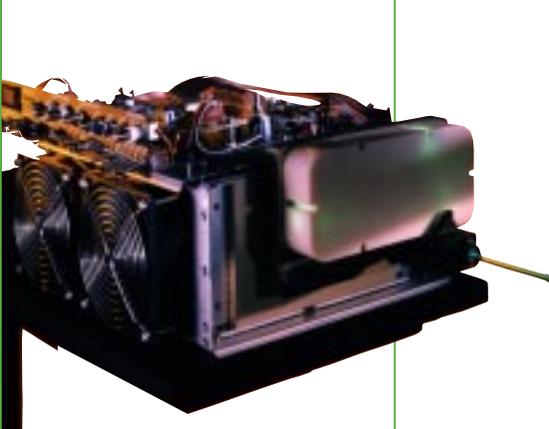
Laser Guidance. Its laser-based visual landing aid for aircraft carrier flight operations shows pilots landing aircraft at night whether they are properly lined up and how to make flight adjustments when they are not. The Navy recently awarded Laser Guidance and Raytheon a \$9 million contract to install the system on the entire fleet of aircraft carriers. This technology, by increasing the rate at which planes can board the carriers, is expected to save the Navy at least \$22 million per year in aircraft fuel and maintenance costs, and also to significantly reduce the risk of aircraft accidents.

Magnetic Imaging Technologies, Inc. Its latest imaging technology dramatically improves the ability of Magnetic Resonance Imaging (MRI) machines in imaging a patient's lungs, head, and heart, and represents a major advance in medical diagnosis. Whereas existing MRI machines create images based on water in the human body, this technology creates images based on gas, which produces 10 times the signal magnitude of water and improves the resolution of the MRI machine by a factor of three. As the project now enters Phase II, it has already attracted \$1.5 million in equity investment from outside investors to match the DoD funding.

A number of independent studies dating back to the late 1980s have consistently affirmed the value of the SBIR program. These studies include a 1996 study by the National Bureau of Economic Research at Harvard; a 1992 assessment by the National Academy of Sciences; and four separate, favorable evaluations by the General Accounting Office (GAO), in 1989, 1992, 1995, and 1997. GAO found, among other things, that the quality of SBIR research is comparable to, and in some cases exceeds, the quality of other research funded by DoD. On the basis of such evidence, in 1992 Con-

AN SBIR-DEVELOPED TECHNOLOGY — THE “SAVITAG” — RECENTLY HAD A DIRECT, MAJOR IMPACT ON DoD OPERATIONS IN BOSNIA AND ELSEWHERE. DEVELOPED UNDER THE NAVY SBIR PROGRAM BY SAVI TECHNOLOGY, A START-UP COMPANY BASED IN MOUNTAIN VIEW, CALIFORNIA, LOCATED IN THE HEART OF SILICON VALLEY, THE SAVITAG IS A MINIATURE RADIO TRANSCEIVER WITH AN EMBEDDED MICROCOMPUTER. WHEN ATTACHED TO MILITARY CARGO CONTAINERS, OR ANY OTHER CRATE OR CONTAINER USED FOR TRANSPORT, THE SAVITAG WILL AUTOMATICALLY TRACK THE CONTAINER'S LOCATION AND CONTENTS.

Photo courtesy Lightwave Electronics Corporation



cial/military sales since 1993 totaled \$10 million.

Integrated Systems. Its technology for the automated writing of embedded software reduced the cost and time of software development for the DC-X experimental launch vehicle by over 50 percent. Integrated Systems, which began as a start-up company under SBIR, is now publicly traded with a market valuation of \$500 million.

Active Technologies. Its “Lightning Charger” — an engine-driven alternator that is one-third the weight and twice the power of comparable alternators — is used for powering such equipment as emergency lights and

THIS COMPANY CREDITS AN SBIR AWARD (CRITICAL ENABLING TECHNOLOGIES FOR MANPACK TERMINALS) FOR LAUNCHING THEM INTO THE DoD AND COMMERCIAL SATCOM MARKETS. THE EMBEDDED INFOSEC PRODUCT (EIP), DEVELOPED UNDER AN SBIR CONTRACT TO THE SPACE AND NAVAL WARFARE SYSTEMS COMMAND (SPAWAR), IS USED AS AN EMBEDDABLE COMPONENT IN A LARGER NETWORK SYSTEM. ITS PRIMARY APPLICATION IS DATA ENCRYPTION PROTECTION IN TWO COMMUNICATIONS SYSTEMS LOCATIONS: COMMUNICATIONS BETWEEN SUBSCRIBERS AND USERS OF A NETWORK, AND COMMUNICATIONS BETWEEN NETWORK NODES ACROSS COMMUNICATION LINKS.

refrigerators, and to start vehicles including cars and airplanes. Generating commercial/military sales of \$8 million since 1994 (an additional \$90 million anticipated by the end of 1998), Lightning Charger is sold in major home appliance stores across the country and is currently used by the Army to start tank engines when the batteries die.

Ophir Corporation. Its infrared-absorption hygrometer led to development of the “pilot alert” system

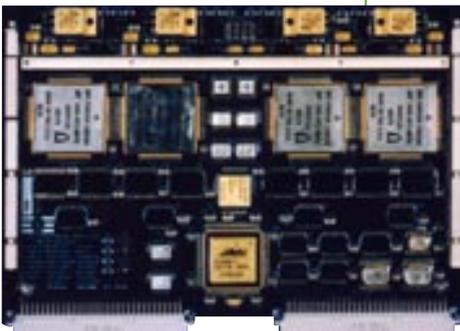


Photo courtesy SEAKR Engineering, Inc.

gress reauthorized and expanded the SBIR program with broad bipartisan backing, based on its finding that SBIR is "one of the most effective technology programs in the Federal Government."

Recent Improvements in the DoD SBIR Program

In 1995, a DoD-wide SBIR Process Action Team developed several major reforms in the SBIR program. These reforms, endorsed by upper-level acquisition management in OSD, the Military Departments, Defense Agencies as well as the White House, were subsequently approved by Kaminski.

By streamlining the SBIR proposal evaluation and contracting process, the reforms approved by Kaminski and enacted by Congress render the program considerably more attractive for program managers who choose to participate. For example, over the past two years, DoD reduced the time needed for proposal evaluation and contracting by nearly 40 percent in Phase I. DoD also significantly reduced the evaluation and contracting time in Phase II by 20 percent. Most DoD organizations are now close to meeting the DoD-wide goal of reducing the time between SBIR proposal receipt and award to four months in Phase I, and six months in Phase II.

In addition, the Department's new SBIR "Fast Track" policy allows DoD to leverage funding from the private sector and other sources, and further streamlines the evaluation and contracting process. Specifically, under the Fast Track policy, SBIR projects that obtain matching funds from outside investors stand a significantly higher chance of progressing to Phase II award. (Outside investors may include other companies, venture capital firms, individual investors, and non-SBIR government programs.) These projects also receive an interim award between Phases I and II, and expedited processing to ensure no significant gap in funding between the two phases. Thus, the Fast Track enables DoD to leverage outside funding to support the Department's R&D needs; focuses SBIR funding on those

projects with the strongest potential for commercialization in military or private-sector markets (as evidenced by the outside investment); and allows these projects to move into production in a timely fashion.

How Program Managers Throughout DoD Can Participate in the SBIR Program

Program managers can participate in the SBIR program in the following ways. First, if you are seeking a new technology to address a need in your program, contact the SBIR program manager for your Component to discuss how you can participate. (A complete list of Component SBIR program managers accompanies this article.) Based on your discussions, you may wish to propose an R&D topic for inclusion in the next DoD SBIR solicitation.

Second, you can search the abstracts of DoD-sponsored ongoing or recently completed SBIR projects to see if any of these projects meets a technology need in your program. The DoD SBIR Home Page (<http://www.acq.osd.mil/sadbu/sbir>) now posts a complete list of these abstracts. If you find an ongoing Phase I SBIR project that is of particular interest, and decide to contribute funds from your own program toward the Phase II effort, you can qualify the project for the Fast Track, as discussed earlier in this article. In effect, every \$1 in program funds that you contribute may entitle you to matching funds from the SBIR program of between \$1 and \$4. The DoD SBIR Home Page (<http://www.acq.osd.mil/sadbu/sbir>) contains further information on Fast Track and matching funds.

Conclusion

Small technology companies are a powerful and growing source of innovative talent in the U.S. economy. The DoD SBIR program has proven its worth as an effective means for DoD to tap that talent for the benefit of the U.S. military. If you are interested in participating in the SBIR program, contact your Component's SBIR program manager or visit the DoD SBIR Home Page.

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