NASA Utilization of SBIR-Developed Technologies

A primary objective of the NASA SBIR program is that the work benefits the Agency. The SBIR Program Office is continually looking for ways to better bring those benefits to NASA. The realignment of the solicitation to reflect the needs of the Enterprises is one example; our increased emphasis of publicizing successes is another. Further, the SBIR and STTR programs are increasingly viewed as an important leveraging tool for the development of technologies, and their applications, needed for NASA mission success.

Many of the successful SBIR and STTR technologies that have been incorporated into NASA spacecraft and instruments did not get there as part of any preconceived plan to utilize the SBIR program to solve a mission need. Frequently, it has been the persistence of both the small business and the NASA personnel that has led to the technologies being used by missions.

In recent years, some NASA programs have taken a strategic approach to using the SBIR and STTR programs to help achieve goals and objectives. The success of this strategic approach, especially technologies relevant to General Aviation, has influenced other NASA programs toward including the SBIR program in their planning processes.

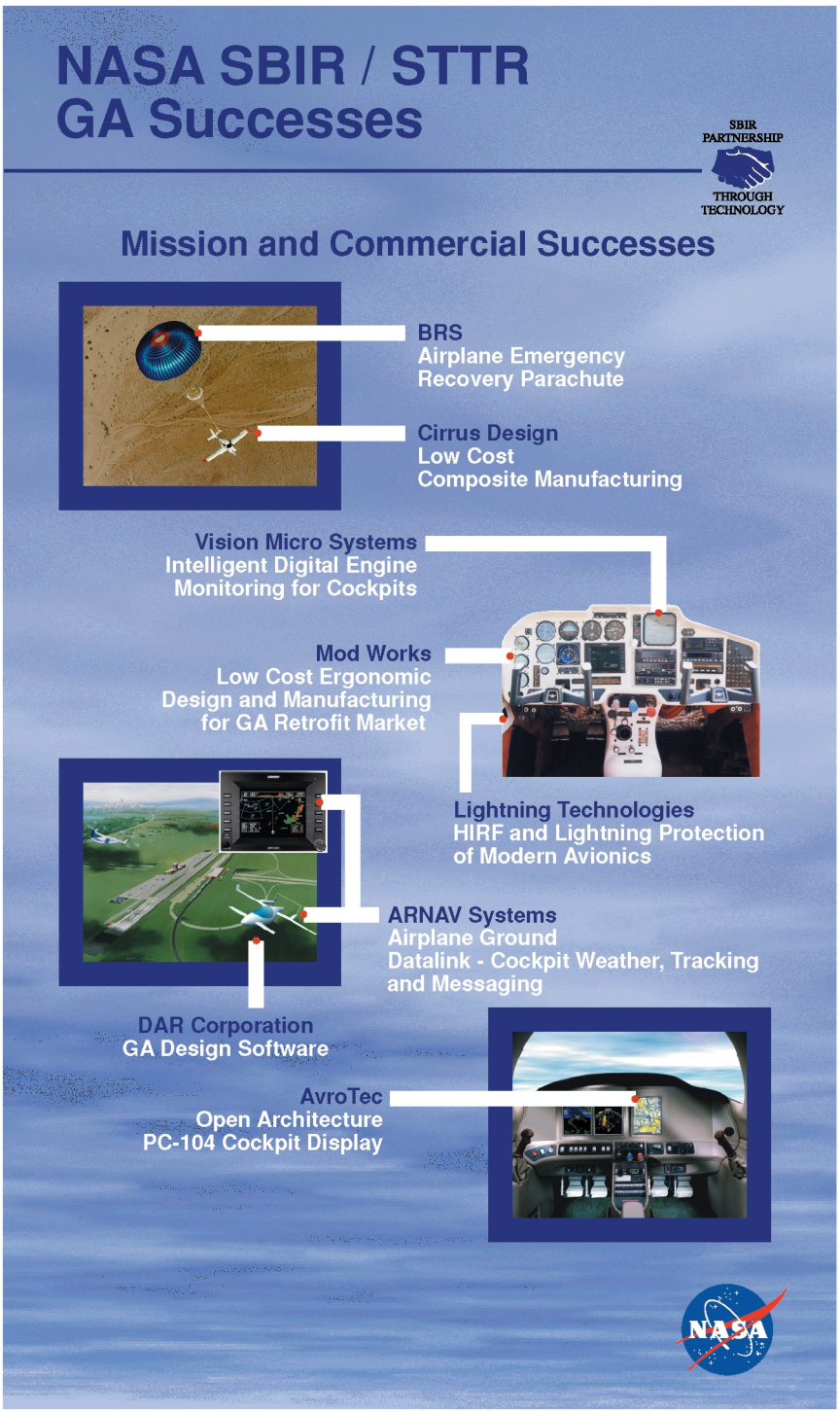
The stories that follow illustrate the recent contributions that the SBIR program has made to NASA missions and programs.

General Aviation, the AGATE Consortium, and the SBIR and STTR Programs

NASA mission programs are looking for SBIR and STTR developed technologies to meet programmatic objectives. SBIR and STTR technologies have been shown to be an effective way—both in terms of cost and technical parameters—to help meet mission requirements. As an example, the General Aviation (GA) revitalization effort at Langley Research Center has successfully leveraged the SBIR and STTR programs to obtain new technologies.

The GA revitalization effort, embodied in the AGATE (Advanced General Aviation Transport Experiments) consortium, has strategically leveraged the SBIR and STTR programs to support its efforts. The GA projects have received more the $34 million in SBIR and STTR funds from 1993 to 1998. The funds went directly to SBIR and STTR award winners, the small businesses that worked on the problems specified as subtopics in the SBIR and STTR solicitations.

The AGATE program is a consortium of over 70 members from industry, universities, NASA, the Federal Aviation Administration, and other government agencies. Its goals are to help revitalize the ailing aviation industry by developing affordable new technologies and advocating new standards and certification methods for next-generation single-pilot, near all-weather, light aircraft.



Companies that address the revitalization effort and win SBIR phase II contracts automatically become part of the consortium. These companies then have a pathway to the development of partnerships and other business relationships through the consortium. The GA and AGATE programs' strategic approach to leveraging the SBIR and STTR programs has led to some impressive results. One example of both the benefits of SBIR and

STTR and the AGATE consortium is Cirrus Design Corp.'s SR20 aircraft.

The SR20 is a four-seat single-engine aircraft that was designed with innovative improvements in speed, comfort, and safety. The company has over 500 confirmed orders for the SR20 aircraft and production has been consistently increasing over the past year.

Cirrus Design was awarded two SBIR phase II contracts that developed innovative manufacturing techniques. In addition, the innovations of several other SBIR companies are integral parts of the aircraft. A few of the new technologies are discussed in the following paragraphs.

The SR20 includes as standard equipment an aircraft emergency recovery parachute that was developed by Ballistic Recovery System (BRS) in part through an SBIR contract with the Langley Research Center. The SR20 parachute is known as CAPS—the Cirrus Airframe Parachute System. BRS has a $1 million contract with Cirrus to supply the parachutes for the SR20.

The BRS parachute is also used in over 25 small experimental airplanes, which provides BRS with approximately $1 million in revenue per year. More importantly, the BRS system is a proven lifesaver. BRS has over 100 stories from pilots who have survived crashes because they had a BRS parachute system in their aircraft.

ARNAV Systems Inc. is another company that has technology incorporated into the SR20 aircraft. Through its SBIR project "Affordable Electronic Weather Reporting System for General Aviation Pilots," ARNAV developed innovative "weather in the cockpit" technology. This technology is a low-cost data link that provides weather information graphically to the cockpit. ARNAV has since expanded the application and has developed a cockpit multifunction display (MFD) which includes the weather in the cockpit function. ARNAV's MFD has been incorporated into the SR20 avionics system.

ARNAV has applied this technology to other efforts. For the 1996 Summer Olympics in Atlanta, Operation Helistar, an AGATE-based effort, required that all aircraft flying over the games be equipped with an ARNAV data link. This link provided both weather and traffic information graphically to each cockpit. The AGATE ground control station had two-way text messaging capability with the aircraft as well, thus increasing the safety of the many planes and helicopters over Atlanta.

In 1999, ARNAV continued to expand the availability of up to the minute weather data to the general aviation community when it was awarded a 5-year Flight Information System (FIS) contract with the Federal Aviation Administration (FAA). Under the contract, ARNAV will receive two nationwide data link frequencies on which to broadcast basic aviation weather reports. FIS is considered fundamental to the National Airspace System architecture modernization program.

The GA and AGATE programs' success is not limited to technologies incorporated into the Cirrus SR20, nor has the SR20 been the only example of SBIR companies partnering (and thus increasing the success of both). Several other innovations have improved the safety, reliability, and cost-effectiveness of small aircraft.

Mod Works and Vision Micro Systems joined forces in the creation of Mod Works' human factors engineered ergonomic instrument panel. This panel includes Vision Micro System's intelligent digital engine monitoring system for small airplanes. This low-cost system reduces the pilot's engine management workload and improves operation safety and reliability. Mod Works' manufacturing technology, which was developed under the STTR program, is key to the company's ability to produce the instrument panel at a low cost.

The instrument panel received FAA certification and has found a market in the retrofitting of older planes. In addition, Mod Works used the technology in a different product when it developed an FAA certified training simulator. The simulator has the same type of ergonomic instrument panel that was incorporated into the aircraft—hence the market appeal of the simulator. Over 250 simulators have been built and shipped in the last few years.

Innovative Dynamics Inc. (IDI) has been working on ice protection technology through the SBIR program at Glenn Research Center for several years. IDI has developed a sensor system that assists in the detection of ice buildup, as well as in determining if the accreted ice has been shed after system operation. The technology has been licensed to B.F. Goodrich and integrated into its pneumatic deicers, which has brought ice detection technology to general aviation at an affordable price.

AGATE has shown that the inclusion of SBIR in strategic planning is a way for programs and projects to gain access to additional resources and to bring in small businesses which, in turn often bring novel ways of solving problems. Other NASA programs are now trying to emulate AGATE's success.

A large portion of the total GA revitalization is yet to be solved. There are over 5000 public aviation landing facilities within the United States and most are underused because of limited systems capabilities. The Small Aircraft Transportation System (SATS) is a NASA initiative that focuses on these challenges with a goal of increasing personal mobility by providing affordable all-weather use of the Nation's public landing facilities and better integration of small aircraft into our air transportation system. Technology areas include the integration of safe, low-cost, and easy-to-fly aircraft with smart, small airports. The SATS team will continue to form partnerships with the SBIR program.

Other Centers are learning from AGATE's successful utilization of the SBIR Program. The Kennedy Space Center is including the SBIR program as one of the strategic resources in its plan for acquiring technologies in support of the Spaceport Technology Center. The Spaceport Technology Center is envisioned as a world class resource for the emerging space transportation industry. It is dedicated to furthering the visionary approaches and strategies for developing the technologies for future spaceports. Such spaceports will help space flight become so affordable that industry will be able to take advantage of it for research, manufacturing, and human exploration.

Emerging spaceport technologies that are conducive to SBIR and STTR businesses include new techniques, methods,

"The NASA SBIR program has allowed Mod Works to build a world class engineering team. We can now compete globally."

Tim Coons
President
Mod Works

mechanisms, and machinery to process space cargo, and space vehicles, as well as technologies to launch and land space vehicles.

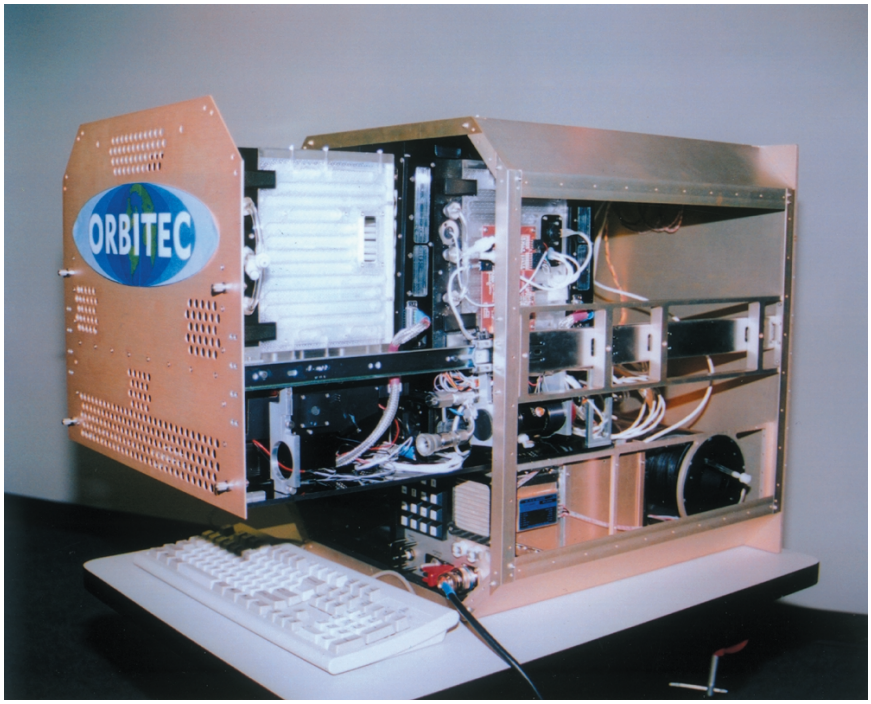
International Space Station Applications

The International Space Station Program is another example of a NASA project that is very successfully making use of SBIR innovations.

The International Space Station will make long term scientific experimentation a reality. To prepare for that, the Space Station Biological Research Project (SSBRP) team at Ames Research Center was tasked to design and build experimentation facilities to aid in the study of the fundamental impact of gravitational forces on living systems, from single cells to entire systems of plants, animals, and humans.

Over the last several years, three SBIR companies have been awarded significant phase III contracts to develop the necessary research hardware. The SSBRP has used these companies to assist in achieving its goals for experimentation facilities. SSBRP worked with the SBIR companies for several reasons—primary among those reasons was that the companies had proposed strong and innovative approaches to the challenges posed. In addition, the smaller companies were able to implement their programs with a level of cost efficiency and design flexibility that would be difficult for a larger aerospace company to achieve.

The three SBIR companies participating in the SSBRP activities are STAR Enterprises of Bloomington, Indiana; Space Hardware Optimization Technology (SHOT) Inc. of Floyd Knobs, Indiana; and Orbital Technologies Corporation (ORBITEC) of Madison, Wisconsin. The total value of the contracts awarded to these companies is in excess of $95 million.



STAR Enterprises is developing an advanced animal habitat for rats and mice that will be used for both basic and biological research. The habitat will allow both scientists on Earth and astronauts to view the animals and monitor their physiology and behavior while the rodents live under microgravity or under different levels of artificial gravity created when the habitat is attached to the Space Station's centrifuge.

SHOT is developing two avian habitats for the Space Station Gravitational Biological Facility. In addition to this direct contract, SHOT also has a significant role as a subcontractor in the STAR contract.

ORBITEC's work is in plant growth facilities. Its contract with SSBRP is for the delivery of a multifunctional plant research facility for the Space Station. This facility will provide life support for a variety of plants; the capability to conduct experiments in microgravity; and the capability to collect, record, and transmit science and engineering data—including video—to ground stations.

Through experience, the SSBRP has learned that working with SBIR companies can have great benefits. The project estimates that it has saved several million dollars by contracting with the SBIR companies. In addition, the use of the phase III contracting mechanism reduces the contracting time significantly, which, for a project like Space Station with critical launch dates, can be very important.

The New Millennium Program's Deep Space I

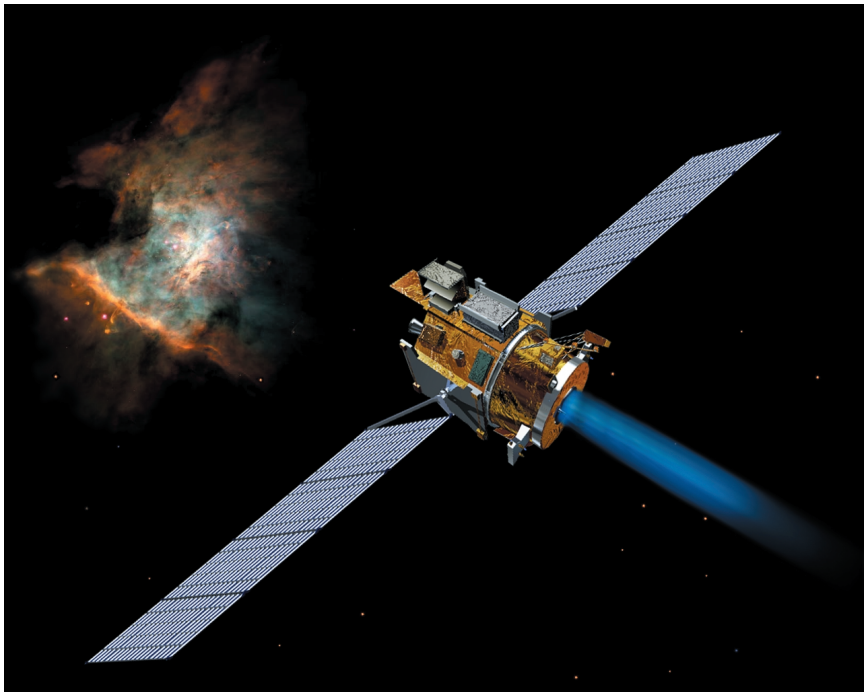
Deep Space 1, the first New Millennium Program project to be launched, benefited from two technologies that began with the SBIR program. One technology is integral to the operation of the spacecraft; the other is one of the demonstration instruments that was part of the science mission.

Entech Inc. started work on its domed/arched Fresnel optics for space applications through a Glenn Research Center SBIR contract that was awarded over 15 years ago. That concentrator lens work has evolved into the key element of the Solar Concentrator Array with Refractive Linear Element Technology® or SCARLET solar array, which powers Deep Space 1.

The SCARLET solar array can reduce, typically by a factor of 8 to10, the amount of solar cells necessary to generate a given amount of power. The array does this by using a unique refractive lens system that concentrates sunlight like a magnifying glass onto a line of smaller high efficiency solar cells, essentially replacing the solar cells with lightweight, inexpensive concentrator optics. Because of its high performance, the array can be small and, since solar cells are the most costly part of an array, overall costs can be significantly reduced.

Under another government contract, Entech teamed with ACE-Able Engineering Co., specialists in solar arrays and space structures, to develop and build SCARLET for the Deep Space 1 mission. Launched in October 1998, this array was the first refractive photovoltaic concentrator array to be used as the primary power source for a spacecraft. Its unprecedented success and flawless operation has laid the groundwork for the possible use of concentrator solar arrays for future government and commercial space missions.

The Deep Space I with refractive solar arrays and a miniature integrated camera spectrometer.



On board the Deep Space 1 spacecraft is an instrument known as the miniature integrated camera spectrometer or MICAS. The MICAS instrument was constructed by using silicon carbide composites, which yielded a multipurpose instrument that costs 10 times less and consumes 10 times less power than conventional instruments that perform the same tasks.

The innovative technology used in the construction of the MICAS instrument by SSG, Inc. was developed under an SBIR contract with the Jet Propulsion Laboratory. With SBIR support, which began in 1992, SSG Inc. developed technology for building telescopes, including visible quality mirrors, from silicon carbide composites. In addition to the weight savings, the composites display exceptional stability during changes in temperature.

Both of these SBIR related technologies have performed exceptionally well and are great examples of the value SBIR developed technologies bring to NASA.