Small Business Innovation Research (SBIR) & Small Business Technology Transfer (STTR) Programs

The federal SBIR program was created to stimulate technological innovation, utilize small businesses to meet federal research and development (R&D) needs, and increase private sector commercialization derived from federal R&D. This is a highly competitive program that encourages small businesses with the potential for commercialization to engage in federal R&D.

The federal STTR program is modeled on the SBIR program with similar objectives. It also serves to encourage tech transfer through research between small business concerns and non-profit research institutions. STTR's most important and fundamental role is to bridge the gap between the performance of science and commercialization of resulting innovations.

SBIR grants: Successfully funded university spin-off

This case study describes how SBIR grants helped a young company develop a large intellectual property portfolio centered on adding the sense of touch to diverse computer applications, and how the company grew the business over its first decade to approximately 141 employees and $24 million in annual revenue. It illustrates how government funding can be used by a university spin-off to leverage funding from private sources to achieve faster growth, eventually essentially eliminating the need for government R&D support. The case also illustrates how a basic idea—adding the sense of touch to computer applications—can be used to enhance entertainment experiences, increase the productivity of computer use, train doctors, and more. Immersion's technology was inspired by a NASA system, but its growth centers on its embodiment in consumer products. The case provides a number of suggestions for improving the SBIR program.

SBIR Case Study: Immersion Corporation
Rosalie Ruegg
TIA Consulting

THE COMPANY

As a Stanford graduate student in mechanical engineering, Louis Rosenberg investigated computer-based and physical simulations of remote space environments to provide a bridge across the sensory time gap created when an action is performed remotely and the resulting effect is known only after a time delay. For example, a satellite robot tightens a screw and scientists on the ground find out with a delay if the screw was stripped. As earlier described by Dr. Rosenberg, “I was trying to understand conceptually how people decompose tactile feeling. How do they sense a hard surface? Crispness? Sponginess? Vision and sound alone do not convey all the information a person needs to understand his environment. Feel is an important information channel.”

From aerospace researcher, Dr. Rosenberg turned entrepreneur with a focus on the less-studied sensory problem of feel, which was also closely attuned to his specialization in mechanical engineering. He took as his first business challenge to convert a $100,000, dishwasher-sized NASA test flight simulator into a $99 gaming joystick. To take advantage of his breakthroughs, he founded Immersion Corporation in 1993 in San Jose, initially drawing heavily on other Stanford graduates to staff the company. Reflecting the early NASA-inspired challenge, Immersion’s first products were computer games with joysticks and steering wheels that move in synch with video displays. Other application areas followed.

The company grew to 141 employees. Growth over the first seven years reflected internal gains mainly in the entertainment area. Then, in 2000, Immersion grew mainly by acquiring two companies: Haptic Technologies, located in Montreal, Canada, and Virtual Technologies, Inc.10, located in Palo Alto, California, both acquisitions now an integral part of Immersion Corporation. And, in 2001, Immersion acquired HT Medical Systems, located in Gaithersburg, Maryland, renamed it Immersion Medical, and made it a subsidiary of Immersion Corporation. In the case of Haptic Technology and HT Medical Systems, the acquisitions brought into the company competitors’ technologies in application areas new for Immersion. In the case of Virtual Technologies, the acquisition brought in a complementary technology.

IMMERSION CORPORATION: COMPANY FACTS AT A GLANCE

- Address: 801 Fox Lane, San Jose, CA 95131
- Telephone: 408-467-1900
- Year Started: 1993
- Ownership: Publicly traded on NASDAQ: IMMR
- Revenue: Approx. $23.8 million in 2004
- Revenue share from SBIR/STTR grants & contracts: approx. 4 percent
- Revenue share from sales, licensing, & retained earnings: 96 percent
- Number of Employees: 141
- Patent Portfolio: Over 550 issued or pending patents, U.S. and foreign
- SIC: Primary SIC: 3577, Computer Peripheral Equipment

35779907, Manufacture Input/output Equipment, Computer
Secondary SIC: 7374, Data Processing and Preparation

73740000, Data Processing and Preparation, Computer

- Technology Focus: Touch-feedback technologies
- Application Areas: Computer peripherals, medical training systems, video and arcade games, touch-screens, automotive controls, 3-D modeling, and other
- Funding Sources: Licensing fees, product sales, contracts, stock issue, commercial loans, federal government grants, and reinvestment of retained earnings
- Number of SBIR grants:
  - From NSF: 10 (4 Phase I, 3 Phase II, and 3 Phase IIB)
  - From other agencies: 33 (20 Phase I and 13 Phase II)

THE TECHNOLOGY AND ITS USE

Of our five senses, the sense of touch differs from the others in that "it requires action to trigger perception." Development of a technology to sense touch draws on the disciplines of mechanical and electrical engineering, computer science, modeling of anatomy and physiology, and haptic content design. The technology uses extensive computer power to bring the sense of touch to many kinds of computer-based applications, making them more compelling or more informative processes. As a company publication puts it, "At last, the world inside your computer can take on the physical characteristics of the world around you…. Tactile feedback makes software programs more intuitive."

The technology was brought to life for the interviewer by a series of demonstrations. The first demonstration was of a medical training simulator that teaches and reinforces the skills doctors need to perform a colonoscopy. Low grunts from "the patient" informed the performer that a small correction in technique was needed for patient comfort. "Stop, you are really hurting me!" informed the performer in no uncertain terms that her technique was in need of substantial improvement.

Immersion has developed five main AccuTouch® platforms for helping to teach medical professionals. The five platforms teach skills needed for endoscopy, endovascular, hysteroscopy, laparoscopy, and vascular access—all minimally invasive procedures.

The next demonstration was of a gaming application. The weight of a ball on the end of a string was "felt" to swing in different directions in response to manipulating a joystick. The technology is used also to enhance the computer feedback experience when using a mouse or other peripheral computer controllers for PC gaming systems, arcade games, and theme park attractions, as well as for other PC uses.

A third demonstration was of a "haptic interface control knob" to provide human-machine touch interface on an automobile dash to help manage the growing number of feedbacks from navigational, safety, convenience, and other systems. The purpose is to lessen the risk of overloading the driver.

A fourth demonstration was of Immersion's "Vibe-Tonz" system for mobile phones. The system expands the touch sensations for wireless communications by providing vibrotactile accompaniment to ringtones, silent caller ID, mobile gaming haptics and many other tactile features.

THE ROLE OF SBIR IN COMPANY FUNDING

Though the initial funding of Immersion Corporation was through private equity, the company applied for and received its first SBIR grant in its second year, 1994. In addition, the acquired companies, HT Medical and Virtual Technologies, had received SBIR grants prior to their acquisition by Immersion, and HT Medical had also received a grant from the Advanced Technology Program (ATP) that was nearing completion at the time Immersion acquired the company. All totaled, Immersion and its acquired companies have received 24 Phase I SBIR grants and 19 Phase II (including 3 Phase IIB) grants, summing to approximately $10.6 million. SBIR funding agencies include NIH, DoE, DoD, Navy, Army, and NSF.

Immersion Corporation: SBIR/STTR Grants from NSF and Other Agencies.

According to Mr. Ullrich, SBIR grants gave the company the ability to further develop its intellectual property and to help to grow its intellectual property portfolio, which is the very core of the company's commercial success. The company has leveraged its government funding by investment funding from private sources in the amount of $12.7 million. The company attributes approximately $33 million in revenue to products directly derived from Phase II SBIR research projects, including licensing, direct sales of products, and product sales due to licensees. However, due to the company's licensing model, third-party revenues and tertiary economic activity, which are very significant, are not tracked directly by Immersion.

The company now receives only a small fraction of its annual revenue from SBIR/STTR funding, with the percentage ranging variously between 4 percent and 9 percent from 2001 to 2004. Its objectives for rapid commercialization growth are expected to reduce this percentage to an even lower level in the near future.

BUSINESS STRATEGY, COMMERCIALIZATION, AND BENEFITS

From its beginning, Immersion's prime business strategy has been to develop intellectual property in the field of touch sense and to license it. In addition, the company performs limited manufacturing operations in its 47,000 sq. foot facility in San Jose and in Gaithersburg, and arranges for some contract manufacturing. But far and away, the company's wealth generation depends on its ever-growing portfolio of patents which it licenses to others. At the time of this interview, the company had more than 270 patents issued in the United States and another 280 pending in the United States and abroad.

Important to identifying and developing relationships with new licensing partners is the company's participation in trade shows and conferences, and its ongoing interactions with industry associations and teaching universities. The company employs a business development specialist in each of its core business areas to cultivate these contacts.

Because direct sales for Immersion's technologies are derived from the much larger markets into which its licensees typically sell, estimating ultimate market size is considered "complicated" for Immersion, and it takes a more narrow view. For example, Immersion markets its cell phone vibration technology to a limited number of cell phone OEMs, and those OEMs in turn market to millions of customers. Estimating the larger consumer markets is not Immersion's focus.

Potential benefits of the technology include boosting the productivity of software use; enhanced online shopping experiences; enhanced entertainment from computer-based games; improved skills of medical professionals resulting, in turn, in improved outcomes for patients; increased automotive safety due to reduced visual distractions to drivers; and savings to industry through the ability to experience prototypes "first hand," but virtually, before building costly physical prototypes, and the ability to capture 3-D measurements from physical objects. In addition, visually impaired computer users may benefit from the tactile feedback of the mouse, keyboard, or touch-screen.

VIEWS ON THE SBIR PROGRAM AND PROCESSES

Mr. Ullrich made several observations about the SBIR program and its processes that may serve to improve the program. These are summarized as follows:

Difference in Agency Program Intent Helpful to Companies

Mr. Ullrich thought it was clear that there is "a difference in intent" among the various SBIR programs. In particular, DoD is focused on solutions to well-specified problems, while NSF and NIH are more interested in basic technology development that has commercial potential. This distinction is helpful to companies who may wish to develop technologies under both sets of condition. Given the need to respond to fast-developing commercial markets, Mr. Ullrich finds the openness and flexibility of a program to accommodate where a company needs to go to find market acceptance to be a big advantage.

SBIR Application Process

According to Mr. Ullrich, there are only minor differences among the agencies in their proposal application processes, and these differences do not pose a major concern in terms of proposal logistics. At the same time, he noted that the last time the company proposed to NIH, there was no electronic submission process, and he expressed the hope that this lack has been remedied.

SBIR Proposal Review Process

Mr. Ullrich has found the review process in support of the various agencies' SBIR grant selection to be "tough but fair." He has found the NSF review to be "much more academic" than the others. Overall, he sees no need for change in the review process.

Turning more exclusively to the NSF's SBIR program, Mr. Ullrich offered the following comments.

Timing Issue—Funding Cycle Too Long for Software Providers

According to Mr. Ullrich, the biggest drawback in NSF's SBIR program is the two deadlines per year, with six months between application and grant and 18 months to Phase II grants. This can be too slow for a software developer.

Timing Issue—Funding Gap

Mr. Ullrich pointed to an associated gap in funding that arises in the NSF program, which he thought would be a real hardship for start-up companies that had not yet developed any sales to sustain them in the interval. He pointed to the Fast Track program at NIH and DoD as being very good ideas. At the same time, he noted that having to develop both Phase I and Phase II proposals at once entails a huge investment of time for an all or nothing outcome. He suggested that providing a supplement—as he recalled some parts of DoD do—to close the funding gap would likely be a preferable approach from the company's perspective.

Phase IIB Matching Funds Requirement

For Immersion, NSF's Phase IIB matching requirement of "cash in the bank" was an easy test to meet—once the company had partners. At the same time, he found the associated review awkward in one respect: The company was required to take its business partner (the investor) to a panel review at NSF. The problem was that the company was required to discuss certain financial issues in front of its investor that it would have preferred to have discussed with NSF in private. Furthermore, it found the need to insist that the investor attend the meeting to be cumbersome and, in its opinion, unnecessary.

Commercialization Assistance

The company participated earlier in the Dawnbreaker Commercialization Assistance Program, and found that “it made sense.” However, given the company’s current level of business experience, Mr. Ullrich does not think the company would wish to participate again, and is glad participation is optional. Currently, the company is participating in the Foresight Commercialization Assistance Program for the first time and is “seeing if it will help.”

SUMMARY

This case study describes how SBIR grants helped a young company develop a large intellectual property portfolio centered on adding the sense of touch to diverse computer applications, and how the company grew the business over its first decade to approximately 141 employees and $24 million in annual revenue. It illustrates how government funding can be used by a university spin-off to leverage funding from private sources to achieve faster growth, eventually essentially eliminating the need for government R&D support. The case also illustrates how a basic idea—adding the sense of touch to computer applications—can be used to enhance entertainment experiences, increase the productivity of computer use, train doctors, and more. Immersion’s technology was inspired by a NASA system, but its growth centers on its embodiment in consumer products. The case provides a number of suggestions for improving the SBIR program.

Source: National Research Council (US) Committee for Capitalizing on Science, Technology, and Innovation: An Assessment of the Small Business Innovation Research Program; Wessner CW, editor. An Assessment of the SBIR Program. Washington (DC): National Academies Press (US); 2008. C, Case Studies. Available from: http://www.ncbi.nlm.nih.gov/books/NBK23754/

SBIR grants: Successfully funded academic collaboration

This case shows a relatively small company that has emphasized product sales since its inception in 1985. It has leveraged $40,500 of Vermont’s EPSCoR “Phase O” grants to obtain $3.6 million in federal SBIR grants. With SBIR support it developed an innovative line of microminiature, digital wireless sensors, which it is manufacturing. These sensors can autonomously and automatically collect and report data in a variety of applications. Unlike most research companies, MicroStrain, started by a graduate student, has emphasized product sales since its inception in 1985. Its sensors have been used to protect the Liberty Bell during a move and to determine the need for major retrofit of a bridge linking Philadelphia and Camden. Current development projects include power-harvesting wireless sensors for use aboard Navy ships and damage-tracking wireless sensors for use on Navy aircraft. Although annual revenues are relatively small ($3 million in 2004), the company can document many millions of dollars of savings achieved by users of its wireless sensor networks. A little more than a quarter of the company’s revenue comes from government sources.

SBIR Case Study: MicroStrain, Inc.

Rosalie Ruegg
TIA Consulting

THE COMPANY

While pursuing a graduate degree in mechanical engineering at the University of Vermont, Steve Arms witnessed an incident that led him to his future business. During a horse vaulting gymnastics competition, a friend flipping off the back of a horse injured the anterior cruciate ligaments in both knees when she landed. That set Steve, an avid sportsman himself, wondering about the amount of strain a human knee can take and how to measure that strain. Soon he was making tiny devices called “sensors” in his dorm room to measure biomechanical strain, and soon afterward he was making money for graduate school by selling sensors around the world—the first a tiny sensor designed for arthroscopic implantation on human knee ligaments.

In 1985, Steve Arms left graduate school to start his company, MicroStrain, Inc. “In many ways,” he said, “an excellent time to start a business is when you first leave school and it is easier to take the risk, the opportunity cost is small, and one is used to living on a budget.” He operated the business out of his home at first.

The company is not a university spin-off, but the company has a number of academic collaborators. Among them are the University of Vermont, Carnegie Mellon, the University of Arizona, Penn State, and Dartmouth University.

He located the company in Vermont to be close to family and friends, and to continue to enjoy the excellent quality of life offered by that location. In the longer run, the location has proven positive for high employee retention.

From its initial focus on microsensors with biomechanical applications, MicroStrain moved into producing microsensors for a variety of applications. Its sensor networks are in defense applications, security systems, assembly line testing, condition-based maintenance, and applications that increase the smartness of machines, structures, and materials.

MICROSTRAIN, INC.: COMPANY FACTS AT A GLANCE

- Address: 310 Hurricane Lane, Suite 4, Williston, VT 05495-3211
- Telephone: 802-862-6629
- Year Started: 1985
- Ownership: Privately held
- Revenue: Approx. $3.0 million in 2004
    - Revenue share from SBIR/STTR and other government grants: approx. 25 percent
    - Revenue share from sale of product and contract research: approx. 75 percent
- Number of Employees: 22

- SIC: Primary SIC: 3823 Industrial Instruments for Measurement, Display, and Control of Process Variables, and Related Products

Secondary SICs:

3625 Relays and Industrial Controls
3679 Electronic Components, not elsewhere classified
3812 Search, Detection, Navigation, Guidance, Aeronautical, and Nautical Systems and Instruments
3823 8711 Engineering Services

- Technology Focus: Wireless sensors and sensor networks for monitoring strain, loads, temperature, and orientation
- Application Areas: Condition-based maintenance; smart machines, smart structures, and smart materials; vibration and acoustic noise testing; sports performance and sports medicine analysis; security systems; assembly line testing
- Funding Sources: Product sales, contract research, and federal government grants
- Number of SBIR Grants:
    - From NSF: 3 Phase I, 3 Phase II, and 3 Phase IIB
    - From other agencies: 6 Phase I, 2 Phase II, 1 Phase III

The company has grown to approximately 22 employees, including mechanical and electrical engineers. It occupies 4,200 square feet of industrial space near Burlington, Vermont. Its annual sales revenue was recently reported as $3.0 million in 2004, with revenues growing at about 30 percent per year. Revenues are expected to reach $4.0 million in 2005.

THE TECHNOLOGY AND ITS USES

A "sensor" is a device that detects a change in a physical stimulus, such as sound, electric charge, magnetic flux, optical wave velocity, thermal flux, or mechanical force, and turns it into a signal that can be measured and recorded. Often, a given stimulus may be measured by using different physical phenomena, and, hence, detected by different kinds of sensors. The best sensor depends on the application and consideration of a host of other variables.

MicroStrain focuses on producing smarter and smaller sensors, capable of operating in scaleable networks. Its technology goal is to provide networks of smart wireless sensing nodes that can be used to perform testing and evaluation automatically and autonomously in the field and to report resulting data to decision-makers in a timely and convenient manner. The data can be used to monitor structural health and maintenance requirements of such things as bridges, roads, trains, dams, buildings, ground vehicles, aircraft, and watercraft. The resulting reports can alert those responsible for problems before they become serious or even turn into disasters.

They can eliminate unnecessary maintenance and improve the safety and reliability of transportation and military system infrastructure while reducing overall costs.

Among the features that determine how useful sensors will be for the type of system monitoring function described above are the degree to which the sensors are integrated into the structures, machinery, and environments they are to monitor; the degree to which the systems are autonomous, i.e., operate on their own with little need for frequent servicing; and the degree to which they provide efficient and effective delivery of sensed information back to users. MicroStrain's research has focused on improving its technology with respect to each of these performance features.

Another way to look at it is that MicroStrain has addressed barriers that were impeding the wider use of networks of sensors. For example, MicroStrain was one of the first sensor companies to add wireless capability. Wireless technology overcomes the barrier imposed by the long wire bundles that are costly to install, tend to break, have connector failures, and are costly to maintain. A recently passed international standard for wireless sensors (IEEE 802.15-4) is expected to facilitate wider acceptance of wireless networks.

A barrier to the use of wireless sensor networks is the time and cost of changing batteries. MicroStrain is an innovator in making its networks autonomous, without need of battery changes, by pursuing two strategies: First, it has adopted various passive energy harvesting systems to supply power, such as by using piezoelectric materials to convert strain energy from a structure into electrical energy for powering a wireless sensing node, or by harvesting energy from vibrating machinery and rotating structures, or by using solar cells. Second, the company has reduced the need for power consumption by such strategies as using sleep modes for the networks in-between data samples.

A recent newsworthy application of MicroStrain's sensors was to assist the National Park Service to move the Liberty Bell into a new museum. The Bell has a hairline fracture that extends from its famous larger crack, making the Bell quite frail. MicroStrain applied its wireless sensors developed as part of an NSF SBIR grant to detect motion in the crack and fracture as small as 1/100th the width of a human hair. During a lifting operation at the end of the move, the sensors detected shearing motions of about 15 microns (roughly half the width of a human hair) at the visible crack with simultaneous strain activity at the hairline crack's tip. MicroStrain's engineers stopped the riggers during this activity, and the sensor readings returned to baseline. Further lifting proceeded very slowly, and no further readings of concern were observed. The Bell was protected by this early warning detection system, which saved it by literally splitting hairs.

Another newsworthy application by the company of a sensor network was to the Ben Franklin Bridge which links Philadelphia and Camden, New Jersey, across the Delaware River. The bridge carries automobile, train, and pedestrian traffic. At issue was the possible need for major and costly structural upgrades to accommodate strains on the bridge from high-speed commuter trains crossing the bridge. MicroStrain placed a wireless network of strain sensors on the tracks of the commuter train to generate the data needed to assess the added strain to the bridge. “For a cost of only about $20,000 for installing the wireless sensor network, millions were saved in unnecessary retrofit costs,” explained Mr. Arms.

In the future, military systems will benefit from the cost-saving information from MicroStrain’s sensor networks. Current development projects include power-harvesting wireless sensors for use aboard Navy ships and damage-tracking wireless sensors for use on Navy aircraft. Mr. Arms explained that the data collected in this application is expected to result in recognition that the lives of the aircraft can be safely extended, avoiding billions of dollars of replacement costs.

THE ROLE OF SBIR IN COMPANY FUNDING

Early on, SBIR funding played an important role in supporting company research. While in graduate school at the University of Vermont, Mr. Arms was involved in proposal writing. He also had learned of the SBIR program. “Were it not for this,” he said, “the application process may have seemed intimidating.” He tapped Vermont’s EPSCoR17 Phase O grants to leverage his ability to gain federal SBIR grants. EPSCoR Phase O grants provide about $10,000 per grant. According to Mr. Arms, these Phase O grants helped the company get preliminary data for convincing results and helped it write competitive proposals. The company has leveraged a total of $40,500 in EPSCoR grants to obtain $3.6 million in SBIR funds.

According to Mr. Arms, he found the NSF SBIR program with its “more open topics” particularly helpful in the early stages when the company was building capacity. “The open topics allowed the company to pursue the technical development that best fit its know-how,” he explained. “Now the company is better able to respond to the solicitations of the Navy and the other agencies that issue very specific topics.”

The company regards the receipt of an SBIR grant as “a strong positive factor that is helpful in seeking other funding,” said Mr. Arms. “It is used not only to fund the development of new products but as a marketing tool,” he continued, pointing out that the company issues a press release whenever it receives an SBIR grant.

MicroStrain has received a total of nine Phase I SBIR grants, five Phase II grants, three Phase IIB supplemental grants, and one Phase III grant. It has received SBIR grants from the National Science Foundation (NSF), Navy, Army, and the Department of Health and Human Services. The amount the company has received in SBIR grants since its founding in 1985 totals about $3.6 million.

MicroStrain, Inc.: SBIR/STTR Grants from NSF and Other Agencies.

According to Mr. Arms, the receipt of additional SBIR grants in the future is hoped for as a means to enable it to continue to innovate and stay at the forefront of its field. The company is targeting about 25 percent of its total funding to come from SBIR grants in the coming years.

BUSINESS STRATEGY, COMMERCIALIZATION, AND BENEFITS

The company operates at an applied R&D level, and, unlike most R&D-based companies, has had sales from its beginning. Mr. Arms, the company founder, and president emphasized his belief in the need to produce a product “to make it real as soon as possible.” Continuing, Mr. Arms said, “Having products lets people know you know how to commercialize and that you intend to do it.”

Mr. Arms sees the company’s main competitive advantage as its role as an integrator of networked sensors. “Our goal is to produce the ideal wireless sensor networks,” he explained, “smart, tiny in size, networked and scalable in number, able to run on very little power, software programmable from a remote site, capable of fast, accurate data delivery over the long run, capable of automated data analysis and reporting, low in cost to purchase and install, and with essentially no maintenance costs.” These features are important because they help to overcome the multiple barriers that were impeding the wider acceptance of sensors.

While the company sells its sensors mainly in domestic markets, it has from the beginning shipped sensors to customers around the world. Now the company sees market potential, particularly in Japan and China. Patenting is reportedly very important to the company’s commercialization strategy.

MicroStrain has received a number of grants in recognition of outstanding new product development in the sensors industry. It has received seven new product grants in the “Best of Sensors Expo” competition. Products that have been recognized by grants include the company’s V-Link/G-Link/SG-Link microdata-logging transceivers for high-speed sensor data logging and bidirectional wireless communications; its WWSN wireless Web sensor networks for remote, internet-enabled, ad hoc sensor node monitoring; its FAS-G gyro enhanced MEMS-based inclinometer; its MG-DVRT microgauging linear displacement sensor; its 3DM-G gyro enhanced MEMS-based orientation sensor; its EMBEDSENSE embeddable sensing RFID tag; AGILE-Link frequency-agile wireless sensor networks; and INERTIA-LINK wireless inertial sensor.

Society stands to benefit in a variety of ways from improved sensors and networks of sensors. Structures, such as buildings, bridges, and dams, as well as transportation and industrial equipment should have fewer catastrophic failures because managers will be alerted to emerging problems in time to take preventative action. Homeland security should be enhanced by smarter networks of sensor-based warning systems. Manufacturing productivity may be increased by better planning of required maintenance and avoidance of costly, unplanned downtime. In general, integration of smart sensor networks into civilian and military structures and infrastructure, transportation equipment, machinery, and even the human body can conserve resources, improve performance, and increase safety.

VIEWS ON THE SBIR PROGRAM AND ITS PROCESSES

Mr. Arms made the following several observations about the SBIR program and its processes, some of which focused on the NSF program, some on the Navy program.

Topic Specification

Mr. Arms contrasted the “open topics” of NSF with the “very specific topics” of the Navy and other agencies, noting the former is particularly important to a company when it is “building capacity,” while the latter is important when the company is positioned to generate a variety of new products.

Financing Gap

Mr. Arms noted that “early on in the life of the company the funding gap was very difficult, but now the company is able to bridge the gap using its sales revenue.”

Value of Keeping Phase I Grants as Prerequisite to Phase II

“Phase I grants are important for getting a reaction to an area; to understanding better a technology’s potential,” said Mr. Arms. “I would not want to see this phase eliminated or bypassed.”

Size of Grants

“It is great that the agencies are beginning to increase the size of their grants,” commented Mr. Arms. “I especially like the NSF’s Phase IIB match grant; it fits well with my company’s commercial emphasis.”

Application Process

Mr. Arms finds the Navy’s SBIR application process particularly agreeable, calling it “the best!”

Value of Commercialization Assistance

The company has not participated in an NSF-sponsored commercialization assistance program, but it has participated in Navy-sponsored opportunity forums and in NSF conferences. It has found the networking provided by these forums and conferences to be very valuable. In fact, it was at an NSF-sponsored conference that MicroStrain made contact with Caterpillar Company, leading it to become a participant in a joint venture led by Caterpillar and sponsored by the Advanced Technology Program.

Observations about NSF's and Navy's SBIR Program Manager Systems

"The way NSF conferences facilitate face to face meetings between program managers, who have extensive business experience, with budding entrepreneur-scientists is excellent," Mr. Arms said. He expressed special enthusiasm for the Navy program managers, calling them "extremely knowledgeable and focused."

NSF's Student and Teacher Programs (outside SBIR)

Like several of the other companies interviewed, MicroStrain has used the NSF students program, "but, regretfully, not the teacher program." Like the other companies that have used these programs, Mr. Arms said MicroStrain had found the NSF students program valuable. "I think it would be a great thing to expand this idea to the other agencies," he suggested.

SUMMARY

This case shows a still-small company that has emphasized product sales since its inception in 1985. It has leveraged $40,500 of Vermont's EPSCoR "Phase 0" grants to obtain $3.6 million in federal SBIR grants. With SBIR support it developed an innovative line of microminiature, digital wireless sensors, which it is manufacturing. These sensors can autonomously and automatically collect and report data in a variety of applications. Unlike most research companies, MicroStrain, started by a graduate student, has emphasized product sales since its inception in 1985. Its sensors have been used to protect the Liberty Bell during a move and to determine the need for major retrofit of a bridge linking Philadelphia and Camden. Current development projects include power-harvesting wireless sensors for use aboard Navy ships and damage-tracking wireless sensors for use on Navy aircraft. Although annual revenues are relatively small ($3 million in 2004), the company can document many millions of dollars of savings achieved by users of its wireless sensor networks. A little more than a quarter of the company's revenue comes from government sources.

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