Testimony
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Good afternoon, Mr. Chairman. My name is Kesh Narayanan and I appreciate the opportunity to provide the committee with some background on NSF's Small Business Innovation Research program. I am Division Director, Industrial Innovation and Partnerships (IIP), National Science Foundation. In that role, I have oversight responsibility for the Small Business Innovation Research (SBIR) Program at the National Science Foundation (NSF). The SBIR program is located within the Industrial Innovation and Partnerships Division reporting to the Assistant Director of the Engineering Directorate (ENG).

Background of SBIR

Let me begin by noting that SBIR was invented at NSF. As early as 1976, Roland Tibbetts of NSF initiated a new program for the support of the small business community with early-stage financial support for high-risk technologies with commercial promise. In 1982, based in part on the success of this program, Congress expanded the SBIR program to other agencies by passing the Small Business Innovation Research Development Act.

The Small Business Administration (SBA) is responsible for setting SBIR operational guidelines. All federal agencies submit annual reports to the SBA on SBIR budget calculation, list of awards made during the fiscal year and project abstracts. Agencies request clearance from the SBA on issues falling outside the guidelines. The SBA monitors all the Federal SBIR programs and issues reports and recommendations to Congress.

Phase I SBIR awards can be up to $100,000 for up to 6 months and provide a small business with support to conduct research on a new technique or product. NSF provides a Phase IB supplement with awards up to $50,000 to bridge the gap between Phase I and Phase II and to stimulate investment in Phase I programs. All Phase I grantees are eligible to apply for Phase II awards to conduct expanded research efforts to complete technical milestones as a pre-requisite for further commercialization. Phase II award size can be up to $500,000 for a period of 2 years. The NSF SBIR program does not fund Phase III, the

transformation of technology to a prototype and into the marketplace. NSF does, however, have a Phase IIB supplement program with awards up to $500,000 to help bridge the research gap and to meet the needs of the third party investor.

NSF Phase I proposals are reviewed for their technical merit by panels of experts from the academic and business communities. Phase II proposals are reviewed in the panel process for their technical merit by appropriate technical experts and for their commercial potential by experts from the business community. The funding recommendations from these review panels are advisory to the program managers who make the final funding recommendations.

The table below summarizes the results of the SBIR Phase I and Phase II program for 2000-2006.

YEAR	PHASE I PROPOSALS	AWARDS	PHASE II PROPOSALS	AWARDS	PHASE IIB	TOTAL SBIR FUNDING
2000	1400	212	211	108	9	$65,359,304
2001	1248	217	169	88	14	$72,173,978
2002	1477	277	148	66	39	$78,000,000
2003	2794	447	225	77	27	$91,400,000
2004	2450	236	308	127	25	$95,396,808
2005	1482	152	271	132	47	$92,094,021
2006	1620	259	140	76	50	$90,450,000

SBIR at NSF

Since NSF is not a 'mission agency' with significant procurement needs, the focus of the NSF SBIR program from its inception has been on the commercialization of research. NSF historically has directed small businesses applying for SBIR grants to plan beyond Phase I to Phase II and Phase III all the way to full commercialization. The NSF SBIR program participates in outreach conferences across the nation to educate the small business community on the goals of the SBIR program and emphasizes the need for commercialization focus when applying for a NSF SBIR Phase I grant.

All Phase I grantees are given an opportunity to compete for Phase II grants upon completion of their Phase I research. Phase II proposals require not only a research plan, but also a commercialization plan. External assessments of the program by NSF SBIR Committee of Visitors (COV) noted that commercialization plans for Phase II proposals were not of the same quality of the technical plans. Partially in response, in 1999, SBIR introduced a Phase I training workshop "Doing Business with the NSF" in which the Phase I grantees are provided training in preparing commercialization plans as well as in other aspects of the Phase II submittal process.

In 2001 NSF initiated a contracted Commercialization Planning Assistance (CPA) program for all Phase I grantees using technical assistance set-aside funds. The success of the CPA program in developing commercialization plans was confirmed by subsequent external assessments by the COV that analyzed Phase II proposals received from 2001-

2003 and the subsequent COV that analyzed proposals from 2004-2006 as well as from the comments from the business reviewers of the commercialization plans.

A similar commercialization assistance program for Phase II awards is under consideration.

In 2001 SBIR began an Annual Phase II Grantees Conference that featured reviews of technical and commercial progress, networking among grantees and potential investors, and training sessions on intellectual property protection, licensing strategy and investment strategies. Both the small business and the investment communities have endorsed these conferences. They are continuing as an annual event.

Since 2000, NSF SBIR program management has been transformed into an electronic process from the receipt of proposals, through the decision notification, and progress reports and payments. This process has shortened the dwell times from submission to decision notification as well as more timely report review and payments.

Bridging the Gap

In 1998 NSF SBIR introduced a new supplemental program called Phase IIB as an incentive for partnering between the small business and investment communities. This was introduced as a public private partnership with a shared risk to advance the innovation research towards commercial readiness. The NSF supplemental proposal is submitted while the company is conducting the Phase II research. With Phase II research underway the small business is better positioned to attract investors because most of the earlier research risk has already been addressed with NSF funding.

Supplemental NSF funding can be targeted at fine-tuning the research to address the needs of the investor, customer or strategic partner. The SBIR program requires that third party commitments be double the level of supplemental funding from NSF. The Phase IIB supplement was initiated to ‘fill the gap’ between the $500,000 from an NSF Phase II grant and commercialization. The supplemental funding ranges between $50,000 and $500,000. Third party investors included both public and private sectors. For supplements over $250,000, the small business must do a site visit to NSF with their investor. The Phase IIB program at NSF has been tremendously successful.

In 2006 the NSF SBIR program introduced a new supplemental funding opportunity, modeled after Phase IIB, called Phase IB to Phase I grantees to foster partnerships between strategic partners and investors and the SBIR companies. NSF offers a mechanism to advance Phase I research, bridge the gap between Phase I and Phase II funding while encouraging partnering as a means to increase the potential for SBIR/STTR grantees to successfully commercialize their technology.

Through this supplemental program, small businesses can effectively leverage funding and investment from interested outside parties - that could lead to successful commercial products and processes and at the same time provide some of the gap funding required to

carry the grantees' effort from Phase I to Phase II. The maximum supplemental Phase IB award is $50,000 of NSF funding based on $100,000 of outside funding. For outside funding less than $100,000, the supplemental amount of NSF funding is determined on the basis of 50% of funding provided by the outside party. This recent gap funding incentive has already attracted considerable interest from Phase I grantees.

The NSF SBIR participates in venture forums and other networking opportunities to publicize the NSF programs. The SBIR program officers have built personal relationships with members of the investment community to help make them aware of the opportunities with the small business community.

The NSF has also created 'SBIR MatchMaker' to encourage contact between investors and grantees. Members of the MatchMaker program as well as other potential strategic investment partners are invited to the annual Phase II Grantees Conferences to review technologies to see if it is potentially valuable to the investor. At the same meeting the industrial companies presented overviews of their own product requirements and identified technologies they are seeking to acquire. To stimulate interest by investors and strategic partners NSF has compiled a CD containing all Phase II awards over the span of the last five years and grouped by solicitation topics and subtopics representing a wide spectrum of technologies. This information is also available and searchable on the NSF SBIR website. The SBIR MatchMaker list of investors and strategic partners has grown to almost 50 potential third party partners and several 'matches' have been made.

NSF Unique Role

Since NSF is not the ultimate customer of the innovation stimulated by the SBIR program, the NSF SBIR research topics are oriented to the external needs of the market place and the nation as a whole.

The solicitation topics fall into the following three broad areas:

- *Investment Business Focused Technology*: The NSF SBIR program encourages public-private innovation partnerships. Technologies of interest to private sector investment businesses include *biotechnology, electronics technology and information-based technology.*

- *Industrial Market Driven Technology*: The NSF SBIR program identifies technologies of interest to the large business that the small business community can respond such as *advanced materials and manufacturing and chemical based technology.*

Technology in Response to National Needs: The NSF SBIR program also targets certain recognized national needs.

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Security-Based Technology (ST)

International terrorism triggered a heightened national need for security. Since NSF is already investing in the areas of Nanotechnology, Biotechnology and Information Technology, the SBIR program supports proposals that address security opportunities at the intersection of one or more of these technologies.

Manufacturing Innovation (MI)

In response to Executive Order 13329 requiring all federal agencies with SBIR programs to emphasize manufacturing research, the NSF SBIR is positioned to stimulate innovation in other technologies in support of national needs.

In addition, small business innovations provide tools to further advanced research and education by academia. Some examples include robust remote sensors for geosciences, enhanced data gathering by atomic force microscopes for materials science and biosciences and education software for bringing science to elementary schools.

NSF makes extensive use of the SBIR External Advisory Committee that meets semiannually as well as special workshops to secure input on research topics to be included in the solicitations for Phase I proposals that are updated every six months.

SBIR Role in Workforce Development

The NSF has a very successful supplemental program - Research Experience for Undergraduates (REU) - to attract undergraduate students to careers in research. This was recently expanded to include K-12 teachers through the Research Experience of Teachers (RET) supplemented program. The Research Assistantship Supplements for High School Students (RAHSS), which support active research participation by high schools students in the SBIR Program, is intended to broaden the participation of women and minority students in both academic and small business research and thereby foster interest in pursuing science, technology and engineering at the college level.

The SBIR grantees perceive these programs as very attractive supplements and are glad to offer students and teachers an opportunity to experience the small business research environment. In addition, the small business has an opportunity to attract and hire students as their businesses grow. Recognizing that the small business is the major employer of scientists and engineers in the U.S., these supplemental programs help train the future workforce of scientists and engineers for their careers.

The Small Business Innovation Development Act stipulates - ‘Foster and encourage participation by minorities and disadvantaged persons in technological innovation’. Currently participation by minority- and woman-owned businesses in the NSF SBIR/STTR program averages 20% overall with a ratio of 2:1 between minorities and women. There is a need to be proactive to expose qualified minority and women owned businesses to the competitive opportunities in the SBIR program.

In 2005 the SBIR program initiated a contracted field representative position to give special priority to mentoring minority and other small businesses that are classically under-represented in the SBIR program and thereby increasing their skills to compete on a national level in the small business programs offered by the Federal government. In collaboration with the SBIR External Advisory Committee and the Engineering Directorate Program Director for Diversity and Outreach, the NSF SBIR program has embarked on a number of programs to enable qualified minority and women to compete in the small business community.

SBIR has initiated a partnership (Phase IIA) with the Centers for Research Excellence in Science and Technology (CREST) program in the NSF Education and Human Resources (EHR) Directorate to offer supplements to SBIR Phase II grants to partner with the predominantly minority CREST academic research institutions. The goal of this pilot supplemental program is to encourage researchers from CREST institutions to conduct basic research that has a direct consequence to the SBIR grantee and expose minority researchers to opportunities in the small business sector. The Phase IICC program awards research supplements to Phase II grantees that are able to host a research team from a minority-serving community colleges (MSCC). This supplement opportunity is intended to further SBIR Phase II research and facilitate progress toward their grant goals while providing a substantial scientific research experience for the MSCC research team.

Historically the SBIR program has collaborated with the Experimental Program to Stimulate Competitive Research (EPSCoR) to co-fund SBIR awards to small businesses in EPSCoR designated states. This program has had a positive impact on that community. The EPSCoR program also supports SBIR outreach in those areas.

Building Partnerships

Recently the NSF SBIR program announced two new partnership programs for SBIR Phase II grantees designed to stimulate collaboration between academia and the small business community.

The first program invites supplemental requests from Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) grantees to join an Industry/University Cooperative Research Centers (I/UCRC). These centers conduct research directed to the needs of specific industries.

The second program aims to open the doors for NSF SBIR Phase II Grantees to benefit from the research performed at Engineering Research Centers (ERCs) and for the ERCs to benefit from the role of small firms in carrying out research to speed research results into commercial products. Supplemental funding will enable the ERCs and SBIR Phase II grantees to perform collaborative research.

SBIR Outreach

Since its inception in the early '80s, the NSF SBIR program has taken a leadership role in organizing national conferences to attract small businesses to participate in the SBIR programs. Currently, all eleven (11) federal agencies that implement the SBIR program participate in two national conferences each year. In order to stimulate small businesses outreach in the rural states, conference sites are selected such that these outreach national conference are regularly scheduled in locations such as EPSCoR states.

The NSF SBIR External Advisory Committee recognizes the federal leadership achievement of NSF in support of the small business community outreach and is encouraging SBIR to move on to the next important role of providing mentorship and assistance to the small business grantees base. Beginning in FY 2007, the individual states, in collaboration with the 11 participating federal agencies, have taken over the national conference planning.

The NSF SBIR is channeling more of its resources to the mentorship of small business grantees (i.e. the Phase II CAP under development). The individual states are increasingly proactive in attempting to bring more federal SBIR dollars into their regions as part of economic development in their region. The NSF SBIR supports and participates in States' efforts subject to the limited availability of time and travel funds. Invitational travel for outreach from the EPSCoR states is often supported by the NSF EPSCoR program.

Historically over 50% of the NSF SBIR Phase I awards are made to new investigators each cycle. This is considered strong evidence that the outreach efforts are having a positive effect.

Measuring Success

Assessment of the outcome of awards in the SBIR program is essential to determining the value created by the program. While anecdotal information has been broadly collected, the systematic collection of commercialization results on individual awards has been problematic to collect and systematically analyze. The NSF SBIR Phase II awardees were asked to provide a Commercialization Report for five years after the conclusion of the award. Compliance to this request was inconsistent at best.

In 2005, the NSF SBIR program developed a telephone interview process (endorsed by the SBIR External Advisory Committee) to gather commercialization information on the 3rd, 5th and 8th anniversary of the receipt of the Phase II award. The telephone interview is part of the expanded awards management responsibilities of the program manager. The information on the company, the current status of commercialization, the products and/or services developed, why commercialization may have failed, intellectual property situation, key strategic and /or investor relationships, and employment statistics is collected for a data base for subsequent analysis and regular reports.

The telephone interview process has had a contact success rate of 87% and indicated that 29% have measurable revenue after one year to $1 million revenue after 6 years as a

consequence of the NSF SBIR Phase II award. Companies claiming success note strong intellectual property positions, strong academic collaborations, and strong ties to market leaders as major reasons for success. Of the companies that noted that they were unsuccessful 39% cited technical problems while 61% had market-based issues.

The program is continuing to refine the information collection and the data analysis and reports on the finding at each External SBIR Advisory Committee Meeting.

Areas for Improvement

Over the last 7-8 years the SBIR program has significantly increased the emphasis on commercialization planning and private sector commercialization success. Given this emphasis it seems reasonable to evaluate the provisions of the SBIR reauthorization legislation for discretionary technical assistance to determine if they are adequate.

A Committee of Visitor (COV) evaluation of the SBIR program was conducted on January 23-24, 2007 based on programmatic information from 2004 through 2006. The COV found the integrity and efficiency of the program's processes and management to be sound and the results of NSF's investments in the SBIR program were meeting the goals of the program. The COV and the SBIR External Advisory Committee in analyzing the COV report recommended (1) that the Phase II award impact study (via telephone) be maintained and that an independent research organization be retained for the analysis of the data and in enhancing the interview tool to better capture key success metrics; (2) commercial reviewers be used earlier in the review process (Phase I) and that they be trained in the various commercialization models endorsed by the program; (3) that more funds be made available for the Phase II awards management process, such as site visits and external outreach as well as the establishment of a comprehensive Phase II commercialization assistance program that allows for the technical and geographic dispersion of the grantees and (4) documentation of standard processes and procedures to train new program directors.

Mr. Chairman, this concludes my testimony. I would be pleased to provide any additional information that would be useful to you.