



# **DIVISION PLAN**

**DIVISION OF  
INDUSTRIAL INNOVATION AND PARTNERSHIPS (IIP)**

**DIRECTORATE FOR ENGINEERING**

**NATIONAL SCIENCE FOUNDATION**

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## EXECUTIVE SUMMARY

The Division of Industrial Innovation and Partnerships (IIP) was established in 2006 and is one of five (5) Divisions in the Directorate for Engineering (ENG) at the National Science Foundation (NSF). The Division's vision is to be the pre-eminent federal resource driving the expansion of our nation's innovation capacity by stimulating partnerships among industry, academe, investors, government and other stakeholders. The Division's mission is to enhance our nation's economic competitiveness by catalyzing the transformation of discovery into societal benefits through stimulating partnerships and promoting learning environments for innovators. IIP manages the Small Business Innovation Research (SBIR) Program, the Small Business Technology Transfer (STTR) Program, the Industry/University Cooperative Research Center (I/UCRC) Program, the Grant Opportunities for Academic Liaison with Industry (GOALI) Program and the Partnerships for Innovation (PFI) Program for the Foundation.

The IIP Division Plan is part of the overall NSF Strategy. In particular, the plan fits the ENG strategic direction to "strengthen technological innovation," aligns with the 2006-2011 NSF Strategy to strengthen the nation's collaborative advantage by developing unique networks and innovative partnerships, and responds to the American Competitiveness Initiative (ACI) and the America COMPETES Act (ACA). In this context, five major goals are identified:

1. **Innovation Partnership:** enhance our nation's innovation capacity through public and private partnerships.
2. **Global Innovation Leadership:** cultivate innovation by promoting the exchange of discoveries, technologies and expertise between industry and academe.
3. **Pre-eminent, Globally-Adept Workforce:** stimulate the growth of a competitive workforce by encouraging innovation through relevant training and education.
4. **Increased Commercialization:** enhance the commercial success of business opportunities arising from innovative research through partnerships with the industrial and investment sectors.
5. **Stewardship:** maximize the division's impact on the nation's economy by continually improving the effectiveness of operations and developing and sustaining a world-class team.

The plan presents each of these goals and their objectives with a recommended implementation strategy. To efficiently manage available IIP resources, action steps are prioritized with those marked in **bold** targeted for initial implementation.

## STRATEGIC APPROACH

In the long-term the IIP Divisional Plan must respond to the American Competitiveness Initiative (ACI) and the America Competes Act (ACA) by contributing to the NSF strategy and in the medium term develop a compelling rationale for accelerated

investment growth in Division programs. IIP must play a pro-active role in accelerating the innovation process, to increase industry participation in university research, and stimulate entrepreneurship and commercialization. NSF-funded research supports the discovery that enables innovation—it is discovery *for* innovation. The IIP supports both industry and academia such that innovation can realize commercialization—it is discovery *to* innovation.

IIP grants are designed to support businesses at the early investment stages when technical risk is highest but when financial and other support could aid in taking NSF-enabled transformational research and move ideas to the marketplace. Unfortunately, there is a demonstrated negative trend in early-stage private sector investment, with venture capital firms often abandoning ideas at this crucial stage. Large industries have moved away from early stage research and are seeking a higher degree of technology completion for potential insertion into their firms. There is an immediate need to address global technology competitive threats and forestall the appropriation of U.S. innovations wherein the United States makes the discoveries only to have the applications and products developed elsewhere and then sold back to this country.

IIP will systematically facilitate the acceleration of the use of basic research results to impact U.S. innovation capability. It will also invest in cutting-edge, high risk, high-quality research in science, engineering and education through its four programs. The goal in all these investments is to promote innovation that benefits society and the nation through successful commercialization. Effective ways will be found to leverage and exploit synergistic relationships among the innovation-oriented programs in the division and to achieve fruitful partnerships with the academic and industrial sectors. New models of innovation arising across the country must be further nurtured and developed to accelerate innovation and to increase the efficiency of innovation processes. The Division will develop performance metrics and outcomes assessment modalities to achieve an efficient integration among the various programs to show its significant impact on the innovation capability in the country.

## **ORIGIN OF IIP PROGRAMS**

### **Small Business Innovation Research Program**

As early as 1976, Roland Tibbetts and Ritchie Coryell of NSF initiated a new program for the support of the small business community, specifically to provide early-stage financial support for high-risk technologies with commercial promise. In 1980, under the Carter Administration, a White House Conference on Small Business recommended that a program for small business innovation research be created. Congress responded under the Reagan Administration with the passage of the Small Business Innovation Research Development Act of 1982 (SBIDA, Public Law 97-219, codified as 15 U.S.C. 638). The Industrial Innovation and Partnerships (IIP) Division of the Directorate for Engineering (ENG) is responsible for the implementation of the SBIDA.

The history of the federal Small Business Innovation Research (SBIR) program tracing from its origin at the NSF in 1976 up to 2002 is described in a National Academies publication entitled, *SBIR Program Diversity and Assessment Challenges* (<http://books.nap.edu/catalog/11082.html>). The Small Business Innovation Research (SBIR) program and the Small Business Technology Transfer (STTR) program were initially located in the Division of Design, Manufacture and Industrial Innovation (DMII) from 1994 to 2004. To highlight contributions of the above two legislated small business community programs and to advocate for a stronger innovation role for ENG, these programs were moved out of DMII and a separate Office of Industrial Innovation (OII) was established in 2005.

The SBIR program encourages partnership between the profit-seeking small business community and the academic community, while the STTR program mandates this partnership. Other than this difference, both programs are managed identically at NSF. The Small Business Innovation Research (SBIR) and the Small Business Technology Transfer Programs are a highly competitive three-phase award system which provides qualified small business concerns with opportunities to propose innovative ideas that meet the specific research and development needs of the Federal Government. Phase I is the feasibility phase with awards of up to \$100,000 made to the small business for approximately six (6) months in SBIR and twelve (12) months for STTR that support exploration of the technical merit or feasibility of an idea or technology. Phase II awards of up to \$500,000, up to two (2) years, are awarded to expand Phase I results. All Phase I grantees are eligible to apply for Phase II awards to conduct a full-fledged scientific and engineering research effort to complete technical milestones as a pre-requisite for further commercialization. Phase III is the period during which Phase II innovation moves from a prototype in the laboratory to the marketplace. No SBIR funds support this phase. The small business must find funding in the private sector or other non-SBIR federal agency funding.

The Small Business Administration (SBA) (<http://www.sba.gov/sbir>) is responsible for setting SBIR/STTR operational guidelines. All federal agencies submit annual reports to the SBA on SBIR/STTR 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/STTR programs and issues reports and recommendations to Congress.

### **Industry/University Cooperative Research Program**

The Industry/University Cooperative Research Centers (I/UCRC) program was initiated in 1973 to develop long-term partnerships among industry, academe and government. Alex Schwartzkopf is the founding program director who has nurtured and grown the program to a strong academic-industry partnership network. The National Science Foundation invests in these partnerships to promote research programs of mutual interest, contribute to the Nation's research infrastructure base and enhance the intellectual capacity of the engineering workforce through the integration of research and education.

Each center is catalyzed by a small investment from NSF and then primarily supported by center industry members, with NSF then taking a supporting role in their development and evolution. The centers are encouraged to have a multi-institutional base. This program initially offers five-year awards to centers, allowing time for development of a strong partnership between the academic researchers and their industrial and government members. After five years, centers that continue to meet program requirements may apply for a second five-year award. These awards allow centers to continue to grow and diversify their non-NSF membership. After 10 years, the centers are expected to be fully supported by partners from industry, other Federal agencies, and state and local governments. A center can re-compete for a new cycle after 10 years only if the proposed center involves significant new intellectual substance.

### **Partnership for Innovation Program**

The U.S. Congress initiated the Partnerships for Innovation (PFI) program in 2000 to enable stimulation of our Nation's innovation leadership and contribution to the U.S. economy and society through partnerships between academic institutions and other entities (e.g., private sector, government, economic development organizations, etc.). The PFI mission is to advance partnering arrangements that lead to sustainable economic and social outcomes through innovation; and to support high-impact projects with potential for replication and/or national-level implementation. The goals are to stimulate the transformation of knowledge created by the research and education enterprise into innovations that create new wealth; build strong local, regional and national economies; improve the national well-being; broaden the participation of all types of academic institutions and citizens in NSF activities to more fully meet the broad workforce needs of the national innovation enterprise; and to catalyze or enhance enabling infrastructure necessary to foster and sustain innovation in the long-term.

### **Grant Opportunities for Academic Liaison with Industry Program**

A major objective in NSF strategy is to improve the nation's capacity for intellectual and economic growth by increasing the number of partnerships and collaborations between industry and academe. Grant Opportunities for Academic Liaison with Industry (GOALI) is an NSF cross-directorate program that meets this NSF strategic objective by connecting universities and industry for their mutual benefit. Industry outlines new technical challenges and assists in the support of academic institutions. By serving as a catalyst for industry-university partnerships, NSF helps ensure that intellectual capital and emerging technologies are brought together in ways that promote economic growth and an improved quality of life.

GOALI was launched in 1993 with two experimental awards, and ENG began awarding GOALI grants in 1994. The next year, the initiative grew to include the Directorates for Mathematical and Physical Sciences (MPS) and Computer and Information Science and

Engineering (CISE). The initiative has been so successful that it was expanded in 1996 to include all NSF directorates. The GOALI program seeks to fund research that lies beyond that which industry would normally fund. Benefits to universities may include extensions to in-house research capabilities; alignment of efforts with viable technology options; direct and more immediate impact on technology and its design infrastructure; and the training of students for industrial positions. Possible benefits for industry include more research-intensive activities, investigations of high-risk ideas, increased manpower for research, the training of students for future employment, and vetting of future hires.

## **I. INNOVATION PARTNERSHIP GOAL**

**Enhance our nation’s innovation capacity by promoting and accelerating the development of sustainable networks of public and private partnerships.**

### **Objective A: Invest in Internal Partnerships**

The relationship within NSF between the IIP program officers and the program officers overseeing discipline-based programs are being reinforced and stimulated. Active efforts are underway to create partnerships between IIP and other divisions in various NSF Directorates like the Mathematical and Physical Sciences (MPS), Computer and Information Science and Engineering (CISE), Geosciences (GEO), Education and Human Resources (HER), Biological Sciences (BIO) and Social, Behavioral and Economic Sciences (SBE). In the past, the I/UCRC, PFI and GOALI programs operated independently. Efforts are also underway to form partnerships between the various divisions in the ENG Directorate. An example of this is the recently introduced supplement program for SBIR/STTR Phase II grantees to work with an Engineering Research Center (ERC). These centers are administered by the Division of Engineering Education and Centers (EEC). Opportunities to build synergistic relationships between the various programs within the division are also being sought. An example of this is the recently introduced supplement program for SBIR/STTR Phase II grantees to become members of an I/UCRC.

### **The Operation Plan**

- 1. Implement the Engineering Research Center (ERC)-IIP partnership plan.*
- 2. Implement a supplement program for small businesses in I/UCRC and extend this to GOALI and PFI.*
- 3. Develop a White Paper on “Modeling & Simulation of Innovation” in collaboration with SBE to position for a future topic within the Office of Emerging Frontiers in Research and Innovation (EFRI).*
- 4. Expand GOALI outreach to other directorates.*
- 5. Match SBIR/STTR companies with other engineering programs such as nano-science, energy and cyber-infrastructure that align with NSF priority areas and ENG themes.*
- 6. Explore science and engineering research across NSF that are “ripe” for innovation.*
- 7. Increase collaboration with other NSF Directorates, such as Mathematical and Physical Sciences (MPS), Computer and Information Science and Engineering (CISE), Geosciences (GEO), Education and Human Resources (HER), Biological Sciences (BIO) and Social, Behavioral and Economic Sciences (SBE).*



8. *Expand the collaboration with EPSCoR.*

**Objective B: Invest in External Partnerships among Academe, Industry, Investors, Government and Other Entities**

The IIP program officers have strong relationships with faculty members, particularly younger faculty who are working at the frontiers of research. These younger faculty members are eager to serve as reviewers and wish to participate more in IIP programs. In fact, some express interest in knowing and following the progress of the grantees that they had recommended for awards. Additionally, the IIP program officers also have good relationships with leaders of academic departments across the nation. Uniformly, the department heads, especially from smaller universities, encourage their faculty to actively participate in and support the division's programs by acting as reviewers. The degree of partnership between academia and small businesses varies. In instances where academia is the lead, such as faculty-founded small business or university-led STTR partnerships, the relationship is naturally strong. In other cases, it is often the small business that initiates contacts with a recognized faculty member, often seeking consulting agreements. Even in these instances, the small business tries to maximize its research dollars by avoiding subcontracts with universities to avoid overheads. They prefer the faculty consultancy route unless the subcontract is mandated, as it is in STTR. The partnership with academia can be enhanced both by encouraging small businesses to more effectively work with academia to transform discovery into innovation, and also by actively supporting emerging small businesses rooted in university-based technology toward commercialization.

I/UCRC and PFI programs draw on experienced faculty members who have strong connections with industry and with state, federal, and other entities. The GOALI program is built with industry-connected faculty members. The Matchmaker program is an effort to match IIP Phase II Grantees with strategic industry partners and/or venture capital firms and angel investors. The partnership with industry can be further strengthened by increasing the interaction with the Industrial Research Institute, an association of companies founded by the National Research Council in 1938. The partnership can also be strengthened by making the division's Matchmaker program more effective, and by leveraging synergies among SBIR/STTR, I/UCRC, PFI and GOALI. The division is actively promoting relationships with investor communities and entrepreneurial support entities through partnering with organizations such as the Kauffman Foundation, the MIT Enterprise Forum, the National Venture Capital Association and the Angel Capital Association. IIP Program Officers are also exploring collaborations with university technology transfer managers and other federal agencies.

**The Operation Plan**

1. *Strengthen the partnership with the Industrial Research Institute (IRI) through the MatchMaker Program.*
2. *Strengthen the partnership with the Kauffman Foundation.*

3. *Explore IIP collaboration with other federal agencies.*
4. *Strengthen the partnership with Angel Capital Association (ACA).*
5. *Strengthen the partnership with the MIT Enterprise Forum.*
6. *Strengthen the partnership with the National Venture Capital Association (NVCA).*
7. *Strengthen the partnership with the Association of University Tech Transfer Managers (AUTM).*
8. *Explore opportunities for SBIR companies to further their use of the National Nanotechnology Infrastructure Network (NNIN).*

## **II. GLOBAL INNOVATION LEADERSHIP GOAL**

**Cultivate the creation of innovative, globally competitive products, processes and services by promoting the exchange of discoveries, technologies and expertise between industry and academe.**

### **Objective A: Create Platforms and Fora for Effective Knowledge Exchange**

It is critical to create and sustain robust mechanisms for exchange of knowledge among innovation stakeholders such as NSF, small business entrepreneurs, universities, investors and large industry. Global competition, the creation of worldwide innovation hotspots and centers of innovation, the use and practice of new innovation concepts (e.g. Open Innovation), directives such as the American Competitiveness Initiative (ACI) and the America Competes Act (ACA), and the need to demonstrate the impact of NSF funding make this objective imperative. What must be implemented is an effective and continuing effort to sponsor fora on innovation and commercialization, which in turn will catalyze communication by bringing together researchers, innovators, entrepreneurs and investors. IIP will sponsor and participate in vertical fora on specialized topics that reflect current technology trends, and also sponsor fora at national and international technical and business conferences.

### **The Operation Plan**

- 1. Sponsor fora on innovation and commercialization, e.g., distinguished lectures on innovation.*
- 2. Sponsor vertical fora on specialized topics, e.g., alternate energy, security, greentech, biofuels, nano.*
- 3. Sponsor fora at technical conferences.*

### **Objective B: Identify and Capture Opportunities to Stimulate Innovation**

Many studies and reports show that certain U.S. universities have developed best practices for commercializing research ideas and concepts. It is important that IIP program officers build and cultivate relationships with these universities in order to leverage these best practices as tools to stimulate innovation opportunities in an even larger set of U.S. universities.

IIP will develop an interactive and more user-friendly Web site (e.g. IIP 101, a course that explains programs, opportunities, the characters, the funding options, etc.) to cultivate and nurture the innovation marketplace. The goal is to increase deal flow so that IIP has the right opportunities to fund research ideas having high-risk and high-payback. Many researchers with ideas that could have high impact are not seeking IIP support. The

division can seek these researchers out by more actively mining for innovative ideas; by tracking and studying the effectiveness of leading innovation centers around the world that are affiliated with industry, government and universities; and by tracking the efforts by large industry and studying their associated case studies. A good source of global innovation outlooks and technology trends are those described in annual reports published by large investment banks.

IIP program officers must develop new models of innovation by working more closely with investors, university administration, and small and large industry. They must also work at proactively identifying ‘matchmaking’ opportunities for NSF-funded research.

### **The Operation Plan**

- 1. Build relationships with the top ten “commercialization” universities to identify better opportunities to stimulate innovation.*
- 2. Create a marketplace for innovation and increased deal flow (e.g., provide opportunities through the division Web page and use of other Web-based tools; create a database of leading innovation centers; mine fora for innovation opportunities).*
- 3. Empower panelists to act as advocates of IIP when addressing university faculty, students and administration.*
- 4. Investigate and support ERC innovation opportunities.*

### **Objective C: Facilitate and Enable the Innovation Process in Academic Institutions**

Education is the key component to meeting this objective. IIP program officers can increase their efforts to educate university researchers about the commercialization process. They can conduct regular workshops at universities to promote better and more robust partnerships. Other goals are to help develop better performance and promotion metrics for younger faculty, particularly those funded by NSF (e.g. post-CAREER grantees); to better recognize opportunities; to streamline innovation processes; and to better enable the entire innovation process chain in universities. A sustained effort must be made to change the innovation culture in academe by working effectively with open-minded and future-leaning university administrators, in order to facilitate trusting, long-term relationships. We must inspire leading young researchers at universities to innovate, by educating them and the technology transfer professionals about open innovation, and help get their ideas to the marketplace to benefit society.

IIP will seek ways to leverage the I/UCRC model and other IIP programs such as GOALI and PFI to facilitate the innovation process at universities. Pathways connecting engineering, science and business schools can be created by working with appropriate organizations, such as the Kauffman Foundation, to educate university administrators and potential innovators with new innovative technology transfer models—such as spin-offs versus working with existing small businesses versus working with large industry.

Leading U.S. universities, such as Stanford, Purdue, and Georgia Tech, are already practicing these models.

### **The Operation Plan**

1. *Establish a regular workshop series on innovation to disseminate information to university, investment and industrial stakeholders on the power of effective partnerships.*
2. *Investigate intellectual property transfer to already existing small businesses versus university spin-offs, to accelerate the innovation process.*
3. *Enhance partnership opportunities with NSF post-CAREER grantees.*
4. *Create links and pathways between engineering, arts and sciences and business schools.*
5. *Enhance “Opportunity Recognition” and target IIP 101 for the most “entrepreneurial” universities, including “Kauffman” campuses (see <http://www.kauffman.org/items.cfm?itemID=475>).*
6. *Facilitate a change of culture by addressing, for example, how faculty members are recognized, attitudes about working individually versus collaborating, or ideas about tenure issues.*

### **Objective D: Identify and Disseminate Successful Intellectual Property Models to Enhance Innovation Efficiency**

Intellectual Property (IP) issues are among the most complex and by far one of the most vexing issues that befuddle researchers, potential innovators, university administrators and industry in their efforts to commercialize research. The entire IP ownership issue needs to be systematically addressed through coordinated efforts among industry, universities and government. It needs to be carefully studied by sponsoring and conducting workshops on IP ownership, its use and transfer, so as to disseminate knowledge about new models of IP usage and sharing.

There exists a plethora of IP reports published from around the world on IP best practices and knowledge. Examples are reports from the National Academies’ Government University Industry Research Roundtable (GUIRR) and the 2006 review of IP law in the United Kingdom by Andrew Gowers. Sharing this information effectively can improve understanding of this issue and help in determining new, innovative models to tackle this often intractable problem. Urgently needed are benchmarking guidelines, standard practices and uniform outcomes measures. It may be necessary for universities to change current Technology License Office (TLO) business models and practices, and for new and more appropriate metrics to be developed for their more successful operations and increased revenue generation.

## The Operation Plan

1. *Create ways of establishing ‘Trust’ or ‘Alignment of Interests’ (e.g. backdoor issues—benchmark, standards, structures; work of National Academies’ Government-University-Industry-Research Roundtable).*
2. *Enhance the rate of successful technology transfer from universities by leading efforts for developing a fair, sustainable, universal set of technology transfer standards/best practices. Pursue this effort in partnership with public and private universities and with leaders in the investment community. For example, encourage the use of the ‘right’ metrics by Technology Licensing Offices (TLO), or sponsor/conduct seminars on negotiating licenses.*

## Objective E: Select Program Themes to Support Innovation Leadership

At the start of the SBIR/STTR program, solicitation topics were aligned with NSF scientific and engineering directorates, divisions and programs resulting in twenty seven (27) topics and more than a hundred sub-topics for which small businesses could submit proposals. This methodology supported high-quality scientific and engineering research. However, many small businesses encountered difficulties in attracting private investors. The business sector is not organized along the lines of math, science and engineering disciplines but uses the discoveries from these disciplines to develop new technologies for implementation using a business model to stake out a competitive position. It became clear that the program solicitation was not oriented to increase private sector commercialization of innovations derived from federal research and development. Therefore, the SBIR/STTR program aligned the solicitation topics with external investment and market opportunities and simultaneously preserved the science and engineering alliances with NSF directorates.

I/UCRC and PFI programs draw on innovation opportunities identified by industry and the Science, Technology, Engineering and Mathematics (STEM) community. For example, research projects at I/UCRC centers are chosen by the Industrial Advisory Board (IAB) providing a strong connection between pre-competitive research and the commercial interests of industry. GOALI is naturally aligned with industry-led engineering research topics. It is clear that IIP programs encourage partnerships between small and large businesses and academic researchers in order to move the emerging discoveries from NSF-supported academic research into the private sector.

The collapse of the 1990s dotcom industry suggested that the large number of business ventures focused on a single industry lacked strategic value. At the same time, continued job erosion in the core industry sectors suggested that businesses needed to rethink how they determined market directions. This need affects IIP as well, which must be sure its programs are aligned with national needs. Such alignment requires the identification of

technologies with external investment/market focus; second, a strategy to best leverage emerging discoveries from NSF-supported STEM research as subtopics; a determination of how emerging technologies respond to national priorities set forth by the Administration; and pursuit of the goal to address other emerging or pressing societal needs.

NSF/IIP is a research-funding entity that underwrites the technical risk of new research before the private sector investment market is willing to. NSF does not buy any products or processes resulting from these research investments and is not the ultimate customer of the innovation stimulated by IIP research funding. Therefore, NSF is not a funding resource for large businesses beyond nurturing and growing I/UCRC centers to attract industrial board members and is not a funding resource for small businesses beyond SBIR/STTR Phase II support and does not fund Phase III product development and commercialization of research results. The I/UCRC program supports a wide range of industrially relevant research. Below is the list of topic areas supported by various centers:

A.           ENG Multi-University Centers

- Advanced Forestry
- Built-Environment
- Ceramic and Composite Materials
- Computational Materials Design
- Dielectrics
- Friction STIR Processing
- Fuel Cells
- Laser and Plasma for Advanced Manufacturing
- Logistics and Distribution
- Membranes
- Minimally Invasive Diagnostics
- Multi-Phase Flow
- Precision Forming
- Repair of Building and Bridges
- Sensors and Actuators
- Smart Vehicles
- Water Quality

B.           ENG Single-University Centers

- Advanced Studies in Novel Surfactants
- Nondestructive Evaluation
- Advanced Vehicle Electronics
- Bio-catalysis and Bio-processing of Macro-molecules
- Bio-molecular Interaction
- Electronic Micro-cooling
- Child Injury Studies

Precision Metrology

C. CISE Multi-University Centers

Cyber Protection

e-Design

Embedded Systems

Experimental Computer Systems

Identification

Intelligent Maintenance

Reconfigurable Computers

Search & Rescue Robots

Wireless Internet

Management of Information

Telecommunications

Autonomics

The SBIR/STTR solicitation topics fall into three broad areas:

- A. Technology focused on investment business
- B. Technology driven by the industrial market
- C. Technology that responds to national needs

A. Technology focused on investment business: The venture capital community is small, organized and well networked. Their investment tends to be regional and occasionally national. In contrast, angels (individual wealthy investors) and angel networks are not equally well organized and tend to be local, and their investments are not widely known. These private-investment funding sources represented by the venture capital community and angel networks are significant. However, they tend not to invest in start-ups at an early stage. Moreover such investment from private sources is not available nationally. IIP programs fill this gap in the national innovation model by stimulating public-private innovation partnerships. Technologies of interest to private-sector investment businesses fall into three broad areas. SBIR/STTR solicitations encourage the small-business community to submit proposals aligned with the following technologies, which are listed in the order of decreasing time scales to obtain a Return On Investment (ROI) for the investment community:

1. Biotechnology (BT)
2. Electronics Technology (EL)
3. Information Based Technology (IT)

B. Technology driven by the industrial market: Large industries invest in innovations that provide leverage in building strengths in manufacturing, distribution, and market presence. The majority of them are Fortune 500 businesses and each has its own core competencies and technology base. Large businesses are increasingly



abandoning internal investment in early stage research and are seeking instead to leverage academic and small-business research. The IIP Division is in a unique position to orient its funding to create public-private partnerships by identifying where small businesses can pursue market-driven technologies of interest to the large businesses. The Industrial Advisory Board of I/UCRC grantees and industrial partners in GOALI and PFI are predominantly large businesses.

Beyond the three technologies (BT, EL, IT) already identified, two broader technologies interest the large-business community. SBIR/STTR addresses them with these solicitation topics:

1. Advanced Materials and Manufacturing (AM)
2. Chemical Based Technology (CT)

- C. Technology that responds to national needs: At times, national needs arise to which the private sector cannot immediately respond with the available technology base. In fact, the genesis of the SBIR and I/UCRC programs hark back to global competitive forces felt by the U.S. automotive and electronic industries in the seventies and eighties. Often, the market is not considered large enough for the private sector to commit to the type of long-term research that would yield technologies for which need often does not exist until an unplanned-for event makes it necessary.

The 9/11 tragedy triggered a heightened national need for security. One result was creation of the Department of Homeland Security (DHS), which seeks immediately available security enhancements and solutions and supports research directed towards short-term solutions. IIP has the flexibility to seek novel innovation research ideas from the small business community that could answer the needs DHS aims to fill. The Division is responding to the gap between short-term needs and long-term goals by emphasizing research that can lead to future products and processes.

Recognizing that NSF is already investing substantial research dollars in the areas of nanotechnology, biotechnology and information technology, IIP has sought proposals that address the frontiers of innovation at the *intersection* of one or more of these technologies.

Another example of a national need is the continuous shift in the U.S. manufacturing base to other countries. In response, the Administration in 2004 issued Executive Order 13329, which requires all federal agencies with small business programs to emphasize manufacturing research as a way to spur innovations in order to reverse erosion of the manufacturing base. The SBIR/STTR program responded with timely solicitation topics noted below and is positioned to stimulate innovation in other technologies in support of national needs:

1. Security Based Technology (ST)

## 2. Manufacturing Innovation (MI)

In addition, small business innovations provide tools to further advance the research and education conducted by academia. Some examples include robust remote sensors for geosciences, enhanced data gathering by atomic force microscopes for research in materials science and biosciences, and education software for elementary school teaching.

### **The Operation Plan**

- 1. Conduct workshops to incorporate global industry roadmaps into IIP program themes.*
- 2. Align IIP program themes with Office of Science and Technology Policy national research priorities.*
- 3. Continuously update solicitation topics.*
- 4. Refine and enhance the whole gamut of IIP supplemental opportunities.*

### **III. PRE-EMINENT, GLOBALLY ADEPT WORKFORCE GOAL**

**Stimulate the growth of a diverse, creative and globally competitive workforce by encouraging innovation through relevant training and education.**

#### **Objective A: Apply Divisional Resources to Encourage, Support and Develop the next Generation of Researchers, Innovators and Entrepreneurs**

The next generation of researchers, innovators and entrepreneurs has to be encouraged, supported and developed. One method to educate this group and improve their ability to recognize opportunities is to develop toolkits and Web courses that can be offered through the IIP Web site. IIP programs such as I/UCRC, PFI and GOALI, along with programs and centers of other divisions in ENG (e.g. EEC), can be leveraged to enhance both innovation and recognition of commercial opportunities. The Division can continue to educate targeted groups at fora that include annual meetings of national societies in the many different technology areas. Mentorship for cross-collaboration activities can be encouraged and a better methodology implemented for mining and collecting data strategically so as to find synergies among various IIP programs. The entire gamut of IIP supplemental opportunities among all four IIP programs can be explored and used to possibly tie up with other ENG Division programs (e.g. ERC).

#### **The Operation Plan**

- 1. Develop Phase 0 toolkit (IIP 101) for opportunity recognition.*
- 2. Work with I/UCRC and ERC researchers toward recognizing the feasibility of certain opportunities (e.g. provide the above toolkit).*
- 3. Conduct workshops during national society meetings.*
- 4. Collect additional data on the PFI program.*
- 5. Encourage the utilization of SBIR supplements in PFI.*
- 6. Aim to educate post-CAREER awardees on how to recognize commercialization opportunities.*
- 7. Provide mentorship for cross collaboration among NSF programs.*

#### **Objective B: Apply Divisional and Other Resources to Attract and Develop Personnel for High-Quality Jobs in an Entrepreneurial Economy**

NSF has a very successful supplemental program, Research Experiences for Undergraduates (REU), to attract undergraduate students. The program was recently expanded to include K–12 teachers through the Research Experiences for Teachers

(RET) supplemental program. IIP Phase II grantees perceive these programs as attractive supplements offering students and teachers opportunities to experience the small business research environment. In addition, the small businesses have an opportunity to attract and hire students as their businesses grow. Recognizing that the small business sector is the major employer of scientists and engineers in the United States, these supplemental programs - along with others such as Phase IIA targeted toward minority research institutions and Phase IICC targeted toward community colleges - play a critical role in training the future workforce of scientists and engineers in their careers. Recently, IIP instituted a supplement to help SBIR Phase II grantees become members of an I/UCRC. The challenge is now to increase the number and kind of supplements to support other IIP programs, and to collaborate with REU and RET sites, and perhaps even with the ERC and National Nanotechnology Initiative Network (NNIN) programs.

### **The Operation Plan**

1. *Increase the number of supplements through internships (e.g. GOALI working with EHR and the International Research and Engineering in Education program within ENG).*
2. *Increase REU, RET participation.*
3. *Collaborate with REU and RET sites and NNIN sites.*

### **Objective C: Encourage Diversity among Researchers, Innovators and Entrepreneurs**

Currently, participation by minority- and woman-owned businesses in IIP programs averages 20 percent with a ratio of 2:1 between minorities and women. To date, few efforts have been made to target, attract, mentor and channel minorities and women to compete for IIP funds. There is a need to go beyond data gathering and seek ways to add qualified minority- and women-owned businesses to the competitive pool in the Division's programs. Even though several programs within NSF are designed to encourage minority and female populations to pursue careers in science and engineering, participation by this segment of the population, especially in engineering, is still very low—a situation the Engineering Directorate is working to redress.

This challenge presents an opportunity to partner with other Directorates and with other divisions within ENG to attract scientists and engineers to start small businesses, compete for IIP funds and participate in the federal procurement process. As a start in 2004, IIP initiated a partnership with the Centers for Research Excellence in Science and Technology (CREST) program in EHR. The partnership offers supplements to SBIR/STTR Phase II grants to partner with CREST academic research institutions, which host predominantly minority student populations.

## The Operation Plan

1. *Expand SBIR/STTR Phase IIA supplemental program beyond Centers for Research Excellence in Science and Technology (CREST) or Reinvestment Initiative in Science and Engineering (RISE)—e.g., include Advanced Technological Education (ATE) in the Division of Undergraduate Education, (Louis Stokes Alliance for Minority Participation (LSAMP), and Graduate Research Supplements (GRS).*
2. *Seek ways to increase underrepresented participation in all IIP Programs (e.g. SBIR/STTR–Research Assistantships for High School Students); target underrepresented community pockets such as the HUBZone (Historically Underutilized Business Zone), rural and border towns; target both the disabled community and the technologies for that community.*
3. *Increase Phase IIA, Phase IICC outreach efforts.*
4. *Once Phase 0 is complete, establish linkages to institutions serving underrepresented groups, and to EPSCoR institutions.*
5. *Increase subcontractor efforts to expose underrepresented small businesses to all business resources, including national outreach conferences.*
6. *Target for geographic, age, gender, occupational, ethnic and cultural diversity.*

### **Objective D: Encourage Global Leadership Skills and Competencies among Researchers, Innovators and Entrepreneurs**

Increasingly, innovation is not confined to the United States. Innovation hotbeds and pockets exist and are being formed all around the globe. Customers are now more than likely to be found in emerging large markets, and it is inevitable that entrepreneurs and innovators need to be close to such customers so as to deliver innovative products to them. Multinational U.S. companies are already setting up innovation centers in these countries. It therefore pays to collaborate and to develop global leadership skills in technology transfer and innovation. In order to further the above objective, IIP can cosponsor and participate in international innovation workshops held in other countries and explore international collaborations to leapfrog or to catch up with such efforts. IIP can better leverage its existing international collaborations, which include: participation in the MIT \$50K Global Startup Workshop in Latin America; and the division's Industry/University Cooperative Research Centers or I/UCRC program, which already has international collaborations. To further such collaborations IIP is working more closely with the Office of International Science and Engineering (OISE). IIP can serve as a catalyst for more such global events. Many foreign countries are emulating the U.S. small business innovation model of the SBIR program. Large industries are already global in presence and increasingly moving more engineering and research to foreign affiliates. The investment community, which tends to invest locally and regionally, is starting to look to emerging markets for investments. These factors make it essential to build international connections for sharing and learning.

## **The Operation Plan**

- 1. Co-sponsor and participate in international innovation workshops in other countries.*
- 2. Explore international collaborations to leapfrog/catch-up - e.g. target EU7, Israel, South Korea, the BRIC (Brazil, Russia, India and China) countries.*
- 3. Explore the I/UCRC model for international collaboration.*
- 4. Continue participation in the MIT \$50K Global Startup Workshop.*
- 5. Work more closely with OISE.*

#### **IV. INCREASED COMMERCIALIZATION GOAL**

**Enhance the commercial success of business opportunities arising from innovative research through support of partnerships with the industrial and investment sectors.**

##### **Objective A: Expand Training and Assistance for the Successful Commercialization of Award Results**

The Small Business Innovation Act of 1982 and subsequent reauthorizations in 1986, 1992 and 2000 recognized the importance of commercialization. Increasing private sector commercialization is one of the four stated purposes of the Act. The National Academies study *The Small Business Innovation Program: An Assessment of the Department of Defense Fast Track Initiative* (<http://books.nap.edu/catalog/11082.html>) found that not all small businesses were focused on commercialization, and that small businesses could be classified into three groups based on the strategies they pursued in seeking SBIR funding.

1. Meet an agency's mission and secure a spot on the agency procurement list.
2. Strengthen the core research capability to position the firm for major contract research opportunities.
3. Leverage federal funding to accelerate commercialization.

Because NSF is not a "mission agency" with significant procurement needs, the focus of the NSF SBIR/STTR program from its inception has been on the commercialization of research. From the beginning, NSF took the lead in directing small businesses applying for SBIR/STTR grants to plan beyond Phase I to Phase II and into Phase III and commercialization.

IIP organizes several workshops and conferences to educate grantees on the goals of the SBIR/STTR program and emphasizes the need for a focus on commercialization when applying for a Phase I grant. Successful Phase I grantees competing for Phase II research grants are required to prepare a commercialization plan and obtain a Follow-on Funding Commitment (FFC) from investors or strategic partners or customers. In the absence of FFC, the Phase I grantee is required to demonstrate possession of substantial in-house resources for "self-funding" the prototype demonstration in Phase III and further commercialization. In 1996, a self-assessment by management on the efficacy of FFC led to the conclusion that very few of the commitments were honored at the completion of Phase II grants for various reasons, e.g. the investor was not convinced of the ROI once he/she had a better understanding of the research results; or the perceived market at the end of Phase I did not materialize or had shifted.

Given these findings, the program recognized that the Phase I grantees need assistance in preparing commercialization plans. The grantees and the company founders are skilled and talented scientists and engineers. While their strengths lie in building a technology base, their weakness often lies in a lack of comprehension of the full scope of the

business aspects required in transforming their research results into profitable commercial products or processes. The Division recognizes the opportunity to assist grantees through all three Phases of the program through the following:

- i. Strengthen commercialization plan assistance to Phase I grantees.
- ii. Select and offer business plan assistance to Phase II grantees.
- iii. Implement and enforce commercialization reporting requirements.
- iv. Organize and support Phase III workshops.

The Phase I review at NSF is focused on assessing the quality of technical research. IIP draws on the knowledge and the expertise of leading academic researchers to review proposals and participate in interactive panels. The panel selects the best proposals, labels them Highly Recommended (HR) proposals and rank orders them for funding recommendations.

Working from this technical foundation, 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. Prior to 1996, the review process for Phase II was the same as Phase I, relying on external academic researchers to evaluate the technical merits.

With the growth of the program and the NSF culture of the peer-review process, external commercial panels to augment the technical panels were introduced. NSF is the only agency among all the federal SBIR agencies that uses commercial reviewers to evaluate and help select Phase II proposals for funding based on commercialization merits. Depending on the technologies and panel size, the technical and commercial panels are either combined into one panel or divided into separate panels. The Division brings in investors, strategic partners, business-school faculty members, market researchers, business assistance service providers from state economic development and private firms, and successful entrepreneurs - people who have strong knowledge in commercialization and the intricacies of growing a technology-based business. The 2001 Committee of Visitors (COV) analyzed proposals received between 1998 and 2000 and reported an encouraging trend toward improved commercialization plans in Phase II proposals. The 2004 COV confirmed this trend in its review of proposals received between 2001 and 2003. The 2007 COV analyzed proposals received in 2004–2006 and further confirmed that the commercialization plans in Phase II are of high quality and professionally prepared. In 2001, the NSF Cost Analysis and Audit Resolution (CAAR) Branch reviewing the fixed price Phase II grants noticed that the Phase I grantees were insufficiently prepared in accounting and financial management practices. In 2002, an accounting workshop offered by a Chartered Accounting Firm was added to the Phase I grantees training workshop.

In 2001, an Intellectual Property Protection workshop was enthusiastically received by the grantees and endorsed by the Advisory Committee for the SBIR/STTR program, a subcommittee of the ENG Advisory Committee. In 2004, the workshop content was expanded to include Licensing Strategy. IIP is poised to offer further assistance to the



small business community working within the language of the legislation of using SBIR set-aside funding for technical assistance. In addition, it seeks partnerships and other options to provide business assistance through the judicious use of its limited administrative resources.

### **The Operation Plan**

- 1. Deploy the SBIR Phase II commercialization assistance program.*
- 2. Invite SBIR Grantees to I/UCRC, GOALI and PFI conferences and site/center visits and vice-versa.*
- 3. Establish IIP Annual Conference (to include SBIR, GOALI, I/UCRC and PFI) and include targeted commercialization training sessions.*

### **Objective B: Catalyze Partnerships among Entrepreneurs, Academics, Investors and Corporate Partners**

The original intent of the SBIR/STTR grantees conference was to facilitate face-to-face meetings of IIP program officers with their grantees while also limiting travel expenses and managing within a tight budget. Since becoming an independent entity, IIP has on its own created a new agenda for recent grantees conferences, bringing together IP, licensing and technology transfer experts, entities that are involved in educating entrepreneurs, panel sessions consisting of experts from industry, and representatives from the investing community.

In the mid 1990s, the Department of Defense (DoD) introduced Fast Track, an incentive for partnering between the small business and investment communities. The DoD Fast Track required third-party funding as a prerequisite for Phase II application for contract funding. The DoD program manager would automatically raise the ranking of Fast Track proposals to the top of the funding category. The DoD selection process is completely within the agency and evaluated against meeting its mission.

Recognizing the value of attracting investors early on, IIP decided to adapt Fast Track to the NSF SBIR/STTR program, introducing Phase IIB in 1998. This supplemental program differs in several significant ways from the DoD Fast Track. The NSF supplemental proposal is submitted while a small business is conducting the Phase II research. With Phase II research underway the small business is better positioned to attract investors because federal funding has already supported most of the early stage research risk. During Phase II, supplemental federal funding can be targeted at fine-tuning the research to address the needs of the investor, customer or strategic partner. Thus, when a company applies for a Phase IIB grant, it has already received Phase I and Phase II funding that has diminished its technical risk and positions it well to secure private funding. Under Phase IIB, the NSF/SBIR program matches 50 cents for every dollar of private funding the company raises, up to the legal limit of \$750,000 that SBIR

can grant per business. Traditionally, this supplement has ranged from \$50,000 to \$250,000. Increasingly, the businesses are securing larger amounts of private funding, and NSF/SBIR has responded with a “Super-sized” Phase IIB supplement for up to \$500,000 (the requirement is that, if a company raises enough money to gain a Super-sized Phase IIB and exceeds the \$750,000 limit, the money raised that sets it beyond this limit must all be from private sources, rather than from a mix of public and private). The Phase IIB program at NSF has been tremendously successful and, during its 2004 meeting, the National Academies advanced Phase IIB as a model for giving small businesses the required boost to reach Phase III.

The investment business is often referred to as a contact sport because of its emphasis on personal contacts and relationships. Recognizing this fact, IIP has participated in regional venture fora, National Association of Seed Venture Funds (NASVF) Annual Conferences, the World’s Best Technologies (WBT) forum, Mid-Atlantic Venture Association (MAVA) and Industrial Research Institute (IRI) meetings to network with investors and publicize IIP programs. IIP program officers have built personal relationships with members of the investment community by inviting them to serve as reviewers of the Phase II commercialization plan.

The Division created a new program called MatchMaker and invited both investors and grantees to register. The Venture Capital (VC) community immediately recognized the value of MatchMaker. They could see the value of the peer-review process to select the best technical ideas. They gain partial due diligence from IIP screening. IIP provides the management knowledge of the program officers in assessing the ability of small business firms to meet milestones, conduct and manage research. The Division has compiled a technology prospectus containing all Phase II awards over the span of the last five years. These awards are grouped by solicitation topics and subtopics representing a wide spectrum of technologies of interest to large industries. The prospectus was presented at the IRI meeting, and during that meeting IIP program officers made personal contacts with the external technology representatives from Fortune 500 companies. In addition, several large industrial companies who are members of the MatchMaker program have been invited to grantees conferences to review grantees’ technologies for potential value to the company.

At the same IRI meeting, the industrial companies presented overviews of their own product requirements and identified technologies they are seeking to acquire. These face-to-face meetings result in faster “matching” between grantees and industry partners thereby speeding the commercialization of the technology for the small company and, equally important, accelerating industrial innovation, the mission of the division. The MatchMaker list of investors and strategic partners has grown to almost 50 potential third party partners. Several “matches” have been made thus far but it is too early to realize tangible results.

Among the eleven (11) SBIR agencies, NSF is the first to proactively create partnerships with the investment community. The Advisory Committee continues to encourage IIP to assist all of its grantees on a nationwide basis in connecting with private sector investors.

## **The Operation Plan**

1. *Incorporate Web-based MatchMaking (e.g. implement AngelSoft tool for I/UCRC members, SBIR and investors).*
2. *Establish “Vertical” IIP Conferences by clustering like-technologies among SBIR companies and updating/developing the “Technology Prospectus.”*
3. *Bring Investors and Corporate Partners to Grantee Conferences.*
4. *Invite SBIR POs to I/UCRC site visits and vice versa.*
5. *Develop proactive relationships with other selected government agencies.*
6. *Investigate increasing award sizes.*
7. *Use a Principal Investigator’s country of origin to develop relationships in that country to enhance commercialization outcomes.*

## **Objective C: Establish a Deeper Understanding of the Innovation Process including Optimization for Industrial Applications**

The Directorate for Social, Behavioral and Economic Sciences (SBE) aims to develop the knowledge, theories, data, tools, and human capital needed to cultivate a new Science of Science and Innovation Policy. As this initiative further develops, SBE plans to facilitate transformative research on a topic of international importance: the ecology of innovation. These activities will build research capabilities along three dimensions: measurement, understanding, and community development.

Science and innovation policy discussions are frequently based upon past practice or data trends that may be out of date or have limited relevance to the present. Traditional models available for informing investment policies are often static, unidirectional and not developed for domain-specific applications. Past investments in basic scientific research have had an enormous impact on innovation, economic growth and societal well-being. However, there is modest capability of predicting how future investments will yield the most promising and important opportunities.

IIP will cooperate with SBE in this effort and will conduct workshops to bring together experts from universities, think tanks and industry to develop an IIP Emerging Frontiers in Research and Innovation (EFRI) project toward further and deeper understanding and optimization of the innovation process in industrial applications specifically directed toward small business settings.

## **The Operation Plan**

1. *Convene a workshop of experts to update and expand the IIP EFRI project on "Engineering Modeling, Simulation and Analysis of the Technological Innovation Process."*
2. *Cooperate with SBE on the study of the science of the innovation process and how it applies to industrial examples.*
3. *Explore non-EFRI options.*

## **V. STEWARDSHIP GOAL**

**Continually improve the effectiveness of IIP operations to maximize the division's impact on the nation's economy by developing and sustaining a world-class team**

### **Objective A: Process IIP Proposals within Six Months of Receipt of Proposals**

It is mandated by legislation and consistent with the NSF Government Performance and Results Act (GPRA) dwell time requirements to award all Phase I and Phase II grants within six (6) months of the posted solicitation deadline. The division receives about 8 percent of all NSF proposals, approaching 3,000 proposals in the peak years. IIP represents the entire Foundation in its research base. Therefore, research proposals submitted by the small business community cover a wide spectrum of science and engineering. Recognizing that small businesses are often without a safety net for continuous operation, Congress mandated that agencies managing SBIR/STTR programs should make all Phase I awards within six months. Prior to 1998, when the reorganization of solicitation topics occurred, small businesses submitted proposals in response to almost twenty seven (27) NSF academic divisional interests covering over a hundred (100) NSF program topics. Organizationally resident within the Division of Design, Manufacture and Industrial Innovation (DMII), the program relied heavily on NSF program officers across the Foundation. IIP program officers acted as coordinators and business evaluators and by and large were not technically trained. The academic program officers, on whom the Division relied on for the technical review and award/declination recommendations, could not give the same priority to the small business proposals as their own academic proposals resulting in the NSF SBIR/STTR program not meeting the legislated requirements to grant awards within six months. At the same time, NSF added targets for six months dwell time in response to GPRA. To smooth the workflow, the program moved the annual one-time solicitation deadline to selecting a few topics and releasing solicitations every six months. In addition, the Division rebuilt the team of program officers to include personnel with strong technical backgrounds and with experience in industry and small business. As a result of these organizational and staffing changes, the IIP program officers generate the topics, review the proposals and manage the awards. This "one-stop" point of contact for the small business community is unique amongst all the eleven federal agencies managing the SBIR program. To support the high volume of proposals, it became necessary to have a flexible support staffing option with freedom to bring in and remove temporary staff members in response to the cyclical proposal processing demand. In order to accomplish this operational need, the Division hired a support contractor, who offers the necessary flexibility while working with the NSF support and program staff. The following actions summarize how IIP has been able to continue to meet the six-month processing time requirement for all proposals:

- i. Organize for high volume operation
- ii. Implement an efficient panel review process
- iii. Supplement NSF staff with contract support staff

## **The Operation Plan**

- 1. Achieve the goal of six months proposal processing time for the SBIR/STTR program and establish similar timelines for GOALI, PFI and I/UCRC programs.*
- 2. Develop, update, promote, monitor and track progress of the IIP Divisional Plan.*
- 3. Educate reviewers, especially commercial reviewers, to increase transparency of IIP Programs' award decisions.*
- 4. Review SBIR/STTR COV (2007), I/UCRC & PFI COV (2007) and GOALI COV (2006) and incorporate necessary changes to the divisional plan.*
- 5. Redefine and expand Technology Assistant tasks, and train and increase the skills of current IIP staff members.*
- 6. Finalize the topic mix for the next 2-3 years and investigate a sub-6 month award process.*
- 7. Uniformly embrace organizational "Best Practices".*
- 8. Efficiently manage the entire supplement process.*
- 9. Work with CAAR/DGA to provide better efficiency.*
- 10. Investigate the number of submission dates to allow the program to be more responsive to the needs of entrepreneurs.*

## **Objective B: Improve the Awards Management Program**

Recently hired program officers in IIP include personnel with deep domain knowledge and strong technical backgrounds representing technologies of interest to the investment business and industrial market segments. These newly recruited program officers have many years of industrial experience, either in small or large businesses where they either founded the technology company and/or had technical and management responsibilities. The IIP Advisory Committee noted independently that these IIP program officers are a resource to the small business beyond the award/declination process. This rebuilt team of talented and experienced program officers provide significant added value for the small business community and for the national innovation process. As a first step toward portfolio management and mentoring of grantees by IIP program managers, Technology Assistants (TAs) were recently hired as additional contract staff to assist the program officers. This experiment is ongoing. The recipe for success so far is hiring people with the right qualifications and incentives and giving them clearly defined responsibilities. As a result, the TA program helped lower the workload for the program officers so that are able to devote time to coaching and mentoring grantees, further enhancing the program management function.

## The Operation Plan

1. *Increase the coaching and mentoring of IIP grantees.*
2. *Establish connections to professional organizations and identify technology roadmaps (e.g. semiconductor, chemical, energy, nanotech) and connect IIP grantees to it.*
3. *Streamline the review-and-approval-of-reports process and implement the “Contract Management” process.*
4. *Simplify the resolution-of-grant structuring process (e.g. PI Change, No Cost Extension, Novation) involved for making routine changes to existing grants.*

### **Objective C: Optimize Outreach to Identify High-Potential Grantee Candidates and Encourage Submission of Quality Proposals**

Since its inception, the NSF SBIR/STTR program has taken a federal leadership role in organizing national conferences to attract small businesses to participate in the SBIR/STTR programs. Similarly, the I/UCRC program also conducts annual meetings for its grantees. It is planned to have similar annual conferences and workshops for the GOALI and PFI programs. Currently, all eleven (11) federal agencies that implement the SBIR program participate at these NSF sponsored conferences.

The IIP Advisory Committee recognizes the federal leadership achievement of NSF in support of the small business community outreach and is encouraging the division to move on to the next important role of providing mentorship and assistance to the small business grantees base. IIP recognizes the need for assisting small businesses through the innovation process in order to bring the federal research investment to commercialization. Toward this end, the division in 2007 handed-off the responsibility of conducting national conferences to states, so that IIP can channel its resources to the mentorship of small business grantees.

In order to stimulate small businesses in the rural states, conference sites are selected such that at least one outreach national conference in a year occurs in an Experimental Program to Stimulate Competitive Research (EPSCoR) state. To encourage broad participation from all the EPSCoR small businesses, NSF underwrites their registration cost. The visibility of NSF across the United States is increasing significantly and perception is positive among the small business community. Having built this base and trust in the last 20 years, NSF has clearly achieved a leadership role among the federal agencies. States are increasingly proactive in attempting to bring more federal SBIR dollars into their regions and are taking a more active role in bringing economic development to their region.

## **The Operation Plan**

- 1. Track technology trends – e.g. trawl university hallways.*
- 2. Develop IIP website for Small Business training (e.g. implement Phase 0 web outreach and training similar to AVATAR, Ask Alex, and a Phase I educational component).*
- 3. Webcasts for outreach with the media and NSF Office of Legislative and Public Affairs (OLPA) in the loop.*
- 4. Enable POs to make site visits and to attend IIP programs' grantees conferences.*
- 5. Proposal vetting with POs prior to submission.*
- 6. Increase S&E travel and optimally manage regional/local conference invitations to coordinate with company site visits.*
- 7. Increase the number of talks by POs at professional conferences.*

## **Objective D: Increase Public Awareness of IIP Programs**

An NRC study on the effectiveness of the largest program managed by IIP, the SBIR/STTR program, was published in August 2007. The study results were positive and will help to increase public awareness of all the division's programs. There is a compelling and urgent need to work effectively with the Office of Legislative and Public Affairs (OLPA) to showcase our successes in highly visible fora, and to highlight the economic and societal benefits of IIP programs. It is imperative that IIP, with the help of OLPA, develop initiatives and methodologies to communicate more effectively with the entrepreneurial, academic and investment communities so as to optimize our outreach efforts. This can be done, for example, by participating in prestigious national events and for IIP programs to be supportive of and aligned with urgent and important national initiatives. The division is also in the process of developing more effective marketing materials and a website to showcase its efforts, and to publicize success stories. It must be noted that the many hundreds of reviewers that participate in IIP program panels are a valuable resource for advocating to the public and to their individual constituencies the importance and impact of the various programs of the division.

## **The Operation Plan**

- 1. Establish an effective working partnership with OLPA to improve communication/outreach efforts that showcase the division's economic and societal impact.*
- 2. Increase outreach to the entrepreneurial and investment communities by participating in highly visible national events/initiatives (e.g. ACI-related events; Entrepreneurship Week; NSF Days (OLPA); PFI "Events" with senators/governors).*
- 3. Use highlights, brochures, marketing materials and posters for each IIP program to*



*effectively publicize IIP success stories, and find ways to empower communications by IIP program directors.*

*4. Set up a contract to manage grantee and outreach conferences.*

## **Objective E: Strengthen IIP Human Capital**

A vision without a task is but a dream, a task without a vision is drudgery, and a vision with a task is the hope of the organization. It is imperative that the best contract support team and a stellar team of program officers continue to always be an integral part of this division so that IIP can deliver on its vision and mission. It is equally important that program officers take ownership of implementing prioritized-by-impact tasks associated with the goals and objectives in order that services to the small business community and universities interested in commercializing research results are most efficiently and diligently delivered so as to provide maximum value.

### **The Operation Plan**

- 1. Update Program Director performance metrics: revisit the current performance evaluation plan, and align strategic plan tasks to PD performance.*
- 2. Build and maintain cordial relationships with NSF's internal service providers, and establish a continuity plan for critical internal services.*
- 3. Involve Program Directors in continuous training (e.g. VCI (local)).*
- 4. Increase the use of collaborative work (e.g. Groove).*
- 5. Correctly anticipate IIP needs and hire accordingly.*
- 6. Explore new contract support options for the entire division.*

## **Objective F: Develop a Robust Methodology to Conduct Assessment of Outcomes**

Innovation is critical to the growth of the nation's economy and wellbeing. To drive the innovation economy and to be the standard bearers of innovation in the federal government, it is important to widely and effectively publicize the success stories of the various programs managed within the division. Innovation is a part of the vision for both NSF and the ENG directorate, and IIP has to assume the leadership role to showcase how technology innovation is done and to serve as a nationwide model on to how to do it well.

IIP must coordinate its efforts with the Council on Competitiveness and the National Innovation Initiative, and align its efforts with the American Competitiveness Initiative (ACI), and respond to the America COMPETES Act (ACA). This division must compile qualitative and quantitative data on the performance of its four programs over the last eight years to show that these programs have indeed been successful and have had a major impact on the national economy and in the creation of high-wage jobs. Pertinent

data will also help to further refine the program and better position the division to offer help to high technology small businesses and universities that are willing and able to transform their fundamental research into innovative products and services in the market. A sustained effort is required to develop performance metrics to track the progress and impact of IIP programs. The I/UCRC program has developed a good benchmark with an excellent database. The SBIR/STTR program recently initiated a comprehensive program to contact and track grantees to collect outcomes data.

### **The Operation Plan**

- 1. Implement a plan to develop IIP metrics, collect data and measure success (coordinate with SBE: systematic, internal and external; issues of credibility, objectivity, independence; develop benchmarks).*
- 2. Conduct longitudinal studies and improve the Highlights collection process.*
- 3. Update the Technology Prospectus to include Phase IIB awardees and develop similar compendiums for PFI, GOALI and I/UCRC programs, and integrate these.*
- 4. Participate in the NRC study and the Program Assessment Rating Tool (PART) process and integrate findings into IIP programs.*

## CONCLUSION

This Division Plan outlines the vision and mission of the Division of Industrial Innovation and Partnerships (IIP), and offers a roadmap to strive toward the vision and achieve the mission through clearly identified goals, objectives, tasks, *and* task ownership. With this common strategic purpose and approach in mind, and with the agreed upon vision, mission and the guiding principles for the organization established, the IIP team arrived at a consensus on the prioritization of the tasks. The challenge now is to determine the most efficient way to take these prioritized tasks - which will clearly have a strong, positive impact on the division's four innovation-related programs and on the nation's capacity for innovation - and integrate them into robust yet flexible and productive day-to-day operational processes. Finally it is important that the IIP division develop a yearly tactical plan and associated metrics for follow-up on the effectiveness of this plan once every six months.