



Testimony of

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Before the

**U.S. House of Representatives
Committee on Science, Space and Technology
Subcommittee on Research and Technology**

America's Seed Fund: A Review of SBIR and STTR

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Introduction

Chairwoman Stevens, Ranking Member Baird, and members of the Subcommittee, thank you for this opportunity to testify on the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs at the National Science Foundation (NSF), how NSF is supporting the creation of new businesses and bringing new technologies to the public, and to provide comments on H.R. 3774, *The Small Business Innovation Research and Small Business Technology Transfer Improvements Act of 2019*. My name is Dawn Tilbury, and I am the Assistant Director (AD) for Engineering at NSF.

NSF is recognized and respected as a global leader in identifying and supporting fundamental research in science, technology, engineering, and mathematics (STEM) and supporting all levels of STEM education. Our process through which we select proposals based on peer review, merit-based evaluations, by definition and by construction, selects the best and most creative ideas, those that offer the greatest promise for success. NSF funding accounts for approximately 25 percent of the total federal budget for basic research conducted at U.S. colleges and universities and has been vital to many discoveries that impact our daily lives and drive the economy. In many fields such as mathematics and computer science, NSF is the major source of federal support for academic research. Many NSF-funded discoveries and technological advances have

been truly revolutionary and have led to entirely new industrial sectors, such as the hot springs bacterium discovery key to DNA fingerprinting, the introduction of directed evolution now being used to support an entirely new generation of nontoxic, natural pest control, and the optical technology that led to laser eye surgery. Indeed, these last examples represent just three of the 242 Nobel Prize winners supported by NSF at some point in their careers. NSF's unique mission to support basic research across all fields of science and engineering places the agency at the forefront of innovation and discovery. Our awardees are often investigating novel concepts that may have unforeseen applications or immediate commercial use. Recognizing this, NSF has made a concerted effort to support researchers who believe they have a commercially viable idea, and the SBIR and STTR programs are vital components of NSF's agenda to enable commercialization of technologies stemming from basic research.

History of SBIR/STTR

In 1977 the National Science Foundation (NSF) initiated a pilot program that became the "Small Business Innovation Research" (SBIR) program. This program solicited research proposals from profit-seeking small firms. Subsequently in 1982, Congress established the SBIR program across government to provide increased opportunities for small businesses to:

- meet federal research and development needs,
- stimulate technological innovation,
- foster and encourage participation in technological innovation by socially and economically disadvantaged persons,
- increase private-sector commercialization of innovations derived from federal research and development.

The primary objective of the NSF SBIR program is to increase incentives and opportunities for startups and small businesses to undertake transformative, high-risk, research across all technology areas. NSF funds projects that have the potential for economic payoff and broad societal impact if the innovation is successful. Additionally, the program seeks to stimulate technological innovation in the private sector, increase commercial application of NSF-supported research, and improve the return on our investment in federally funded research for its economic and social benefits to the nation. With this goal in mind, unique within NSF, most SBIR/STTR program officers are highly trained scientists who are also former entrepreneurs, investors, or both – and indeed, they represent one of the only agencies with program officers dedicated strictly to SBIR and STTR.

SBIR has broad reach throughout the government, as eleven federal agencies now have SBIR programs. Government-wide, these programs set aside ~\$3 billion annually and have granted ~160,000 awards. The budget is 3.2% of a research agency's extramural R&D budget – which is approximately \$200 million at NSF.

The STTR program was established in 1992 and also focuses on transforming scientific discovery into products and services with commercial potential and/or societal benefit. It differs from SBIR in that a small business must partner with a university or federally funded research

center to do a percentage of the R&D work. Five federal agencies have STTR programs. The budget for STTR is 0.45% of extramural R&D.

Overview of Engineering Directorate

The Engineering Directorate provides approximately 40 percent of the federal funding for fundamental research in engineering at academic institutions in the United States. It also invests in programs to educate the next generation of engineers. Research funded by the NSF's Directorate for Engineering has enabled major advances in manufacturing, electronics, communications, and chemical processes, and has created new knowledge that has helped to fortify the nation's infrastructure, such as Neuvokas, a Michigan-based company making an alternative to steel rebar – two times stronger and seven times lighter – that would not corrode and could be used in roads and bridges.

Engineering is home to many of NSF's activities that foster innovation and technology transfer and commercialization. The SBIR program at NSF is managed within the Engineering Directorate, Division of Industrial Innovation and Partnerships. While NSF's primary mission is to advance the frontiers of science and engineering through basic research, the SBIR program is an integral part of the NSF strategy to stimulate innovation and address societal needs through the commercialization of the results of fundamental research. We fund small businesses to determine if their technology will work, and often long before the private sector is willing to invest.

Since NSF is never envisioned to be the ultimate customer of the technologies it funds, the NSF SBIR research topics are oriented to the needs of the marketplace and the nation as a whole. For example, NSF SBIR seed funding led to Symantec, which is now a global leader in cybersecurity. It was founded in 1982 by Gary Hendrix who was funded by an NSF SBIR grant. Qualcomm was launched after co-founder Andrew Viterbi invented the “Viterbi Algorithm”, a mathematical formula to eliminate signal interference, paving the way for widespread use of cellular technology. After receiving NSF SBIR funding during the 1980's in its early years as a small business, Qualcomm grew to become a world leader in wireless technologies and particularly 5G, a critical industry of the future.

At NSF, SBIR grants are divided into two competitive phases. Phase I awards have a duration of six to twelve months and a maximum of \$256,000. These awards provide support to conduct feasibility research into new techniques or products. All Phase I awardees are eligible to apply for a Phase II award which can be for up to \$1,000,000 and two years in duration.

NSF has also designed several supplemental funding opportunities to spur the commercial success of its SBIR companies. The flagship amongst these is the “Phase IIB” supplement which provides up to an additional \$500,000 for a firm generating marketplace traction for the first time.

Established in 1998, the Phase IIB supplement incentivizes active NSF-funded Phase II companies to attract private sector funding for further technology commercialization. The Phase IIB proposal is submitted while the company is conducting the Phase II research. The objective

of the Phase IIB is to incentivize companies to extend the R&D efforts to meet the product, process, or software requirements of a third-party investor, thereby accelerating commercial success of a Phase II project.

Supplements are also available to provide support for college and high school students, and for teachers and veterans to participate in research with SBIR awardees; to form partnerships with minority-serving universities, colleges, and community colleges; and to help firms form partnerships with NSF-funded research centers, among others.

In addition to providing funding, NSF uses experiential education to help researchers gain valuable insight into starting a business or industry requirements and challenges. The NSF Innovation Corps (I-Corps) program helps entrepreneurs and small businesses understand market needs and opportunities, thus increasing their chances of successfully translating new technologies. I-Corps was designed to foster entrepreneurship that will lead to the commercialization of basic research. More than 1,300 teams have participated in the program since 2011. In addition, over 1,000 NSF SBIR and STTR Phase I awardees have participated over the past six years in a condensed version of the I-Corps program called the “Beat-the-Odds Boot Camp”.

While the I-Corps Teams program is not changing, NSF recently modified the I-Corps operational model to leverage and amplify the best practices of the program’s first eight years of operation. The I-Corps “Hubs” program will create larger university consortia that can more easily share lessons learned. In addition, I-Corps will continue expanding its geographical reach to ensure that all the nation’s communities have the opportunity to learn from and contribute to the innovation ecosystem. The new model also offers a path for promising technologies funded by other federal agencies to benefit from I-Corps training, enhancing access to scientists and engineers in historically black colleges and universities (HBCUs), Hispanic-serving institutions (HSIs), and other organizations with a rich portfolio of technologies that can potentially benefit the nation.

Another program closely related to I-Corps and similarly responsive to the goals of the 2017 American Innovation and Competitiveness Act (AICA) to foster a national innovation ecosystem is Partnerships for Innovation (PFI). The PFI program encourages the translation of promising, fundamental discoveries made by NSF researchers into products and services that benefit the nation. PFI nurtures entrepreneurial spirit by pairing I-Corps training with prototyping and advanced technology development, giving technologists and engineers in academia a set of tools to successfully transition their inventions into impact. Through I-Corps and PFI, NSF helps prepare researchers in advance of starting new firms. These programs serve as important training grounds and help researchers improve their success rates in securing SBIR and STTR funding and follow-on investments.

Partnerships are critically important in moving scientific and engineering discoveries funded by NSF to the marketplace. In addition to the small business, entrepreneurship and translation programs, the Industrial Innovation and Partnerships Division manages the Industry-University Cooperative Research Centers (IUCRC) to better engage industry and academia. Beyond IUCRC and PFI, existing NSF innovation research alliances such as Engineering Research

Centers (ERC), Science and Technology Centers (STC), Nanoscale Science and Engineering Centers (NSEC) and Materials Research Science and Engineering Centers (MRSEC), complement NSF's significant investments in fundamental scientific and engineering research. They do so by offering multiple pathways to move discovery to innovation to technology.

Frequently, NSF-funded researchers will pursue and receive grants from many of these programs in parallel, in sequence, or on a combined path. We are seeing strong interactions between these programs as well as with our SBIR/STTR program where researchers start with NSF-funded fundamental research, participate in I-Corps training to learn about the marketplace and the opportunities for new technologies to impact industry, then create technology demonstration projects in PFI before launching a new firm and pursuing SBIR and STTR funding.

Workforce Development

There are several ways in which NSF SBIR and STTR awards contribute to the development of an advanced workforce for the entire research enterprise. Firms may take advantage of the many supplements available to all NSF investigators through short-term training activities such as the Research Experiences for Undergraduates (REU), Research Experiences for Teachers (RET), Research Assistance Supplements for High School Students (RAHSS), INTERN, a graduate student supplement, and the Veterans Research Supplement (VRS) program. These NSF programs have had tremendous impacts beyond technical and economic development. They support future researchers, engineers, and educators in STEM fields as well.

Professional development of students through research experience in a fast-paced entrepreneurial setting is an important part of NSF's SBIR and STTR programs. Undergraduates typically work ten weeks in the summer and receive an average stipend of \$8,000. Throughout NSF, REU is a critical program to creating the next generation of STEM professionals, and REU slots are hotly competed for by students.

The RAHSS program is designed to foster both opportunity and interest in science and engineering among female and minority high school students. The program provides an opportunity to work on scientific and engineering projects, and we hope fosters these students' interest in pursuing science, technology, and engineering studies in college. This program is unique to NSF and is only one element of our broader support of inclusion.

NSF remains deeply committed to providing access for all the nation's communities to participate in the economic and industrial transformation offered by technology translation opportunities. NSF has recently launched an inclusion initiative built on the three pillars of affinity, community, and opportunity. NSF partners with affinity groups, such as groups focused on underrepresented STEM students, to identify young scientists and engineers interested in understanding the potential impact of their technologies. By creating models for shared leadership between the affinity group and the I-Corps community to jointly provide experiential learning opportunities, NSF accelerates the process by which enterprising researchers throughout the country learn about innovation opportunities.

The RET program brings high school teachers and community college professors to work at a small business in SBIR-funded research projects. They can then bring their experiences in engineering and technological innovation into their classrooms, and ultimately to their students.

A relatively new supplement, INTERN, is designed to prepare the highly trained graduate students for the workforce by funding a six-month internship in a non-academic setting, such as in industry, a government laboratory, or a policy think tank. INTERN provides up to \$50,000 for a graduate student to work with a non-academic mentor in one of these settings. In the first two years of the program, more than 500 graduate students – and their professors – were supported to learn about the breadth of American science and engineering job opportunities and use the non-academic experience to enrich their university-based research program.

The Veterans Research Supplement (VRS) is another supplement opportunity that NSF offers to engage former service members in the research enterprise. NSF offers up to \$10,000 to awardees to attract veterans who are full- or part-time students or even serving as STEM teachers or faculty.

Together these programs enhance the capabilities of students and teachers, and synergistically foster an interest in technical innovation, engineering, and entrepreneurship in the broader community.

Comments on H.R. 3774:

Now let me turn my attention to H.R. 3774. NSF appreciates the attention of the Congress and this Committee to these important programs and efforts to improve the opportunities for small businesses to successfully enter the marketplace. While the Administration has not taken a position H.R. 3774, *The Small Business Innovation Research and Small Business Technology Transfer Improvements Act of 2019*, we have provided some comments below on those parts of the legislation that relate most directly to NSF.

First, let me provide an overview of the role of these programs. The SBIR and STTR programs, now several decades old, are central to the health of our nation's economy. Startups and small businesses create jobs for Americans. Plus, companies with roots in science and engineering – and with Intellectual Property – present opportunity for unusually high economic and social impact. Unfortunately, the changing investment landscape makes it difficult for startups or small businesses founded around disruptive technical innovations to attract private capital. Therefore, SBIR and STTR fill a significant gap by enabling firms with significant potential to grow, addressing both technical and economic risks as they become ready for the private markets.

Sections 4 and 5 of the legislation instruct the Administrator of the Small Business Administration to ensure that in selecting small businesses to participate in SBIR or STTR programs, federal agencies give high priority to small manufacturing companies and business concerns engaged or planning to engage in manufacturing R&D, and small business concerns that are engaged in cybersecurity, respectively. The NSF SBIR program funds a broad set of technologies. In the manufacturing space we support advanced manufacturing, advanced materials, chemical technologies, Internet of things, nanotechnology, photonics, instrumentation

and hardware systems, robotics, semiconductors, space, and wireless systems. Cybersecurity technology development is supported through many fields related to computer science, such as artificial intelligence, information technologies, quantum information technologies, and distributed ledger. To accelerate the growing bioeconomy, our topics include biomedical technologies, medical devices, biological technologies, digital health, and our newest topic, pharmaceutical technologies. To support the nation's infrastructure, we have recently expanded topics in the area of power management, energy technologies, and environmental technologies.

All of these areas represent innovations important to current and future economic growth. NSF appreciates the flexibilities provided by the current program, which allow NSF to support activities to strengthen the nation's innovation ecosystem across all areas of research and education supported by the Foundation. Because any novel concept may have unforeseen future economic applications, by concentrating funding in selected areas, other meritorious proposals would go unfunded and lead to fewer innovations.

Section 6 of the legislation stipulates the issuance of Phase III awards to SBIR and STTR award recipients that developed the technology as direct follow-on awards without further competition. As mentioned earlier, NSF's Phase IIB program helps bridge the gap in funding between Phase II and ultimate commercialization. A Phase IIB Supplement of up to \$500,000 is available for small businesses able to attract third-party investment. NSF has found that awardee companies who qualify for Phase IIB successfully commercialize their innovations and that the NSF funding is critical in helping these firms address the remaining technical and market risk. Many Phase IIB firms have grown in both revenue and employment and are even ready for acquisition by larger firms.

Sec. 8 of the legislation requires increased outreach efforts to HBCUs and HSIs. As part of the inclusion initiative described earlier, NSF has multiple outreach efforts focused on underrepresented communities in STEM. These include Accelerating Women And under-Represented Entrepreneurs (AWARE) – a set of awards to recruit, educate, and retain underrepresented groups in entrepreneurship; Culturally Relevant Enterprise Development (CRED), consisting of short courses piloted with the Native American/Alaska Native (NA/AN) communities to develop entrepreneurial skills and new ventures aligned with their communities' needs and priorities; Innovative Postdoctoral Entrepreneurial Research Fellowship (I-PERF), a partnership with the American Society of Engineering Education (ASEE) to support underrepresented scientists and engineers in postdoctoral fellowships in startups; and a biannual women's networking luncheon at SBIR/STTR Phase II workshops. These programs complement other NSF broadening participation programs to recruit and retain all STEM communities.

With respect to Section 10, the Engineering Directorate has many programs that address commercialization readiness, and foster innovation and technology transfer. We are continually reevaluating these programs for effectiveness through the Engineering Advisory Committee and through our Committee of Visitors, which reviews each Division and Program within the Directorate every few years, including SBIR/STTR.

Section 11 calls for the establishment of a commercialization assistance pilot program. NSF already has in place multiple programs that accomplish the objectives of this pilot program. NSF provides supplemental awards to grantees to support commercialization assistance through its Commercialization Assistance Program (CAP), which is \$10,000 per Phase II award.

NSF also provides supplemental funding to grantees through its Technology Enhancement for Commercial Partnerships (TECP) program. The TECP supplement is intended to pave the way for partnerships with strategic corporate partners and investors as a means to increase the potential for the SBIR-STTR awardees to successfully commercialize their technology. The supplemental funding allows the small business to conduct additional research needed to meet the needs of a corporate partner or customer that will consume the commercial outcome. The TECP supplement can be up to 20% of the original Phase II award for a maximum TECP supplement of \$150,000.

Finally, NSF provides additional funding to small businesses through its Phase IIB matching funds program as described above. In the longer term, angel investors, venture capitalists, or corporate partners may invest capital to finance continued business development.

Conclusion

For over 40 years, NSF has helped startups and small businesses across the country transform their ideas into marketable products and services through our SBIR and STTR programs. NSF focuses on high-risk, high-impact technologies in startups – those teams and technologies that show promise but whose success hasn't yet been validated. Our goals are to foster innovation and spur businesses and job creation in the United States. Since 2012, NSF has made nearly 3,000 awards to startups and small businesses. Since 2014, NSF-funded small businesses have received roughly \$9 billion in private investment, and indeed over 100 firms have had successful startup exits by acquisition.

NSF is always assessing its performance against the broad goals of the SBIR and STTR programs, and this process has led to new supplements, new outreach and enhancements to other NSF programs because it takes far more than the SBIR or STTR investment to translate a technical vision into a realized solution. NSF is focused on helping these startups address all the potential risks – marketplace and technical risks, and even the potential skills gap – that researchers may experience in exploring the broader market. The SBIR/STTR programs anchor an extensive activity in identifying and leveraging the opportunities that new technologies offer the nation.

On behalf of the National Science Foundation, the SBIR/STTR programs and our awardees, I want to thank you for your support of NSF and for this opportunity to highlight programs that provide startups and small businesses with the means to keep America on the forefront of innovation. I would be pleased to answer any questions at this time.