AMERICA'S SEED FUND: A REVIEW OF SBIR AND STTR

HEARING

BEFORE THE

SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

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C O N T E N T S

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Appendix II: Additional Material for the Record

AMERICA'S SEED FUND: A REVIEW OF SBIR AND STTR

WEDNESDAY, FEBRUARY 5, 2020

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Subcommittee met, pursuant to notice, at 2 p.m., in room 2318 of the Rayburn House Office Building, Hon. Haley Stevens [Chairwoman of the Subcommittee] presiding.

U.S. HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON RESEARCH & TECHNOLOGY
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HEARING CHARTER

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

Wednesday, February 5, 2020
2:00 p.m. – 4:00 p.m.
2318 Rayburn House Office Building

PURPOSE

On Wednesday, February 5, 2020, the Subcommittee on Research and Technology of the Committee on Science, Space, and Technology will hold a hearing to review the role of the Small Business Innovation Research (SBIR) Program and Small Business Technology Transfer (STTR) Program in helping to move the results of Federally funded research into commercial development and generating new economic growth, as well as in assisting federal science agencies in meeting their respective missions. The Subcommittee will also consider recommendations for improvements to the SBIR and STTR Programs and receive testimony on *The Small Business Innovation Research and Small Business Technology Transfer Improvements Act of 2019*.

WITNESSES

- **Dr. Dawn Tilbury,** Assistant Director, Directorate of Engineering, National Science Foundation
- **Dr. Maryann Feldman,** S.K. Heninger Distinguished Professor of Public Policy, Department of Public Policy; Adjunct Professor of Finance, Kenan-Flagler Business School; Faculty Director, CREATE, Kenan Institute of Private Enterprise; The University of North Carolina at Chapel Hill
- **Mr. Nicholas Cucinelli,** Chief Executive Officer, Endectra
- **Dr. Johnny Park**, Chief Executive Officer, Wabash Heartland Innovation Network

OVERARCHING QUESTIONS

- What role does, or could, SBIR and STTR play in U.S. innovation policy? What is the value of the SBIR and STTR programs for start-ups and early-stage entrepreneurs?
- What do the data and assessments tell us about the SBIR and STTR programs' successes and/or challenges? Are there any policy recommendations for the current reauthorization process?
- What are additional and/or complementary ways to increase commercialization of federally funded university research and to achieve the goals of the SBIR Program?

SBIR and STTR

Congress established the Small Business Innovation Research Program (SBIR) in 1982 and the Small Business Technology Transfer (STTR) Program in 1992 [hereafter referred to as "SBIR" collectively unless otherwise noted] as a way to encourage and facilitate small business participation in the federal research mission and to support transfer of federally funded research into market-ready technologies. The laws governing these programs is found under Section 9 of the Small Business Act (15 U.S.C. 638). SBIR awards are made using a competitive and merit-based selection process. The key distinction between the programs is that STTR requires collaboration with universities or federally funded research and development centers.

The Small Business Administration (SBA) administers the SBIR program; however, the program is funded from set-asides in extramural research and development (R&D) accounts at each agency required to participate in the Program. Each agency with an annual extramural R&D budget over $100 million is required allocate 3.2% of its budget for SBIR grants and contracts[1] and each agency with an annual extramural R&D budget of $1 billion or more must allocate an additional 0.45% of its extramural budget to STTR.[2] The five agencies required to participate in STTR account for over 90% of the overall SBIR program's expenditures, which totaled approximately $2.7 billion for SBIR and $368 million for STTR in FY17, the most recent year for which data is available.

Agencies award SBIR and STTR grants and contracts in three designated phases. In Phase I, agencies may award funding up to $150,000 for six to 12 months. These funds are to be used for determining technical and scientific merit and feasibility of ideas. During Phase II, agencies may make awards up to $1,000,000 for up to two years, which are to be used for further development activities and for determining commercial potential. Phase III of the program is for commercialization and is funded by non-federal sources for most agencies. However, if the agency intends to purchase the SBIR-funded technology, an agency may use its non-SBIR federal funds to fund Phase III.

In recent history, the annual defense authorization laws have served as the vehicle for periodically reauthorizing or extending SBIR. NDAA 2012 [P.L. 112-81] reauthorized the SBIR and STTR programs and increased the allocations for each program. It increased the SBIR set-aside levels from 2.5% in FY 2011 to 3.2% in FY 2017 and increased the STTR set-aside levels from 0.35% in FY 2011 to 0.45% in FY 2017. In the 2017 NDAA (P.L. 114-328, sec. 1834), Congress passed a simple extension of the programs through the end of FY 2022, holding the program at the 2017 allocation levels, and without addressing policy issues.

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[1] Eleven agencies are required to have SBIR programs, these include: Department of Agriculture; Department of Commerce – National Institute of Standards and Technology; Department of Commerce – National Oceanic and Atmospheric Administration; Department of Defense; Department of Energy; Department of Health and Human Services (the National Institutes of Health); National Aeronautics and Space Administration; and National Science Foundation.

[2] Five agencies are required to have STTR programs, these include: Department of Defense; Department of Energy; Department of Health and Human Services (National Institutes of Health); National Aeronautics and Space Administration; and National Science Foundation.

NDAA 2019 included a number of policy amendments to SBIR, including the extension of several pilot programs established in the 2011 reauthorization. In addition, NDAA 2020 included several amendments to the Department of Defense SBIR program as well as an amendment to include consultation with procurement personnel in the SBIR process at each of the Federal agencies participating in SBIR.

The Science Committee shares SBIR jurisdiction with the House Small Business Committee (SBC). The House passed a bipartisan SBIR reauthorization bill in 2018; however, it was not taken up by the Senate. Ranking Member Baird and Chairwoman Stevens, in addition to Rep. Burchett and Rep. Crow of the SBC, introduced H.R. 3774, "*The Small Business Innovation Research and Small Business Technology Transfer Improvements Act of 2019*" in July 2019. The bill is largely based on the 2018 House-passed bill minus provisions enacted into law under NDAA 2019. H.R. 3774, as introduced, does not reflect the amendments made in NDAA 2020. While a number of pilots and other policy matters were extended or established in NDAA 2019 and NDAA 2020, this hearing is intended to be an opportunity to receive recommendations for additional improvements Congress should consider for the SBIR program as it moves toward a more comprehensive 5-year reauthorization.

BILL SUMMARY

The following are the major provisions of H.R. 3774, as introduced:

- Sec. 1 – Short Title.
- Sec. 2 –Requires DOD to establish goals for the transition of Phase III technologies into subcontracting plans.
- Sec. 3 – Requires DOD to submit a report to Congress on the establishment of goals for the transition of Phase III technologies into subcontracting plans.
- Sec. 4 – Requires SBA to ensure that agencies give high priority to manufacturing companies.
- Sec. 5 – Requires SBA to ensure that agencies engaged in cybersecurity give high priority for SBIR awards to small businesses engaged in cybersecurity.
- Sec. 6 – Makes Phase III language compliant with competitive procedures.
- Sec. 7 – Requires SBIR and STTR agencies to coordinate with procurement and other acquisition personnel. [Similar language was included in NDAA 2020]
- Sec. 8 – Requires increased SBIR and STTR outreach to Minority-Serving Institutions.
- Sec. 9 – Requires SBA and each SBIR and STTR agency to meet annually to discuss methods to improve data collection, reporting, the application process, and participation in the SBIR and STTR programs.
- Sec. 10 – Gives all SBIR agencies permanent authority to establish a civilian commercialization readiness program using 10% of their SBIR and STTR funds for technology development, testing and evaluation, and commercialization assistance.

- Sec. 11 – Requires SBIR agencies to implement a Commercialization Assistance Pilot Program under which an eligible entity may receive a subsequent Phase II SBIR award; if an agency has a sufficiently similar program then they are not required to implement a commercialization assistance pilot program under this section.
- Sec. 12 – Expands the current pilot to allow NIH, NSF, NASA, and DOE to use $5 million of each agencies' STTR funds to establish a Phase 0 Proof of Concept Partnership Pilot Program. The existing authority expires at the end of FY 2022.
- Sec. 13 – Requires that SBA's annual SBIR and STTR report to Congress be submitted by December 31 of each year. Requires that each agency's annual SBIR/STTR report to SBA be submitted by March 30 of each year.
- Sec. 14 – Authorizes all SBIR agencies to make Direct to Phase II awards and extends the authority through FY 2024. The existing authority expires at the end of FY 2022.

SBIR Program Flexibility

Each Federal agency required to participate in SBIR carries out its own unique SBIR program that fits its need. Each agency determines the categories of projects to be supported by its SBIR program, the solicitation schedule, final decisions on proposals, and makes other decisions in the administration of the program. However, as administrator of the overall SBIR program, the SBA issues, and periodically updates, SBIR policy directives for the general conduct of the SBIR program.

Congress has authorized several exceptions and waivers to make the SBIR program more flexible to suit the needs of the participating Federal agencies. For example, agencies are authorized to make awards up to 50 percent greater than the award guidelines. Currently, an agency may award a Phase 1 for up to $256,000 and a Phase II award for up to $1.7 million without seeking a waiver from the SBA.

In addition, small businesses that have received a Phase I award from one agency may receive a subsequent Phase II award from another Federal agency. NIH, DOD, and the Department of Education may award Phase II awards to small businesses that have not been provided a Phase I award if the agency determines that the small business meets the merit and feasibility qualifications required for Phase I. This is referred to as a "Direct to Phase II award." Additional agencies would like the flexibility that this authority provides. Finally, agencies may award one additional Phase II award to a small business to fund continued work on a project for which that small business has received a Phase II SBIR or STTR award. This is referred to as a "sequential Phase II award." Congress mandates agencies verify there is no duplication of funding for these projects under another Federal agency's SBIR or STTR program.

ISSUES

Early-stage Funding

When a researcher has a good idea, it takes significant effort to move that idea to a prototype and assess the potential market for the technology. Anecdotally, many innovators prematurely form a

company in order to get an SBIR grant to help with their proof of concept research and customer discovery, much of which could or should be carried out prior to company formation. The 2011 SBIR reauthorization established a Phase 0 Proof of Concept Partnership pilot program. It allowed NIH to use $5 million of its STTR funds to make awards to universities and research institutions to make grants to individual researchers for technical validations, market research, clarifying intellectual property rights, and investigating commercial or business opportunities. NIH's National Heart, Blood, and Lung Institute implemented the Research Evaluation and Commercialization Hubs (REACH) to develop best practices to translate university innovations into real-world drugs, devices, and diagnostics. NIH submitted the Congressionally mandated evaluation of the pilot to Congress in June 2019. The agency reported that it has funded three sites and 109 technology development projects, and that over 1,000 innovators received commercialization and entrepreneurship training since it stood up the program in 2015. The agency reported that as of November 2018, 22 startup companies had formed to commercialize REACH-funded technologies and these companies had submitted 12 SBIR/STTR applications, five of which had been funded. Additionally, eight technologies had been licensed and two had been optioned to license.

Currently, there are limited resources for the early, pre-SBIR stages of the innovation pipeline. In 2012, NSF launched the Innovation Corps, or I-Corps program, which is supported separately from SBIR. The I-Corps program provides funding and mentorship to help assess the viability for possible commercialization of nascent technological concepts developed through research funded by NSF. This January, NSF announced a new, more integrated structure for the program, now referred to as the "I-Corps Hubs Program," and will begin to welcome researchers funded by other Federal agencies. The data show that roughly 50-60% of I-Corps teams go on to form companies, and 2/3 of those teams choose to apply for SBIR funding.[3,4] I-Corps teams who do apply are four times[5] more likely to receive an SBIR award than the overall population of applicants for NSF SBIR funding (40% compared to 11%).[6] Other Federal agencies, including NIH and DOE, have started their own I-Corps programs. I-Corps may be considered another approach to "Phase 0" for SBIR and additional resources in support of the I-Corps program may strengthen the overall SBIR outcomes. H.R. 3774, as introduced, is intended to expand the Phase 0 pilot to NSF, NASA, and DOE. If enacted, this would support Phase 0 programs at all the civilian agencies participating in the STTR program.

Commercialization

One of the missions of SBIR is private-sector commercialization of innovation. To help improve SBIR's effectiveness in the later stages of the innovation lifecycle, Congress has authorized agencies to support commercialization assistance programs for SBIR awardees at defense and civilian agencies. Agencies may enter into agreements with vendors to contract with SBIR

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[3] https://viterbiinnovation.usc.edu/wp-content/uploads/2020/01/SBIR-VC-USOs-SSRN.pdf, presented at peer-reviewed conferences West Coast Research Symposium, 2018; and Strategy Science Conference, 2019.
[4] https://www.nsf.gov/news/special_reports/i-corps/pdf/I-CorpsReport--6_4_19FINAL_508.pdf.
[5] https://viterbiinnovation.usc.edu/wp-content/uploads/2020/01/SBIR-VC-USOs-SSRN.pdf, presented at peer-reviewed conferences West Coast Research Symposium, 2018; and Strategy Science Conference, 2019.
[6] https://www.sbir.gov/awards/annual-reports.

awardees to provide technical and business assistance. While many small businesses do use SBIR awards as a springboard to private sector funding and commercialization of their business, there are some companies that receive SBIR awards year after year and never fully commercialize. To address this issue, the 2011 reauthorization required agencies to establish a way to measure the rate of commercialization for a small business, establish a minimum performance standard, and track commercialization success of the small business and its progress to Phase II and Phase III. If a small business does not meet these performance goals, they are ineligible to receive a Phase I or Phase II award for one year.

Administrative Fee

Congress authorized an administrative pilot program ("administrative fee") that allowed agencies to use 3% of their SBIR funds for new activities that go toward achieving six program goals including: outreach activities; commercialization; streamlining and simplification; prevention and detection of fraud, waste, and abuse; reporting; and administration and implementation of the reauthorization. A May 2016 report from the U.S. Government Accountability Office[7] found that in FY 2014, 7 of the 11 agencies with SBIR programs participated in the pilot and reported spending $19.1 million to address the pilot program's goals.

Evaluation

Congress has required quadrennial reviews of each agency's SBIR program by the National Academies of Science, Engineering, and Medicine. The last round of reviews was carried out in 2015-2016, and the new round is underway. Those reviews found that agencies were meeting every goal of the SBIR program except for fostering participation by socially and economically disadvantaged persons, which includes women and minority-owned firms. The National Academies' 2015 assessment of SBIR/STTR at NIH[8] found that women and minority participation is "low and declining" at NIH. This is a similar area of concern across all SBIR participating agencies. In its previous round of studies, NAS recommended that SBIR participating agencies develop new benchmarks and metrics to improve participation by underserved populations and to better evaluate agency outreach efforts.

The SBIR programs at two DOE offices, the Office of Energy Efficiency and Renewable Energy and the Office of Fossil Energy, were evaluated in a May 2019 report. The report showed that a Phase I award has positive effects on innovation, firm growth, and patenting for young firms but those effects decline for firms with multiple previous SBIR awards.[9] In addition, the report found that a Phase II award does not have any significant effects on a firm's growth, and even less so for firms with multiple SBIR awards.[10]

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[7] GAO May 2016 Report Small Business Research Programs: Agencies Have Improved Compliance with Spending and Reporting Requirements, but Challenges Remain."

[8] The National Academies of Science, "SBIR/STTR at the National Institutes of Health," 2015.

[9] Howell, Sabrina T., "Analysis of the U.S. Department of Energy's Energy Efficiency & Renewable Energy and Fossil Energy SBIR Programs," February 2019.
https://www.energy.gov/sites/prod/files/2019/03/f60/sbir-eere-fe-analysis-howell-report-2019.pdf

[10] Id.

Chairwoman STEVENS. This hearing will come to order. Without objection, the Chair is authorized to declare recess at any time. Good afternoon, and welcome to this hearing of the Subcommittee on Research and Technology to review opportunities and challenges for the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. I'd like to extend a warm welcome to our distinguished panel of witnesses. We look forward to hearing your testimony, and to having this discussion this afternoon. Today we're going to explore the role of these important programs in catalyzing the innovation and commercialization accomplishments from our Federal research investments to generate new economic growth, and further American leadership in innovation.

The SBIR and STTR programs have helped entrepreneurs in my home State of Michigan to pursue their big ideas, and contribute to our thriving innovation economy. Since the creation of these programs, small businesses, as an example, in Michigan have been able to leverage $1.2 billion in funds to develop an amazing array of new technologies, while creating jobs and driving economic growth in our region. These investments transform communities and competitively grow small businesses.

For instance, Variation Reduction Solutions, Incorporated, VRSI, is a small business located in my district in Plymouth, Michigan, and they're focused on manufacturing production technology. With our great roots in Southeastern Michigan in the auto industry, this, you know, we needed to kind of find a way to continue to grow our economy as we were coming out of the Great Recession that began in Michigan in 2007. So with the help of an SBIR grant, VRSI expanded into the aerospace industry. See, this is the plight of diversification, right? So we love our auto industry, but if there's a downturn, we want to be able to sell into other industries as well. And so they became involved with the F–35 Program, and generated relationships with the Department of Defense and large industry players, such as Lockheed-Martin and Northrop Grumman. The SBIR program was an essential piece of this successful transition to allow VRSI to not only weather through the transition of the Great Recession, but also to grow into a stronger and more thriving business.

Today SBIR programs continue to allow small businesses in my district with the opportunity to scale into new industries and new markets, while building critical relationships with government and industry partners. It's because of successes like these that I am so proud to co-sponsor a bipartisan bill, and we did this earlier this Congress. I did this with my friend Ranking Member Baird, and two of our colleagues on the other Committee, on the House Small Business Committee, to further strengthen SBIR and STTR programs. H.R. 3774, the *Small Business Innovation Research and Small Business Technology Transfer Improvement Act of 2019* encourages agencies to give high priority to funding small manufacturers and cybersecurity forums, right? These are places where we need and want to innovate, and it's absolutely critical for our economic and national security for the U.S. to maintain a domestic manufacturing base, and to develop the best cybersecurity tools for all businesses.

For these entrepreneurs who are just getting started, early stage funding, right, helps them to get on the path for success. So this legislation, H.R. 3774, would require the Phase 0 proof of Concept Pilot Program currently carried out by NIH (National Institutes of Health) to be expanded to NSF (National Science Foundation), DOE (Department of Energy), and NASA (National Aeronautics and Space Administration). This pilot program has been instrumental in providing funds to innovators to identify research with commercial potential, engage in entrepreneurial training, and make technical validations. What could be greater? Phase Zero awards also allow researchers to take these important steps before company formation and before spending weeks to months to complete an SBIR application. Data from the NIH pilot program have clearly demonstrated the potential for this program to improve the overall outcomes of the SBIR program. Phase Zero efforts have also demonstrated success in broadening the participation of women and minorities in entrepreneurship, which is an important goal of the SBIR program that the agencies have long grappled with.

SBIR has also been an important program in our overall Federal R&D (research and development) portfolio. It helps the agencies achieve their missions, and it supports innovative entrepreneurs who are creating jobs and generating economic growth in communities across the Nation. The improvements to the SBIR program proposed in H.R. 3774 will ensure that we can continue to build upon the program's successes and lessons learned. I cannot think of a more essential and exciting topic for us to explore and learn more about today. I want to thank our witnesses again for being here. We are really looking forward to your feedback on the legislation, and any other additional ideas that Congress should consider for improving the SBIR program.

[The prepared statement of Chairwoman Stevens follows:]

Good afternoon and welcome to this hearing of the Subcommittee on Research & Technology to review opportunities and challenges for the Small Business Innovation Research and Small Business Technology Transfer program. I'd also like to extend a warm welcome to our distinguished panel of witnesses. We look forward to your testimony and having this discussion this afternoon.

Today, we will explore the role of these important programs in catalyzing the innovation and commercialization accomplishments from our federal research investments to generate new economic growth and further American leadership in innovation.

The SBIR and STTR programs have helped entrepreneurs in Michigan pursue their big ideas and contribute to our thriving innovation economy. Since the creation of these programs, small businesses in Michigan have leveraged $1.2 billion in funds to develop an amazing array of new technologies while creating jobs and driving economic growth in our region.

These investments transform communities and grow small businesses. For instance, Variation Reduction Solutions, Incorporated, VRSI, is a small business in my district in Plymouth, Michigan focused on manufacturing production technology. With its roots in the auto industry, it needed to find a way to succeed as the economy was crashing in 2007.

With the help of an SBIR grant, VRSI expanded into the aerospace industry, becoming involved with the F-35 program and generating relationships with the Department of Defense and large industry players such as Lockheed Martin and Northrup Grumman. The SBIR program was an essential piece of this successful transition to allow VRSI to not only weather the Great Recession but to grow into a stronger and thriving business.

Today the SBIR Program continues to allow small businesses in districts like mine the opportunity to scale into new industries and new markets while building critical relationships with government and industry partners.

It is because of successes like these that I was proud to cosponsor a bipartisan bill earlier this Congress with Ranking Member Baird and two of our colleagues on the House Small Business Committee to further strengthen the SBIR and STTR programs. H.R. 3774, *The Small Business Innovation Research and Small Business Technology Transfer Improvements Act of 2019*, encourages agencies to give high priority to funding small manufacturers and cybersecurity firms. It is critical for our economic and national security for the U.S. to maintain a domestic manufacturing base and to develop the best cybersecurity tools for all businesses.

For those entrepreneurs who are just getting started, early stage funding helps set them on the path to success. H.R. 3774 would require the Phase 0 Proof of Concept pilot program currently carried out by NIH to be expanded to NSF, DOE, and NASA. This pilot program has been instrumental in providing funds to innovators to identify research with commercial potential, engage in entrepreneurial training, and make technical validations. Phase 0 awards allow researchers to take these important steps before company formation and before spending weeks to months to complete an SBIR application. Data from the NIH pilot program have clearly demonstrated the potential for this program to improve the overall outcomes of the SBIR program. Phase 0 efforts have also demonstrated success in broadening the participation of women and minorities in entrepreneurship. That is an important goal of the SBIR program that the agencies have long struggled with.

SBIR has long been an important program in our Federal R&D portfolio. It helps the agencies achieve their missions and it supports innovative entrepreneurs who are creating jobs and generating economic growth in communities across the nation. The improvements to the SBIR program proposed in H.R. 3774 will ensure that we can continue to build upon the program's successes and lessons learned.

I cannot think of a more essential and exciting topic for us to explore and learn more about today. I want to thank the witnesses for being here today. I look forward to your feedback on our legislation and any additional ideas Congress should consider for improving the SBIR Program.

Chairwoman STEVENS. Before I recognize Dr. Baird for his opening remarks, I would like to present for the record statements from the National Institutes of Health and Clean Energy Business Network regarding this hearing, so we have statements from both of these organizations for the official record today.

And now, without further ado, our Chair is going to recognize Dr. Baird for an opening statement.

Mr. BAIRD. Thank you, Chairwoman Stevens. Anyway, let's not get confused here. I really appreciate you holding this hearing, and you know I really appreciated the opportunity to work with you to introduce that H.R. 3774. And, you know, these are, you know, descriptive terms, I guess, but when you talk about small business innovation research, if you really think through that, that's extremely important, and then you add to it the small business technology transfer improvement, I mean, that's so important to our economy, to our country, and to our citizenship, so we really appreciate the opportunity to do that with you, and I appreciate all the witnesses being here.

I'm really proud of America for our leadership in science and technology over the years and through the centuries, and as I mentioned, it is critical to our economy, and it's critical our national security. And so basic research, supported with taxpayer dollars through the National Science Foundation, through NASA, NIH, DOD (Department of Defense), and other Federal agencies have led to key scientific discoveries that have created today's world, the Internet, wireless communications, life-saving medicines, lasers, and so on. So when you think about the products and innovations that have evolved from this kind of research, it's phenomenal. So basic research produces the scientific fuel for innovation, risk-taking small businesses are the engines for converting that knowledge,

and into new products and services. Small businesses are the catalysts for economic growth for producing good paying jobs in our communities. So I think a lot of us recognize how important small businesses are to our communities, and to our States, and to the country.

So SBIR and STTR programs help accelerate the commercialization of taxpayer funded research into new products and services. They also help the Department of Defense and other Federal agencies meet their research and development needs. The SBIR and STTR programs are funded from set-asides of the extramural research budget at Federal agencies to the tune of 3.2 percent for SBIR grants, and just less than half a percent for the STTR. These set-asides sound small, but they amount to about $2.7 billion for SBIR and $368 million for STTR on an annual basis, so this is a huge taxpayer investment, so it's important that we ensure that these programs are working. And I think that's why we have these kinds of hearings, to share with us, as Congress Members, how the programs are working.

My legislation takes steps to improve the accountability portion of that. First, it reinforces the requirement that the Small Business Association give a comprehensive annual report to SBIR and STTR programs to Congress, and hold the Department of Defense accountable to stimulate technological innovation. The bill also sets priorities for SBIR and STTR—boy, programs to stimulate manufacturing and cybersecurity, and the products and services that we utilize in the United States.

The bill extends the flexibility given to agencies for innovative funding mechanisms for those two programs. Congress acted to extend those two programs through Fiscal Year 2022, but our work must continue to ensure the success of these programs. They're vital to helping the Hoosier small businesses, and the other segments of our Nation. I'm proud to have one of those Hoosier success stories on the panel here today. Dr. Johnny Park took basic research he developed in his lab at Purdue University. Did you hear that? Purdue University, yes.

Chairwoman STEVENS. OK——

Mr. BAIRD. Anyway——

Chairwoman STEVENS [continuing]. We heard you.

Mr. BAIRD [continuing]. And started a company with the assistance of an SBIR award to develop his research, then he created products for farmers, and a thriving business that has been acquired since then. I look forward to hearing his testimony today as a great example of the innovation system in America. We must take every opportunity to strengthen investment in R&D so that we can continue breaking boundaries and moving our economy forward. I'm proud to work with our colleagues to encourage innovation and give our businesses the resources they need to thrive. I look forward to hearing ideas from our panel and witnesses on how we can continue to strengthen the two programs. And I yield back. Thank you.

[The prepared statement of Mr. Baird follows:]

Chairwoman Stevens, I appreciate you holding today's hearing to review the SBIR and STTR programs.

I was proud to introduce H.R. 3774, *the Small Business Innovation Research and Small Business Technology Transfer Improvements Act.*

I want to thank the Chairwoman for joining me in sponsoring the bill, and for advancing that effort with today's legislative hearing.

America's leadership in science and technology is critical to our economic and national security. Basic research supported with taxpayer dollars through the National Science Foundation, NASA, NIH, DOD, and other federal agencies has led to the key scientific discoveries that have created today's world: the internet, wireless communications, life-saving medicines, lasers, and more.

If basic research produces the scientific fuel for innovation, risk-taking small businesses are the engines for converting knowledge into new products and services. Small businesses are the catalysts for economic growth, for producing good-paying jobs in our communities.

The SBIR and STTR programs help accelerate the commercialization of taxpayer-funded research into new products and services. They also help the Department of Defense and other federal agencies meet their research and development needs.

The SBIR and STTR programs are funded from set-asides of the extramural research budgets at federal agencies—3.2% for SBIR grants and just less than half a percent for STTR. These set-asides sound small, but they amount to over $2.7 billion for SBIR and $368 million for STTR annually. This is a huge taxpayer investment, so it is important for Congress to ensure the programs are working.

My legislation takes steps to improve accountability.

First, it reinforces the requirement that the Small Business Administration (SBA) give a comprehensive annual report of the SBIR and STTR programs to Congress and holds the Department of Defense (DoD) accountable to stimulate technological innovation.

The bill also sets priorities for the SBIR and STTR programs to stimulate manufacturing and cybersecurity products and services in the United States. The bill also extends flexibility given to agencies for innovative funding mechanisms under the SBIR and STTR programs.

Congress acted to extend the SBIR and STTR programs through Fiscal Year 2022, but our work must continue to ensure the success of these programs. The SBIR and STTR programs are vital to helping our Hoosier small businesses and our nation.

I am proud to have one of those Hoosier success stories on our panel today. Dr. Johnny Park took basic research he developed in his lab at Purdue University, and started a company with the assistance of SBIR awards to develop his research. He created products for farmers and a thriving business that was then acquired. I look forward to hearing his testimony today, as a great example of the innovation system in America.

We must take every opportunity to strengthen investment in R&D so we can continue breaking boundaries and moving our economy forward. I'm proud to work with my colleagues to encourage innovation and give our businesses the resources they need to thrive.

I look forward to hearing ideas from our panel of witnesses of how we can continue to strengthen the SBIR and STTR programs.

I yield back.

Chairwoman STEVENS. If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

[The prepared statement of Chairwoman Johnson follows:]

Good afternoon and thank you to the Chair and Ranking Member for holding this hearing and for introducing a good, bipartisan bill making improvements to the SBIR and STTR programs. I would also like to welcome our witnesses to today's hearing and thank them for sharing their expertise with us on these important programs.

The SBIR program is known as "America's Seed Fund." A strength of the Federal scientific enterprise is its ability to harness research and ideas from a wide range of innovators including small businesses. Just a modest amount of early stage support for these ideas can propel them forward and open the door to significant private sector investment and commercial success.

To build on these successes for the future, it is important to periodically evaluate the SBIR program and ensure policies are in place to help the agencies meet the goals of the program.

There is no one size fits all assessment of SBIR because each agency implements a unique program. And Congress has recognized the need to provide agencies the flexibility to do so. Each agency has its own mission and research needs. However,

the overarching goals are constant across the agencies, and Congress requires the National Academies of Science, Engineering, and Medicine to review these programs every four years with those goals in mind. The Academies has recently initiated a new round of reviews so we don't have new recommendations yet. However, in their last round in 2015-2016 they found that overall, agencies were doing a good job in meeting the statutory goals, except when it came to achieving increased women and minority participation in SBIR and STTR.

Whether this is a pipeline issue or an accessibility issue, the status quo is not good enough. Congress authorized agencies to use 3 percent of their SBIR funds for administrative activities, program evaluation, and outreach. I am interested in any feedback the witnesses might offer on the use of these funds for increasing the participation of underrepresented groups in the program. I am also eager to learn more from NSF about the promise of the Innovation Corps and other preSBIR activities in engaging more women and minorities in entrepreneurship. We should continue to experiment with these and other potential solutions to addressing the lack of diversity in the SBIR program and our innovation pipeline.

Finally, this Committee has long advocated for early-stage funding. It takes business acumen, a solid technology foundation, and adequate resources to get an idea into the market. NIH recently reported a number of successes funded through a Congressionally mandated pilot program to fund activities to improve the commercialization potential of pre-competitive technologies. Considering these successes, I would like to see other agencies carry out a similar program.

I look forward to an informative hearing, and I appreciate the witnesses being with us to share their insights and legislative recommendations.

Thank you, and I yield the balance of my time.

Chairwoman STEVENS. And at this time, I'd also like to introduce our witnesses in full.

Our first witness is Dr. Dawn Tilbury. Dr. Tilbury is the Assistant Director of the Directorate of Engineering at the National Science Foundation. In this role she leads the directorate in its mission to support engineering research and education critical to the Nation's future. The engineering directorate also manages the National Science Foundation's SBIR and STTR programs. Dr. Tilbury is on temporary leave, wait for it, from the University of Michigan, where she has been a professor since 1995 in both mechanical and electrical engineering. She is also the inaugural chair of the Robotics Steering Committee, and served as an associate dean for research in the College of Engineering at the University of Michigan. And, as we just launched last week the Women in STEM (science, technology, engineering and mathematics) Caucus for the House of Representatives, we look forward to engaging you in that caucus as well in that Committee.

And then our next witness is Dr. Maryann Feldman. Dr. Feldman is the Distinguished Professor in the Department of Public Policy and Adjunct Professor of Finance in the Kenan-Flagler Business School at the University of North Carolina at Chapel Hill. Her research focuses on the geography of innovation, the commercialization of academic research, and the factors that promote technological change and economic growth. Dr. Feldman is also the co-chair of several assessments of the SBIR and STTR programs that are underway at the National Academies of Sciences, Engineering, and Medicine, and we're counting you in our Women in STEM Caucus too. We're promoting it, since we just launched it.

And then next, and we're so delighted to have Mr. Nicholas Cucinelli. Mr. Cucinelli is the Chief Executive Officer of Endectra LLC, an SBIR funded spinout from the University of Michigan launched in 2015 that has a portfolio of photonic and nano-sensor technologies for defense, medical, and industrial applications. He is also an entrepreneurial leadership instructor at the University of

Michigan Center for Entrepreneurship. And from 2013 to 2018 he served as a mentor in residence for the Tech Transfer Talent Network Program, supporting university startup teams Statewide. Mr. Cucinelli served 16 years with the U.S. Coast Guard, where he focused on environmental protection, and was named Coast Guard Hero in 2000, and thank you so much for doing that important work.

Our fourth witness, who we heard a little bit about, is Dr. Johnny Park. Dr. Park is the Chief Executive Officer of Wabash Heartland Innovation Network, a consortium of 10 counties in North Central Indiana devoted to developing the region into a global epicenter of digital agriculture and next generation manufacturing by using the Internet of Things. Prior to his position at this network, Dr. Park founded, scaled, and led a successful exit of an ag tech company, Spensa Technologies. He was previously a faculty member in the School of Electrical and Computer Engineering at Purdue University, where his research included projects on robotics, computer vision, machine learning, and distributed sensor networks. We will make note that not all SBIR funding goes through Michigan and Indiana, but we are very pleased to have these great witnesses here today. And there's one thing we know on this Committee, is that the Midwest is best.

So, as our witnesses should know, you're each going to have 5 minutes for your spoken testimony, and make sure to turn on your microphone when you're speaking. Your written testimony will be included in the record for the hearing, and then, after each of you have completed your spoken testimony, we'll begin with questions, and each Member will have 5 minutes to question the panel. And, with that, we're going to start with Dr. Tilbury.

TESTIMONY OF DR. DAWN TILBURY,
ASSISTANT DIRECTOR, DIRECTORATE FOR ENGINEERING,
NATIONAL SCIENCE FOUNDATION

Dr. TILBURY. Great. Well, thank you very much, Chairwoman Stevens, Ranking Member Baird, and Members of the Subcommittee. Thank you for the opportunity to testify on the SBIR and STTR programs at the National Science Foundation. It's great to see a little Big Ten rivalry up there. So this year, as NSF celebrates its 70th anniversary, we reflect on the many breakthrough discoveries and innovations that have been enabled by NSF investments that sustain, accelerate, and transform America's globally preeminent research ecosystem. Some of the most well-known innovative companies of today, such as Qualcomm, started with NSF support, and specifically with support from SBIR and STTR. These programs are an integral part of the NSF strategy to stimulate innovation and address societal needs through the commercialization of the results of fundamental research.

NSF is unique across the Federal Government, with a mission to support fundamental research across all fields of science, technology, engineering, and mathematics, or STEM, and all levels of STEM education. Given this unique role in supporting innovators, the agency recognized early on the potential for greater and faster commercialization of NSF funded research. That is why, in the late 1970s, NSF created the SBIR program. The primary objective of

the SBIR and STTR programs is to transform scientific discoveries into products and services with commercial potential or societal benefits. Within NSF most of our SBIR and STTR Program officers are scientists, and also former entrepreneurs, investors, or both.

At NSF, SBIR research topics cover the entire spectrum of the marketplace and the Nation, and I'll tell you a story about one of my colleagues from the University of Michigan, Dr. Shorya Awtar. Shorya started his career getting some early NSF funding for basic research into kinematics, which, if any of you are mechanical engineers, that's pretty old-fashioned mechanical engineering. However, he had an innovative idea about how to re-map the surgeon's hand movements in a laparoscopic surgical instrument using purely kinematics, so when the surgeon moves his fingers this way, the end-effector moves the same way, instead of the opposite way, as you would expect.

Now, current technology, such as the DaVinci Robot, can do this remapping, but it takes a whole room of electronics and costs a million dollars. Shorya's mechanical device costs less than $500. So he went through I-Corps, one of NSF's programs, started a company, and got SBIR Phase 1 and Phase 2 awards, and his company is currently operating in Michigan with several dozen employees, producing these surgical devices as fast as they can. Now he's back at the university, has another basic research award, and possibly the cycle will start all over again. We'll wait and see.

NSF's I-Corps Program provides training to potential entrepreneurs, faculty, graduate students, post-docs, teaching them about what the market needs are, and how they might commercialize their product. PIs who have been through the I-Corps Program are three to four times more likely to receive an NSF SBIR Phase 1 award than the general population. So, building on this success, over the last year we have put more than 1,000 NSF SBIR and STTR Phase 1 awardees through a condensed version of the I-Corps Program called Beat the Odds Bootcamp.

So, in conclusion, I'll echo what we heard earlier. Small businesses create jobs. They fuel the economy, and they support communities. 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 is constantly assessing its performance against the goals of these programs, and has taken on new initiatives, and new outreach, and new enhancements. We know that it takes more than the SBIR and STTR investment to translate a technical vision into a realized, economically viable company, but these SBIR and STTR Programs anchor our extensive activity in identifying and leveraging the opportunities for new technologies.

On behalf of the National Science Foundation, and all of our awardees, I want to thank you for your support of NSF, and for this opportunity to highlight the programs that provide startups and small businesses with the means to keep America on the forefront of innovation. Thank you.

[The prepared statement of Dr. Tilbury follows:]

Testimony of

Dr. Dawn Tilbury
Assistant Director
Directorate for Engineering
National Science Foundation

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

February 5, 2020

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.

Dawn M. Tilbury, Ph.D.
Biography

Dr. Tilbury leads NSF's Directorate for Engineering in its mission to support engineering research and education critical to the nation's future and fosters innovations to benefit society. Engineering breakthroughs address national challenges, such as smart manufacturing, resilient infrastructure and sustainable energy systems. Engineering also brings about new opportunities in areas ranging from advanced photonics to prosthetic devices. The Engineering Directorate helps to advance NSF's Ten Big Ideas, including the Future of Work at the Human-Technology Frontier, the Quantum Leap, Understanding the Rules of Life, and NSF INCLUDES. The Engineering Directorate provides about 40 percent of the federal funding for fundamental research in engineering at academic institutions and distributes about 1,600 research awards each year.

Partnerships with industry are a key component of the Engineering Directorate's programs, including GOALI (Grant Opportunity for Academic Liaison with Industry) where industry researchers collaborate directly on academic research projects, and INTERN which allows graduate students funded on NSF projects to spent up to 6 months in a non-academic internship (such as a company, government lab, or non-profit organization). The IUCRC (Industry-University Cooperative Research Center) program brings together NSF researchers with funding provided by industry and other government agencies to do pre-competitive research, and the ERC (Engineering Research Centers) program supports large-scale convergence research projects together with workforce development, diversity and inclusion, and an innovation ecosystem. The Engineering Directorate coordinates NSF's I-Corps program, providing entrepreneurial training to faculty, graduate students and postdocs. NSF's SBIR and STTR programs, housed in the Engineering Directorate, support fundamental research being done in high-tech small businesses helping them transition new technologies into the commercial marketplace.

A professor at the University of Michigan since 1995, in both mechanical and electrical engineering, Dr. Tilbury has a background in systems and control engineering. She received the B.S. degree in Electrical Engineering, *summa cum laude,* from the University of Minnesota in 1989, and the M.S. and Ph.D. degrees in Electrical Engineering and Computer Sciences from the University of California, Berkeley, in 1992 and 1994, respectively. She is the inaugural chair of the Robotics Steering Committee and served as an associate dean for research in the College of Engineering. She was elected Fellow of the IEEE in 2008 and Fellow of the ASME in 2012, and is a Life Member of SWE. Dr. Tilbury retains her position with the University of Michigan and shall return after her term with NSF expires.

**TESTIMONY OF DR. MARYANN FELDMAN,
S.K. HENINGER DISTINGUISHED PROFESSOR
OF PUBLIC POLICY, DEPARTMENT OF PUBLIC POLICY,
ADJUNCT PROFESSOR OF FINANCE,
KENAN-FLAGLER BUSINESS SCHOOL,
FACULTY DIRECTOR, CREATE,
KENAN INSTITUTE OF PRIVATE ENTERPRISE,
THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL**

Dr. FELDMAN. So, Chair Stevens, Ranking Member Baird, and Members of the Committee, thank you so much for inviting me to testify. And I am the Co-Chair of several ongoing National Academies assessments of the SBIR program. Our first assessment of the Department of Energy will be released at the end of March, so I'm not able to speak to any of the findings or recommendations of the Committee. I'm appearing today in my capacity as an expert in innovation, and as a scholar who was studied the SBIR program, its impacts, and also the ways in which those impacts may be broadened. And so this program is highly successful. It's copied around the world, and it deserves Congress' continued and enthusiastic support.

The program strengthens the capacity for private sector innovation in the U.S., but there are opportunities. States have been experimenting with programs to encourage technology commercialization, but these State resources are not evenly distributed, and there's a tendency for the States that have a lot of activity to get more. And so an example of the way that we could level the playing field are increased funding for the Phase Zero Proof of Concept centers, and about half of the States currently have these programs. With small amounts of money in the range of $2 to $10,000, they increase the competitiveness of the SBIR proposals, and this is very important for first time applicants, but also, when people have an unsuccessful application, they can then revise it.

Another example is the SBIR State match, and these are for companies that have been awarded funding, and it tops off the amount of the funding, and there are currently 15 States that offer a match that will increase the amount of funding. My own research with Lauren Lanahan has examined this program. We find that small amounts of money, in the range of $25 to $50,000, increase the probability of a firm moving from a Phase 1 to a Phase 2. That suggests that increasing the amount of funding will increase the success of the program. Now, these State programs are copied on an ad hoc basis, and having them be a national program might increase the success of the program. Many States simply don't have the access to adopt these programs, and these are the States where there is the greatest need.

The evidence suggests that the SBIR program is working well, but the SBIR program is only one component of a larger system of innovation. The program's called America's Seed Fund, and it is meant to address this colorfully named funding gap, the Valley of Death, but venture capital has not been moving in with follow-on funding. Many SBIR recipients are unable to secure the needed funding to move forward, and this is especially true for the high risk, high reward technologies that are central in energy independ-

ence, providing new and better industrial materials, and really those technologies that have the potential to create new industries. Venture capital (VC) has increasingly been moving toward software investments, and this is where you have lower—shorter development times, lower capital cost, and less market uncertainty. The VC model is also predicated on returning moneys to investors within 5 to 10 years, and that's not enough time to develop these technologies, where there is such great uncertainty.

I'd also like to suggest that these wonderful pilot programs you've been trying should be part of this landscape, and should be institutionalized, and so this is a way of nesting the companies in support organization. The idea of public/private partnerships which would blend funding, bringing together different users will help validate discoveries, and move business forward. NSF, excuse me, NIH has tried this very successful with their REACH Program, that's Research Evaluation and Commercialization Hubs, but this could be extended to other agencies.

And so I think that, as we think of reforming the SBIR program, it's important to remember it works very well, and that we need to get other components of the system supporting SBIR in a better way. Thank you.

[The prepared statement of Dr. Feldman follows:]

Testimony of Maryann Feldman before the Subcommittee on Research and Technology
America's Seed Fund: A Review of SBIR and STTR
February 5, 2020

Chair Stevens, Ranking Member Baird, Chair Johnson, Ranking Member Lucas and Members of the Research and Technology Subcommittee of the Committee on Science, Space, and Technology, thank you very much for inviting me to testify at this hearing.

I am the Heninger Distinguished Professor in the Department of Public Policy at the University of North Carolina, an Adjunct Professor of Finance at Kenan-Flagler Business School and a Research Director at UNC Kenan Institute of Private Enterprise. While I am appearing today in my capacity as an expert in innovation and a scholar of the SBIR and STTR programs, I will note that I am currently the co-chair of several assessments of the programs that are underway at the National Academies of Sciences, Engineering, and Medicine. I would also like to state that my comments and recommendations today are my own, and they do not reflect consensus findings and/or recommendations of the National Academies.

The Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR) programs demonstrate that effective public-private partnerships can play an important role in stimulating America's innovation economy and promoting the commercialization of science.

The SBIR and STTR programs have been highly successful and deserve Congress's continued and enthusiastic support. The program strengthens the United States' capacity for private-sector innovation.

Global competition for innovation advantage is intensifying. Efforts to continue to enhance the programs' potential to contribute to greater levels of technology transfer and commercialization are warranted. Our trading partners are investing in overtaking America's technological leadership. The U.S needs to keep pace.

Eleven federal agencies participate in SBIR, using the program to promote their federally designated mission and to commercialize technology important to the public good. The program is key to university technology transfer. Still, there is much more to do to promote technology transfer and commercialization from U.S. universities, federal laboratories, and other research institutions. There are also opportunities to link forward to increase opportunity in manufacturing, which is essential if we are to see wider effects from our public investments. Efforts to scale up technology and engage in

manufacturing suggest that further innovation is needed, and such investments will put in place the increasing returns that yield wider prosperity.

A bold broader initiative is needed.

The locus of inventive activity is essentially local and through the efforts of legislation such as the Bayh-Dole Act and the SBIR/STTR programs we have pockets of prosperity in university towns across the nation. The system works well in some places but not everywhere.

States have been experimenting with programs to encourage technology commercialization but state resources are unevenly spread. There is a need for additional federal resources to help U.S. states stimulate commercialization activity, such as by supporting state science and technology programs or by providing a pool of funds that could be used to provide matching funds for state initiatives. State programs assist the initial proof of concept stage before the SBIR application, provide funding to top-off the award amount, and also seek to further commercialization.

One example is the state Phase 0 proof of concept programs that encourage preliminary research and other activities related to development and submission of a Phase I SBIR/STTR proposal. About half the states have these programs, which typically provide $2,000 to $10,000 to increase the competitiveness of the SBIR/STTR proposal.

Once companies have been awarded SBIR funding, there are currently 15 states that offer a state match to increase the SBIR award amount. My own research, which is joint work with Lauren Lanahan, examined state SBIR matching programs. This research demonstrates that small amounts of additional funding, say $25,000 to $50,000 increase the probability of a firm successfully moving from a Phase 1 to a Phase 2 award. The program is being copied by states and rolled out on an ad hoc basis. The success of the state programs and their rapid diffusion across states argues for greater national consideration. Many states do not have the resources to adopt these programs causing a loss of potential benefits to the innovation ecosystem that would ordinarily accrue because of the SBIR/STTR programs.

The SBIR/STTR programs are only one component in the American innovation system. While SBIR/STTR is working well, other components of the system are not doing their part. Many SBIR/STTR recipients are unable to secure the required funding to move them forward.

The SBIR/STTR program, called *America's Seed Fund,* was intended to address the colorfully named *Valley of Death*. Venture Capital (VC) was expected to step in with follow-on funding to move the technology forward. Yet, in reality, most VC funding

lands on lower risk software investments, eschewing the longer development times, high capital costs, and less certain markets associated with the types of emerging technologies that SBIR/STTR funds and that are needed to address America's energy independence, provide new and better industrial materials, and create entirely new industries.

Tax credits for investment in high-risk technology sectors could help bridge this gap. The VC model is predicated on returning money to investors with a limited time span of 7 to 10 years. This is simply not enough time to incubate radical new technologies. Moreover VCs make their money on firm exits not when firms grow – these exits increasingly involve mergers and acquisitions. Technology companies incubated in university towns that receive venture capital funding are very likely to relocate away from their university town when they receive VC investment.

This is not the immediate concern today but I would encourage you to consider the larger system of technology commercialization surrounding the SBIR/STTR programs.

There are public-private partnerships that could move SBIR/STTR companies forward. For example, the National Institutes of Health's Research Evaluation and Commercialization Hubs (REACH) provides a national network of proof-of-concept centers that seek to accelerate the translation of biomedical innovations into public benefit. Each hub is required to secure non-federal matching funds and develop partnerships with state and regional economic development organizations to enhance the impact of federal investment.

The REACH program merges the strengths of high-impact research institutions with product development expertise and resources from federal and private-sector partners. This program could be copied or expanded for other technologies to enable SBIR/STTR firms to validate their discoveries and advance their small businesses and impacts. For many new technologies, this would involve scale-up manufacturing, and open opportunities for new suppliers and workers.

One thing to note, the SBIR/STTR programs should be considered in their totality as part of a larger system. In addition to providing support for knowledge creation, the SBIR program helps the government set a long-term agenda for scientific progress and innovation.

As seen in many academic studies -- the programs help firms overcome credit and capital constraints at early stages of innovation. But innovative small business benefit from all types of collaboration with the federal mission agencies provided by the SBIR/STTR programs. The programs help diversify the government supplier base and promote entry into technical fields. The SBIR/STTR programs open new procurement pipelines for federal agencies.

I also want to point out that there is strong evidence that technological innovation is most successful when it is combined with market opportunities as is the case with the SBIR/STTR programs. I want to caution the committee from placing too much importance on commercialization – too large of an emphasis on commercialization may push the agencies toward projects that have short-term commercialization potential rather than long term innovation potential.

I note that the proposed legislation adds a new emphasis on cybersecurity, which affects all agencies. I am most familiar with some of the work being done at the Department of Energy, which recently created the Office of Cybersecurity, Energy Security, and Emergency Response. Because this office is relatively new, the National Academies committee will not be providing an assessment of the topics or the awardees. SBIR topics offered by this office are focusing on cybersecurity to prevent attacks on the power grid. There may be benefit for Congress to encourage coordination across agencies on this topic, because cybersecurity cuts across most federal agencies.

Although I am the co-chair of several on-going National Academies assessments, I cannot speak to any findings or recommendations that the committee may end up with (although our first assessment – for the Department of Energy – will be published by the end of March). I can tell you that the committees are focused on the overall impact of the programs on the innovation ecosystem and that impact may be broader than simply the impact of the awardees. The committees are also focusing on how the program can help strengthen participation of women and underrepresented groups in the innovation ecosystem.

In conclusion, the SBIR/STTR programs are some of the most effective in America's arsenal of programs to stimulate innovation, though efforts toward continued refinement and improvement are warranted.

Maryann P. Feldman is the Heninger Distinguished Professor in the Department of Public Policy at the University of North Carolina, Professor of Finance at Kenan-Flagler Business School and Research Director at the CREATE Prosperity Center at the UNC Kenan Institute of Private Enterprise. She is an editor of the *Oxford Handbook of Economic Geography,* which is in its second edition. Dr. Feldman is also an editor of *Research Policy,* a multi-disciplinary journal devoted to analyzing, understanding and effectively responding to the economic, policy, management, organizational, environmental and other challenges posed by innovation, technology, R&D and science. Her research and teaching interests focus on innovation, the commercialization of academic research and the factors that promote technological change and economic growth. Dr. Feldman was the winner of the 2013 Global Award for Entrepreneurship Research for her contributions to the study of the geography of innovation and the role of entrepreneurial activity in the formation of regional industry clusters. From 2014-2017, Dr. Feldman was the Director of the National Science Foundation's Science of Science and Innovation Policy (SciSIP) Program and chaired an inter-agency working group on Science Policy. She received the 2018 Technology & Innovation Management Distinguished Scholar Award from the Academy of Management for her career achievements.

TESTIMONY OF MR. NICHOLAS CUCINELLI,
CHIEF EXECUTIVE OFFICER, ENDECTRA, LLC

Mr. CUCINELLI. Chairwoman Stevens, Ranking Member Baird, and Members of the Subcommittee, thank you for inviting me here today to offer an entrepreneur's perspective on H.R. 3774 and the overall SBIR/STTR program. Apologies in advance for saying that acronym over and over again. I offer my perspective through the unique lens of having professionally mentored or personally managed more than 15 technology ventures that have received approximately eight million in seed funding from the SBIR/STTR program over the last 12 years. This funding has spanned the NSF, NIH, DOE, NASA, and the DOD, and in many cases led to follow-on angel, venture capital, and strategic investment, and the commercialization of technologies that now meet important civilian and military needs, and keep the U.S. at the forefront of global technological innovation.

One great example is Intralase, which launched out of the University of Michigan in 1997, and commercialized the blade free laser technology used in LASIK eye surgery. The company received about 2.2 million in SBIR seed funding in the 1990s, and was eventually acquired for over 800 million in 2007. More than 40 million people worldwide have benefited from this life-changing technology, including me, and probably many people in this chamber. It has created high tech jobs, economic growth, and contributed to our technological leadership. The inventor of this platform laser technology received a Nobel Prize in Physics in 2018, and is now working on a way to use it to render nuclear waste harmless. These are truly remarkable economic and societal dividends for a $2.2 million seed investment by the U.S. Government.

More recent examples from the past decade include H3D, a 2013 spinout from the University of Michigan with a novel radiation imaging technology, and SkySpecs, a company launched by Michigan grad students in 2012, which uses autonomous drones to conduct wind turbine inspections. Together these companies have received a total of about 2.3 million in SBIR funding, and have gone on to create over 85 high tech jobs, reach in excess of 15 million in combined annual revenue, and deliver revolutionary technologies into the global energy industry. 70 percent of the U.S. nuclear power plant fleet now uses H3D radiation detectors, while SkySpecs has completed over 30,000 wind turbine inspections in 19 countries. Again, this is a remarkable return on a relatively small investment by the U.S. Government.

Some ongoing projects with which I am involved include Enertia Microsystems, with NSF SBIR funding to develop a high precision gyroscope that can enable autonomous vehicles to operate on inertial navigation alone for up to 15 minutes, and iReprogram, with DARPA (Defense Advanced Research Projects Agency)/STTR funding to develop a biocomputational platform for cellular reprogramming. Imagine having a simple skin biopsy and converting your own body's cells into personalized treatments for wound healing, obesity, diabetes, cancer, and even aging. My own company, Endectra, has received $1.3 million in SBIR and STTR funding from NSF and the DOD, resulting in a broad portfolio of sensor technologies for defense, medical, and industrial applications, in-

cluding distributed radiation and gas detectors, bio-photonic probes for cancer radiotherapy and real-time diabetes monitoring, and power meters for enterprise energy management.

These, and thousands of other high potential companies, are currently using SBIR and STTR funding to move federally funded research across the wide chasm that exists between laboratory and marketplace. But like Intralase, H3D, and SkySpecs, they will typically not succeed overnight, but rather require seven to 10 years, exceptional dedication, and the patient bridge capital that the SBIR/STTR program provides. I applaud the Subcommittee's ongoing support of this program, and its efforts to prioritize small manufacturers, cybersecurity, and diversity in H.R. 3774. I would also recommend that in future you prioritize small businesses developing low carbon energy and climate mitigation technologies in order to address the existential threat of global warming.

In closing, SBIR/STTR funded innovations have a long record of creating American jobs, improving our lives, and meeting strategic national needs. Thank you for the opportunity to participate in today's hearing, and for your continued support of this important program. I'll be pleased to answer any questions you may have, and, for the record, I was born in Fort Wayne.

[The prepared statement of Mr. Cucinelli follows:]

Mr. Nicholas S. Cucinelli
Chief Executive Officer – Endectra LLC and
Entrepreneurial Leadership Faculty,
University of Michigan Center for Entrepreneurship

Before the

Subcommittee on Research and Technology
Committee on Science, Space and Technology
United States House of Representatives

on

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

February 5th, 2020

Chairwoman Stevens, Ranking Member Baird, and Members of the Subcommittee on Research and Technology, Committee on Science, Space and Technology:

It is an honor and a privilege to submit this written statement and to join you today to discuss how the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs play a critical role in translating Federally funded research into commercial development; create high-tech jobs, build new industries, and fuel economic growth; help federal science and defense agencies meet their respective missions; help maintain the position of the United States as the preeminent global leader in technology innovation; and protect the health, safety, and security of every American citizen.

I will first provide an overview of my experience as a tech entrepreneur with the SBIR/STTR program, framed by my personal interactions with six SBIR/STTR-funded companies launched out of the University of Michigan (U-M), including my own current venture, Endectra LLC. I will discuss some strengths and weaknesses which I have observed in the various programs and comment on variations in administration between different agencies. Finally, I will offer some ideas for potential improvements to the SBIR/STTR program and U.S. innovation policy in general, including specific observations concerning the *The Small Business Innovation Research and Small Business Technology Transfer Improvements Act of 2019*.

I offer these observations through a unique lens, having professionally mentored and helped to seed finance—often through SBIR/STTR awards—over 30 university spinouts, several student-initiated startups, and two university spinouts of my own over the last 12 years. I have managed successful SBIR and STTR projects representing over $2.7M in critical seed-stage funding for my own ventures, and helped to secure over $5M in SBIR/STTR funding for other student- and faculty-led startups. These proposals and funding have spanned the National Science Foundation (NSF), National Institutes of Health (NIH), Department of Energy (DOE), National Aeronautics and Space Administration (NASA), and Department of Defense (DoD - Army, Navy, Air Force, Defense Threat Reduction Agency, and Defense Advanced Research Projects Agency), giving me firsthand experience with the administrative variations between many of the SBIR/STTR-awarding agencies. The SBIR/STTR funding I've helped to secure has in many cases led to follow-on angel, venture capital, and/or strategic investments and commercialization of technologies that now meet important "dual use" civilian and military needs and keep the U.S. at the forefront of technological innovation globally (see in particular the stories of H3D and SkySpecs below).

I have also served as a Mentor-in-Residence (MIR) for the U-M Office of Technology Transfer, as an Entrepreneur in Residence for Invest Detroit Ventures, and as a program advisor and MIR for the Michigan Economic Development Corporation's statewide "Tech Transfer Talent Network" (T3N) program. Through these diverse experiences, I've accumulated numerous lessons learned and more than a few "useful scars" concerning university sponsored research, intellectual property, startup formation, tech transfer, venture capital, and the SBIR/STTR program. It is my hope that my experience and observations will be highly complementary to the views offered by the other distinguished professionals providing testimony today.

Intralase Corp.

Federally-funded research at the University of Michigan has led to a number of high profile innovations and companies, and one of the most successful was Intralase, which commercialized the blade-free laser technology used in LASIK eye surgery (Figure 1). This project was well before my time in Ann Arbor, with the company spinning out[1] in 1997 (and the basic university research going back as far as 1992), but I reference it here because it is an SBIR success story, and one which has had a profound effect on my life—I had a very successful LASIK procedure in 2006—and one which has benefited many millions of Americans, perhaps including some attendees of this hearing.

The Intralase team, under the technology leadership of Dr. Gerard Mourou, utilized SBIR funding to develop the ultrafast femtosecond laser technology that is used to create the corneal flap required in LASIK surgery. The laser technology has many additional applications, which I will return to later, but the Intralase team leveraged SBIR funding specifically to develop a method for automated refractive eye surgery. The team secured **5 Phase I SBIRs and 3 Phase II SBIRs between 1992 and 2002, for a total of approximately $2.2M in seed funding** from three agencies: Dept. of Health and Human Services (DHHS), DoD/USAF, and NSF. Their innovation created a smoother, more accurate, and more secure corneal flap than was possible with a metal blade, yielding consistently better visual acuity after surgery and enabling many patients with thin corneas to benefit from LASIK surgery who otherwise might not be candidates. Intralase went public via IPO in 2004 and was then acquired by Advanced Medical Optics (AMO) for $808M in 2007. AMO combined the Intralase technology with its a complementary laser technology for reshaping the cornea, making "all laser LASIK" possible; AMO was then acquired by Abbott Laboratories for $2.9B in 2009, and Abbot Laboratories was in turn acquired by Johnson & Johnson for $4.3B in 2017. Dr. Mourou shared the Nobel Prize in Physics in 2018 for his method of generating high-intensity, ultra-short optical pulses.

Fig. 1: LASIK (Laser-Assisted in Situ Keratomileusis) is a type of refractive surgery for the correction of myopia, hyperopia, and astigmatism in which a laser is used to reshape the eye's cornea to improve visual acuity.

Intralase provides an excellent example of the many benefits and long term value creation that can be catalyzed through SBIR/STTR investment: high tech job creation; wealth creation (which is plowed back into universities and local entrepreneurial ecosystems); global technological leadership (a Nobel Prize, plus over 40 million LASIK procedures performed worldwide); increased economic growth (including Federal tax revenues); and military benefits (NASA and DoD eventually approved LASIK for most personnel). In this case the DHHS, DoD, and NSF all also met their respective missions and received an outstanding return on their SBIR investments. Furthermore, as noted above, the ultrafast laser technology,

[1] In university tech transfer, a new company is generally considered "spun out" or "launched" when it signs a license agreement for the university technology on which it is based; companies operate prior to that point under an "option agreement."

which was substantially advanced both within Intralase and at the University of Michigan through SBIR funding and follow-on private investment, also has other applications. As is typical of many "platform" innovations developed at universities and national labs, U-M licensed the ultrafast laser technology to Intralase for a specific field of use (ophthalmic medical devices), retaining the right to license out additional applications such as materials processing, advanced manufacturing, high precision military ranging, and remote sensing of air pollutants.[2] Dr. Mourou is even working on a technique to transmute nuclear waste into new forms of atoms which are no longer radioactive.[3] These are truly remarkable economic and societal dividends for a $2.2M SBIR seed investment.

The Intralase story is also illustrative of the challenge of commercializing what I call "hardtech"—physical science innovations with far-reaching impact, often based on many years of prior basic and applied R&D at universities and national labs, that require substantial scientific, engineering, and technical expertise, large teams, numerous rounds of investment by "patient" capital, and 5-10 years to reach maturity. Provided of course that they first find a way to cross the daunting "chasm" that exists between the laboratory and marketplace, a chasm which is far larger in the physical sciences than in software; consider the hard constraints of fundamental physics, biology, and Moore's law versus the infinite scalability of information technology, or the cost and time required to protoype a battery versus that required to host a weekend hackathon. Imagine the challenge, in 1992, to map a pathway for a laboratory laser to eventually gain FDA approval and patient/ophthalmologist acceptance for cutting into and reshaping a human eye! The prevailing "fail fast" mantra is also problematic for the university professor who has made a hardtech innovation his or her life's work, and university tech transfer professionals and mentors, representing the fiduciary duty and societal mission of the university, cannot allow Federally-funded research with valuable applications to end up on the proverbial university shelf merely because they need time to mature. The SBIR/STTR program is one of the most powerful and flexible tools we have to address these hardtech challenges, and I offer the following five additional SBIR/STTR-funded hardtech companies to further illustrate this point.

H3D, Inc.

H3D (www.h3dgamma.com) is a 2013 spinout from the U-M Nuclear Engineering and Radiological Sciences (NERS) program. Over the past decade, the H3D team, led by CEO Dr. Willy Kaye and his former professor Dr. Zhong He, have successfully commercialized a novel gamma radiation imaging technology for nuclear power plants, defense, and homeland security applications (Figure 2). I had the pleasure of working with H3D first as a U-M MIR, then as a private consultant, and finally as a collaborator on a DTRA SBIR. In 2010, the technology had already received over 10 years and $16M in Federal funding for basic and applied research, and we were able to articulate a robust, "dual use" path to commercial deployment in nuclear power plants and through direct sales to DOE, DHS, and DOE. Using a subaward from a Federal grant to U-M NERS, a small cash award from the 2011 Accelerate Michigan Innovation Competition, and employing four recent NERS PhD graduates, H3D managed an extremely lean launch in 2013 and then scaled with a combination of SBIR support and revenues from the early adoption of its "Polaris-H" detectors in U.S. nuclear power plants. The H3D team secured **6 Phase I SBIRs and 2 Phase II SBIRs between 2014 and 2019, for a total of approximately $2.15M in seed and early-stage funding** from three agencies: DOE, NIST, and DoD. Today H3D has approximately 35 employees and its gamma imaging spectrometers have been widely adopted for radiological monitoring of nuclear power plants, nuclear materials security and safeguards, and defense applications. 70% of the U.S. nuclear power plant fleet now uses H3D detectors.

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[2] *IntraLase to develop, market laser systems for eye surgery.* 29Jan2007. https://news.umich.edu/intralase-to-develop-market-laser-systems-for-eye-surgery/

[3] *Zapping Nuclear Waste in Minutes Is Nobel Winner's Holy Grail Quest.* 02Apr2019. https://www.bloomberg.com/graphics/.2019-nuclear-waste-storage-france/

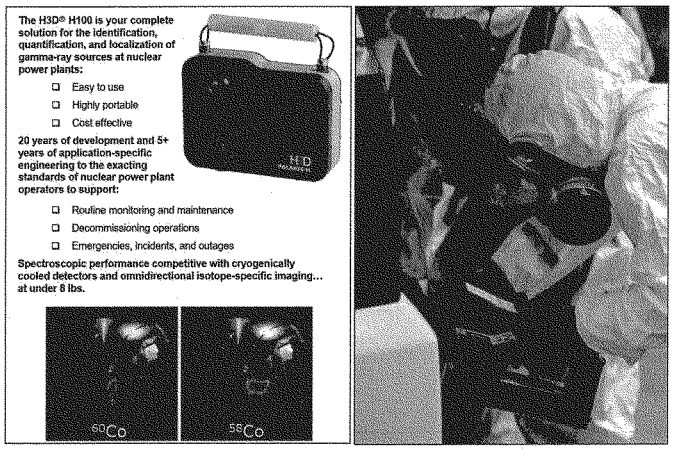

Fig. 2: H3D currently sells seven different gamma imaging spectrometers based on Cadmium Zinc Telluride (CZT) for use in nuclear power plants and border security. Additional military-grade systems are in various states of technology insertion.

While H3D was very unique in "crossing the chasm" without initial SBIR/STTR support or other seed investment, the team credits SBIR funding with driving much of the subsequent growth of the company. The total dollar value of the company's SBIR funding is relatively small versus the company's aggregate revenues 2013-2019, but according to Dr. Kaye, SBIR funding has driven the innovation of the H3D technology platform more than any other funding source. DOE has provided the most substantial SBIR funding to date, including a Phase II SBIR effort to develop a handheld device for the characterization of radiological sources inside a nuclear facility. This device answered a specific need articulated by the DOE program office—enhancing fuel cycle safeguards—but it also enabled H3D to enter other adjacent markets such as radiation chemistry and waste processing with the same underlying technology.

However, the most important contribution of this DOE SBIR research effort to the company's growth was the fact that some of the core technology required to accomplish the SBIR effort also improved the entire H3D product line. This greatly enhanced the company's core product offering and helped H3D achieve such rapid and deep market penetration in domestic nuclear power plants. For an early-stage company there are almost always aspects of a product that could be greatly improved but which would be risky to undertake for a small company with limited funds. SBIR/STTR funding allows company researchers to focus on higher risk and higher reward activities with large commercial potential, which even if not entirely successful, often yield new manufacturing techniques, cost reductions, and other beneficial innovations that can be applied enterprise-wide across a company's entire product portfolio. H3D's rapid penetration of a conservative industry such as nuclear power would not have been possible without the technological enhancements it developed with SBIR funding.

H3D technology, advanced with SBIR funding, has also reached customers on four continents and in more than 15 countries worldwide. The International Atomic Energy Agency (IAEA) has purchased multiple gamma-ray imaging spectrometers developed through the SBIR program and is investigating a next-generation spectroscopic handheld device with technical specifications that were derived directly from the results of several DOE/H3D SBIR projects. H3D technology is also being integrated into a vehicle-based imaging system under the DoD Joint Program Executive Office for Chemical, Biological,

Radiological and Nuclear Defense (JPEO-CBRND). The company hopes to participate in an even larger sensor suite upgrade program to create a standard CBRNe payload for the entire US military. This is an excellent example of how the SBIR/STTR program creates innovation that often reaches beyond our borders and across agencies to achieve exponential impact.

Every company with which I've worked has submitted promising, compelling SBIR and STTR proposals that have not been funded. H3D is no exception, but it is particularly illustrative of the fact that the very exercise of thinking through the SBIR/STTR technical scope of work for an innovative product, assessing the market, developing a sound business plan, and securing collaborators is often a worthwhile process even if the proposal is not funded. The same agency may reopen the same opportunity in future years if the need is not properly addressed, and sometimes other agencies may ultimately decide they want to fund the work. I worked with H3D on one particular SBIR proposal that was rejected by NIH, but later much of the work was rolled into a funded NIH R01 grant in a collaborative effort between H3D and the University of Maryland. Likewise, some of the DOE Phase I SBIR efforts that did not receive Phase II funding were deemed so valuable that H3D internally funded the Phase II R&D using commercial profits. This is yet another example of the power of the SBIR/STTR program; even when companies "fail" in the process (or elect not to proceed, as in the example below), it still tends to catalyze valuable technical and business innovation.

SkySpecs, Inc.

Federal funding to university labs produces a great deal of technological innovation, but it also produces talent in the form of brilliant undergrad and graduate students who go on to become outstanding inventors and entrepreneurs across multiple ventures. SkySpecs (www.skyspecs.com), an autonomous drone company that is revolutionizing wind farm inspections, is a prime example of this (Figure 3).

Fig. 3: A SkySpecs drone conducts an automated inspection on a wind turbine at a wind farm.

I first met the co-founders in 2011 when they were aerospace engineering and computer science grad students at U-M. I was still focused on mentoring several companies spinning out of the U-M Office of Tech Transfer, but I quickly recognized a unique combination of market opportunity, passion, and technical capability and so decided to try mentoring my first student startup team. The team launched SkySpecs in 2012 after winning the International Aerial Robotics Competition, and then won the Michigan Clean Energy Venture Challenge in 2013. I helped them close a seed round led by Invest Detroit (where I was an Entrepreneur in Residence) later that year and strongly encouraged them to seek additional SBIR/STTR funding. In July 2014, SkySpecs was awarded an **NSF Phase I SBIR for an additional $150,000 in seed funding.** Today, SkySpecs has nearly $10M in annual revenue, 50 employees spanning five countries, and has completed over 30,000 wind turbine inspections in 19 countries. The company closed a Series C financing of $17M in late 2019, for a total of $29.3M capital invested.

The focus of the SkySpecs Phase I SBIR was to develop sense and avoid capabilities for small unmanned aerial systems to help the Federal Aviation Administration safely integrate drones into the national airspace. While the project did not proceed to Phase II—the company won $500,000 at the Accelerate Michigan Innovation Competition in November 2014 and decided to forego the effort—SkySpecs is similar to H3D in that the act of executing the Phase I SBIR scope of work still led to innovations which benefited the company's entire technology platform. Furthermore, developing the organizational discipline required to execute the technical scope of work of the SBIR, comply with the programmatic

rules that apply to federal grant recipients, and be responsive to external stakeholders like Federal Program Managers was invaluable in preparing the company for its rapid growth. This "positive organizational side effect" of the SBIR/STTR program is something I have repeatedly observed in numerous early-stage companies; SBIR/STTR funding is often the first capital into these companies and it comes with a number of rigid rules, deadlines, and reporting requirements that engender individual and organizational growth, radically accelerate company and technology development, and prepare the startup team for bigger future challenges. The two very early-stage companies below are excellent examples of this phenomenon.

Enertia Microsystems, LLC

Enertia Microsystems is developing an ultra-high-precision Micro Electromechanical Systems (MEMS) gyroscope called the birdbath resonator gyroscope (Figure 4). The BRG can enable autonomous vehicles to operate on inertial navigation alone for up to 15 minutes. The basic and applied research behind the BRG was funded by DARPA over many years, and the team has subsequently secured an **NSF Phase I SBIR, a DoD/USAF Phase I subaward, and a NASA Phase II subaward, for a total of $580K in seed funding.** The company is pre-revenue with four part-time employees, but is hoping to grow rapidly in 2020 with a pending NSF Phase II award and numerous strategic relationships. In negotiating and managing subaward contracts across two different agencies, the technical founders, who are also presently the management team, have had to develop substantial new contracting and compliance skills and make the transition from conducting R&D within a major research university to doing so in a minimally-resourced startup, sometimes with sponsored research agreements. This exercise of managing SBIR/STTR grants and contracts is not for everyone, and while some technical founders positively flourish in the process, such as Dr. Kaye at H3D and Dr. Cho at Enertia Microsystems, it can be an invaluable experience in encouraging others to partner with professional management talent.

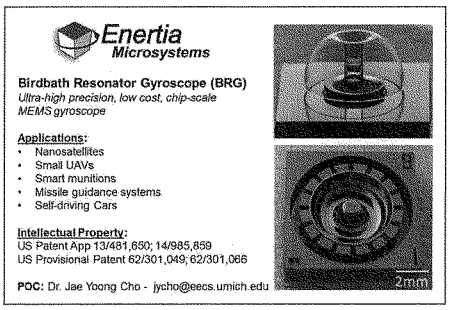

Fig. 4: Enertia Microsystems is developing the next generation of MEMS gyroscopes.

iReprogram LLC

I had the pleasure of helping to launch iReprogram out of the U-M Department of Computational Medicine and Bioinformatics in 2017 and assisted the faculty founders in winning **DoD/DARPA Phase I and Phase II STTRs for a total of $1.08M**. Building upon prior discoveries by Dr. Indika Rajapakse and his research team, the company succeeded in creating a prototype MATLAB bio-computational tool which can analyze, predict, and optimize cell conversion and differentiation (Figure 5). In addition to meeting this important technological goal for the Phase I effort and validating the tool through wet lab experiments, the SBIR also pushed the team to meet important business objectives, including establishing a well-equipped computer lab within company controlled space, hiring key employees and consultants, recruiting additional management talent and advisors, and establishing preliminary relationships with DoD transition and private-sector commercialization partners, such as MathWorks. As it evolves, the iReprogram bio-computational tool will be applicable to an extremely broad range of applications and market opportunities relating to cell-cycle progression, growth, metabolism, healing, aging, and cell death. This is yet another example of the broad "dual use" impact that SBIR/STTR awards can catalyze; iReprogram could have just as easily launched with NSF or NIH funding (and might still pursue such funding), but the outcomes and benefits to humanity will be the same.

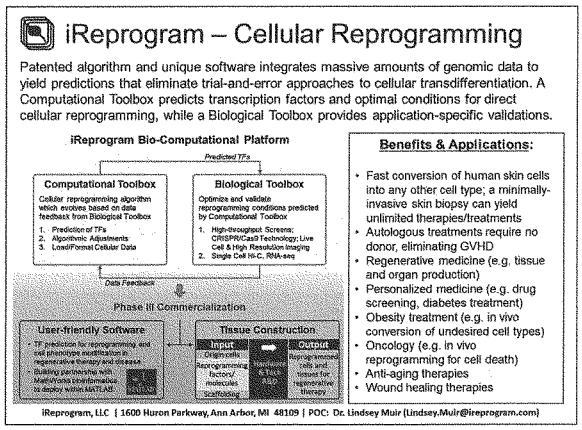

Fig. 5: iReprogram technical summary (unclassified).

Endectra

Finally we come to my own company, Endectra LLC (www.endectra.com). As with Enertia and iReprogram, my co-founders and I launched the company with Phase I SBIR funding and a $25K match from the Michigan Emerging Technologies Fund (MI-ETF), plus I had some in-kind support from Invest Detroit Ventures. We subsequently secured an **NSF Phase IB SBIR, DoD/DTRA Phase I SBIR, NSF Phase II SBIR, NSF Technology Enhancement Commercialization Partnership (TECP) supplement, and a DoD/USAF Phase I STTR for a total of $1.3M in seed funding.** Our five years of translational research have yielded a portfolio of distributed sensors for defense, medical, and industrial applications (Figure 6). We have developed a patented, compact, low cost photonic sensor module for radiation detection which can be integrated into existing handheld and mobile threat detection systems, deployed in a series of interconnected sensor nodes for stationary detection, and miniaturized for integration with small drones. We have also adapted this silicon photomultiplier-based (SiPM) technology to a Cerenkov MultiSpectral Imaging (CMSI) probe for cancer radiotherapy (NIH STTR pending), a non-invasive blood glucose meter, and an atomic absorption spectrometer for industrial metrology.

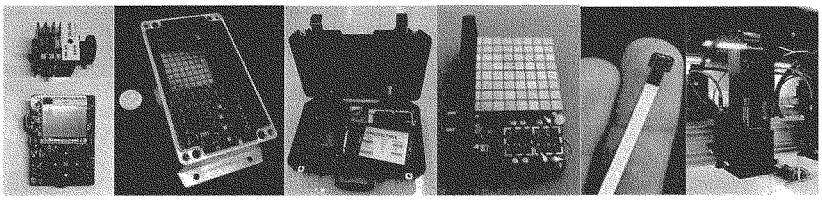

Fig 6. Endectra SBIR funded innovations, from Left to Right: (a) Endectra CBSG-2 (Cerenkov Borosilicate Glass) prototype neutron detector (Aug 2015); (b) CBSG-3 neutron detector module (Jun 2016); (c) Tri-Modal (gamma, fast neutron, slow neutron) Radioisotope Identification Device incorporating Endectra and H3D technology (Aug 2016); (d) CBSG-4 wireless radiation sensor network module (Feb 2017); (e) CMSI probe utilized in arrays of multiple on-skin probes for radiotherapy (Dec 2017); (f) Online metrology tool within which we helped integrate a SiPM-based spectrometer for a leading domestic photovoltaic manufacturer (July 2018).

Endectra has also combined the proprietary, low power network technology originally developed to interconnect our distributed radiation detectors with a unique plug-load power metering technology conceived by our CTO Dr. Sam DeBruin (who is also a co-founder of SkySpecs) to rapid prototype an extremely compact plug-load power meter (Figure 7a-c). This "uSense" system is specifically designed for large-scale enterprise energy management; the uSense plug is the smallest plug-load power meter in the world today and is far more accurate, rugged, and reliable than current consumer-oriented, commercial-off-the-shelf power meters. We also extended our network technology and embedded systems expertise to produce a small batch of networked ammonia gas sensors in a "smoke detector" form factor to facilitate industrial demonstrations by a research team at Wayne State University (Figure 7d). This led us to a new collaboration in 2019 with Michigan Technological Research Institute, Wayne State University, and Lockheed Martin to develop a palm-sized gas sniffing drone under a DoD STTR project.

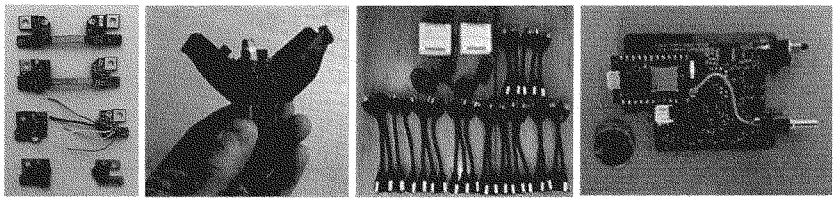

Fig 7. Left to Right: (a) 3D printed model and 3 generations of uSense PCB prototypes; (b) the latest uSense 3.0 PCB incorporates a rigid-flex design derived from our CMSI radiotherapy probes to streamline assembly; (c) Endectra wireless gateways and uSense meters in Beta trials (Jan 2019); (d) WSU ammonia sensor PCB incorporating nanowire vapor sensor, battery management system, and wireless backhaul (Dec 2018).

Every company I have highlighted is a great example of university-derived hardtech: they required (or likely will require) millions of dollars in follow-on funding, a decade or more to reach full commercialization and/or an exit, a large and highly educated team, and a great deal of persistence. The SBIR/STTR program plays a critical role in the viability of these ventures, providing seed funding sufficient to refine the technology and de-risk the venture until it becomes attractive to investors or organically achieves sustainability on revenues. Endectra is no different, with the exception that our first attempt to commercialize our radiation detection technology collided head on with external forces beyond our control and necessitated that we pivot and opportunistically pursue other related technology applications. We would not have survived this experience without the flexibility of the NSF SBIR/STTR program, which unlike other agencies' programs tends to focus more on the development of the company than a specific technology. I now recommend that newly forming university spinouts first pursue NSF funding before appealing to the other agencies under a tech-specific topic, or to consider submitting differentiated proposals in parallel (e.g. submitting a strictly military tech proposal to DoD and a dual-use civilian tech proposal to NSF).

Additional Observations and Recommendations

- I cannot overemphasize the importance of the SBIR/STTR program with respect to "hardtech" commercialization. The venture capital community has prospered for over 25 years by investing primarily in infinitely scalable, software-enabled ventures and there is relatively little "patient capital" for early-stage ventures facing a 7-10 year development path. It is so bad that companies are even "lying about their age" in order to look like the Next Big Thing.[4] The bottom line is that hardtech has a longer, bigger chasm to cross, but the outcomes are often in the strategic interest of the United States and its taxpayers. Therefore maintaining the SBIR/STTR program is absolutely essential.

[4] "Dating Game Helps Them Stay Forever Young - Resetting the clock, startups pick and choose later 'founding' dates to suit their agenda." The Wall Street Journal, 07Aug2017.

- It is a cliché that "business needs certainty" from the Federal Government, but it is particularly true for fragile, early stage companies which are already facing substantial tech and market risk. Greater certainty in the SBIR/STTR process could be achieved in many ways, including keeping to publicized (and preferably faster) timelines for proposal review and funding decisions; providing transparency with respect to expected selection rates and funds available for Phase II projects; transitioning contract-based awards away from small payments/tranches to the larger up-front payments made under grant-based awards (this is particularly important to very early stage companies with limited working capital); and standardizing, as much as possible, the proposal processes of each agency.
- The NIH should be explicitly encouraged to follow the NSF model of seeking "high risk, high return" research in Phase I, with emphasis on proof of concept in Phase I and translation in Phase II. I have relatively limited experience with NIH, but in my experience and that of many colleagues, the NIH is tending toward a very risk-averse approach to Phase I SBIR/STTR proposals.
- All agencies should redouble efforts to screen panelists for conflicts of interest. I am aware of at least two instances in which a competitor gained confidential and sensitive information about an SBIR applicant, and one in which an excluded individual negatively influenced a marginal funding decision. No entrepreneur wants to spend the personal capital or risk having his or her company "blacklisted" to resolve such an issue, and it is in the best interests of the government to ensure the absolute integrity of the SBIR/STTR program.
- The NSF recently increased its baseline SBIR/STTR Phase I funding level to $225K and the NIH has routinely obtained SBA waivers for Phase I awards as high as $400K. I believe that all agencies should be encouraged to follow suit; it can be extremely difficult to complete a quality Phase I project on $150K, especially when it is the first capital into a new company with little or no prior working capital. I recognize that in some situations this might limit the number of topics and/or awards, but I believe that the net outcome would be positive in most cases.
- All agencies need to address the "success to the successor" problem, wherein new startups (1-10 employees) and established/scaling companies (11-50 employees) are beaten out for Phase II funding by relatively large, established companies that have a long track record of SBIR/STTR success and/or an incumbent technology, yet still meet the SBA SBC size standard. In my experience, opportunities have been missed for the Federal Government to help establish an alternative domestic technology vendor (to ensure healthy economic competition and create jobs in new parts of the country) or finance an alternative technological solution to a particular problem, because an award panel or Program Manager chose the "sure thing" over the fledgling startup. In many cases, the established company was merely making incremental improvements to an existing offering, while the smaller company was attempting to deliver a new, more advanced technology into the market. I believe the latter is more consistent with the spirit and intent of the SBIR/STTR program. This often happens when Program Managers are forced to downselect from several projects to a single Phase II award, so creating more flexibility in SBIR/STTR budgeting and funding mechanisms is one solution.
- With the exception of NSF, which already has very broad topic areas, all agencies should be encouraged to solicit "open topics" to capture innovations relevant to their mission areas which otherwise do not fit their technology topics. The Air Force piloted just such a program last year to increase the efficiency, effectiveness, and transition rate of their SBIR program, and this might be a useful model.[5]
- Endectra and many of the companies with which I have worked have significantly benefited from participation in the NSF I-Corps program, which is designed to reduce the time and risk associated with translating promising ideas and technologies from the laboratory to the marketplace, identify viable paths to market, and prepare tech entrepreneurs for participation in the SBIR/STTR program. I

[5] https://www.afwerx.af.mil/sbir.html

recommend that other federal agencies leverage the work that NSF has done to create a Nationwide Innovation Network focused on finding those critical first markets for emerging technologies.

- To increase the number of hardtech SBIR/STTR success stories like those I have highlighted above, all agencies should increase engagement with the university engineering and biomedical programs training the next generation of PhD scientists and engineers for entrepreneurial careers. Programs like the Center for Entrepreneurship in the U-M College of Engineering, where I teach entrepreneurial leadership, have a key role to play in instilling an entrepreneurial mindset in our tech communities.
- All agencies should also consider adopting the new "Project Pitch" recently piloted at NSF. From the entrepreneur's perspective, this is an excellent way to minimize the time spent on a process with an uncertain outcome and to de-risk that process. From the agency perspective, it is a way to reduce the number of poor quality or off-target proposals and increase throughput of high quality research.
- I have observed a large influx of foreign capital targeting tech transfer over the past decade (in fact, one of my prior companies was negatively impacted by it), which is yet another reason why we must preserve and strengthen the SBIR/STTR program. Our university innovators need this perfect bridge funding to cross the chasm, or else there are international sources of funding just waiting to fill the gap and harvest valuable American innovations. The SBIR/STTR program helps to ensure that our groundbreaking technologies get developed here and capitalized by domestic financiers who will return any wealth created to our own economy.
- I have also noted that research universities and state governments are increasingly stepping up to help the Federal Government provide this bridge. Many universities are doubling down on their innovations using donor and endowment money. For example, U-M now has the Michigan Investment in New Technology Startups (MINTS) fund, the Michigan Biomedical Venture Fund (MBVF), and the recently launched Accelerate Blue Fund to provide seed capital to nascent U-M startup companies. Many universities have also adopted MIR programs to build and support companies before and during SBIR/STTR projects. Meanwhile the State of Michigan and the SBDC offers the aforementioned MI-ETF matching fund for SBIR/STTRs.
- Concerning *The Small Business Innovation Research and Small Business Technology Transfer Improvements Act of 2019*, I applaud the decision to prioritize small manufacturing companies, SBCs engaged in cybersecurity R&D, and minority and Hispanic research institutions. We have a long way to go to rebuild our domestic manufacturing base and counter the cyber threats of the coming years, and we need to leverage the diversity of our nation to produce the very best science and innovation. I would suggest that in the future we also prioritize SBCs developing low carbon energy and climate mitigation technologies in order to address the existential threat of global warming. I strongly approve of the Commercialization Assistance Pilot Program, wherein an SBIR Phase II awardee may receive a subsequent Phase II award with a 1:1 external funding match. This seems like an enhancement to the NSF Phase IIB Supplement, which has been widely successful in giving awardees a valuable extra "push" into the marketplace.

Conclusion

The SBIR/STTR program helps to fill the large gap between laboratory research and commercialization and is an essential component in our nation's innovation ecosystem. The very best universities and national labs are only as good as the innovations they deliver and the real-world problems they solve for humanity, and the most impactful innovations sometimes require the most patience, talent, and investment. Innovations funded under the SBIR/STTR program have a long record of creating American jobs, improving our lives, and meeting national needs, and I am grateful to have personally benefited from such innovations and to be an active participant in inventing and commercializing new ones. Thank you for the opportunity to testify today and for your continued support of the SBIR/STTR program. I will be pleased to answer any questions you may have.

Short Form Bio for HSST SBIR/STTR Testimony (05Feb2020)

Mr. Cucinelli is the CEO of Endectra LLC, an SBIR/STTR-funded spinout from the University of Michigan with a portfolio of advanced sensor technologies. He is also an entrepreneurial leadership instructor at the University of Michigan's Center for Entrepreneurship. Mr. Cucinelli has over 20 years of experience commercializing transformative technologies rooted in the physical sciences. In addition to leadership roles in seven companies, he has mentored over 50 student and faculty startup teams and raised over $16M in SBIR/STTR grants and early-stage investment for cleantech, advanced manufacturing, defense, and nanotechnology ventures. He holds a bachelor's degree with High Honors from the U.S. Coast Guard Academy and MBA and Master's Degrees from the University of Michigan.

Long Form Bio

Nick is a serial "hardtech" entrepreneur and expert in university tech transfer with over 20 years of experience commercializing transformative technologies rooted in the physical sciences. In addition to leadership roles in seven startups, he has mentored over 50 student and faculty startup teams, acquiring hands-on experience in photovoltaics, wind energy, batteries, fuel cells, hydrogen storage, biofuels, nuclear energy, mechatronics, photonics, nanomanufacturing, sensors, UAVs, bioinformatics, and medical devices. He has raised over $16M in SBIR/STTR grants and early-stage investment for cleantech, advanced manufacturing, defense, and nanotech ventures and made a number of angel investments within the Ann Arbor startup ecosystem.

Nick is currently the CEO of Endectra LLC, a University of Michigan spinout launched in 2015 which has a portfolio of photonic and nanosensor technologies for defense, medical, and industrial applications. From 2013-2018, he also served as a Mentor-in-Residence for the Tech Transfer Talent Network (T3N) program, supporting university startup teams statewide. Other prior engagements include Entrepreneur-in-Residence for Invest Detroit Ventures, CEO of U-M spinout CSquared Innovations, Non-Executive Director at SkySpecs, business development manager for a British fuel cell company, and CEO of a publicly-traded energy tech incubator.

Nick also served 16 years with the U.S. Coast Guard, where he focused on environmental protection and was named a "Coast Guard Hero" in 2000. He holds a BS with High Honors in Marine & Environmental Science from the U.S. Coast Guard Academy, an MBA and M.S. (Sustainable Energy Systems) from the University of Michigan, and a 200-ton USCG captain's license.

TESTIMONY OF DR. JOHNNY PARK,
CHIEF EXECUTIVE OFFICER,
WABASH HEARTLAND INNOVATION NETWORK

Dr. PARK. Thank you for the opportunity to speak to you today about the SBIR and STTR program. I hope you'll find that my own experience provides compelling evidence of the value of this very important program. I was a professor at Purdue doing research in robotics, machine learning, and wireless system networks. In 2008 I received a grant from USDA (United States Department of Agriculture) to develop technologies that could automate labor intensive activities in agriculture. I knew very little about agriculture back then, so this project served as an entry door for me to this very important industry.

In that USDA project, my work focused on automating the process of monitoring insect populations. Traditionally, monitoring insect populations is done by deploying a large number of cardboard sticky traps in the field. Each week, workers have to go in the field, first find a trap, open it up, count the number of bugs that are caught in the trap, write the number down on a piece of paper, clean the trap up, hang it back up, and repeat that process for hundreds of traps deployed in the field. As you can imagine, this is very labor intensive, but it's critically important because those trap numbers determine and inform when, where, and how much insecticide to apply.

About a year of research and development at Purdue, we were able to demonstrate the feasibility of automatically monitoring insect populations with a wireless network of highly specialized sensors. Because of the potential for this technology to drastically improve the practice of pest management, I started a company, Spensa, to commercialize the research. But as with many technology startups that stem from university research, commercialization took much longer than anticipated. We had several problems to resolve in order to take our lab prototype into a full commercial product.

The SBIR program helped us in two specific ways. First, it provided a necessary infusion of money to allow us to complete the research and development to the point where venture capital could participate. Second, the SBIR program taught me, through its very well organized SBIR grantee workshops, how to navigate between the paradigms of scientific research and entrepreneurship. Both were critically important to an academic-turned-entrepreneur like myself.

Spensa received approximately $1.5 million in SBIR grants from USDA and NSF. Spensa was named by Forbes as one of the top 25 most innovative ag tech startups in 2017. Spensa created jobs, hiring over 70 technical and business professionals. Its products helped growers reduce the labor costs associated with pest management, and helped them make more informed and timely, judicious spray decisions. On average, Spensa doubled its annual revenue in each of the last 5 years before it was acquired by DTN, which continues to operate the business from the Purdue research park where Spensa was founded.

But well beyond this impact on Spensa was SBIR's impact on me. The program taught me to understand entrepreneurship as a customer-centered engine for innovation that accelerates change through the strategic, value sensitive, and nimble deployment of resources. And resources include not only financial capital and intellectual property, but also the team's talents, time, and passion. The entrepreneurship model is thus a resource engine, as each new asset comes to fruition, becomes the basis for the new deployment and generation of value, ultimately helping others in need, and making their lives better.

As I mentioned earlier, Spensa was ultimately acquired, but my current role as CEO of the Wabash Heartland Innovation Network, or WHIN, is an even greater and truly unique opportunity to put research and entrepreneurship together to meet the needs of rural America. With very generous funding from the Lilly Endowment, WHIN was created by the 10 county rural region of Indiana with the goal of enabling the region to leverage its many assets, especially Purdue University, Ivy Tech Community College, and strong manufacturing and agricultural sectors to improve the region's economic prospects. WHIN is a nonprofit organization with a very ambitious goal, and I am leading this organization like a startup. I believe WHIN is benefiting tremendously from lessons learned from Spensa. I believe its story illustrates how the SBR program, in action with Spensa, continues to generate economic growth. In the long run, WHIN envisions the Wabash heartland as the global epicenter of digital ag and next generation manufacturing, powered by IoT technology. That is quite a return for $1.5 million in SBR grant funding to a little startup in West Lafayette, Indiana.

I hope this gives you an idea of both the short and the long-term impact of the SBR program. I hope you will continue to give it your full support. Thank you.

[The prepared statement of Dr. Park follows:]

Testimony to U. S. House Committee on Science, Space and Technology/ Subcommittee on Research and Technology

AMERICA'S SEED FUND: A REVIEW OF SBIR AND STTR

Johnny Park, Ph.D.
CEO, Wabash Heartland Innovation Network (WHIN)

February 5, 2020

I would like to thank Congressman Baird for the opportunity to speak to you today about the Small Business Innovation Research (SBIR) program. I hope you will find that my own experience with SBIR provides compelling evidence of the value of this very important program.

As you know, the SBIR program benefits certain businesses whose roots are usually in university research projects. At the research stage, those projects have typically received federal agency funding, and business from the research is started, if at all, usually by the researchers who are conducting that research. Indeed, SBIR is intended to facilitate and accelerate the commercialization of research, enabling it to contribute to economic growth that benefits the nation, and thereby increasing the return on federal agency research investment. Specifically, SBIR grants cover the very early part of the commercialization runway, where promising ideas are still too risky for conventional venture capital investment.

Successful commercialization is the expected outcome for an SBIR grant. In my case, a total of approximately $1.5M in SBIR phase I, II, and IIB grants helped my startup, Spensa Technologies, go on to be named by Forbes as one of the Top 25 Most Innovative Ag-Tech Startups in 2017. Spensa created jobs, hiring over 70 technical and business professionals. Its products helped growers reduce the labor cost associated with insect control and make more timely and judicious spray decisions. On average, Spensa doubled its annual revenue in each of the last five years before it was acquired by DTN, which continues to operate the business from the Purdue Research Park where Spensa was founded.

But the numbers do not account for the full value of the SBIR program. An injection of money into any startup may be necessary but it is almost never sufficient for the startup to succeed. That is especially true when the entrepreneurs are academics.

Following the traditional path of a newly minted Ph.D., I became a Purdue professor, pursuing my research interest in robotics, machine learning and wireless networks. Then in 2008, I received a USDA grant to develop technologies that could automate key labor-intensive activities in agriculture. Although it involved basic research, the project was intended to address a compelling industry need. Adopting that outward perspective was a transformational move for me. I became very interested in agriculture as a sector that could truly benefit from my research. In fact, the challenges faced by agriculture and the related struggles of rural America moved me deeply. I became determined to use my expertise to find solutions that would support and advance rural development.

As it turned out, the first opportunity I had to make a difference occurred precisely at the nexus of research and entrepreneurship. My work for the USDA project focused on automating insect monitoring in high-value specialty crops such as tree fruits. The problem was that the spraying that helps growers reduce losses due to pests is most efficiently, cost-effectively, and safely performed when growers have data about the actual insect populations in their orchards and fields. But the pheromone-baited paper traps that were considered to be state-of-the art pest monitoring technology required manual inspection involving locating traps, counting the number of target pests captured in the trap, and replacing the sticky bottom as it became covered with insects and other debris. The expense of such a labor-intensive process was the primary hindrance to widespread adoption of data-based spraying.

After about a year of research and development, my team demonstrated the feasibility of automatically monitoring insect populations with a wireless network of highly specialized sensors. Because of the potential for this IoT technology to dramatically impact the financial model of farming, Spensa was born in order to commercialize our research.

But though we had moved into development of our prototype, we had not reached the point of market-ready product. For example, we still had issues with the sensors robustly detecting target insects under harsh and highly varying environments across different agricultural fields. Ensuring that the devices could communicate data reliably throughout the entire growing season was also a difficult challenge that needed to be resolved. Indeed, with several problems not fully resolved, we were too high a risk for most venture capital. We needed much more time to get to market than I had originally anticipated.

At this point, the SBIR program became critical to the survival of Spensa. Because the program is affiliated with federal agencies that fund research, the SBIR program staff understand and are patient with the research timeline. They also understand the tendency of research-driven projects often requiring major changes of direction. SBIR grants, in conjunction with a tolerance for the research paradigm, bought Spensa the runway it needed to develop its product to the point that venture capital could also participate. Notably, another benefit of the SBIR grants is the prestige that comes along with the award. SBIR grants are highly competitive, so the fact that Spensa was awarded SBIR grants helped attract additional investments as well as customers.

But more than a long and well-funded runway was needed for Spensa to succeed. The fact that university researchers start with basic scientific research affects more than the length and complexity of the road to commercialization. It means that the researchers must perform a 180-degree turn in thinking and methodology in order to become entrepreneurs. In a sense, both the scientific method and the development of a product for market depend on formulating and testing hypotheses based on prior knowledge. But if the goal is science, or knowledge, the researcher will follow the path wherever it leads in order to bring a phenomenon to light. The entrepreneur doesn't really care about phenomena per se, and sometimes not even at all, unless such knowledge contributes to meeting a customer need profitably. Proverbially, humans invented, built and sold boats long before Archimedes formulated the principle that underlies flotation. But it is unlikely that they would have been able to invent submarines without that scientific discovery. Basic science is not replaced by entrepreneurial thinking: in fact, they need to co-exist.

Indeed, the SBIR program taught me how to navigate between the paradigms of scientific research and entrepreneurship. For Spensa, the result was, first and foremost, a product that met a critical and costly need for growers. But the SBIR-guided experience had a much more profound and long-lasting effect, because along with funding, SBIR passed along some very important DNA. Perhaps the biggest lesson I learned was the sheer power of research in conjunction with an entrepreneurial model to effect meaningful and substantial change. Spensa was founded with the vision of serving as a storehouse (*spensa* means storehouse in Latin.) The purpose of a storehouse is not to keep its resources to itself, but to serve as a base to deploy those resources strategically and judiciously so as to generate the most value to stakeholders, especially customers. The DNA that I inherited from SBIR informs my understanding of entrepreneurship as a customer-centered innovation that accelerates change through the strategic, value-sensitive, and nimble deployment of resources. And "resources" includes not only financial capital and intellectual property, but also the team's talents, time and passion. The entrepreneurship model is thus a resource engine. As each new asset comes to fruition, it becomes the basis for new deployment and generation of value.

As I mentioned earlier, Spensa was ultimately acquired. But my current role as CEO of the Wabash Heartland Innovation Network (WHIN) is an even greater and truly unique opportunity to put research and entrepreneurship together to meet the needs of rural America. WHIN benefits tremendously from lessons learned from Spensa. I believe its story illustrates how the SBIR program in action with Spensa continues to generate economic growth, especially for rural America.

WHIN was originally funded in 2017 with a $40 million grant from Lilly Endowment, Inc. (LEI). The funding followed a lengthy process of self-discovery by a ten-county region in north-central Indiana that is anchored by Tippecanoe County, home of Purdue University. LEI's goal was to enable the region to leverage its many assets, especially Purdue University, Ivy Tech Community College, and strong manufacturing and agricultural sectors, not only to increase core competitiveness, but also to identify new drivers of innovation to improve the region's economic prospects.

The strategy that evolved in the proposal was to utilize a Purdue research strength in the Internet of Things (IoT) to make the region a global epicenter of digital agriculture and next-gen manufacturing, powered by IoT technology.

Because of the technical aspects of the project, Purdue wrote the grant on behalf of the CFGL. Grant resources are heavily tilted toward research, with about half of the grant designated to sponsor Purdue IoT research, education and engagement, as well as to enable the Lafayette campus of Ivy Tech Community College to enhance IoT workforce development. A small portion of the grant provides for its region to be a "living laboratory," with the original idea being for Purdue researchers working with regional farmers and manufacturers to test Purdue technology in real applications. The grant includes sponsored funding for university outreach to increase awareness and utilization of Purdue IoT in the region.

The grant also provides for a Regional Cultivation Fund that re-grants funds to encourage and support place-making projects throughout the region.

But LEI had a stipulation. At the end of the five-year grant period, WHIN, which is a community-based organization, had to be sustainable. As WHIN's only real activity was to regrant funds to others, primarily for research activities, sustainability was an enormous problem. Indeed, LEI had no expectation that WHIN would raise future funds simply to regrant them to others. The original grant was essentially for capacity-building. LEI wanted something new to emerge.

Notably, the sustainability stipulation can be seen to be analogous to a federal agency's aspiration that the basic research it sponsors be commercialized. And according to that analogy, the next step would involve building on and leveraging that capacity. The WHIN Board hired me in 2018 to figure it out.

The grant included a lot of foci. Its own DNA involved research, engagement, place-making, community development, economic development, IoT, technology adoption, agriculture and manufacturing. But boiled down, the grant relied on university research, with a little help from engagement, to transform the region. The Spensa experience, along with my work as an academic, had taught me that is a very long-term project, and so it was proving to be with WHIN. Eighteen months into the grant, the region had not adopted any IoT. In fact, that was WHIN's real problem: adoption. That is the only way the region could benefit from research. It had to actually use IoT, and on a scale, and at a speed, large enough to be transformational.

But WHIN is committed to research in a fundamental and non-negotiable way. It is a 501c3 nonprofit organization whose charitable purpose is research and education. And it is presently supported by LEI, whose own 501c3 status restricts the use of its funds to charitable purposes.

WHIN's research DNA looked a lot like an impediment to sustainability. But WHIN is, after all, a community organization and the role of the community in the grant's research component was basically to be a research subject. Instinctively falling back on the entrepreneurship DNA that we had inherited from SBIR, we asked, what does the research paradigm produce that is needed by a customer, besides a new piece of intellectual property? In particular, what do experimental subjects produce? The answer, of course, is data. Data is exactly what a living lab contributes to research. And in the knowledge economy, data is in demand. It has enormous value. Data could be WHIN's product.

The research paradigm moved from liability to asset, enabling the grant to fully activate all of its DNA: that long list of foci for which the grant is responsible. If the ten-county living lab could be made to produce data that WHIN could license for research, every WHIN activity that supported the production of data would serve WHIN's charitable purpose. And that activity would necessarily include introducing IoT on farms and in factories throughout the region. The key to all of this, though, was to accelerate the grant by accelerating adoption of IoT.

At first glance, depending on IoT adoption to enable WHIN to fulfill its mission and sustain itself seemed like a form of circular reasoning, an infinite regress in which WHIN was established to accelerate IoT adoption, but it needed IoT adoption to be accelerated in order to accomplish its mission sustainably. But within its charitable purpose as a collector and disseminator of data for research, WHIN could simply use grant resources to incentivize adoption of IoT in order to generate that data.

The resulting model is called WHIN Alliance and it looks like this:

- Farmers and manufacturers are recruited to become members of their respective Alliances and they pay an annual membership fee.
- WHIN identifies and vets commercial and near-commercial IoT technology and services that are likely to have an immediate, significant impact on agricultural and manufacturer Alliance members. By agreement with the tech vendors (tech partners) the vetted products and services are offered to Alliance members at an initial substantial discount. The discount decreases each year the product or service is in use and, in the third year, WHIN begins to receive a percentage of the vendor's revenue for installed products and services.
- Both the farmers and manufacturers who own the IoT technology and the vendors who install it agree to grant WHIN access to their data. WHIN collects, warehouses, and structures the data, which is available at no cost for K-16 education purposes, unless such education is grant-funded and the grant allows for data licensing. The data is also licensed to university researchers who include the data licensing fee as a line item in grants. WHIN may also receive a portion of royalties for IP that is commercialized as a result of the use of its data.

The Alliance model allows WHIN to generate value for all of its stakeholders.

WHIN's living lab and the data it generates has value for research:

- The data it generates comes from real and diverse farm and manufacturing operations
- The technology that generates the data is replicated throughout the living lab, providing consistent, structured data sets
- The network that serves the data includes both conventional and novel technology
- The living lab that produces the data is very large, extending across ten counties for a total of 4,321 square miles
- The living lab is a complete representation of IoT that can be used to research both the connectivity and sensor components of IoT

WHIN's living lab directly supports IoT research, education, and innovation:

- WHIN seeks grants for specific projects related to IoT, such as installing and testing innovative rural broadband technology.
- If funding designated for the purpose is available, WHIN sponsors IoT-related research at Purdue University and educational programs at Ivy Tech Community College. WHIN collaborates with the university and Ivy Tech to secure grants related to IoT technology.

WHIN's data and living laboratory platform are valuable to the country. WHIN serves many of the same priorities as federal agencies, including contributing to economic growth in rural America:

- WHIN's model is highly amenable to public-private partnerships that advance Indiana and national research interests.
- WHIN utilizes a geographically-defined living lab to mobilize entire sectors, notably agriculture and manufacturing, to participate in relevant basic and applied research, as well as to support relevant education and workforce training. Wabash Heartland farmers and manufacturers are

learning how to use a highly disruptive technology in advance of their peers, and that learning will shape the adoption of that technology nationally.

- Likewise, the opportunity for the IoT industry to participate directly in a living lab that hosts a world-class university accelerates those benefits for that industry. The edge in competitiveness offered by the living lab benefits all stakeholders in IoT, including the U.S.

WHIN's industrial sectors, including agriculture, manufacturing and technology, benefit from being in a living lab:

- Purdue University partners with WHIN, regional industry, and global technology partners to conduct research and educate the IoT workforce.
- Ivy Tech Community College partners with WHIN to train the region's IoT workforce and participate in research projects.

WHIN's region benefits from the economic development impact of being a living lab:

- Tech partners that supply IoT to the lab are a source of jobs and investment in the region. One ag tech partner, Solinftec, recently located its global headquarters in West Lafayette because of WHIN and synergy with the research opportunities at Purdue. The company is planning to hire 334 high-wage, skilled workers by 2022.
- Because being in the living lab has measurable value to manufacturers, it is a value proposition for economic developers trying to attract and retain jobs in the region. It likewise functions to allow farms to be more competitive and to face strong headwinds.

In the long run, WHIN envisions the Wabash Heartland as the global epicenter of digital agriculture and next-gen manufacturing, powered by IoT technology. That is quite a return for $1.5 million in SBIR grant funding to a little start up in West Lafayette, Indiana.

Thank you for your time and interest. I urge you to support the SBIR and related programs. They are delivering all you ask and more.

Johnny Park

Johnny is CEO of Wabash Heartland Innovation Network (WHIN), a consortium of 10 counties in north-central Indiana devoted to developing the region into a global epicenter of digital agriculture and next-generation manufacturing by harnessing the power of IoT (Internet of Things). Prior to WHIN, Johnny founded, scaled and led a successful exit of an agtech company, Spensa Technologies, focused on smart IoT devices and data analytics to help growers better manage agronomic pests such as insects, weeds and disease. Spensa was named by Forbes as one of the Top 25 Most Innovative Ag-Tech Startups in 2017. Before Spensa, Johnny was a faculty in the School of Electrical and Computer Engineering at Purdue University where he served as Principal and Co-Principal Investigator of $12M research projects in robotics, computer vision, machine learning and distributed sensor networks. He supervised and co-supervised 10 PhD students, published over 50 peer-reviewed papers and was granted 4 patents. Johnny received his BS, MS and Ph.D. degrees all from the School of Electrical and Computer Engineering at Purdue University.

Professional Experience

2018 - present	CEO, Wabash Heartland Innovation Network (WHIN)
2019 - present	Agriculture Advisory Council for US Senator Mike Braun
2018 - present	Board Director, AgriNovus Indiana
2009 - 2018	Founder and CEO, Spensa Technologies (acquired by DTN)
2008 - 2014	Research Assistant Professor, Electrical and Computer Engineering at Purdue University
2004 - 2008	Principal Research Scientist, Electrical and Computer Engineering at Purdue University

Education

Purdue University	Electrical and Computer Engineering	PhD, 2004
Purdue University	Electrical and Computer Engineering	MS, 2000
Purdue University	Electrical and Computer Engineering Minor in Economics	BS, 1998

Chairwoman STEVENS. And, with that, we're going to begin with our first round of 5 minute questions, and the Chair is going to recognize herself at this time.

Thank you again for the very informative testimony. A lot to unpack here, and I think where I'd like to start is kind of where we left off on the commercialization and the flexibility component of things. Obviously we're always in such a rush, commercialize, commercialize, but we also need a little bit of flexibility and some time with that. We need to recognize not everything is going to have the same turnaround for commercialization. In fact, Dr. Park, I almost believe—I can guarantee you that I was at a venture connector's presentation in Louisville, Kentucky, where I heard about your company in 2014, and thought, wow, what a neat idea, and fascinating six years on to see what Spensa's been able to achieve and do.

But if you don't mind, just—Mr. Cucinelli and Dr. Park, just talking a little bit more about the flexibility, particularly even at the beginning stages, when you're, you know, processing the award, getting the dollars, you know, working with the agency, and then also maybe some thoughts that you might have around allowing the agencies to implement more flexible award structures to make them more compatible with the pace of innovation? If you don't mind shedding light on that? And I'll let you two duke it out for who goes first. Yes.

Dr. PARK. I'll get started. Yes, so, again, I'm a first-time entrepreneur, and SBR program was something that I was not very familiar with. But as any businesses—as we embark on commercializing a research project to a commercial market, you are embarked with very different scenarios, something that you had not anticipated. And because I believe SBR programs and program managers stem from kind of research related projects, they understand the uncertainty of the path that we're on. So I was very appreciative of our program manager at NSF being very flexible and understanding of our need for pivoting, even during the project.

For instance, we had—in our proposal was to develop a certain type of sensor that we believed would solve a certain issue that we had in mind, but in about 2 to 3 months into the project, we quickly realized that the sensor type was not viable commercially, and so we requested to the program manager that we think we need to change the type of sensor that we need to research on, and program manager was very, very flexible on allowing us to do that because he saw ultimately is this type of flexibility and pivoting was a critical piece of making sure the research moves on, and successful commercialization path.

Chairwoman STEVENS. Yes. Great.

Dr. PARK. Um-hum.

Mr. CUCINELLI. So I have two observations. One is that I really like the idea in the legislation of the second Phase 2, the follow-on funding. So the idea that the government can double down, so to speak, on the investments that are going pretty well, but need a little more push into the private sector. I think, from what you've heard about these different companies that have succeeded, you can tell that there's a significant return on investment here, and I think, especially with what I call the hard tech, physical science-

based companies that have a really big chasm to cross, a big Valley of Death, they can really be helped by that second Phase 2, when it's appropriate. It has to be vetted properly.

My second observation is it would be really helpful if the agencies that award SBIRs and STTRs by contract, as opposed to as a grant, push more of their funding up front so that the money isn't tranched in small drips and drabs along the way. So, for example, with the $150,000—I'm—not to pick on DOD, but with a DOD contract, you're going to get $30,000 every 2 months along the way, and then a final project payment, as opposed to an NSF grant, where you're going to get $150,000, now $225, right up front. If you're talking about a brand new company that's trying to jump out of the lab and into the private sector, that DOD contract is very difficult to manage because you don't have any working capital yet, whereas the NSF is giving you that money right up front. So if there was a way to encourage the contracting agencies to just move some of that funding earlier, I think it would be very, very helpful.

Chairwoman STEVENS. Yes, as needed. OK. I'm going to cede my time to the next questioner, but we are going to do another round of questions. So, with that, I'm going to recognize Dr. Baird, and then we'll go through everyone that's here, and then we'll start again.

Mr. BAIRD. Well, I'm going to continue on, Mr. Cucinelli, and have Dr. Park give his impression of, you know, you started with an SBIR award from USDA, and then you went to one from NSF, so can you share your experiences in those two programs, and how effective or efficient they were to work with?

Dr. PARK. Right. So USDA SBIR, we only received Phase 1, and then we received NSF Phase 1, 2, and 2B. We did apply for a USA Phase B—I'm sorry, Phase 2, but we did not get it, so I have a lot more experience with NSF than USDA. But both cases we were awarded the full amount up front, at least for Phase 1, but Phase 2 was tranched. But I think it was very helpful for us to get—again, I agree that, as a startup, you need working capital, and this is already a very competitive process, and this has been vetted for, you know, maybe 10, 20 percent of the applications only get Phase 1. So I think having that—going through the vetting process, at least in Phase 1, my recommendation is also to have all that money put in up front.

I would also say that NSF has wonderful grantee workshops. Every time I attend the workshops, I am so energized and inspired, and I learn so much because, again, the business formation, venture capital raising—and that is something that, you know, you don't really learn much, and—but having the experience of like-minded entrepreneurs and experienced VCs as a speaker, and learn from them firsthand, for me, it was extremely valuable as a first time entrepreneur.

Mr. BAIRD. Thank you. My next question, Dr. Tilbury, what steps does the NSF take to measure the success of its two programs?

Dr. TILBURY. So we do a lot of assessment of all of our programs at NSF. We certainly survey the awardees and get their feedback on what they're doing, and we've made quite a lot of changes in the last few years. In fact, a couple years ago we changed the program so people could submit a pitch before they had to register with the

Federal Government, and fill out 37 forms before they could write a 15 page proposal, and hear that their project wasn't appropriate for NSF. So we try to streamline, based on the assessment that we had, and the feedback from the PIs, and we, you know, take data.

So there's some data in my written testimony, but a new number that I got this morning was that, if you look at awards we've made since 2014 there's been more than $9 billion in subsequent funding that these companies have received from venture capital, or other awards, and more than 100 of those companies have been acquired, which is often a goal, as Johnny Park talked about with this company. Do you have more specific questions, or——

Mr. BAIRD. No, I think that's good. Dr. Feldman, would you continue that on, what you look for, what criteria you used to measure the success?

Dr. FELDMAN. The success of the program, I think, extends way beyond just the individual companies, and so the SBIR program at universities has really helped to change the culture and to put more emphasis on commercializing academic discoveries, and so that has been very positive. We also know that, through the program, agencies are able to source great ideas from small companies, and those companies will have ideas that have escaped larger corporations. And in—we have some evidence that this induces other people to look at those topics, so that fundamental discoveries that result from SBIR projects actually help to cede scientific fields that work—that result in translational, additional follow-on work. And so that is sort of an indirect effect. There are lots of effects in creating follow-on products, generating patents, but the generation of fundamental knowledge really helps to keep America competitive.

Mr. BAIRD. Thank you, and I'm out of time. Mr. Cucinelli, your answer to the previous question is going to have to count as my question to you. So thank you, and I yield back.

Chairwoman STEVENS. And with that, the Chair would like recognize Congressman Tonko for 5 minutes of questioning.

Mr. TONKO. Well, the Member would like to acknowledge your recognition, so thank you, Chair, and welcome, to our witnesses. America's SBIR and STTR programs support our Nation's most forward-thinking entrepreneurs and innovators. The Small Business Innovation Research and Technology Transfer Programs have proven to be among the most successful Federal programs for driving technological innovation in U.S. history. Combined, they, excuse me, have delivered more than 70,000 patents, including extraordinary innovations in agriculture, defense, energy, health sciences, homeland security, space transportation, and other fields. Phase 1 and Phase 2 SBIR awards have made it possible for countless jobs to be created in my district in the capital region of New York. Thanks to these, and other similar programs, our region has built itself into a boom in high technology innovation and economic development.

Among our many success stories, four stand out from our capital region. The first is Kitware. A company based in Clifton Park, New York, Kitware's first round of funding came from the SBIR program in 1998, when they received a Phase 1 award from the Air Force to develop technology related to the visualization of uncer-

tainty in data. While this effort did not progress to Phase 2, they were able to attract additional customers with the developed technology to fuel their early growth. Since then they've relied upon SBIR/STTR program to develop advanced technology that improves lives, grows businesses, and meets the critical needs of the Federal Government.

Kitware's story is inspiring, but in many ways it is also entirely typical of SBIR companies. New York's capital region is also home to another SBIR success story, that being Automated Dynamics, which credits their existing technology to the SBIR program. In fact, Automated Dynamics was one of the original inventors of 3D printing in the 1980's, with the help of a National Science Foundation SBIR grant. This is now an $8 billion a year industry that is expected to grow 30 percent this year. Automated Dynamics also helped to develop its core technology, namely additive manufacturing of advanced composites—composite structures through Army and Navy SBIR awards. They remain the world leader in this technology, and while they have managed to outgrow the SBIR program, as they are no longer a small business, they continue to credit the program as a springboard for their success.

Speaking of grateful SBIR winners, International Electronic Machines, IEM, a small company located currently in Troy, New York, has said they, quote, and I quote, "have had the great privilege and honor of participating multiple times in the SBIR Program". SBIR contracts that IEM has won have helped support the company over the three decades that IEM has been in business, and have resulted in more than 50 patents, both here and overseas. Some of the products that have resulted from their SBIR work have generated millions of dollars in revenue over the years, supporting the success of the business, and their employees, consultants, vendors, and broader community.

Last, but not least, Innovative Technology, Inc., or MITI for short, has been in business in the capital district for 25 years, and is a previous recipient of the prestigious SBIR Tibbetts Award. They shared how they believe that they, and the capital district tech valley, have benefited greatly from the SBIR/STTR program by making it possible to keep engineers and scientists locally, but also to attract and retain high caliber international technologists and researchers.

These extraordinary successes demonstrate, to me, clearly that research funding has a powerful economic return, and we need to continue to fight to ensure these agencies have the funding they need, and, in turn, ensure productive funding levels for the SBIR/STTR programs. To me, the reinvestment in the community from SBIR and STTR is absolutely amazing. It's keeping talent at work, it's providing for additional people to claim my district as their now homefront, and is unleashing untold amounts of progress and success that obviously percolates into the greater society, so that we're all benefited by it.

So—wanted to share those on the record in the 5 minutes that was allotted, but I think it's important to document the real-life outcomes in our given congressional districts, and for that we thank you. I yield back.

Chairwoman STEVENS. With that, the Chair's going to recognize Mr. Balderson for 5 minutes of questioning.

Mr. BALDERSON. Thank you, Madam Chair. Thank you, panel, for being here, and this first question that I'm going to ask I can direct it to the whole panel, and Dr. Tilbury, you could start from there, and we'll go down along. But thank you all again for being here, and when I'm talking to small business owners in central Ohio, I often hear about the most important things that Congress and the Administration can do to help small businesses grow and create new jobs is to reduce taxes on businesses, make the tax code simpler, and clear away unnecessary and excessive government regulations. In the small businesses you work with, what barriers to success do you see?

Dr. TILBURY. So, at NSF, we fund small businesses to try to take the technological risk out of their ideas, so these are the high tech companies, and this is the stage before venture capital really has an appetite to come in. The companies that we fund, in fact, 92 percent of them have fewer than 10 employees, and 77 percent are less than 5 years old. So these are really young, really small companies with really high tech ideas, and they need this SBIR or STTR funding to get over that technological risk.

Dr. FELDMAN. So as I'm sitting on a panel with people from Michigan and Indiana, let me reveal that I'm from Ohio, and I'm a Midwesterner who had to go south——

Mr. BALDERSON. Thank you very much. I will ask my staff why they didn't tell me that.

Dr. FELDMAN. Sorry. And—it's probably somewhere on a very deep resume. But let me mention, for these innovative small firms, taxes are not the problem because they're not profitable yet. Really what they require is more in terms of resources and support. I think that, you know, it is encouraging to hear the importance of training things with the I-Corps Program. So really smart scientists, who are then suddenly confronted with starting a business, that's a completely different set of skills, so providing that type of expertise is costly. I'm a great believer in the State Technology Economic Development Programs, and, you know, that, again, provides incredible resources to small companies.

Mr. CUCINELLI. So, again, to comment on the taxes issue, boots on the ground perspective, I don't pay any taxes because I spend every single penny of my SBIR funding as fast as I get it. I spend it every year. I work with my accountant to make sure that I don't pay taxes until I become profitable, so that's how I manage that. I get really frustrated when people talk about small business, and they're talking about the sort of Main Street bricks and mortar small business, whereas I'm doing scalable tech startup business. They're very different in terms of their needs, and that's an example where that dialog can go sideways. It sounds like you've got a great handle on that.

Second point is to build on something Dr. Feldman said, but from a different perspective, the idea that the SBIR program can provide cultural benefits in the universities. As a mentor in residence, or entrepreneur in residence, what I've seen is I can use the SBIR program as a way to help influence that culture shift when I'm coaching a senior faculty member. You know, if I'm working with

someone who has built a laboratory over the course of 20 years, and knows how to manage graduate students, Ph.D.'s, post-docs, they don't know how to run a small business yet, and I can use the SBIR program to have a framework to help them begin to adopt the right mindsets.

Dr. PARK. I would concur, tax was not at all an issue for us throughout our—the course of Spensa. I would say, yes, I think the impact the small business or tech startups has in the economy is great, but I would also like to emphasize its impact on people, the entrepreneurs, the researchers and scientists who may not have gone to entrepreneurship if it wasn't for SBIR, like myself, right? I was an academic, but SBIR really opened an opportunity for me to get into starting a startup, which led to now leading something that I had never imagined that I could do.

I would really consider and encourage you to think about not just the company's impact on the economy. How about the—all the people that have been touched by SBIR? What's their second career or third career looks like? How have they really changed the way they lead, the way they run businesses because of the impact of SBIR?

Mr. BALDERSON. Thank you all very much. I yield back.

Chairwoman STEVENS. The Chair would like to recognize Mr. Gonzalez for 5 minutes of questioning.

Mr. GONZALEZ. Thank you, Madam Chair, and thank you to our panel. Dr. Feldman, I too am from Ohio, went to Ohio State. Mr. Cucinelli, you will see that, in this Committee, not only are we bipartisan, but we can actually work across enemy lines geographically as well. This is a fantastic Committee in that regard. So, as many folks here would know, I'm somebody who wants to make sure that we are properly funding our research enterprise, that we're supporting entrepreneurs in particular in fast growing industries, and so, as a general premise, as somebody who'd be very supportive of SBIR and STTR, I do have some questions around how we're measuring success, and I want to start with Dr. Tilbury.

So you kind of highlighted some brief data points at the end, but I'd love to hear kind of any numbers you have, or any barriers to acquiring these numbers, around, you know, percent of companies that receive follow-on private investment, dollars raised, percent still operating versus acquired employment numbers, geographical split. I'm trying to figure out kind of how we're tracking from funding to viable company.

Dr. TILBURY. So I might defer that to Dr. Feldman——

Mr. GONZALEZ. OK.

Dr. TILBURY [continuing]. But I will say we are trying to track all of those numbers, and we have data on people who get the Phase 2B, which is a matching. If you're——

Mr. GONZALEZ. Right.

Dr. TILBURY [continuing]. In a Phase 2, and you get external input, then NSF will match that up to a certain amount, so that number we absolutely know, because we gave them matching.

Mr. GONZALEZ. Right.

Dr. TILBURY. But as was also mentioned earlier, some of these companies, you know, the Phase 2 is a couple of years, and it might take many more years until they're commercially viable, or they're acquired. And so, during that lag time, I think we are absolutely

interested in acquiring that data, and that's why we work with the National Academies. And you may not be able to say yet, but——

Dr. FELDMAN. Yes, and so I am co-chairing the National Academies assessment of the SBIR program——

Mr. GONZALEZ. OK.

Dr. FELDMAN [continuing]. And I'm not able to really talk about our findings yet, and I'm happy to come back. Our report on the Department of Energy will be released in March.

Mr. GONZALEZ. OK.

Dr. FELDMAN. But, you know, this is an important question because we have a need for government investment because these technologies are so early stage, and so risky——

Mr. GONZALEZ. Yes. Absolutely.

Dr. FELDMAN [continuing]. And so it's very complicated, and this is where we're now able, with new digital technologies scraping the web, to sort of be able to follow this sort of initial receipt of a grant to companies.

Mr. GONZALEZ. Right.

Dr. FELDMAN. Sometimes when companies fail, that might be appropriate, right?

Mr. GONZALEZ. Yes.

Dr. FELDMAN. Because the technology——

Mr. GONZALEZ. That happens.

Dr. FELDMAN [continuing]. Right—wasn't——

Mr. GONZALEZ. Yes.

Dr. FELDMAN [continuing]. Going anywhere. And then I think the entrepreneur, the entrepreneurial team, other people in the company, will then be recycled and do other things in a local economy.

Mr. GONZALEZ. And then, if I could step in for a second? Dr. Tilbury, the average grant size is what? So you talk about there's some who are kind of operating for years before they receive the follow-on funding. I ran a venture-backed company at one point. We didn't have years, right? You know, you're usually doing it in 18-month increments.

Dr. TILBURY. So I believe that—so it's not an average. So the Phase 1, if you get it from NSF, is $225,000——

Mr. GONZALEZ. OK.

Dr. TILBURY [continuing]. All in one shot——

Mr. GONZALEZ. And that'll be——

Dr. TILBURY [continuing]. And then——

Mr. GONZALEZ [continuing]. Two to three——

Dr. TILBURY [continuing]. Phase 2——

Mr. GONZALEZ [continuing]. Employees.

Dr. TILBURY [continuing]. Has been increased now to 700,000.

Mr. GONZALEZ. Yes.

Dr. TILBURY. And then they can get matching on top of that, and there's——

Mr. GONZALEZ. Got it.

Dr. TILBURY [continuing]. Supplements on top of that. So there's a lot of—even though that's the base number, there's a lot of extra supplements, opportunities.

Mr. GONZALEZ. OK. And then, with my last minute, Dr. Feldman, without getting into specifics of your report, and what's you're going to release, what are the key barriers, that you're seeing to

acquiring the data that I outlined that I think would be helpful, in terms of collecting it?

Dr. FELDMAN. Well—and—so ideally we would like to know who was applying to the program, right, and then not only—we now know, through the SBA, who was awarded funding, but if we could follow those who applied and didn't get funding, or did they come back, that's capturing another kind of learning, so that would be very valuable. It would also be much easier for us if we could access some of the census data centers, and the data that is behind that sort of security wall.

Mr. GONZALEZ. All right. Thank you. Yes, sure, Mr. Cucinelli.

Mr. CUCINELLI. I don't have this in front of me, I apologize, but in preparing my written testimony, I found an Air Force report from I believe 2014 that is worth taking a look at. I'll followup with your staff, if you'd like——

Mr. GONZALEZ. That'd be great.

Mr. CUCINELLI [continuing]. But it did this across hundreds and hundreds of SBIR awards, and came up with metrics——

Mr. GONZALEZ. Thank you. And, as I said at the beginning, I want to be helpful, I want to empower you guys, but we need some data so we can just measure how we're doing. With that, I yield back.

Chairwoman STEVENS. Thank you, Mr. Gonzalez. We're going to do one more round of questions. It might just be Dr. Baird and myself, but we've got a lot to chew on here. I wanted to go back to the geographic diversity component that you brought up, Dr. Feldman. You talked about the pockets of prosperity in university towns, and then you also talked about how this system, with SBIR and STTR funding, works well in some places, but not everywhere. And I know the other part of what you do is the research on the geography of innovation. And I'd love to hear a little bit more about how we can better democratize innovation, especially through the SBIR program, so that towns all throughout this country can participate in our innovation economy. And if you have any thoughts, I'd really appreciate it.

Dr. FELDMAN. Thank you. And so, you know, as we study this, we do see these pockets of prosperity, mainly in college towns, where the SBIR program is working well. But one of the problems when we rely on venture capital funding, when you take money from outside, and, you know, it—you're not going to be able to stay, in many cases, so companies will relocate. And also, given that the venture capital model is predicated on a 5 to 7 year return, what that means is that there will be an exit, and with that exit it's very likely that you would have the company relocating as it was acquired. And so it doesn't really keep the company local, and grow to employment. And I think one of the things about the Phase 2B additional funding helps stream tips—bring that along. Also, having more proof of concept centers.

But, you know, as we talk about these companies, SBIR is not really meant to be a jobs program. It is an innovation program, but we need something else in place to give us the jobs that we need in many parts of the country to spread that prosperity more widely.

Chairwoman STEVENS. Right. And it's, you know, spanning 11 agencies for SBIR, five for STTR funding, and you sort of wonder,

you know, does it help to have regions as designated—self-designated areas, for instance. I know the Economic Development Administration has looked at this. Obviously that might get overly prescriptive, and too quick—it could get overly prescriptive too quickly, however, you know, when we're looking at how do we make sure that we're spreading the peanut butter throughout our—all of these great towns and communities, and into the hands of innovators. I mean, part of why we are having this hearing, and having this go into the congressional record, is that we want America to hear this. We want people to know that this is available, and whether you're at one of the big universities or not, that these 11 agencies, right, are coordinated in this way, and in their own research areas.

And this is a small point, but I just wanted to ask about it, which is the administrative fee that Congress has authorized that these pilot programs, you know, it's allowing agencies to use the 3-percent of their SBIR funds for new activities such as outreach, and commercialization, and oversight, and administration of the program, and this is known as the administrative fee pilot. There was this 2016 GAO (Government Accountability Office) report that found 7 of the 11 SBIR agencies spent $19.1 million of these funds. This is going back to Fiscal Year 2014. And, Dr. Tilbury or Dr. Feldman, do you have, you know, any examples of this that you can elaborate on for us, particularly how agencies are tracking the outcomes of these efforts? I know this is a little bit of what Congressman Gonzalez was talking about, but—question about—should we be—is this one of the pilot programs we should be expanding? Is this helpful?

Dr. TILBURY. Absolutely, it's a helpful program. I can tell you that we use some of those administrative fees to send our program directors on outreach trips to underserved geographic areas, underserved communities. We have a joint program right now with GEM, the Graduate Education for Minorities.

Chairwoman STEVENS. Yes.

Dr. TILBURY. We use some of those funds for the Beat the Odds Bootcamp that we put the SBIR Phase 1——

Chairwoman STEVENS. Right.

Dr. TILBURY [continuing]. People through. We sponsor trade shows that provide commercialization opportunities for grantees. We use that to launch this project pitch that I told you about, which allows people to come in at any time with a brief pitch about their idea and see if it's appropriate for NSF, to fund this National Academies study about the impact of the SBIR program. So those are the kinds of things that we do with the administrative fee that are not directly to small business, but absolutely supporting the program.

Chairwoman STEVENS. Right. Thank you. Thanks so much. All right, with—I'm out of time.

Mr. BAIRD. Thank you. You know, I'm a veteran, so I'm kind of partial to veterans. In fact, I think we've got a bill that'll be signed hopefully next week or so that encourages an increased outreach for veterans in the STEM program. So, Dr. Tilbury, you mentioned in your testimony that there's a veterans research supplement that

attracts veterans into the STEM enterprise. Would you care to elaborate on that a little?

Dr. TILBURY. So we have a lot of programs to attract veterans into the research enterprise, research experience for veterans, and I believe they can work with a small business through an SBIR, so the small business would get a supplement to bring in a veteran to help them in their activities. I know we certainly do that for all the basic research awards that we offer.

Mr. BAIRD. Any others want to comment about that, regarding veterans, and——

Dr. FELDMAN. Regarding veterans, what we see is disproportionately veterans come from rural areas in the south and west, and they're more sort of geographically isolated. People would like to return to their small towns, but there are not necessarily opportunities for them. And veterans make great entrepreneurs, right? They're just disciplined, and they know how to work together, so I think this is an area where we could have more fruitful engagement.

Mr. BAIRD. Anyone else?

Mr. CUCINELLI. Yes, I completely agree. I have a number of friends who are currently running small businesses started from scratch, and the skillsets required to do that are a perfect overlap with what many people experience in the military, both in terms of their training and their experience, the creativity under fire, so to speak, the discipline, the dedication that it takes to see something through for 7 to 10 years. So pulling more veterans in is going to be invaluable in increasing the success of the program.

Dr. PARK. I would just mention, in relation to rural communities, there are—the Midwest region has traditionally been kind of labeled as there's not enough capital, but investors are waking up, and there's—increasingly more investors are targeting Midwestern companies, including rural communities. So I think, to me, SBIR is a form of investment from the government, and so if venture capital is waking up to invest more, I think there is a case to be made for SBIR program to consider geographically diverse investments to support rural communities.

Mr. BAIRD. Well, what I just heard was good news, because most of those veterans, if they've been deployed, or been in the service for a period of time, they probably just want to go home, and a lot of those, you just mentioned, from rural areas, so——

Dr. PARK. That's right.

Mr. BAIRD [continuing]. That's good news. Thank you very much.

Dr. PARK. Um-hum.

Chairwoman STEVENS. Thank you. And now the Chair will recognize the gentleman from the great State of New York again for 5 minutes of questioning.

Mr. TONKO. Thank you, Madam Chair. The many, many hearings that we've had recently have spoken to the need for us to maintain a very strong competitive edge, especially when it comes to critical technologies, so my question to any and all of our witnesses is what role do you believe the SBIR and STTR programs can play in the United States' innovation policy, and in helping our Nation maintain science and technology leadership in what is that increasingly competitive world?

Dr. TILBURY. So I believe the SBIR program is a critical component of that increasing competitiveness because it allows the results of basic fundamental research, which is primarily funded by the Federal Government, to make the transition into commercialization. And, as we've heard, it can be a long and slow road to commercialization, and it takes not only investment, but also patience, and passion, perseverance. And so I think the SBIR program helps that transition into the current industries that we have, to strengthen them, as well as create new industries that we haven't imagined yet.

Mr. TONKO. Thank you. Anyone else?

Mr. CUCINELLI. I had the privilege of being involved in a fuel cell startup between 2009 and 2011 in Europe, and it was very, very difficult to get the initial seed capital. I saw just a fundamental difference between here and there, and we talked constantly—some of the people who had been on this side of the pond would lament with me in the pub at lunch about how, you know, I wish we had the SBIR/STTR program to get us to the venture capital. And we eventually raised about I think 3.2 million Euros, or something like that, but it was incredibly difficult. So I think our system here works much, much better to get these early stage companies out of the gate, and get us to a position where we might eventually be able to double down on some of this innovation, and maintain that leadership.

Mr. TONKO. All right. Yes? Dr. Feldman.

Dr. FELDMAN. I think also it's important to remember that this program is just part of our larger innovation system, and we really need to make sure that basic research is going on, these sort of fundamental discoveries, the serendipitous inquiry that will, you know, sort of provide the seed corn for moving things forward, and we don't get too far out of balance by focusing on things that are immediately commercializable and more short range.

Mr. TONKO. Well, there are some of those—some fiscally conservative think tanks that monitor action on the Hill that would advocate that there be no Federal dollars shared with research, that—they don't believe it's appropriate. What would your response to that be?

Dr. FELDMAN. That they are wrong, and that would be an awfully fun debate to engage in, because I think it's critically important. And so in the U.S. for a long time we have issued the idea of industrial policy, yet the, you know, we see that in Asia there is a lot of industrial policy, and a lot of targeted investment, and I think this is the wrong time for us to be questioning government's role.

Mr. TONKO. Dr. Tilbury?

Dr. TILBURY. We talked about the commercialization. NSF is celebrating its 70th anniversary this week, and he mentioned the LASIK eye surgery. Now, that came out of fundamental research in lasers. They weren't trying to build eye surgery when they did that fundamental, basic research. They were trying to understand high energy physics. And so I think we need to continue to fund that fundamental basic research that you're not sure where it's going to lead, because it might lead someplace really interesting.

Mr. TONKO. Right. And—yes, sir?

Mr. CUCINELLI. So I'm——

Mr. TONKO. Mr. Cucinelli.

Mr. CUCINELLI [continuing]. Teaching a course in entrepreneurial leadership to graduate students, Ph.D.s, MBAs, and they asked me the other day, well, where do we get our ideas from? And I said, well, you know, you find a pain point, and you think about it, and you live it, and then you go and fix it, but you can also go and look to the labs. Look around. Look to your engineering colleagues who are taking courses in aeronautics, or whatever, and you'll find innovation there. That's the basic research, and it's being looked for by these bright young innovators who are going to see the idea that maps over to the pain point they've identified, and then go find the professor and his or her lab team, and make a company out of it, and make it go. And they'll use SBIR/STTR to do that. But they can't do it if they don't have the basic research in place.

Mr. TONKO. Thank you. So I'm hearing, with sound rationale, you would reject the advice of those who suggest the Federal Government not apply any dollars toward research. Thank you so much. That's encouraging. I yield back.

Chairwoman STEVENS. Thank you, Mr. Tonko. We didn't invite them to the hearing, so—and, you know, a big thank you to our witnesses. You know, we're so proud of the NSF, and your leadership as one of the 11 SBIR agencies, and what I think we kept hearing today, which is that you're such an example, and a leader of how to do this right.

And, you know, thank you, Dr. Tilbury, for your leadership, and Dr. Feldman for not only your leadership at the Academies at this time, but also for your great research contributions, something that I know is very important to the economic development conversation, as well as how States look to do that technology-based economic development strategies, and so we work very closely with our State partners as well. And then, obviously, a treat to have you here, Mr. Cucinelli, from Michigan, and, you know, thanks for your fabulous leadership, not only as an entrepreneur, but also as an educator, and that's the other piece of it. And, Dr. Park, you know, just wonderful to hear not only about your business success, but what you're also doing with WHIN and the network that I think is going to have some tremendous effects.

We like to say this will—I'll say this, this was all Dr. Baird's idea, OK? The legislation, the hearing, and it's the best in business here on the Science Committee, which is that, you know, we talk about the things that bring people together, and this is what the country wants to see. This is part of the doing and delivering agenda for our country, and we are looking forward to having you back when we get this legislation marked up, passed, and signed into law, and continuing to see the growth of SBIR, and the lives that are changed and influenced. And, yes, as an innovation program, because that is what America does really well. Our plight of innovation in the post-9/11 era, in particular over these last 20 years—we were the ones who proliferated the Internet, propagated the iPhone, mobile apps, just to name one segment of our innovation economy that's really quite tangible to all, so thank you again.

The record's going to remain open for two weeks for additional statements from Members, and for any additional questions that

the Committee Members may have of our witnesses. And at this time our witnesses are excused, and the hearing is adjourned.

[Whereupon, at 3:20 p.m., the Subcommittee was adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Dawn Tilbury

Responses to QFRs for Dawn Tilbury testimony

(Stevens) Question 1: Congress requires the National Academies of Sciences, Engineering, and Medicine review each agency's SBIR program every four years. The last round of reviews was carried out in 2015-2016, and the new round is underway.

a. What information is most valuable to get the true measure of these programs?

The effectiveness of the NSF SBIR/STTR programs can be assessed by a variety of measures, which vary by the program goal. Select outcome measures we believe are important, but by no means an exhaustive list, are as follows:

The economic effect of NSF's program can be measured through the progress of the awardee small businesses in terms of jobs created, revenues realized from SBIR/STTR-supported products and services, follow-on private and public investment of awardee small businesses, and valuations at mergers and acquisitions of such businesses.

The knowledge effect of NSF's program can be measured by intellectual property outputs, such as patents and copyrights, as well as the number and impact of scientific publications that directly result from SBIR work.

The effect of NSF's program in terms of broadening participation can be measured by the numbers of:

- individuals from underrepresented groups who participate, either as a company owner, officer, or technical contributor to the project (especially first-time participants);
- small businesses that are woman-owned and woman-operated and receive SBIR/STTR funding (especially first-time participants);
- small businesses with owners or founders from underrepresented groups who participate (especially first-time participants); and
- firms located in underserved geographies [for example, in states designated by NSF's Established Program to Stimulate Competitive Research (EPSCoR) program or states that do not rank in the top 15 for total NSF SBIR/STTR funding].

The effectiveness of the program in terms of meeting Federal R&D needs can be measured by the revenues from Federal contracts based on products and services offered by NSF SBIR/STTR-companies, and by their subsequent success in obtaining Phase III funding from other agencies.

b. Agencies and businesses have had trouble answering the Academies' data calls. In some cases, the requests are burdensome, in some cases businesses are worried about business confidentiality. As the Academies' undertakes a new round of reviews, what data does NSF release to the Academies' and what additional data, if any, could be released to improve the assessment of the program?

Our current NAS study is in its earliest stages with ongoing discussions about which data to provide for this engagement.

In general, however, NSF does not release any information about declined proposals outside of the Foundation. We also rarely release proposal information (other than public information for awards) outside of the Foundation for the purposes of assessment. The NSF relies on anonymous peer review and protecting the integrity of this process, especially regarding personally identifiable information and proprietary company information, is critical.

(Lipinski) Question 1: I've long supported programs to assist in the transition of research from the laboratory to commercialization, including both SBIR and I-Corps.

a. Can you please describe how I-Corps is complementary to the STTR and SBIR programs?

The I-Corps program had its origins in the SBIR/STTR program at NSF as it became clear that those startups with roots in basic research consistently struggled to commercialize because of insufficient understanding of industry dynamics and market adoption. I-Corps was adapted from best practices to teach this critical skill set. In this way, I-Corps can be viewed as a tool to help reduce the market risk associated with new innovations from NSF-funded small businesses.

Similarly, we view the main goal of the R&D funding provided through our SBIR and STTR programs as the reduction of the technical risk associated with the technology underlying the prospective product or service. Therefore, NSF SBIR/STTR and I-Corps can be thought of two complementary approaches to reduce the risks associated with technology translation and commercialization.

b. Does I-Corps continue to be successful in facilitating tech transfer?

The NSF Innovation Corps (I-Corps) program helps potential entrepreneurs 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. It is a critical element of NSF's approach to accelerating the growth of startups. More than 1,500 teams composed of more than 4,500 people have participated in I-Corps since 2011, and more than 800 businesses have been formed to commercialize technologies. Those teams have raised more than $420 million in follow-on funding. 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.

(Lipinski) Question 2: I was joined by Chairwoman Johnson, Ranking Member Lucas, and others in introducing H.R. 539 the Innovators to Entrepreneurs Act of 2019. This bill would allow SBIR and STTR awardees to use some of their funds to participate in I-Corps courses, increasing access to this successful training curriculum. I was grateful that this bill was quickly passed by the House of Representatives, and I encourage the Senate to consider it.

a. Can you please describe how this bill, if implemented, would be beneficial to SBIR and STTR awardees?

NSF believes that an introduction to industry dynamics and marketplace adoption is critical for the startups commercializing deep technologies and the results of basic research. As a result, several years ago NSF launched and currently conducts the "Beat-The-Odds Boot Camp," an abbreviated version of I-Corps training, for all of our Phase I awardees. This program has had an overwhelmingly positive response from awardees since its inception, leading to tens of thousands of additional interviews

between NSF SBIR/STTR firms and their marketplace stakeholders. H.R. 539 authorizes an expansion of the I-Corps program to SBIR and STTR awardees. The scope of such an expansion would need to be coordinated within NSF, the Administration, and Congress to ensure that the I-Corps program is not overburdened.

Responses by Dr. Maryann Feldman

1. Congress requires that the National Academies of Sciences, Engineering, and Medicine review each agency's SBIR program every four years. The last round of studies was carried out in 2015-2016, and the new round is currently underway.

    a. What information is most valuable to get the true measure of these programs?

    Data useful to the National Academy of Sciences for the Congressionally-mandated evaluation of the SBIR/STTR program would include:
    1) Applicant data for Phase 0, 1, and 2 awards
    2) Data on SBIR collaborations
    3) Data on outcomes
    4) Data on principal investigators and other key researchers, to better understand program outcomes
    5) Firm-level data from the Census Bureau, including revenues and employment

    First and most importantly, applicant data, as opposed to just awardee data, is critical to comprehensive program evaluation. Specifically, without applicant data it is impossible to assess selection into the program. For example, without information about the entire pool of applicants we are unable to assess the effectiveness of outreach efforts and the processes used in the selection of projects for funding. In addition, data on applicants allows us to better understand those applicants who do not receive grant awards, enabling us to offer policy recommendations that will help increase the participation of traditionally under-represented groups.

    Agencies have raised concerns about client confidentiality, however, as stipulated under Public Law 112-81: Sec. 5132 (National Defense Authorization Act for Fiscal Year 2012), agencies are mandated to collect these data, specifically for "each small business concern that applies for, submits a proposal for, or receives an award under Phase I or Phase II of the SBIR program or the STTR program," including, "the names and titles of the key individuals that will carry out the project, the position each key individual holds in the small business concern, and contact information for each key individual."

    The experts convened by the National Academy of Sciences for the Congressionally-mandated evaluation of the SBIR/STTR program would like to access applicant data from the agencies. We are willing to negotiate Memorandums of Understanding and non-disclosure agreements to utilize these data in our evaluation. Indeed, without access to such data, the evaluation will not fully achieve its full potential. In the absence of a counterfactual example of firms that applied unsuccessfully for SBIR funding, we are only able to draw partial conclusions. For example, we would like to be able to compare, over time, the pre- and post-award development trajectories and innovation performance of grantees versus similar applicants that did not receive grant funding.

    Secondly, it would be valuable to understand research partnerships for firms that receive SBIR funding. An objective of the SBIR/STTR evaluation is to understand collaborations. This requires data on partner institutions, which include universities,

national labs, and other non-profit research organizations such as hospitals. No data on collaboration between SBIR grantee small businesses and research institutions is currently reported. Only minimal data are available for STTR. This data is critical because the design of the SBIR program actively encourages, and the STTR formally requires, that awardees partner with external research institutions.

The Agencies track these data to ensure that the firm is conducting research and not subcontracting the full amount of the award to another. The data are not publicly reported and are not systematically collected in a useful manner, and have not been made available to the NAS study team. This limits the traceability of the innovation outputs generated by awardees in conjunction with their R&D partners. Hence we are unable to evaluate the strategic, scientific, and commercial value of involving institutional partners in collaborative R&D. We are also unable to evaluate the participation of different types of research partners such as Historically Black Colleges and Universities (HBCUs) and Hispanic Serving Institutions (HSIs), which limits our ability to make recommendations about broadening participation and building a diverse STEM wokforce.

The third missing data element is better data on commercial outcomes. One important outcome of the SBIR/STTR program is new products introduced to the market. These data are notoriously difficult to trace due to the serendipitous nature of the commercialization process, which involves significant time lags. Yet, specifically for the NIH SBIR/STTR program and due to the regulated nature of drugs and medical devices, the Food and Drug Administration collects data on these important market outcomes. It would be possible to link FDA approvals for a SBIR/STTR funded firms. For example, the FDA provides data on devices that were approved but doesn't provide data on devices that applied for approval, but did not receive approval. These data would be extremely useful for evaluating efficacy of the NIH funding.

Fourth, another important outcome of the program is due investments in human capital. Individual scientists are founders for multiple companies and move between companies. We would like to track the pre- and post-award career trajectories of the Principal Investigators and technical team members who receive one or more SBIR/STTR awards. These data would include institutional affiliation, salary, and federal grant funding from both SBIR and other programs.

Finally, the U.S. Census Bureau collects the highest quality data on American firms. These data, including revenues and employment, are made available through the Census Data Center program to certified researchers for projects that meet the threshold requirement that the information used for study purposes demonstrate usefulness to the Census. Our Congressionally mandated study is not able to satisfy this requirement. Expedited access to these data would greatly assist our work.

b. Agencies and businesses have had trouble answering the Academies' data calls. In some cases, the requests are burdensome, in some cases businesses are worried about business confidentiality. As you undertake a new round of reviews as a co-chair of

the committee, how are you thinking about updating the ways in which you gather data and the kinds of data that are most valuable?

Our approach is to use administrative data that the Agencies already collect for their awarded firms. We match these data with secondary data from a variety of sources. This recommended approach replaces the prior approach of the study team in collecting primary data directly from businesses.

We request access to the government databases collected by the Agencies that was required by Public Law 112-81: Sec. 5132. This eliminates the need to make additional demands to the firm's data reporting burden.

2. In your testimony, you mention that too great an emphasis on commercialization may push agencies toward projects that have more immediate commercialization potential rather than long-term innovation potential.

   a. Why is it so important that we find a balance between supporting projects with good, short-term commercialization potential and projects that offer long-term innovation potential?

R&D is the basis for new innovation, which is the creation of value from ideas. Innovation is the basis for economic growth. Innovation is also risky and involves failure. Creative scientific discovery provide the basis for innovation. One outcome of government funding is to advance new ideas to the point where their commercial potential is known. If we focus on end outcomes, such as rate of return or commercial impact, there is a selection bias towards later stage projects that are less risky. These are the projects that are more likely to be developed by firms.

Projects with short-term commercialization potential are important if they address the mission-specific needs of the commissioning Agency. In such cases, Agencies are able to identify immediate needs where there is no current innovation and induce firms to move into these markets.

Government investment promotes new discovery and reduces technical risk. This seeds the field for business to move ideas forward to the market. SBIR is one small part of the U.S. system of innovation and it is working well.

   b. How would you assess the current balance between these types of projects and what recommendations do you have moving forward to ensure the appropriate balance is maintained?

Currently there is more emphasis on translational research than ever before. Certainly, this emphasis varies within agencies. One current imbalance lies in the underfunding of the National Science Foundation (NSF). NSF is dedicated to basic research across all fields of sciences. The 2020 NSF budget is $7.1B for all fields of science. This compares to the $41.5B for health research at the National Institutes of Health. In contrast, the

Department of Defense has a total budget of $738B for 2020, of which approximately $60 billion spent for research. DoD research is more oriented towards applied research and development and specific end-stage applications.

Ensuring that an appropriate balance is maintained is critical to our nation's future. There is a developing field of study that focuses on the allocation of resources for innovation that had the potential to answer these questions in the future. Agencies need latitude to experiment with different approaches to be meet their needs. With greater data availability, scholars will be able to provide better evidence-based policy recommendations.

Appendix II

Additional Material for the Record

LETTERS SUBMITTED BY REPRESENTATIVE HALEY STEVENS

CLEAN ENERGY BUSINESS NETWORK

The Honorable Eddie Bernice Johnson (TX-30)
Chairwoman
House Committee on Science, Space, & Technology
2306 Rayburn House Office Building
Washington, DC 20515

The Honorable Frank Lucas (OK-3)
Ranking Member
House Committee on Science, Space & Technology
2405 Rayburn House Office Building
Washington, DC 20510

The Honorable Haley Stevens (MI-11)
Chairman, House Science Committee
Subcommittee on Research and Technology
227 Cannon House Office Building
Washington, DC 20515

The Honorable Jim Baird (IN-4)
Ranking Member, House Science Committee
Subcommittee on Research and Technology
532 Cannon House Office Building
Washington, DC 20515

February 4, 2020

Dear Chairwoman Johnson, Ranking Member Lucas, Chairman Stevens, and Ranking Member Baird:

We are writing as members of the Clean Energy Business Network—the small business voice for the clean energy economy—to convey our recommendations for small business policies to support technology research, development, and commercialization.

Our companies and associations are working across the spectrum of clean energy technologies, including energy efficiency, natural gas, renewable energy, advanced transportation, and storage, among others. Our industries support over 3 million jobs across the country, many of those in manufacturing, and represent the major growth sectors of the U.S. energy economy.

Many of our businesses have benefitted from federal research and development initiatives such as the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs. We have seen how critical these programs are to promoting breakthroughs in commercialization of cutting-edge technologies. At the same time, we recommend improvements to make these programs even more impactful and available to small businesses across the nation.

Most of the recommendations below can be implemented at no additional cost to the American taxpayer and only require adjusting program direction and implementation. Where new programming or staff are called for in order to manage small business programs more effectively, these improvements can be achieved at minimal cost while increasing mission impact.

I. Legislative Priorities

A. Improvements to Existing Provisions

1. **Agency Excellence**

   - Recommendation: *Make the Administrative Funding Pilot Program permanent.*

- Background: Since 2011, agencies have been allowed to use 3% of SBIR/STTR funds for program improvements, yielding a profusion of innovative initiatives to diversify the applicant pool, upgrade data reporting systems, and provide high-impact entrepreneurship training. Agencies need long-term certainty to make these critical improvements to their SBIR/STTR programs, without the risk of this authority lapsing as it has done in the recent past.

2. **Entrepreneurial Authority**

- Recommendation: *Allow Technical and Business Assistance funds to be spent in-house, rather than mandating one or more external vendors.*

- Background: Recently, SBIR/STTR awardees have been allowed to spend up to $50,000 of their awards on non-R&D expenses such as technical and business expertise. Entrepreneurs should have the discretion to allocate these dollars in the most efficient way, so they should be allowed to choose between spending on their own employees who possess that technical and business expertise, or a contractor of their choice.

3. **Award Flexibility**

- Recommendation: *Extend direct-to-Phase-II authority to all agencies, and make it permanent.*

- Background: For most agencies, only prior recipients of a Phase I (Feasibility and Proof of Concept) award are eligible to apply for Phase II (Research and Development) award. Every agency should be able to make a Phase II award without a prior Phase I award if the small business is ready for it.

4. **Award Size**

- Recommendation: *Make the Commercialization Readiness Pilot Program for Civilian Agencies and the Commercialization Assistance Pilot Program permanent.*

- Background: Agencies have responsibly used their authority to make follow-on SBIR/STTR awards to promising companies after Phase II, when there is a clear but lengthy path to commercialization (e.g., completing the drug approval pipeline). Agencies need long-term certainty that these authorities will not lapse or expire.

B. New Ideas

5. **Short-Form Applications for First Round of Consideration**

- Recommendation: *Ensure that agencies create a system for reviewing and greenlighting short-form project descriptions before requiring a more time-intensive full application.*

- Background: Preparing a high-quality application is a complex and time-intensive task for any small business. Reviewing lengthy applications that are a poor fit is also a waste of federal resources and staff time. Some federal agencies provide a short-form initial

application that is only a few pages long and can be completed without professional assistance. This approach should be used by all agencies to screen submissions for eligibility and fit.

6. **Vouchers for Application Assistance, Particularly for Diverse Teams**

   - Recommendation: *Create an independent program administered by the SBA—or competitively bid to an external contractor—to review successful short-form applications on the basis of need and provide vouchers for professional assistance.*

   - Background: Once selected to proceed with a full application, first-time applicants should be eligible to compete for $3,000-5,000 vouchers from SBA that pay for high-quality technical assistance from professional consultants or state/local assistance programs of their choosing. In allocating these awards, particular preference should be given to underrepresented populations, regions, and universities. This practice will ensure that the most promising technical ideas are able to compete for awards, regardless of the team's size or prior experience working with the federal government.

7. **Support for Entrepreneurship Programs**

   - Recommendation: *Encourage agencies to allocate funding toward entrepreneurship programs within federal laboratories, universities, and incubators to work collaboratively with companies pursuing tough technical challenges.*

   - Background: Over the past five years, innovative entrepreneurship training programs at universities and federal laboratories have generated above-average cohorts of promising SBIR/STTR awardees. Examples include Chain Reaction Innovations at Argonne National Lab, Cyclotron Road at Berkeley Lab, The Engine at MIT, Innovation Crossroads at Oak Ridge National Lab, and numerous incubators and accelerators across the country. Agencies should be encouraged to competitively allocate some of their funding to existing and future programs that build a pipeline of highly-educated entrepreneurs pursuing tough technical challenges.

<u>II. Agency-Level Priorities</u>

While the following best practices may be difficult to enact via legislation alone, agencies offering small business R&D programs should be encouraged to learn from one another and make progress on these key elements of an entrepreneur-friendly SBIR/STTR program:

8. **Dedicated Program Managers**

   - Recommendation: *Encourage agencies to develop teams of dedicated program managers who possess relevant private-sector experience and the ability to work closely with awardees both before and after awards are made.*

   - Background: Many SBIR/STTR programs are administered as a small portion of an R&D portfolio managed by agency staff with numerous competing priorities. To cater to the unique needs of small businesses with early-stage technologies, it is often ideal to deploy a

team of program managers with relevant private-sector experience who focus exclusively on SBIR/STTR awards, akin to the approach used by typical ARPA-E and DARPA program managers.

9. **Broad, Goal-Oriented Topics**

   - Recommendation: *Encourage agencies to design solicitations based on broad technologies of interest rather than narrow pre-defined research topics.*

   - Background: Some agencies, such as the National Science Foundation, request more broadly-defined, goal-oriented proposals, whereas others are highly prescriptive in their solicitation topics and may miss highly-impactful, mission-relevant technology solutions proposed by entrepreneurs themselves.

10. **Speed and Flexibility**

   - Recommendation: *Encourage the use of prizes and other flexible types of transactions to shorten award times. Having dedicated program managers would also help increase speed and flexibility.*

   - Background: Fast-moving small businesses cannot wait months or a year to hear about funding sources. To the extent possible, agencies should shorten selection and award times, and offer multiple—or even continuous—funding opportunities each year.

11. **Phase III Opportunities**

   - Recommendation: *Encourage agencies to educate and solicit successful SBIR/STTR awardees to seek and win contracts across the federal government based on agencies' missions and needs.*

   - Background: While many agencies offer Phase III (non-SBIR/STTR funding) opportunities, this is typically not widely advertised or understood. Successful SBIR/STTR technologies may have broad applications across the federal government, and facilitating their procurement to serve agency missions is in the best interest of taxpayers.

In closing, small businesses across all sectors are working to develop new technologies that will transform our lives, in part with support from SBIR/STTR programs. The energy sector offers many shining examples of how the U.S. government has worked in partnership with the private sector to spur innovation. These partnerships have contributed to most transformations in the U.S. energy economy—from new oil extraction methods and hydraulic fracturing, to energy-efficient windows, to dramatic declines in the cost of wind turbines and solar panels.

Small business programs such as SBIR/STTR help small businesses rise and compete to develop promising new technological solutions and bring them to market—resulting in job creation, lower energy bills, increased domestic investment, and healthier communities. We urge you to stand beside these entrepreneurs in bringing the best and brightest ideas to market.

Thank you in advance for consideration of our views. Should you have any questions, please contact CEBN President Lynn Abramson at labramson@cebn.org or 202-785-0507 for further information.

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Statement for the Record

House Science, Space, and Technology Committee

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

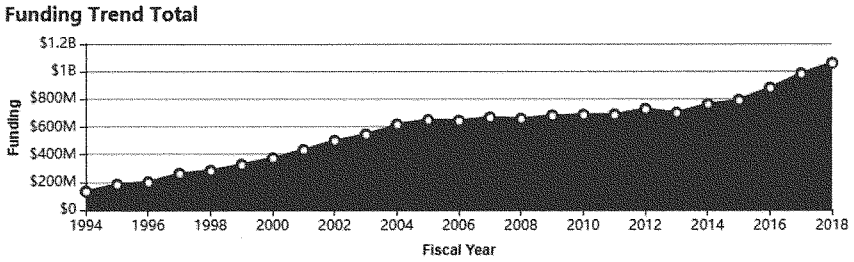
February 5, 2020

Chairwoman Johnson, Ranking Member Lucas, and distinguished members of the Committee. My name is Dr. Michael Lauer and I am the Deputy Director for Extramural Research at the National Institutes of Health (NIH). Thank you for the opportunity to submit this statement about the Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR) programs at the NIH in the context of NIH's research and development portfolio. I will discuss NIH's SBIR and STTR programs and the issues under consideration for reauthorization by this Committee. We believe we have a shared interest in strengthening these already highly productive programs and ensuring that they meet the unique needs of the biomedical research ecosystem.

At NIH, we support a broad, diverse portfolio of biomedical and behavioral research. To turn discovery into health, promising technologies must move from the laboratory into clinical trials, into the marketplace, into the doctor's office, and into our everyday lives. A key way to transition promising technologies is through commercialization. Small businesses help to achieve this commercialization goal. NIH can reduce the barriers to entry and help entrepreneurial scientists move their promising products through the development pipeline by strategically aligning research resources in academic settings with the dedicated funding for small businesses that Congress established decades ago.

The SBIR and STTR programs, also known as America's Seed Fund, are the largest sources of early-stage capital for life science technology commercialization in the United States. NIH's SBIR and STTR programs provide life science small businesses with funding and support to develop innovative technologies that improve health and save lives. These programs allow innovators to validate the potential healthcare potential of their scientific discoveries and to test the feasibility of novel products and services resulting from these discoveries. The SBIR and STTR programs fill a critical gap between basic science and commercial development that is often referred to as "the valley of death." A key objective is to prepare companies to address the unique regulatory and insurance payment issues of innovative healthcare products, to strengthen their ability to obtain the additional investments necessary to move their technologies toward patient access.

NIH's SBIR and STTR programs have grown to provide U. S. life science small businesses with over $1 billion annually to develop innovative technologies that improve health and save lives.



The SBIR and STTR programs are funded by a set-aside of each agency's total research and development budget (3.2 percent and 0.45 percent, respectively). Therefore, as the overall NIH budget increases, the amount NIH spends on SBIR and STTR also increases, allowing the programs to grow while maintaining NIH's balanced portfolio of basic, translational, clinical, and population based research. The current SBIR and STTR set-asides also allow NIH to leverage the diversity of the United States bioeconomy by supporting research and development across universities, academic health centers, and small businesses.

In addition to the funding that the SBIR and STTR programs provide to small businesses, NIH has leveraged a number of pilot programs authorized in section 9 of the Small Business Act to mitigate barriers to participation and commercialization. The authorizations for each of these pilots expire on September 30, 2022.

Administrative Funds Pilot

Section 9(mm) of the Act (15 U.S.C. 638(mm)) authorizes agencies to use up to three percent of their SBIR set-aside budgets to assist with the substantial expansion in commercialization activities, in enhanced outreach strategies, in prevention of fraud/waste/abuse, and in providing support needed for expanded reporting requirements. NIH has utilized these administrative funds to increase participation in the SBIR and STTR programs by women-owned small businesses (WOSBs), socially and economically disadvantaged small businesses (SDB), and small businesses from states under-represented in biomedical research (Institutional Development Award (IDeA) states). Small businesses require specialized assistance to navigate the FDA regulatory requirements and insurance payment issues that are unique to life science innovations. SBIR administrative funding has allowed NIH to develop innovative strategies to improve the commercialization potential of SBIR- and STTR-funded projects by directly addressing these needs. Over the last four years, Entrepreneurs-in-Residence supported by administrative funds have developed on-demand entrepreneurship and business development webinars and provided hands-on technical and business assistance to over 144 companies located in 35 states across the country. Administrative funds have supported NIH-wide access to commercial business intelligence databases and systematic collection of commercialization outcomes to enable continuous monitoring and improvement of program performance. Administrative funds have also supported the execution of a contract with the National Academies of Sciences, Engineering, and Medicine to begin a congressionally-mandated evaluation of the NIH STTR and SBIR programs.

Phase 0 Proof of Concept Partnership Pilot Program
The path to commercialization for biomedical research innovations is long and often begins with basic knowledge gained in an academic research laboratory. The Phase 0 Proof of Concept Partnership Pilot Program authorized by section 9(jj) of the Small Business Act (15 U.S.C. 638(jj)) allows NIH to make awards to academic and non-profit research institutions to help them enhance the commercialization of academic research and accelerate the creation of small businesses. The NIH first implemented this authority by supporting the NIH Centers for Accelerated Innovations (NCAI) and then by establishing the Research Evaluation and Commercialization Hubs (REACH) to address barriers to the commercialization of biomedical basic science discoveries. Such barriers include a lack of knowledge and understanding by academic innovators about how new technologies are brought to market, and a lack of access to adequate technology development and commercialization resources.

NIH's Phase 0 Proof of Concept consortium merges the strengths of high-impact research institutions with the expertise and resources of federal and private-sector product development experts. Each center or hub has local ecosystem partners (e.g., regional biotech and pharma organizations, incubators and accelerators, and state and local economic development agencies) that enhance the scope and impact of NIH's investment by providing guidance and expertise and by matching the NIH funding provided to every project. The consortium, which now includes 92 research institutions across 34 states and Puerto Rico, has supported 277 technology development projects with funding and product development expertise. The projects have led to the creation of 65 robust startup companies. After completion of Phase 0, companies are uniquely positioned to compete for SBIR/STTR awards as evidenced by their 3-fold higher success rate than the average NIH small business program application. The scientists and companies have leveraged the NIH investment to raise $590 million in non-federal follow-on commercialization investments – a striking 13:1 return on the federal investment. The consortium has also increased the profile of entrepreneurism and product development within the academic environment by providing training to over 2,250 innovators.

Commercialization Readiness Pilot Program for Civilian Agencies
The development of medical products is often impeded by barriers between the end of an SBIR or STTR Phase II award and later-stage commercialization activities (human safety and effectiveness testing, manufacturing scale-up, and regulatory approval). Following on a successful program at the Department of Defense, the Commercialization Readiness Pilot Program for Civilian Agencies, authorized by section 9(gg) of the Small Business Act (15 U.S.C. 638(gg)), allows NIH to allocate up to 10 percent of the SBIR and STTR set-asides to support technology development and commercialization assistance of Phase II technologies. So far, the new NIH Commercialization Readiness Pilot Program has supported 44 SBIR and STTR Phase II technologies since being implemented in 2016. These funds help companies cross the final hurdle toward commercialization by supporting replication of key studies, pre-clinical safety testing, clinical trials, and manufacturing and regulatory assistance. For example, Apex Biomedical LLC utilized this program to develop a robust U.S.-based manufacturing process for their WaveCel bicycle helmet technology, which generated $20 million in sales in their first year on the market. This pilot strengthens the pipeline between the end of the small business program and continued development through subsequent private investment, strategic partnerships, or acquisitions by larger life science companies.

Direct to Phase II Pilot Program

The path to commercialization in life sciences is lengthy. Section 9(cc) of the Small Business Act (15 U.S.C. 638(cc)) establishes a pilot program that allows NIH, the Department of Education, and the Department of Defense to make "Direct to Phase II" awards, skipping the Phase I process if feasibility has been proven. This phase flexibility pilot was enacted in response to feedback from many small businesses who had already completed Phase I-type research and wanted to utilize SBIR funding to proceed directly to Phase II scientific, technical, and commercial research and development. NIH has made 280 Direct to Phase II awards to 249 companies in 36 states over the last three fiscal years in which the pilot was available. The program is extremely popular with life science small businesses because it accelerates their time to market for promising technologies by eliminating the previously required cycle time for a Phase I award. For example, RaveraGen Biopharma recently published positive results from their Direct to Phase II funded clinical trial investigating vamorolone as a potential treatment for Duchenne muscular dystrophy, a neurological condition that leaves many patients unable to walk by age 12. The Direct to Phase II program allowed RaveraGen to begin their multi-center clinical trial more quickly, providing results within 3.5 years of receiving funding.

Conclusion

NIH's extramural programs support a robust innovation ecosystem that maximizes the public health and economic impacts of the taxpayers' investments in NIH-supported biomedical research. Because it can take a decade or longer to develop a life science discovery from bench to bedside, we appreciate the time that Congress has given us to implement and manage these pilot programs. Extending these pilots beyond 2022 would improve our ability to conduct outcomes-based evaluations of their ability to accelerate the development of preventions, therapies, and cures. We appreciate the decades of continued SBIR and STTR program support from Congress in this endeavor.