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FIELD HEARING IN LYNN, MA: COMMERCIALIZING ON INNOVATION: REAUTHORIZING THE SMALL BUSINESS INNOVATION RESEARCH AND SMALL BUSINESS TECHNOLOGY TRANSFER PROGRAMS PART II

HEARING

BEFORE THE

SUBCOMMITTEE ON CONTRACTING AND WORKFORCE

OF THE

COMMITTEE ON SMALL BUSINESS
UNITED STATES
HOUSE OF REPRESENTATIVES

ONE HUNDRED FOURTEENTH CONGRESS

SECOND SESSION

HEARING HELD
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None.	
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None.	

COMMERCIALIZING ON INNOVATION: REAUTHORIZING THE SMALL BUSINESS INNOVATION RESEARCH AND SMALL BUSINESS TECHNOLOGY TRANSFER PROGRAMS, PART II

TUESDAY, MARCH 8, 2016

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SMALL BUSINESS,
SUBCOMMITTEE ON CONTRACTING AND THE WORKFORCE,
Washington, DC.

The Subcommittee met, pursuant to call, at 1:00 p.m., at the Lynn Massachusetts City Council Chambers, 3 City Hall Square, Lynn, Massachusetts, Richard Hanna [chairman of the Subcommittee] presiding.

Present: Representative Hanna.

Also Present: Representative Moulton.

Ms. KENNEDY. Good afternoon, everybody. My name is Judy Kennedy. I am the mayor of the City of Lynn, Massachusetts, and we are so proud to be able to host this field meeting on behalf of Congressman Hanna and Congressman Moulton.

I would just like to tell you a little bit about the SBIR Program that will be discussed today. The Small Business Innovation Research Program, which is known as SBIR, is a highly competitive program that encourages domestic small businesses to engage in Federal research and research and development, that has the potential for commercialization. Through a competitive awards-based program, SBIR enables small businesses to explore their technological potential, and provides the incentive to profit from its commercialization. By including qualified small businesses in the Nation's R&D arena, high tech innovation is stimulated, and the United States gains entrepreneurial spirit as it meets its specific research and development needs.

I am so pleased that today's hearing is going to be chaired by Congressman Richard Hanna from New York, who is here visiting with us today, as well as our own congressman from the 6th District, Seth Moulton. It is very nice to see this bipartisan cooperation. With everything that goes on in Washington and the stories we hear, you would think that this would be a rare sight. And I am truly hoping that it is not, and I am hoping that more of our congressmen and women will follow the lead of these two fine gentlemen.

So, again, welcome to all of you, and I would like to turn this hearing over now to Chairman Richard Hanna. Chairman Hanna?

Chairman HANNA. Thank you, Mayor. Thank you, everyone. I call this hearing to order.

Again, I want to thank you all for being here. It is a pleasure to be here. I have never seen a city hall as nice as this in my life, and I have visited a lot of them. It really shows the foresight of the people who built it to be a wonderful auditorium, and it is just great.

Today we are holding the second of two hearings our Committee has conducted this month concerning the reauthorization of the Small Business Innovation Research and Small Business Technology Transfer Programs, also known as "SBIR" and "STTR."

Before I begin, though, I want to thank our ranking member, Mr. Moulton, for inviting us to be in his district today. In the short time we have served together in the House, I have found him to be a tenacious advocate for his constituents and for the causes he cares about. I would expect nothing less from a marine, especially one with his pedigree. Although we have only worked together for about a year on the Small Business Committee, he has shown a great willingness to work across the aisle, find solutions for the challenges facing America, and further improve small businesses climate. I am very happy to be here with him, and I can say that honestly. It is not just rhetoric. I have watched Seth work, and he is a very bright and dedicated individual.

Innovation is the engine that drives our economy. Technological breakthroughs in entrepreneurship build our economy by finding state-of-the-art solutions to difficult problems. In this era of globalization, making it easier for small businesses to develop and commercialize new innovative products is essential for America's competitiveness and national security.

This is why programs like SBIR and STTR are so very, very important. Their purpose is to increase government of small businesses that conduct R&D with a focus on technology and high commercial potential. By including small businesses in the Nation's R&D effort, SBIR and STTR awards stimulate innovative new technologies that help Federal agencies in a wide variety of areas. These programs are important because the awards go to small innovators who have always been at the cutting edge of science and technology, like the folks here on our panel today.

You are the ones that have the ideas and the willingness to take big risk and search for big rewards. Maybe you quit your job and started your business in your garage. Maybe you worked on the side with one of your colleagues to turn an idea into reality. Whatever your individual story is, the entrepreneurial spirit is what drove you to create this new technology that your country benefits from.

The next big thing does not just materialize. It happens with a lot of late nights and even more sweat. Ideas matter, but it is executing those ideas is what is most important. Obviously not every idea is a good one. I work in Congress. I've seen this firsthand. But the long odds rarely discourage entrepreneurs. The successful ones keep driving forward, thinking, inventing, and renewing our economy in the process.

That is why these programs are so vital, whether it is a new software system, or tracking contract payments, a new medical device

to help with cancer treatment, or a new piece of technology that saves lives on the battlefield, the SBIR and the STTR programs have consistently delivered results across many, many agencies.

These programs were last authorized in 2011. In order to give entrepreneurs stable predictability, we are getting a jump start on reauthorizing them before next year's deadline, which is part of why we are having this hearing and had the last one a couple of weeks ago.

Today we have a very distinguished panel of private sector witnesses who have participated in the programs or worked with small firms that have participated in the programs. We look forward to hear from your experiences and listening to your suggestions on how we can make these good programs even better.

Again, I want to thank you for allowing me the privilege of being in your community. I would like to yield now to my good friend, Ranking Member Mr. Moulton, for his opening remarks.

Mr. MOULTON. Thank you, Mr. Chairman. Let me first thank you for driving all the way out here from New York to be with us here in the 6th District in Lynn, and to tangibly thank you for your trip. I have a small gift for you.

Chairman HANNA. Oh.

Mr. MOULTON. It is not a product of the SBIR program, but it is a proud product of Lynn that makes your trip entirely worthwhile. It is, of course, a big tub of marshmallow fluff.

[Laughter.]

[Applause.]

Chairman HANNA. I always thought this stuff came from space.

[Laughter.]

Well, thank you. Thank you very much.

Mr. MOULTON. Mr. Chairman, your leadership on this Subcommittee and your leadership on the Committee at large means a lot to me as a freshman, and as a freshman who is in the minority and was elected on a platform of bipartisanship, but has had to go to Washington to figure out how to actually make that happen. And I will tell you, I found a welcome home on the Small Business Committee.

I passed my first bill in the House of Representatives out of the Small Business Committee, which is because of the bipartisan working spirit that we have on that Committee. And it is thanks to people like you who are willing to across the aisle, even when it may, you know, create trouble in primaries back home or whatnot, that I am able to do that. So thank you very much for your leadership in this difficult Congress.

We are very glad to be here with you today to discuss the SBIR and STTR programs. Since their establishment, these programs have helped launch tens of thousands of successful research projects, many of them right here in Massachusetts. In the past 30 years, the SBIR and STTR programs have become major sources of funding for small businesses, and on average, more than $2 billion each year is awarded through these programs.

With these awards, companies in Massachusetts are working on a wide array of research, from a business in Wilmington working with the Navy to develop a smaller lightweight laser module for NAVSEA, to a Cambridge firm designing a system for modeling

cyber behaviors to assess risk. Firms are researching and developing products that have helped increase military efficiency and minimize adversarial threats, and these are just some examples coming out of the Department of Defense.

At HHS, another Massachusetts firm is developing a device that provides compression to amputees with poor blood flow in their limbs. And at the EPA, an awardee in Marlborough is developing a nanofiltration system that targets emerging contaminants in the water supply like pharmaceuticals and pesticides. After today's hearings, a few SBIR participants showcase their research and technology around the room, further demonstrating the innovative solutions that businesses in the 6th District and beyond are coming up with to solve the problems that agencies are facing today.

Not only do these discoveries aid government agencies, they also help our communities by allowing small companies to be innovative and think big. SBIR and STTR funded firms generate economic growth and create job opportunities in local communities. I look forward hearing the personal stories of our witnesses as to how these programs have allowed them to contribute to our community.

These programs were last reauthorized in 2011, and are set to expire, as the chairman said, in 2017. It is the Small Business Committee's goal to pass a reauthorization during this Congress so as to provide both agencies and businesses the certainty that these programs will continue.

Yet before we do so, it is important to take stock of the most recent reforms and determine how we can improve these programs to better suit small businesses. Last week the chairman and I had the opportunity to hear from various agencies about the administration of these programs and ways by which they are making them more accessible to applicants. But equally, if not more important, is feedback from the actual small business owners who are participating in these programs.

The last reauthorization contained various provisions aimed at commercialization, and I am interested to hear how the SBIR and STTR communities have received these reforms. Additionally, there have been several efforts made to diversify the applicants to these programs. Unfortunately, there has not been as much success on this front, so I am especially looking forward to hearing from our panel to learn how we can get new companies interested in the programs.

I hope that today's hearing can shed light on some of the issues small businesses face in this program to help us identify ways to improve these programs during the upcoming reauthorization. As we have seen, Massachusetts SBIR and STTR participants are leading the way in research, and I am privileged to be here today to solicit their advice.

With that, I would like to thank the panel for their testimony, and, again, thank Chairman Hanna for joining us here in Lynn. Thank you, and I yield back.

Chairman HANNA. Maybe you would like to introduce your witnesses.

Mr. MOULTON. It would be my pleasure to introduce our witnesses. And I will start with Ann, Ann Eskesen, the president of Innovation Development Institute located in Swampscott. At the

institute, Ms. Eskesen helps SBIR and STTR participants bring their technology from the labs to the marketplace. She is a longtime advocate of these programs and we are happy to have her here today to share her expertise.

Next we have Dr. David Green, President and CEO of Physical Sciences, Incorporated, located in Andover, who will today testify on behalf of the New England Innovation Alliance. NEIA is an informal association of small high-technology companies in New England. It acts as forum for small businesses, allowing them to share their experiences and challenges as they have done business with the U.S. government. Dr. Green has a Ph.D. from MIT in physical chemistry and is active in the R&D operations of PSI, a company with approximately 200 active programs annually.

Next, we are also joined by Dr. Charles Kolb, President of Aerodyne Research, Incorporated. I am proud to say that Aeorodyne is located in Billerica, right here in the 6th District, and specializes in advanced sensor and software projects. Dr. Kolb first joined Aerodyne in 1971 after completing his Ph.D. in physical chemistry at Princeton.

He has authored or co-authored over 225 publications, and has actively participated on various National Academy of Sciences boards and committees related to atmospheric and environmental science. I had the opportunity to speak with Dr. Kolb in December at the SBIR/STTR Innovation Awareness Day, and I am grateful that he is here today to share more about his company. Thank you.

Lastly, we have Mr. Jerry Bird. Mr. Bird is the President of MassVentures, located in Boston. Mr. Bird has over 25 years of experience advising and financing companies, including 19 years working in venture capital. He has operated both as an investor and an active partner in helping entrepreneurs build their firms. We have heard from many small businesses that they have difficulty accessing additional capital for their research, so I look forward to hearing from Mr. Bird about what businesses can do to attract investors.

Thank you all for being here today.

[Applause.]

If Committee members have an opening statement prepared, I ask that it be submitted for the record.

We do not have lights for the 5 minutes. We do, okay. Got it, right there in front. Okay.

So let me just explain the timing lights here in front of us, familiar to those of us who spend time in Washington, but certainly new to me this year. So basically you all have 5 minutes. The light will start out as green. When you have 1 minute remaining, the light will turn yellow, and then finally at the end of your 5 minutes, it will turn to red. And try as best you can, please, to adhere to the time limit.

Okay. Mr. Bird, why do we not start with you?

STATEMENTS OF WALTER M. (JERRY) BIRD, PRESIDENT, MASSVENTURES, BOSTON, MASSACHUSETTS; CHARLES E. KOLB, PH.D., PRESIDENT, AERODYNE RESEARCH, INC., BILLERICA, MASSACHUSETTS; B. DAVID GREEN, PH.D., PRESIDENT AND CEO, PHYSICAL SCIENCES INC., ANDOVER, MASSACHUSETTS; AND ANN ESKESEN, PRESIDENT, INNOVATION DEVELOPMENT INSTITUTE LLC, SWAMPSCOTT, MASSACHUSETTS

STATEMENT OF WALTER M. (JERRY) BIRD

Mr. BIRD. Thank you. I want to thank Chairman Hanna and Congressman Moulton for inviting me to testify today on the critical need to reauthorize the SBIR/STTR program. My name is Jerry Bird and I'm the president of MassVentures.

MassVentures is a quasi-public venture capital firm based in Boston and focused on fueling the Commonwealth's innovation economy by funding early-stage, high-risk, high-growth potential Massachusetts startups as they move from concept to commercialization. We were honored last year to receive the prestigious Tibbetts Award from the SBA, recognizing our significant role in driving innovation and creating new jobs through the SBIR and STTR programs.

When MassVentures was formed 38 years ago, it was the first program of its kind in the country. As if often the case here in Massachusetts, our model and our mission, which is to provide startups with early funding, guidance in operations, finance, and sales, and position them for additional rounds of funding from the traditional VC sources, has now been replicated across the country and across the world.

In our 38 years, MassVentures' portfolio companies have raised an additional $1.1 billion in other investors' capital. They've directly created 7,500 jobs in Massachusetts, and 16 have gone public. In many cases, these companies got going based on SBIR/STTR funding.

The SBIR/STTR programs have played a vital role in harnessing the immense human capital of Massachusetts' higher education, medical and research institutions. The programs provide opportunities to small firms which create great ideas, but are unable to attract traditional venture capital funding, or need seed funding to pursue those projects because the private sector has decided they are too high-risk, too early, or not lucrative enough. However, it's exactly these high-risk, high-reward projects that truly drive innovation in Massachusetts.

There is no question SBIR/STTR was been effective in allowing concepts to begin the road to commercialization, but even after 2 years of funding, many companies weren't ready. Research was still ongoing, prototypes needed testing, or often the company's founders weren't ready to juggle innovation with the everyday demands of operations, finance and sales. It's hard to master your elevator pitch when you're spending all your time in a lab trying to create something that's never been created before.

The Federal government has played its role. SBIR/STTR has brought many companies to the verge of commercialization, but

there were still too many instances where we were left asking what could've been. A gap remained.

In 2012, we created the SBIR Targeted Technologies program—START—to bridge that gap and ensure growing Massachusetts companies would be able to commercialize technologies that had been developed under SBIR/STTR contracts. Recognizing that innovation, invention, and disruption take time, the START program provides up to 3 additional years of funding for these SBIR projects.

Stage 1 companies get $100,000 grants. A year later, stage 2 companies receive $200,000 grants, and the third year, two companies are eligible for $500,000 grants. So the most successful ones received $800,000 strictly to commercialize. In just 4 years, START has provided $9 million in grant funding to 40 deserving companies. These companies have already gone on to raise an additional $138 million of capital, and seen at least a 30 percent employee growth in Massachusetts.

We've created an ecosystem of more than 200 companies, reviewers, service providers, and advisors. For example, Energid of Burlington and Cambridge started as a robotic software company serving that created software to control the robotic arm on the space shuttle. It was clear that there was a broader application for their software and expertise, so it took the risk of creating a small arm-sized robot to demonstrate the power and potential of its software. In 2013, we awarded it a stage 1 grant.

The company has gone on to sell its robots to early adopters, and is now in discussions with major global corporations and poised to sell thousands of units. Again, technology developed to control the robotic arm of the space shuttle is now to assemble components and even pick oranges. A Massachusetts-based software company, supported through MassVentures, the SBIR program, and START, Energid has emerged as a leading robotic technology company.

START has proven innovation can happen anywhere. While we evaluate them as investment professionals, there is nonetheless a remarkable geographic diversity among START winners. Companies outside of Boston and Cambridge that might have otherwise lacked the time, resources, support, or network necessary for success now have it. There are START companies in Barnstable, Canton, Charlton, Georgetown, Newburyport, and Wilbraham, and they all have the potential to be economic anchors in their community.

Just as MassVentures was, we believe the START program should serve as a national model for how States can best leverage the Federal government's investment through the $2 billion a year coming out of the program. These programs are essential in order to allow American scientists and researchers to innovate, invent, and discover the technologies of tomorrow. But States must also do their part to build on the progress made through the SBIR/STTR funding, and ensure those technologies of tomorrow are not always a day away.

We encourage you to reauthorize the SBIR/STTR program so Massachusetts can continue to work with the Federal government to grow and commercialize world-changing companies. Thank you.

[Applause.]

Mr. MOULTON. Thank you very much, Mr. Bird.

Dr. Kolb?

STATEMENT OF CHARLES B. KOLB, PH.D.

Mr. KOLB. Mr. Chairman and distinguished Ranking Member, thank you for inviting me to testify today about the effectiveness of the Small Business Innovation Research and the Small Business Technology Transfer programs.

My company, Aerodyne Research, Incorporated, was founded in late 1970 as a contract research organization focused on improving the Nation's strategic defense systems. We have subsequently broadened our range of expertise to include energy technology and major environmental issues such as stratospheric ozone depletion, ambient air quality, acid deposition and climate change.

The SBIR program, started in 1982, and the STTR program, started in 1992, have become major sources of federal R&D funding for many scientists and engineers employed by small businesses. However, the Federal agencies' expectations for successful SBIR and STTR grants or contracts are significantly higher than expectations for normal research funding.

SBIR and STTR funding is expected to produce the same level of new scientific understanding and technological advances as normal R&D funding, all properly documented in scholarly articles and patents in most cases. However, SBIR and STTR is also expected to produce an innovative product that either solves a mission agency's designated need or can be easily engineered to compete successfully in commercial markets. Ideally both mission agency adoption and commercial sales success are achieved.

At ARI we have adopted a strategy of using SBIR and STTR funds to develop proprietary technology that we can use to expand our own staff's research capabilities, then we sell to our R&D peers worldwide. Our most successful tactic is to develop new and better ways to measure both gas phase and small aerosol particle pollutants in real time and with very high sensitivity and specificity.

Starting in the mid-1990s we have used SBIR and STTR funds to develop three lines of mobile, robust instruments that can be used both in the laboratory and in field measurements to measure the properties and concentrations of air pollutants.

Since 2000, the increases in the capabilities and sales of these three instrument lines have evolved dramatically. From 2000 to 2015, our instrument sales have grown from less than a million to over $14 million per year. In Fiscal Year 2015, instrument sales provided 60 percent of our corporate revenue with R&D projects supplying 35 percent.

Over the past 15 years, we have earned $80 million from instrument sales to customers on six continents, with approximately 80 percent of the sales outside the U.S., helping our Nation's balance of payments. We have also hired a significant number of instrument engineers and assembly technicians to help develop, assemble, test and service our instrument product lines.

We are proud of our scientific accomplishments as well. During the Fiscal Year 2000 to 2015 period, we were supported by other funding sources to perform over $18 million worth of laboratory and field measurements using our instrument products. Recent sponsored research projects have measured methane and other pol-

lutant emissions from oil and gas operations, including fracking well pads, gas plants, transmission pipeline compressors, and gas storage facilities all over North America, including the recent Aliso Canyon gas storage facility mega leak near Los Angeles. We have also recently mapped air toxic pollution levels in poor neighborhoods near the Houston Ship Channel, and measured trace gas and fine particle air pollution levels in Beijing.

Our research staff contributes to our Nation's reservoir of scientific knowledge. In 2015, ARI scientists published 75 peer-reviewed archival papers, most based on measurements using our instrument products. We also received three U.S. patents for innovations to improve instrument performance.

ARI has twice been named the Department of Energy's SBIR/STTR Company of the year in 2006 and 2013. These awards recognize our staff's contributions to DOE's environmental research programs as well as our supplying national laboratory scientists with important new research tools.

At our company and many hundreds of others, support from SBIR and STTR programs has successfully stimulated the production of the full range of scientific, technological, and economic benefits envisioned when Congress creates these programs. Reauthorizing them will serve our Nation well.

Mr. MOULTON. Mr. Kolb, thank you very much.

Dr. Green?

STATEMENT OF B. DAVID GREEN, PH.D.

Mr. GREEN. Yes, good afternoon, Chairman Hanna and Ranking Member Moulton. Thank you for your interest in the SBIR program and allowing our innovative companies to participate and share their stories with you today.

SBIR represents America's seed capital and has created many new companies, excellent high technology jobs, and many publications and patents. Its success has not been duplicated anywhere in the world.

The SBIR program funds concepts at a very early stage where no other similar funding source exists. It allows the risk takers to retain and reap the rewards of their dedicated efforts. The government and the agencies are patient investors; however, ultimately the investment is returned through taxes. Recent studies by the National Academies and by the mission agencies report its great success. Every government dollar results in over $3 of revenue after the phase 2 program.

SBIR is a great program, but I wish today to make three suggestions for your consideration to make it even better.

The SBIR program has demonstrated its value over the past 33 years. Please make it permanent. A long-term charter for the program allows for better agency planning and staffing. The 14 short-term continuations before the last reauthorization made it difficult for the agencies to execute the program, and made it impossible for the small businesses to maintain staff and to advance their technologies.

Since reauthorization, the SBIR program managers and staff at SBA and at all the agencies have shown great dedication and com-

mitment to making this good program even better, and to make ever more companies aware of it existence, and we thank you.

My second suggestion is to increase the allocation to the SBIR program. This program is budget neutral. Our request is to shift more resources to the program that has proven its effectiveness. Currently only 3 percent of the R&D funding in Federal agencies is allocated to SBIR. I ask that you increase that allocation gradually to 5 percent over the next decade, and to focus the funds from that increase to maturing technologies after the initial phase 2 program.

For years, many worthy technologies have died at the conclusion of phase 2 programs because the technology, although demonstrated, is not in a form recognized as viable by a commercial company or by a mission agency. The gap has become known as the Valley of Death for SBIR technologies. Too many of them do not make it through to become viable commercial products. Many receive some post-phase 2 funding, but it is too little, too fragmented, and too restrictive.

The Commercialization Readiness Program created in the 2011 Reauthorization has begun to address this need. I urge you to consider increasing the SBIR allocation and focusing it on further maturation of promising technologies after phase 2.

My last suggestion is to make access to the SBIR program easier so that a wider diversity of companies compete and win programs. We all understand that it is not easy doing business with the Federal government. Instructions are complex. Submission is complex. Regulations are complex. The requirement for a government-approved accounting system is a very large barrier to new participants. We ask you to consider strongly encouraging the agencies to use fixed price best efforts contracts for phase 2 programs, with the prototype remaining at the small business to enable its transition to a commercial product. This will reduce the burden on both the companies and the government contracting officers to a fraction of the level that is needed in cost plus type contracts.

Fixed price will enable speedier contract awards and more rapid advances in technology. The innovators will spend more time on their technology rather than complying with the FAR. Most importantly, this will encourage many new entities to participate in the SBIR program.

Our employee-owned company, PSI, has successfully transitioned many SBIR technologies. We find the fastest way to move the technology to market. Just one example. Under NIH-NEI sponsorship, PSI, working with clinical researchers, developed a retinal tracking method permitting greatly improved eye examinations. We partnered with a leading eye equipment manufacturer, and they have sold 16,000 systems containing our technology over the last 8 years, producing $1 billion in revenues for that company, and also, more importantly, providing better eye care for tens of million Americans.

We've also developed a variety of other technologies and environmental monitoring. Through DNDO sponsorship, PSI has implemented novel algorithms that vastly improve radiation sensor performance at screening portals. And under Army sponsorship, we have developed a small UAV to provide our warfighters, law en-

forcement, firefighters with situational awareness. This capability increasing national security and already being used outside of this country, saving lives of our military.

The SBIR program is one of the most successful in the government. Today I have offered three suggestions to improve this wonderful program. I ask you to please move to reauthorize this program now, to increase its allocation, and to use contracting methods that encourage new companies to participate. SBIR's success is documented in the National Academy studies. I ask you to reauthorize it to keep technology innovation strong in America.

Mr. MOULTON. Thank you, Dr. Green.

Ms. Eskesen?

STATEMENT OF ANN ESKESEN

Ms. ESKESEN. Thank you, sir. First of all, I appreciate your scheduling this hearing because it is a different type of hearing, I think, than those that we've had previously, and for giving me opportunity to be one those involved.

As you mentioned, I was part of the small group that was involved in the development, and the passage, and the implementation of the original enabling legislation. And that means that I bring a very different perspective to this hearing than some of those we've heard from individual awardees.

Clearly, as a long-time SBIR advocate, I strongly support reauthorization, and I think the ideas you've heard mentioned are ones very well worth consideration. But I'd also argue that if we're truly to draw down the full value of what SBIR has created, we must understand what that full value is and factor it into our discussions. In my judgment from over 35 years of SBIR involvement, SBIR is better understood not simply as a small business program, but one with enormous, powerful, and considerable impact in the debt of new technologies, new businesses, and an economic development resource that should be managed as such.

I might even argue, just as Roland Tibbetts who recently died, the creator of much of SBIR's program structure, it is probably one of the most important pieces of legislation the Congress has ever passed. With hundreds of success stories and so many studies by the National Academy and the GAO, that if you stacked them up in front of me, you wouldn't be able to see me.

It seems like the 23,000 companies that have been involved in the SBIR have stories to tell that are enormously important in their extent and in their diversity. But even after all this debate and discussion, truly unique, what is important to recognize is that what SBIR has created is half a million graduate-level engineers and scientists making that population probably the largest single concentration of technical talent that exists anywhere.

When I was asked to testify, I was asked to include in my testimony some mechanisms to educate you on some of those program impacts, and I did that in a fair amount of detail, and I will quickly go over some of it here. But what it comes down to is that perhaps reauthorization is to argue that we live in radically changed and changing times. And in a very real sense, we're still managing SBIR as we did when we created it 35 years ago. And it is important that in order to make decisions about how we're going to

change the program, we need to be basing those decisions on actual. There's a novelty, making policy decisions based on factual information.

A caveat: I am not suggesting in some of my recommendations that SBIR is a causative agent. It isn't. SBIR funding has made it possible for a whole lot of people, some here at this table and others in the room, to do things that are quite extraordinary. They got the tools that they needed to do the job.

What I'm trying to argue is that the $43 billion you have so far invested, and that's a term very carefully chosen, has created an identifiable, verifiable pool of technical talent and capacity that the VC community, evidence is clear, and the major corporate community are already tapping into. We should as a country be systematically mining and engaging this talent to include moving away from the stovepipe type approach to project management, which defines SBIR, to doing something about the balkanization of the program that is now clearly occurring where companies in one agency are not known in any sense by any other agency, and all the agencies are now very different in the way they operate.

When I organized the thoughts I put together for this presentation, I looked up the term "realize." I want you to realize the value of what SBIR has created. The easy part is you understand that there has been this enormous impact. The second part, which is a new thought for many, is that "realizing" as a verb means drawing down and making a profit from what it is you have created.

So what I've tried to do in the testimony I provide you is give you an overview of the extent of venture capital involvement in the SBIR program. We track every venture capital transaction, and we now have solid data that $90 billion worth of venture capital has already followed the $43 billion, but has gone to a very small subset of the SBIR program.

We're the largest single creators of intellectual property—on a daily basis, between 10 and 14 patents issued to SBIR companies in the United States. That's 365 days a year, 7 days a week. We have an incredibly high, extensive activity of M&A transactions. Nearly 9 percent of SBIR companies are being acquired. They're being acquired by major and mid-source corporations, who, for reasons I probably don't have time to discuss in my 5 minutes, have enormously reduced their own internal R&D capability, and are compensating for that lack of capability by bringing in and engaging the small business community.

We also provided you data to give you indication of the employment impact that the SBIR community has had. We collectively as a group, and the data is very solid, have created, are responsible for almost 7 percent of all STEM jobs in the United States economy, 20 percent here in Massachusetts. Unfortunately, sir, less than 60 percent in the State of New York.

What I'm trying to suggest is that we continuously track the SBIR program, and in my testimony I gave you a list of some of the things that we track. And what we're seeing is that SBIR is a mirror. It's almost like a mirror for what's going on in the economy overall, but it is also, when you break it out in detail, gives you a clear indication of how the economy is functioning. And our

job becomes not simply to modify now the program runs for those who are in it, but how it can be effectively drawn down as the economic asset that it truly is.

Forward thinking of members of the Senate allowed us to get the legislation passed for SBIR originally almost unanimously. We hit the skids in the House. But the upshot was despite that, we finished up getting the legislation passed. We were subjected to the ultimate of torture, which was a 7-committee sequential referral.

But after the legislation was passed, I was recruited by the SBA to get out the word to the SBIR community potential of the availability of this resource. And the second was to make sure that the agencies who had been a primary source of the opposition to the creation of the program were, in fact, in compliance with the law.

That two-pronged requirement resulted in my doing what I needed to do, which was simply to follow the money, and to keep the SBIR record. And I have no intentions of that becoming my life's work, but eventually that is what it's actually become.

So what I've given you in the full testimony is a clear indication of how the money has flowed. One of the things that we did do is we looked at things like understanding who's new to the program and who isn't. And one of the charts, which I hope you pick up on, if to give you clear indication that despite, since the last reauthorization, an increase in the availability of funding, the number of awards, the number of companies that are involved in the program has dropped precipitously.

And that precipitation, I'm suggesting, is partly to do with the change in the rules when it came to who's eligible for venture capital in the SBIR program. Venture capital has always been a factor in the SBIR program, and I have a table in my testimony that plots that by every single agency. But it's startling when you realize that a full 61 percent of all of the venture capital funded firms in the SBIR program have an NIH connection.

What's interesting and not nearly so obvious is that there is also a similar connection of something like 32 percent of all those who are VC funded are in DOD. Those are very exciting numbers, but as a practical matter, it also means that there are huge percentages of companies that are not getting venture capital, and whose access to the additional resources they need are seriously curtailed.

One thing I will finish up on the VC component is that it is important to recognize that, and we document this very carefully, $1 in $6 invested by the venture capital community in the United States is going to an SBIR company. Those guys are not fools. They are going to where the quality is, where the value is, and where the potential is. And we should very proud of the fact that they're coming, but also very scared of the fact that they're coming in such very large numbers.

I find myself asking the question, when we are funding companies that are in receipt of major amounts of venture capital, whom are we not funding where that company's access is not into the venture capital funding which is available to so many others. I mentioned that we have been very active in the patent area and in the VC area, but one of the things I want to move on to is the fact that the large corporations are increasingly, for a whole lot of reasons I can explain, downsizing their internal R&D operation,

and coming in major numbers to the SBIR program. The data I gave you on M&A shows clearly who's buying SBIR companies, and it's predominantly the major corporations.

There is a steady stream of people who are from major and mid-sized corporations who are coming to SBIR because it is the largest single concentration of technical talent. When we were passing SBIR originally, 15 percent of engineers and scientists with graduate-level degrees were employed in small firms. That number is now 37 percent. 37 percent. And yet the amount of money that we're getting in the SBIR program has not substantially increased over that same time period.

What I also tried to do because you asked me to look for talking points, and obviously I've run out of time, and so I'm going to give these very quickly. We think there are lessons to be learned from how the venture capital community managed their portfolio that could be applied managing SBIR as a portfolio, not the whole program, but let's try it out as a pilot. The second is my judgment, based on what we're looking at right now, is that the agencies have become much more risk averse than they used to be. They are increasingly asking for projects that have a near-term application and requirement, and we are no longer doing the work, the call contact work, where Irving Jacobs told you in Congress that SBIR funded their work at a point in time when nobody else would give them the time of the day. We're doing far less of that than we used to be doing.

We need to be looking at ways in which the SBIR community has access to demonstration funding. There is in every agency a pool of money that is designated for those regularly in receipt of R&D funding to go on to the prototype development activity. We don't have any sort of access, and a second phase to is, frankly, not the answer which is what the last legislation did, because that simply reduces the pool that's available for other companies.

We need to empower the program managers to allow them to do things that are different from the way that they have previously been doing. Navy years ago, for example, deconstructed a project for containership and security, divided it into nine component pieces, recruited nine SBIR companies, put them together as a team. And that technology is now the way that the system for containership and security in the United States is completely handled.

We should be doing more of these types of things, not expecting the small firm to put the whole pathway to commercialization, but to bring their talents to bear in team type projects that are far more valuable. We need to empower the SBIR program managers, probably the most dedicated group of Federal employees you're ever going to find. Give them an opportunity to try out ideas and not be looking over their shoulders to see whether or not that will draw them trouble.

We need to encourage SBIR companies to look at other ways of generating revenue. In the VC community, it is a commonplace condition that the technology that you own has a broader set of applications than you can apply, and so you license that technology out and generate a revenue stream. We don't do that in the SBIR program, and we should be doing that.

And here ends the lesson. Thank you.

[Applause.]

Chairman HANNA. Thank you very much. I will yield to Congressman for the first question.

Mr. MOULTON. Thank you, Mr. Chairman. Ann, in our compelling and lengthy testimony, you mentioned that there are different agencies that oversee programs, and this is something that we heard during our recent hearing in Washington, that not all the agencies handle things the same, and the results differ as well.

And so, I would like to ask the rest of the panel to comment on any differences that you have seen among the agencies' administration of this program. And where are there lessons to be learned? Charles?

Mr. KOLB. I think as you know, Representative Moulton, in addition to running Aerodyne, I have served since 2002 on the National Research Committee that at Congress' request compares the program's 5 largest agencies, and tries to identify best practices and identify core practices, and encourage them to learn from one another.

We find that, for instance, in some agencies, SBIR and STTR programs are run really as a single entity. There is very little distinguishing the two except for some rules about how much money might go out to a non——

Mr. MOULTON. And is that a positive thing or negative thing when they are run as——

Mr. KOLB. Well, our interpretation, and this is brought out clearly in the STTR report for the five agencies that was just published by the National Academy, is that in the various agencies, some agencies have a desire to promote more basic research as we heard, and others do not. And the areas where more basic research is not as highly valued as some of us thing it should be, this special access to universities and other non-corporate nonprofit research agencies, research institutes that STTR promotes directly particularly is not an added attraction for some of the agencies.

Mr. MOULTON. Well, let me just get to the heart of it. I mean, do you think it is a good thing or a bad thing when these programs are managed together?

Mr. KOLB. Well, our conclusion is that the program managers are using the STTR in the way that works best for their agency, and it is just a fact that some agencies are moving away from sponsoring as much fundamental research as the program used to have. And I think there is a wide feeling among the SBIR companies that maintaining some very fundamental research topics in the solicitations actually would be very good for the program going forward.

Mr. MOULTON. Thank you. David?

Mr. GREEN. I agree that there should be a different approach. There are certain agencies that, let me us the expression, mission agencies such as the Department of Defense, in which they would be a potential customer, not the exclusive, but a customer for the technology. And I think that over the last decade the Department of Defense has become aware of how valuable this new technology development program can be to provide technology spiral upgrades toward the national mission.

And so, clearly their emphasis should be, would be, of necessity different than perhaps the National Science Foundation. But I

think there needs to be a room for both of those opinions and those emphases. Even within DOD, there should not be an emphasis only on the highest technology readiness level, TRL, that there needs to be some in this valley of death.

This technology has reached a certain maturity, but it is a long way away from the TRL-9, if you will let me use jargon, the highest technology readiness level where you can hand it to a warfighter or put it on the fleet. And so, the SBIR takes it so far. One of the suggestions I was making was to let the program take it a touch further to where in DOD the mission agency would then begin to put core funds against it.

For the non-mission agencies, they should reach out toward the commercial world, but once again I am advocating that perhaps more funds be placed in after the phase 2 to move it closer to a commercial product. We have transitioned things to commercial products, and the result of a phase 2, which worked in the laboratory, is not a compelling story to the pharmaceutical company who wants to buy a sensor to put on its analytical line. And so, there still is a gap.

Mr. MOULTON. Thank you. Thank you very much, Mr. Chairman.

Chairman HANNA. Thank you. You have the Massachusetts and Connecticut SBA person here in the regional director. I want to ask you about risk because a lot of what we are doing here today is talking about risk, engaging in risk, how do we measure risk, and what are the benefits of risk. Therefore, on that continuum, and you talked about continuing that risk through phase 2 with presumably marginal things at the moment, but with great potential.

I want to ask you if you think that in general we measure risk appropriately, if that is a fair question.

Mr. BIRD. Is that for me or the——

Chairman HANNA. Anybody. No, I mean, you have a chance to talk to the couple of big shots here. You might as well take advantage.

Mr. BIRD. I think it is a $2 billion a year program. It should be managed like a portfolio.

Chairman HANNA. Maybe move your microphone a little closer.

Mr. BIRD. It should be managed like a portfolio, and there should be higher risk components of the portfolio and lower risks. And how to measure it is a very inexact art, but I think technology readiness levels are a proxy for risk that we are taking. And so, I like the idea of experimentation, that some agencies might be focused more on pure research and others on product development. NSF certainly is strong on commercialization, but I think it needs to be managed as a portfolio.

Chairman HANNA. Mr. Kolb?

Mr. KOLB. My personal opinion is that not only in the SBIR and STTR program, but in fairly funded research in general, there is too little high-risk, high potential reward work going on, things that can really change the game. And given the fact that budgets and money agencies, DOD in particular, in terms of their normal 6-1 to 6-3 research and development funding, those dollars are not nearly as plentiful as they were during the Cold War and so on

when there was a lot of opportunity to do research to help with our Nation's military.

So now, many of the DOD sub-agencies use the SBIR/STTR program to solve current and relatively narrow problems, and I do not fault them for that. They have these problems. They do not have options to get money to solve them any other way than to——

Chairman HANNA. You know, about 15 percent of the applications are actually accepted.

Mr. KOLB. Yeah, that is correct as well. But I think all the agencies would benefit from having some funds identified to put on what would look very high-risk proposals, but if they prove to be true could really change how the agencies run their businesses.

Chairman HANNA. Mr. Green?

Ms. ESKESEN. If I could bring a different perspective than the ones we are hearing, we are tracking newcomer, old comers into various agencies, and we were asked to do that by the SBA. And one of the things left out is that there is a significant percentage of the agencies are going with the guys they already know. And the ability of newcomers to get into the program is dropping quite precipitously.

And if you are talking about, for example, any one of the Air Force, Navy, Army, and the like, their percentage of newcomers in any one year is incredibly small. Interestingly, in NIH, it is quite high. It is almost 40 percent. The conversion rate to phase 2 and the ability of that company to go on is an issue to be discussed.

But I think there are ways that the agencies are mitigating their own risk by who they are choosing to fund. One of the things I did not get a chance to mention is that when you look at venture capital in the SBIR space, there used to be a clear patent. A company would be formed or get his SBIR award or vice versa, but it was happening in the same sort of time horizon, and sometime later, venture capital would come onto the scene.

There is virtually no venture capital being awarded anymore to a company that started with SBIR and no venture capital. All the venture capital is going to companies that already have venture capital, that all the companies——

Chairman HANNA. So what you are saying, the whole process has become risk averse.

Ms. ESKESEN. That is right. I am.

Chairman HANNA. Mr. Green?

Mr. GREEN. I guess, remember the SBIR program is 3 percent of the R&D and T&E budget. And so, your statement really needs to be reflected more broadly across the whole research structure of the United States. I mean, I think this SBIR when it was created to address America's, at that time, inadequacy to transition great ideas to products. That was the concept the Japanese were doing far better a job at it than we were at that time.

So I think it began with a bent toward the practical. However, your question is a very good one. Fundamentally, America has become, I believe, focused too much on the immediate payoff.

Chairman HANNA. Well, what I am suggesting is that, and this is going to sound strange coming from my side of the aisle maybe, but that the fact that this program is so successful is actually in a strange way a counter indicator. Thank you for nodding your

head. I appreciate it. That if you were doing things correctly, you would push that environment until you reached a point where you actually started to lose.

That would be that inflection, that X-Y axis that suggests to you that you are taking the maximum amount of risk with the minimum amount of lost opportunity. And it is hard right now to get anything authorized. You know, I am fairly confident this will be reauthorized.

So I wanted to ask you, Mr. Green—with your indulgence.

Mr. MOULTON. Of course.

Chairman HANNA. You mentioned phase 2, and you are disappointed that you see these wonderful things at phase 2 that are not carried on because at some point somebody says this is too risky. It is not going far enough fast enough. How do you change that dynamic? Who is the guy who makes that decision? And why should not he make, or she, make that decision since it is public money?

Mr. GREEN. The SBIR programs have a legislated amount of money, and, yes, different companies have demonstrated different efficiencies. And I am sure there are cases where the phase 2 program is adequate to create a commercial product, but most often it matures it to a certain level, and it is a competitive process. But when we take that experimental prototype and we go to a commercial company, they say that is fine, give me the part number, and I want to buy it.

The commercial entity does not want to fund any R&D. They want to have essentially a finished product. So that gap can either be filled with the company's retained earnings, external investment, and often even to go from that point of the prototype to the product takes a long time.

Chairman HANNA. Can you give me an example?

Mr. GREEN. We are building an instrument for the pharmaceutical industry, and it measures freeze drying efficiency. And the benefits are many-fold in that in that industry, a lot of the medicine could cost millions of dollars. But yet, they want to buy an instrument that is proven and will cost $100K.

The NIH/SBIR and NSF/SBIR that we had to mature it took it along a certain distance, but we still needed to invest significant money. Our company, we explore all the pathways. We invested our own money. We took money from another commercial company as essentially an advanced loan, if you will, an advanced payment. And we eventually matured that to a product, but it took many years. If the SBIR, as it has done in the 2011 reauthorization, permits there to be the next stage of investment of SBIR funds, then that would have moved much more quickly, and it would have probably produced a better product.

We have also tried to spin technologies out to a new company with venture-funded partners. And in that case, the SBIR technology was a certain maturity, but it was still a very long road to a product. And so, as a result, the venture funding needed sequential rounds of funding to have that technology reach product and reach the market. And oftentimes those companies fail just because the technology takes a certain amount of time, and it takes a certain amount of money.

And in that process, often the founders are diluted out of the process, and the venture entity itself faces, as we know these statistics, that only a small fraction actually become homeruns, and many fail. And I would argue yet a little more development funding on the government's part would increase the yield out the other end.

Ms. ESKESEN. And I would concur, and I think a related issue to that is that small firms almost by definition are component, not full systems builders. And no matter the fact that I think SBIR is amazing, we shift the primary burden of risk resolution to the small firm. It becomes your job, their job to get together the other assets that are required to continue the process.

And I think there is an argument to be made by standing back, not the whole program, just parts of it, but standing back from some of these types of concerns and experimenting with different ways of mitigating the risk so that we are not putting the whole entire program at risk, but we are seeing whether or not trying certain things——

Chairman HANNA. But does it not at some point become almost, I mean, it is scientific and it is practical, but at that level it becomes very subjective. Do you not think, Mr. Green? So how do you do that?

Mr. GREEN. How do you do that? Well, it does require the engagement and involvement of the government program managers in that evaluation, not necessarily so much the commercial, as the commercial and the technical together. I will simply state that we did have, we had two SBIRs on this technology from different agencies for different missions. But we have had to seek many, many times that amount of money afterwards to see through to a product, and it has also taken many years because it was moving to get accepted in by the government. It took many years for the government to recognize, test, evaluate, and then put it into their planning documents.

Chairman HANNA. Well, thank you. Thank you all. It has been wonderful testimony, especially from people who have had experience with the programs. So I would imagine there is no one in the country that knows more than you do about this program. So we are grateful and grateful for your statements. I thank you all again.

Independent research conducted by the National Research Council, at the National Academies of Science, and the Government Accountability Office have shown that the SBIR and STTR programs are meeting or exceeding most of their statutory requirements. They are good programs that do what they were supposed to do, and that is very good for our country as you have heard today, but we can do better.

We will take the suggestions you have made and provided us with today, work to incorporate them. And I would urge you if you have an idea that we can put in the form of an amendment or a bill, that Congressman Moulton and I will certainly in our position are capable of carrying that forward and trying to sell your suggestions.

And I will turn to you for your closing statement if you have one.

Mr. MOULTON. Sure. Thank you, Mr. Chairman. I just want to thank all of you for coming here, not just those of you who came to testify, but all of you who came to participate and to listen to this hearing. It is difficult for us to do our job in Congress without truly acting as your representatives, and that means coming here and listening to you, and to understand at the ground level how these programs are working. We are looking forward to reauthorizing this program, but we hope to do with some necessary improvements, and some improvements that will help the program not only continue its amazing track record to date, but really expand on that success for the years to come.

As a member of not just the Small Business Committee, but the Armed Services Committee as well, I see every single day how important it is that we continue our technological development to compete with our adversaries across the world. So in that particular window for DOD, I understand how critical this program is. And we have a little bit of catching up to do, so it is time to make sure that we not only reauthorize this, but improve it for the future. And your testimony today has been immensely helpful for that, so thank you all very much for participating.

And, Mr. Chairman, I yield back.

Chairman HANNA. Thank you, and I think along with my ranking member here, we both go back with, I certainly, a more enthusiastic vision about this program. I am grateful for that. And there is a difference between expense and investment. These are clearly investments in our future. I have heard that from everyone here today.

I ask unanimous consent that members have 5 legislative days to submit their statements and supporting materials for the record.

Without objection, so ordered.

This hearing is now adjourned, and thank you very much.

[Applause.]

[Whereupon, at 2:11 p.m., the Subcommittee was adjourned.]

APPENDIX

MASSVENTURES

I want to thank Chairman Chabot, Ranking Member Velazquez and Congressman Moulton for inviting me to testify today on the critical need to reauthorize the SBIR/STTR program.

My name is Jerry Bird and I am the President of MassVentures. MassVentures is a quasi-public venture capital firm focused on fueling the Commonwealth's innovation economy by funding early-stage, high-growth, Massachusetts startups as they move from concept to commercialization. We were honored to receive the prestigious Tibbetts Award in 2015 from the U.S. Small Business Administration, recognizing our significant role in driving innovation and creating new jobs through the SBIR and STTR programs.

As is often the case here in Massachusetts, when MassVentures was formed 38 years ago, we were the first program of our kind in the country. Our model and our mission to provide start-ups with early funding; guidance in operational, finance and sales, and; position them for additional rounds of funding from the traditional venture capital community has now been replicated throughout the country and across the world.

In our 38 years, MassVentures' portfolio companies have raised $1.1 billion in additional funding; directly created 7500 jobs in Massachusetts, and; 16 MassVentures backed companies have gone public. In many cases, the companies we've been able to invest in and help grow got their start through SBIR/STTR funding.

The SBIR/STTR programs have played a vital role in harnessing the immense human capital of Massachusetts' higher education, medical and research institutions. The SBIR and STTR programs provide opportunities to small firms to create great ideas but are unable to attract traditional venture capital funding or need seed funding to pursue those projects that the private sector has decided are too high-risk or not lucrative enough. However, it's exactly these high-risk, high-reward projects that truly drive innovation in Massachusetts.

There is no question SBIR/STTR has been effective in allowing concepts to begin the road to commercialization. But even after two years of funding, many companies weren't ready.

Research was still ongoing. Prototypes needed testing. Or often the company's founders weren't ready to juggle innovation with the everyday demands of operations, finance and sales. It's hard to master your elevator pitch when you're spending all your time in a lab trying to create something that's never been created before, or attempting to solve a problem long thought unsolvable.

The federal government had played its role. SBIR/STTR had brought many companies to the verge of commercialization. But there were still too many instances where we were left asking "what could've been."

A gap remained.

In 2012, we created the SBIR Targeted Technologies program—START—to bridge that gap and ensure growing Massachusetts-based companies would be able to commercialize technologies developed under SBIR and STTR contracts. Recognizing that innovation, invention, disruption take time, the START program provides up to three additional years of funding for SBIR/STTR projects. Stage I companies are awarded $100,000 grants. Stage II companies receive $200,000 and Stage III companies receive up to an additional $500,000. The most successful START applicants can receive a total of up to $800,000.

In just four years, START has provided $9 million in grant funding to 40 deserving SBIR projects. START companies have raised additional capital of $138 million and seen a 30% employee growth. MassVentures has created an ecosystem of more than 200 companies, reviewers, service providers and advisors.

Energid started as a robotic software company serving almost exclusively NASA and the Department of Defense. However, it was clear there was a broader application for their software and expertise in robotics. The company took the risk of creating small arm-sized robots to demonstrate the power and potential of its software. In 2013, MassVentures awarded Energid a Phase I START grant.

Energid sold their robots to early adaptors and is now in discussion with major global corporations and poised to sell thousands of units. Technology which had been developed to control lunar excavation for NASA is now being used to drill for oil in the North Sea, conduct surgery and even pick oranges. A Massachusetts-based software company, supported through MassVentures and START, Energid has emerged as one of the world's leading robotic technology companies.

START has also proven that innovation can happen anywhere. While we evaluate START applicants through our prism as investment professionals, there is nonetheless a remarkable geographic diversity among START companies. Companies outside Boston and Cambridge that might have otherwise lacked the time, resources, support or network necessary for success now have it.

There are START companies in Barnstable, Canton, Charlton, Chelmsford, Georgetown, Littleton, Newburyport, Wakefield and Wilbraham. These companies have the potential to be economic anchors in their communities, spurring much needed revitalization and attracting new businesses and residents. Without SBIR/STTR, these companies likely never would have begun; without START these companies likely never would have survived.

Just as MassVentures was, we believe the START program should serve as a national model for how states can best leverage the federal government's investment through the SBIR/STTR program. The SBIR/STTR programs are essential in order to allow American scientists and researchers to innovate, invent and discover the technologies of tomorrow. But states must also do their part to build on progress made through SBIR/STTR funding and ensure those technologies of tomorrow are not always a day away.

Testimony of Charles E. Kolb

President and CEO of Aerodyne Research, Inc.

Billerica, MA 01821-3976

Subcommittee on Contracting and Workforce

House Committee on Small Business

"Commercializing on Innovation: Reauthorizing the Small Business Innovation Research and Small Business Technology Transfer Programs Part II"

Lynn City Council Chambers

3 City Hall Square, Lynn, MA

Tuesday, March 8, 2016

Mr. Chairman and Subcommittee Members:

Thank you for inviting me to testify today about the effectiveness of the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) Programs. My company, Aerodyne Research, Inc. (ARI), was founded in late 1970 as a contract research organization focused on improving the nation's strategic defense systems. We subsequently broadened our range of expertise to include energy technology and major environmental issues such as stratospheric ozone depletion, ambient air quality, acid deposition and climate change.

Until Congress passed the Competition in Contracting Act (CICA) in 1984, small high technology companies like ARI could submit unsolicited proposals to research and development (R&D) programs in relevant federal agencies and often win sole source contracts to pursue their best ideas. However, CICA regulations essentially eliminated unsolicited proposals. Also in response to CICA regulations many agencies greatly reduced the number of R&D contracts they issued to small businesses, relying instead on large and complex contract solicitations that required large company led teams to adequately respond. Businesses too small to credibly lead these more substantial requested proposals then had to sell their capabilities to large "system contractors" to be included in proposals. Further, even when small companies managed to join a winning proposal team, they might not receive the funding they expected, since the large prime contractors controlled the flow of project funds and often would prioritize funding distributions to their own employees.

After the CICA took effect the SBIR program, which had started in 1982, and the STTR program, started in 1992, became major

sources of federal R&D funding for many scientists and engineers employed by small businesses (<500 employees). However, the federal government's expectations for "successful" SBIR and STTR grants or contracts are significantly different than expectations for normal research funding.

Normal federal research funding is generally deemed successful if a novel scientific understanding is achieved or a successful technological advance is implemented. These successful outcomes are traditionally documented in patents and/or peer reviewed archival publications, adding to the nation's reservoir of scientific and technological knowledge and capabilities. Of course, the purpose of R&D funding from a mission agency may be to produce information and/or capabilities applicable to some part of the funding agency's mission.

SBIR/STTR funding is expected to produce the same level of new scientific understanding and/or technological advances as normal federal R&D funding; all properly documented in scholarly articles and/or patents in both cases. However, it is also expected to produce an innovative product that either solves a mission agency's designated problem or can be easily engineered to compete successfully in commercial markets (ideally both mission agency adoption and commercial success are achieved). In addition, the "successful" SBIR/STTR company also hires additional, well-paid staff members or spins off new companies that commercialize the parent company's SBIR/STTR funded technologies.

At ARI we have adopted a strategy of using SBIR/STTR funds to develop proprietary technology that we can use to expand our own research capabilities as well as sell to our R&D peers worldwide. Our most successful tactic is to develop new and better ways to measure both gas phase and small aerosol particle pollutants in real-time and with very high sensitivity and specificity. Starting in the mid 1990s we have used SBIR/STTR funds to develop three lines of mobile, robust instruments that can be used in both laboratory and field experiments to measure the properties and concentrations of air pollutants. Initial versions of these instruments were tailored for skilled scientist users, while some subsequent models can operate autonomously and are suitable for routine pollutant monitoring stations.

Since 2000 the increases in the capabilities and sales of these three instrument lines have evolved dramatically. From 2000 to 2015 instrument sales have grown from less than 1 million to over 14 million $/year. In FY2015 instrument sales provided 65% of our corporate revenues and R&D projects 35%. Over the past 15 years we have earned $80 million in instrument sales to customers on six continents; with—80% of the sales outside of the U.S., helping our nation's balance of payments. We have also hired a significant number of instrument engineers and assembly technicians to help develop, assemble, test and service our instrument product lines.

Some of our U.S. instrument sales have been to U.S. federal laboratories, including DOE National Labs, NASA Center Labs, DOD Laboratories, EPA Labs, and the NSF's National Center for Atmospheric Research. So our instrument products have not only been

successfully commercialized worldwide, but they have also directly served the needs of the agencies whose SBIR/STTR funds enabled their development.

We are also proud of our scientific accomplishments, during the FY 2000–2015 period we were supported by other funding sources to perform over $18 million worth of laboratory and field measurements using our instrument products. Recent sponsored research projects have measured methane emissions and other pollutants from oil and gas operations, including fracking well pads, gas plants, transmission pipeline compressors and gas storage facilities all over North America, including the recent Aliso Canyon gas storage facility's mega leak near Los Angeles. We have also recently mapped air toxic pollutant levels in poor neighborhoods near the Houston Ship Channel and measured trace gas and fine particle air pollution levels in Beijing. In fact, ARI has twice been named the Department of Energy's SBIR/STTR Company of the year (2006 and 2013) for our contribution to their environmental research programs as well as our equipping their scientists with important new research tools.

We also contribute to our nation's scientific reservoir; in 2015 ARI scientists published 75 peer reviewed scientific papers, most based on measurements using our instrument products. We also received three U.S. patents for innovations to improve instrument performance.

I believe that we have demonstrated that SBIR/STTR funding stimulates scientific discoveries and technological inventions that both meet federal agency needs and can be successfully commercialized, serving both national and international markets. Further, SBIR/STTR awards promote successful science based companies that provide well paying jobs to talented scientists, engineers, technicians and business staff employees.

At our company, and many hundred others, support from the SBIR/STTR program has successfully stimulated the production of the range of scientific, technological and economic benefits envisioned when Congress created these programs. Reauthorizing these programs will serve our nation well.

Commercializing on Innovation: Reauthorizing the SBIR and STTR Programs Part II.

Testimony by Dr. B. David Green, Physical Sciences Inc. Andover MA on March 8, 2016

Good afternoon Congressman Hanna and Congressman Moulton:

Thank you for your interest in the SBIR program and allowing our innovative companies to participate and share their stories. SBIR represents America's seed capital and has helped create new companies, excellent high technology jobs, and a great many publications and patents. It is the envy of other countries, and its success has not been duplicated due in part to America's unique entrepreneurial culture. The SBIR program funds concepts at very early stage where no other funding source exists. It allows the risk takers to retain and reap the rewards of their dedicated efforts. The government and the agencies are truly patient angel investors. Ultimately the investment is returned through taxes. Recent studies by the National Academies and by the mission agencies report its great success. Every government dollar results in over $3 of revenue after Phase II.

The SBIR is a great program. I wish to make three suggestions for your consideration to make it even better. The SBIR program has demonstrated its value over the past 33 years. First, please make it permanent. A long term charter for the program allows for better agency planning and staffing. Before the 2011 reauthorization, there were 14 short term continuations that made it difficult for the agencies to execute the program and made it impossible for the small businesses to maintain staff and advance their technology. Since the 2011 Reauthorization, the SBIR program managers and staff at all the agencies have shown great dedication and commitment to making this good program even better—making ever more companies aware of this opportunity. We recognize and commend the dedicated efforts by the staff at SBA and the many agencies.

My second suggestions is to increase the allocation to the SBIR program. This program is budget neutral—and our request is to shift more resources to a program that has proven its effectiveness. Currently only 3% of the R&D funding in federal agencies is allocated to SBIR. I ask that you increase that allocation gradually to 5% over the next decade—and to focus the funds from that increase to maturing technology after the initial Phase II program. For years, many worthy technologies have died at the conclusion of Phase II programs because the technology, although demonstrated, is not in a form recognized as viable by a commercial company or a mission agency. At the end of Phase II it has not been demonstrated outside the lab under real world conditions. This gap has become known as the Valley of Death for SBIR technologies. Too many do not make it through to become viable commercial products. A good many receive some post-Phase II funding ut it is too little, too fragmented, too restrictive. The Commercialization Readi-

ness Program created in the 2011 Reauthorization has begun to address this need. I urge you to consider increasing the SBIR allocation and focusing it on further maturation of promising technologies after Phase II.

My last suggestion is to make access to the SBIR program easier so that a wider diversity of companies compete and win programs. We all understand that it is not easy doing business with the federal government. Recently there has been significant effort to involve nontraditional ventures and new companies in providing technology to address our national needs. Instructions are complex. Submission is complex. Regulations are complex. A very large barrier to those new participants is the requirement for a government approved accounting system. We ask you to consider strongly encouraging the agencies with an SBIR program to use Fixed Price Best Efforts contracts for Phase II programs with the prototype remaining with the small business to enable transition to a commercial product. This will reduce the burden on both the companies and the government contracting officers to a fraction of the level needed in Cost Plus type contracts. Fixed Price will enable speedier contract award and more rapid advance of the technology. The innovators will spend more time on their technology rather than complying with the FAR. Most importantly, this will encourage many new entities to participate in the SBIR program.

Our employee owned company, PSI, has successfully transitioned many SBIR technologies. We find the fastest way to move the technology to market. Under NIH NEI sponsorship, PSI, working with clinical researchers, developed a retinal tracking method permitting greatly improved eye examinations. We partnered with a leading eye equipment manufacturer, and have sold 16,000 systems containing this technology over the last eight years—producing over $1B in revenue, and providing better eye care for tens of million Americans. Under EPA sponsorship we developed a handheld LIDAR to detect natural gas leaks. Our partner has sold over 3000 systems and a large fraction of American homes have been made safer using this technology. Under Air Force sponsorship we have developed critical optical components that are now integrated into aircraft systems.

In emerging technology areas we have sought external equity investment and created new companies. And PSI has also manufactured and sold the technology directly into specialized markets. Under NASA sponsorship we created accurate space simulation chambers that have been sold around the world, and offered testing services. Nearly every material that has been put into space has been tested in our chambers. Under Army SBIR sponsorship we have developed and sold sensors to detect chemical warfare agents remotely at distances permitting troop safety. Under Navy sponsorship we have developed fuel quality monitors for naval and commercial aviation. Under DNDO sponsorship PSI has implemented novel algorithms that vastly improve radiation sensor performance at screening portals. And under Army sponsorship we have developed a small UAV to provide our warfighters and law enforcement situational awareness. This capability is now deployed and contributing to national security.

PSI is a founding member of the New England Innovation Alliance. NEIA meets regularly to share best practices and discuss topics of common interest and concern. Many of our fellow members are here today to share their SBIR technology success stories with you.

The SBIR program is already one of the most successful in the government. It is America's seed capital. Today I have offered three suggestions to improve this already terrific program. I ask you to please move to reauthorize this program now, to increase its allocation and to encourage contracting methods that encourage new companies to participate in the program. SBIR's success is documented in the National Academy studies. I ask you to reauthorize it to keep technology innovation strong in America, and help America to remain the world leader in technology.

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Formal Written Testimony for Field Hearing

U.S. House of Representatives Committee on Small Business
Subcommittee on Contracting and the Workforce

Commercializing on Innovation: Reauthorizing the Small Business Innovation Research and Small Business Technology Transfer Programs Part II

Tuesday, March 8, 2016

Lynn MA City Council Chambers
3 City Hall Square
Lynn, MA 01901

The Honorable Richard Hanna (R-NY) Chair

The Honorable Seth Moulton (D.MA)

Ann Eskesen, President
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Good afternoon gentlemen. My name is Ann Eskesen, founding president of the Innovation Development Institute, LLC a small four-person firm that since its founding has been located right here in the MA Sixth District.

First, may I thank you for your scheduling this hearing and particularly for your providing me opportunity to offer testimony on what will be the Fifth Reauthorization of the very important SBIR- STTR programs -- arguably, in terms of overall technology development and business impact briefly to be considered here - perhaps among the most important pieces of legislation ever enacted by the US Congress.

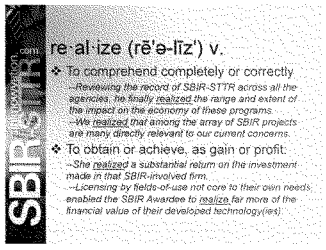
I had the distinct honor, exciting challenge and privilege of having been part of that small group of players involved in the development, passage and subsequent implementation of the original SBIR enabling legislation what is now more than three decades ago. That very active political involvement continued through the 1986, the 1992 and 2000 SBIR reauthorizations and, though to a much lesser extent on the front line, also in the long drawn-out, multiple Continuing Resolution effort required to achieve the Fourth reauthorization.

I make the point of this longtime SBIR association not with the intent of bringing attention to how old I am but to explain why – and to an extent how - the perspective I bring to this important discussion is almost certainly significantly different from that you will hear from almost everybody else. Clearly, as a long-time SBIR advocate, I strongly support Reauthorization but I would energetically argue that if we are truly to draw down the considerable value of *all* that SBIR has created, the extent and form of that value must be understood and factored into this Reauthorization discussion.

In my judgment - based on that thirty-five years of involvement - SBIR is far more usefully understood not simply as a program that funds R&D in small business but rather as an important technology, business and economic development resource that should be being managed as such.

The 'Success Story' approach to documenting the achievement of individual SBIR Awardees is powerful, sometimes awe-inspiring, often game-changing - testimony to the depth in talent and creativity that exists in small firms and to the value of giving such firms access to resources like SBIR. The fact of there being so many of these stories – thousands of them -and across such a range of endeavor further speaks volumes to the contribution of small firms in so many different fields. But, to date, even after what is now decades, there has been remarkably little attention paid to evaluation of the collectivity, the total population of what is now almost 23,000 business entities that are SBIR Awardees.

In these radically changed and changing times, there has perhaps never been a greater need or better opportunity for Congress carefully to review and examine the already considerable SBIR-STTR achievement and impact: in effect, to use actual data to make next generation SBIR policy decisions.



To provide you what I think is a comprehensive and useful overview of what I mean by that and what it involves, my thoughts for this Hearing organized around the important idea of enabling you (and others) more fully

"to realize the value of SBIR"

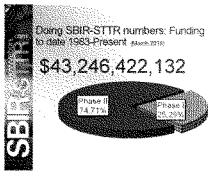
As the attached slide indicates, a dictionary definition of the verb 'to realize' has two distinct, very different meanings.

1. By reference to useful external indicators, more completely to understand how SBIR Awardees – collectively -- measure up.

   Being the data-junky I am - using solidly, real data-anchored[1] charts and graphs – the next few pages will synopsize the SBIR condition/achievement in various relevant areas to include:

   - VC funding
   - Intellectual property: patents
   - Extent of M&A transactions
   - Business Collaborations;
   - As well as a significant Employment Impact Analysis: creation by SBIR awardees by-state of well paid, STEM based jobs with all the ripple-effect impact that that has in a community

2. From the premise that $43B in Phase I and II awards has been a federal 'investment' - a different (but very useful) way to think about SBIR - the data from the various analyses noted above will solidly shows SBIR has already returned many multiples of that sum.



This time[2] I am also arguing, however, that Reauthorization should – *must?* - include serious consideration that we take a leaf out of the VC portfolio management playbook and that of the technology development practices of most major and mid-sized corporations

to allow/enable/encourage management of the program
in ways that support effective drawdown of
significantly *more* of the value of what SBIR has created.

The world in which SBIR awardees – and the rest of us – now do business and function is a fundamentally different place from that in which the idea of SBIR was conceived and crafted … and yet, in real terms, though with genuine efforts attempted by the agencies to help their awardees move the technology to use-condition, the core of how the Phase I and Phase II project specific process is managed is fundamentally as it has ever been.

Continuously tracking, as we do, all things SBIR related – *see next page Table* – certain factors are worth noting. With now almost 23,000 firms having been SBIR involved across every field of technical endeavor

• SBIR-STTR is often a mirror for what is happening in the larger economy. As we continuously data-log and begin to see emerging patterns, trends, changes of emphasis and apparent anomalies, we are struck how so often soon afterwards we are reading in NYT, WSJ, Economist or hearing on PBS what we have noticed in SBIR but that we had seen being talked about for the larger economy: long duration, living lab?

• With some of the detail broken out by a few states as part of the employment-related comments later in this testimony, SBIR has become the largest single concentration of technical talent involving, for example, three times as many graduate level engineers and scientists as all US academic institutions added together

---

[1] Though we have, at their request, provided parts of our data and analyses to some agencies (SBA and DHS) and as a featured speaker in many settings, I am not aware of any other source (public or private) that is tracking the types and sheer range of data about all SBIR-involved firms that we do.

[2] Especially if making SBIR permanent is a serious consideration: not, in my judgment a decision to be made lightly

idi-developed SBIR-STTR relational database systems: tracking elements

Core data on SBIR-STTR involved firms 1983-present (22,865 as March 2016)

- Detailed Company Profile: full contact info
- Names by which firm is/has been known. Address history & multi-site locations. Any/all data relevant to company history
- Personnel: Current & previous management team: job titles and bios; all PIs to include when these persons relocate
- Business Identifier: primary business and technology focus
- Business summary: synopsis of company background, areas of technology focus, target applications/markets
- Overview Financial & Business condition: start date; employment range; revenues; first & last years of SBIR involvement.
- As applicable, detailed sourcing and extent of VC, IPO etc
- IP status to include full detail of patents (US and world), inventors, fee payment status, citations, in- and out-licensing
- Where applicable - spins-in & -out. Acquisitions
- Media coverage: business, popular press and other sources
- Document repository: Professional and technical papers and presentations, White Papers; Nutshells; & marketing materials
- Business or Technology Recognition Awards
- Powerful tech application, indexed classification system in progress.

SBIR-STTR status

- Full detail of extent and form of SBIR-STTR involvement: sources, dollars, Phase I-II conversions, Abstracts, outcomes
- Any forms of follow-on federal funding: Phase III procurement contracts, earmarks and plus-ups

Also tracked: NAICS codes, various tech classification systems, DUNs & CAGE numbers, Congressional District, GSA Schedule status and Number

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Background to idi SBIR database development:

With the considerable support of the then freshman US Senator from New Hampshire, the late Mr Warren Rudman, of U.S. Senator John Glenn and others who understood well the critical importance of technology innovation to a health of an industrialized economy, growing out of the effective functioning of an small-scale pilot program twice in NSF (1977 and 1979) and once in DOD (1980), the bill to initiate SBIR across the range of federal agencies passed the Senate almost unanimously.

In the House, however, the proposed bill was perceived as highly controversial, drawing major opposition from powerful players in

- the academic and non-profit research communities who saw small firms and SBIR as competition for an R&D pie that was, at the time, static. We would be taking a piece of their already limited pie.
- and, importantly, from within the agencies. There was genuine concern that an influx of small firms with little/no federal procurement experience, c/would make an SBIR-type effort very high maintenance. Lots of small deals make for considerably more work than fewer big ones.

These were legitimate concerns that found support among many Members. Those advocating for SBIR were subjected to the rigors of a seven committee sequential referral: a very effective way to run ragged the very small group of us involved.

Passage of the enabling legislation was finally achieved, however. The bill was signed into law by President Reagan in July 1982 with the first round of SBIR Phase I solicitations beginning October 1, 1982: FY 83.

Shortly after, I was recruited by Donald Templeman, the SBA official charged by SBA Administrator[3] George E. Saunders with SBIR implementation. I was assigned two responsibilities:

1. To get out the word to qualified small businesses around the country - the potential SBIR community - about the availability of this as yet very small, but important, new resource.[4]
2. To make sure that those in the agencies who had been a primary source of opposition[5] to the enabling legislation were in compliance with the requirements of the law.

To address these two very different objectives in support of effective SBIR implementation, I began what (entirely unintentionally) has become a more than thirty-year commitment – that of systematically keeping the SBIR[6] Record across all agencies in a single system.

Initially I simply followed the money – agency, company, state, project title, Phase, dollars – in Excel 1.0 (truly) on a DEC Rainbow (a what?). Fortuitously, we were early adopters of 4D[7] , the very powerful relational data-based systems we still use. As the wealth, diversity and detail of data relevant to business and technology endeavor become available – now at an ever accelerating pace – we were, and have, been able to incorporate that new data into our systems and to develop the routines and powerful algorithms most effectively to mine those systems to generate the types of systematic analyses that follows here.

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[3] Long before the head of the SBA became a Cabinet position

[4] SBIR percentage of extramural R&D was a legislated phased-in to 1.25% over five years. At 0.25% in civilian agencies and 0.1% in DOD, across all the participating agencies the FY 83 SBIR budget totaled the princely sum of $35M

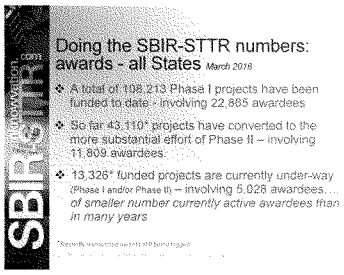
[5] It is interesting that that opposition was not mitigated and did not go away for a long time. What did happen was that, SBIR being so small even when fully implemented at the (then) 1.25%, the problem was solved in many agencies by appointing as SBIR Program Managers interesting players -- many being square pegs in round holes -- who delighted in the freedom that their new position provided them to take risks and to experiment without serious interference from senior persons.

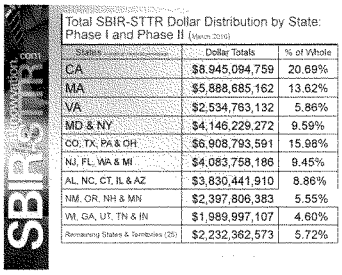
[6] Later to include STTR

[7] 4D; a relational databases management system and IDE with its own programming language that has since expanded to an SQL backend, integrated compiler, integration of PHP a several productivity plug-ins and interfaces.

Doing some basic SBIR-STTR numbers:

These are various idi prepared slides with, as appropriate, supplementary comments. Some of slides – for example these first two being grounded in Awards Data - while in very different format could likely be generated from the Basic Awards and By-State data available on the SBA SBIR.gov site.

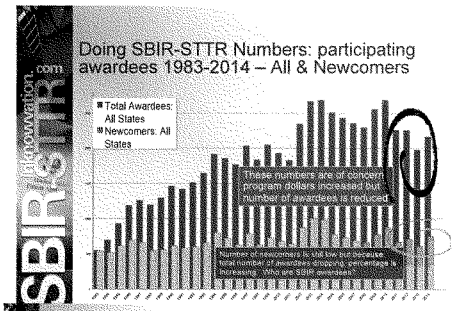


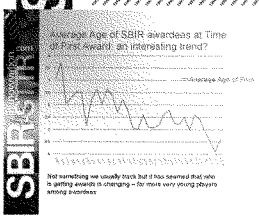


Total SBIR-STTR Dollar Distribution by State: Phase I and Phase II (March 2016)

States	Dollar Totals	% of Whole
CA	$8,945,094,759	20.69%
MA	$5,888,685,162	13.62%
VA	$2,534,763,132	5.86%
MD & NY	$4,146,229,272	9.59%
CO, TX, PA & OH	$6,908,793,591	15.98%
NJ, FL, WA & MI	$4,083,758,186	9.45%
AL, NC, CT, IL & AZ	$3,830,441,910	8.86%
NM, OR, NH & MN	$2,397,806,383	5.55%
WI, GA, UT, TN & IN	$1,989,997,107	4.60%
Remaining States & Territories (25)	$2,232,362,573	5.72%

In strong contrast, we suspect that most of what follows here is not SBA (or other source) do-able.





The idi systems are anchored in a range of useful *Awardee* data. This makes possible, for example, tracking in any year SBIR Newcomer Awardee vs previously funded, either in program as a whole or even in a particular agency. This type of routine can provide useful indicator that something has changed/is changing – a simple example of using data to provide insight into what might be happening - and why. At the very least, it suggests the need to question.

In this example it is clear that beginning in 2011-12, though available program dollars are increasing, number of Awardees is seriously reduced. Why?

In this instance, we had a pretty good idea what was happening – discussed here next in VC funding – but, as an example of data-use, recent entry of a current crop of awards suggested something else might be a factor: an uptick in new awardees being pure start-up: opening doors with SBIR funds.

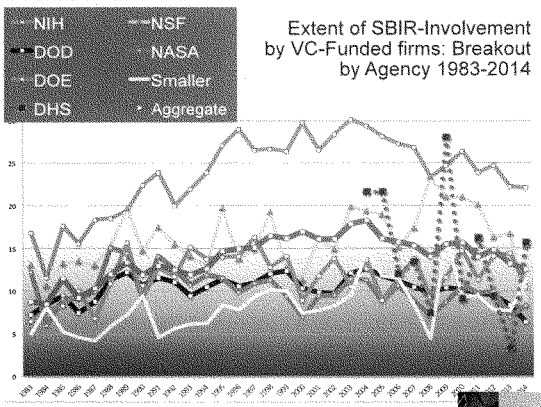
A routine tracking of age of Awardees at time of first SBIR award yielded interesting chart to left did suggests major downward shift in age at which small firms are entering SBIR.

Could this be what we are seeing in the chart above? In fact, while an interesting trend, other changes in the Current Awardee profiles suggest that Age of Awardees was not a factor.

Venture Capital in the SBIR space.

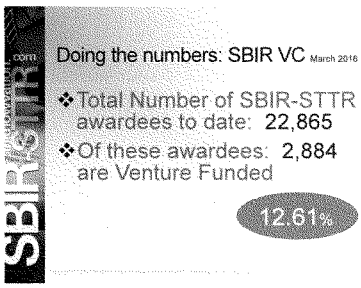
Given the major – one might say dominant - role played in last SBIR Reauthorization to enable full SBIR eligibility and access to VC funded firms, except for a strong emphasis on how to get Venture Capital now major focus at many SBIR organized events and elsewhere, remarkably little focus seems to have been given to the role that VC actually plays – and has long-time played - in the SBIR space. From the premise that this is not only interesting but also very important, for this Discussion I have opted to focus on this area somewhat more than the others indicated.

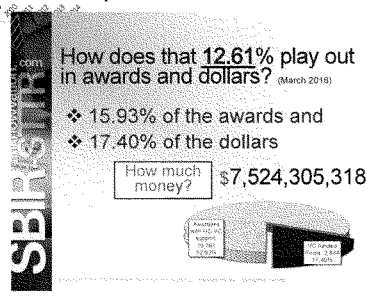
In the midst of the dot.com boom and burgeoning IPOs, we began to track[8] in considerable detail the form and extent of VC activity in the SBIR space – still the only such compilation, I think, that exists and that permits analysis across a number of variables: *see By-Agency chart below.*



Though, not surprisingly, the strongest VC SBIR presence being in the National Institutes of Health, by plotting VC funded firms by Year and By Agency, chart here clearly indicates some level of VC presence in every agency. Other manipulation of VC data also shows clearly that over the life of the program

- A full 60.94% of all VC-funded SBIR Awardees have an NIH involvement
- But–not so obviously–some 31.96% of all VC funded SBIR awardees have Awards in the Department of Defense[9]





[8] Our VC data is compiled and cross-checked across a range of sources, one firm/one round at a time: highly labor intensive. Increasing availability and access to well-grounded (accurate) VC data makes this part of our systems highly detailed and substantial.

[9] Though we do often use aggregate DOD data in some analyses and reports and also for NIH, our systems are set up to support breakout by all Defense Services and by NIH Institutes and Centers. Similarly, we can carve out data by NASA Flight Centers etc i.e. all agencies in which different parts of the larger entity may make and manage their own awards

The very strong VC SBIR presence even before the major changes in most recent Reauthorizations is indicated two slides above. Calculating to 12.61% of awardees over the Life of the Program, collectively VC firms have been awarded 15.93% of the awards and 17.40% of the total dollars.

Important note on "All years" versus "Currently active":
Reflecting radical changes in all aspects of our lives nationally and internationally since passage and implementation of the SBIR enabling legislation, today's United States is a very different place from that of 1982. Though understanding trends through by-year breakouts is often interesting and sometimes highly informative - it is increasingly useful to separate out Current Data from lifetime. There are important differences and much of our analytical work is anchored in making that distinction.

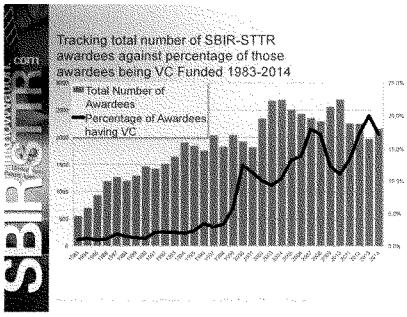
With the preference here being to cover various areas of relevant interest to which we suspect Members have not been previously exposed or even knew is available, to stay with reasonable time/volume limits we opted to do that Lifetime and Current parsing only on a limited basis.

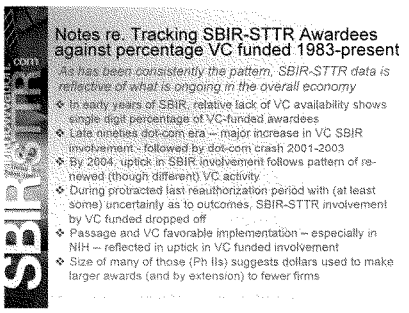
One of those exceptions is the noticeable change in the levels of VC activity.

VC funding in overall SBIR-STTR population: perceived changes

Interested to see what may have been the impact(s) of the provision in the most recent SBIR Reauthorization concerning seriously modified program eligibility requirements involving Small Firms being majority owned (more than 50%) by VC investors – and with our being the ONLY source having the detail re. which SBIR-involved firms are VC funded, by whom for how much and when -- we recently ran a routine through our system to determine what – if anything – had changed.

Though the results are preliminary, they give serious pause for thought:
In key agencies, VC funded firms–in a small number of states–may be pushing out non-VC funded





Related but different routines show that

- In less than four years, the Percentage of VC funded firms being SBIR involved has increased to 14.14% from the 12.62% over life of program: a very fast impact
- Not surprisingly, the most pronounced impact of VC eligibility have been in NIH with a 25% set-aside specific to that agency for VC funded firms, the percentage of *NIH current awardees* being VC funded is now increased to 22.66%

It is striking more recently that, in very strong contrast to earlier years

- Very few SBIR firms are receiving VC funding *after* their becoming awardees – for the longest time - the usual pattern use to be
  - Apply for SBIR/Found the firm (or vice versa) and
  - usually some time later, achieve Series A VC funding status
- Announced VC deals and subsequent rounds primarily now involve those already having VC
- Many coming into the SBIR program for the first time involve those already VC funded

Extensive VC involvement in SBIR:

Over the period of the high profile activity of the dot.com boom and subsequent crash -- when we began a systematic basis to track VC involvement in SBIR -- it was striking that

- while, from 2002, VC activity in the general dropped off precipitously,
- VC involvement in SBIR specifically remained broadly consistent and has stayed within a fairly narrow dollar range for several years.

With 2015 dollars incomplete as yet and the major uptick in VC large-scale investment activity among 'unicorns' in 2014 probably skewing the numbers, the data shows clearly that

- Since 2002, One in SIX/SEVEN VC dollars being invested in the US involves an SBIR firm
- Over the period we track to include some pre-2000 to present, we can document over $82 Billion (with a B) of VC investment in SBIR involved firms – almost DOUBLE the total award dollars of $43B across the entire program: by itself, this is powerful evidence of the strong ROI on the $43B of US federal SBIR 'investment'

SBIR VC Funding: Percentage of all US VC 2000-2015

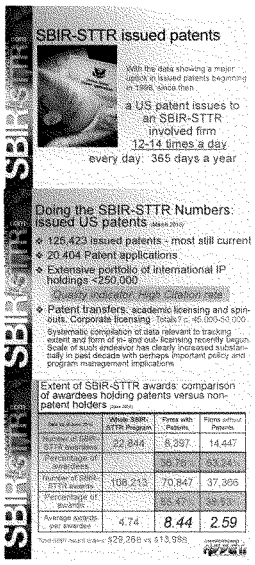
	SBIR VC $$ (B)	All VC Funding ($)	SBIR VC $$ % All US VC
2000	$3.80	$105.00	3.61%
2001	$4.43	$40.94	[illegible]
2002	$3.38	$22.20	15.23%
2003	$3.46	$19.68	17.60%
2004	$3.69	$22.85	16.15%
2005	$4.19	$23.25	18.01%
2006	$3.90	$27.87	13.99%
2007	$5.15	$32.11	16.05%
2008	$4.56	$30.44	15.06%
2009	$3.02	$20.34	14.84%
2010	$3.41	$23.52	14.48%
2011	$3.08	$29.90	10.31%
2012	$5.03	$27.66	18.19%
2013	$4.23	$30.29	13.96%
2014	$4.51	$50.84	8.76%
2015	$3.76	$58.81	6.37
Totals	$72.56	$401.88	18.06%

We have never been under any illusions that the non-dilutive, technology development SBIR dollars were the value-added factor that drove this expansion of VC SBIR involvement but the extent of this involvement ***is*** validation of the importance of SBIR of a population of defined technical capability and talent. The VC (and Tech Seekers) know that. Why don't we?

Now, as the number of small firms in the program is dropping – to include a particular kind of small firm that, in many states, we can ill afford to lose – I find myself asking the question:

> "Whom are we not now funding where the profile they present
> has none of the classic VC appeal and access to SBIR dollars is
> one of their few available options to get their companies off the ground and contributing?"

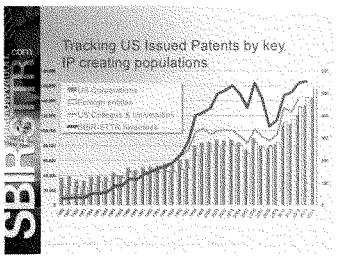
Along with "why are we not systematically mining the SBIR talent pool" as are the VC (and large corporations) this – in my judgment – is a policy question that needs to be asked



Patents: a (the?) key factor in knowledge-based economy:
Since if you don't own your technology, as a small firm you can't raise capital, nor can you collaborate with others on a technical level – the way business is now done. Among the data we carefully track therefore concerning SBIR involved firms is Patent related: filing, in- and out-licensing etc., Citations rates and fee-paying tec.

SBIR-involved companies are diligent Patent Filers in their own right – see top two slides. By any criteria of relevance, a population collectively issuing 12-14 patents a day is a major resource. Further, though our data in this space is still very a work-in-progress, there is clear indication that an increasing number of SBIR-involved are licensing in technology (to underpin their SBIR activities) from Universities and others and, in a growing number of cases, cross-licensing and out-licensing[10] to other small firms, as well as to large and mid-sized corporations.

The data is clear and solid that Patent-holding SBIR Awardees – their own patents and/or those they have licensed-in – do far better in the SBIR Award stakes than non-IP holding. This slide represented strictly patent holders showing clearly that being approximately one-third of awardees, they are receiving over two-thirds of the SBIR awards. Given that a percentage of the Non-Patent holders are in space where patents as such are less relevant, these statistics may be even more impressive than at first sight.



Tracking US issued patents by key IP creating populations:
Consistent with major increase*[11] in SBIR funding in 1992, there was an important uptick in number of issued patents

- ❖ Where patents issued to academic institutions leveled off in late nineties, SBIR patent activity continued to increase.
- ❖ Drop off of patent issuances for both populations in 2008-2009 more a function of problems within Patent Office than of change in filing rates
- ❖ Important recent pick-up in academic patent filings may be reflection of growing interest by smaller institutions in spin-out of start-ups and out-licensing as potential source of revenue.

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[10] Handled properly, patent licensing can be very profitable especially for patented technology already put to use – a sunk cost. Properly structured, such a patent may be licensed many times. Though the scale is different, IBM is a case in point. The firm reports a 90% profit rate on almost $3B of annual patent royalty income. That represents to only 2.1% of IBM revenues but factors to 17+% of IBM's pre-tax profits. There is much to be said for SBIR firms – particularly those rich in IP but limited in market-access – to be encouraged to out-license to generate a revenue stream. Our date shows clearly that out-licensing is common practice among VC funded entities

[11] By careful design, the 1992 reauthorization (incrementally) increased SBIR percentage but also pool against which the percentage applied. Latter was immediately implemented increasing the SBIR total pool from c. $400M in FY 92 to c.$750M in FY 93

Extent of M&A Transactions involving SBIR-STTR firms (March 2016)

To date, we have in-system record of 1,975 M&A transactions involving SBIR-STTR firms

- 22,865 SBIR-STTR involved firms
- 1,975 M&A transactions
- 1,384 acquiring firms

8.64% of SBIR awardees acquired

- 369 of the M&A transactions have involved a buyer themselves being/ having been SBIR awardees

M&A activity in the SBIR-STTR space.
Consistent with the extent of large and mid-sized corporate involvement with SBIR-involved firm in collaborative endeavor of various types – briefly outlined in next section – there is a steady and continuing stream of reported Acquisitions of SBIR-STTR associated firms by Corporate entities.

Ranging in price from a few million – General Electric in 2004 buying the assets of a bankrupt DE-based AstroPower for only $15M – to the more recent acquiring of long-time SBIR-involved MA-based Genzyme by Sanofi-Aventis for an amount in excess of $20B .. and every price between, the fact that over 8.64 percent of SBIR involved firms have been acquired speaks volumes to the perceived value of what SBIR involved firms have created.

We have detail of price paid on some 50% of the deals – the balance are assumed to be smaller transactions i.e. no public record - but those 50% total some $451,290,993,219 – an amount that registers even among those used to federal government budget numbers

Corporations having acquired multiple SBIR-involved *Italics=SBIR involved firms*

L3 Communications	24
Titan Corporation (acquired by L3)	16
SAIC	13
General Electric	12
Raytheon	11
BAE Systems, Lockheed Martin Corporation	10
Agilent Technologies; EDO Corporation, General Dynamics; JDS *Uniphase* Corporation; Philips	9
Invitrogen Corporation; PerkinElmer, Inc., Pfizer Inc.; Teledyne Technologies, Inc	8
Johnson & Johnson; Northup Grumman; Thermo-Fisher Scientific	7
3M; *Amgen*; ATK Inc.; Beckman Coulter; Bristol-Myers Squibb; Charles River Laboratories; Corning, Inc.; *Genzyme Corporation*, *Gilead Sciences, Inc*; Cx Technologies, Inc.; Qiagen NV; *Sierra Nevada Corporation*; Ultra Electronic Holdings	6

L3:40

Corporations having acquired multiple SBIR-involved *Italics=SBIR involved firms*

Affymetrix, Inc.; Becton Dickinson & Co.; Boeing Company; CACI International, Inc.; Danaher Corporation; *Flir Systems, Inc.*; GlaxoSmithKline; Medtronic Inc.; Merck & Company, Inc.; Microsoft Corporation; Roche Holding AG.; SRA International, Inc.; Tyco International Ltd; WL Gore & Associates, Inc.	5
Alion Science & Technology; *Allergan, Inc.*; *Argon ST*; Bayer AG; *Conra Corporation*; DRS Technologies; Goodrich Corporation; Honeywell International; *II-VI, Inc.*; *Integra Life Sciences*; Intel Corporation; *Intermagnetics General Corporation*; Inverness Medical Innovations; ITT Corporation; ManTech International; *Millennium Pharmaceuticals*; Monsanto; Moog Inc.; MSC Software; Novartis AG; Sanofi-Aventis SA; Siemens; Sigma-Aldrich Corporation; Smiths-Group plc; Thermo Electron Corporation; Veeco Instruments, Inc.;	4
37 Firms have acquired Three firms: to include 10 SBIR firms	3
135 Firms have Acquired Two / 1139 Firms have Acquired One	

Tech Seeker-SBIR collaborations:

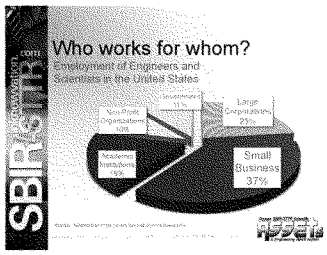
- Our data – ever developing – indicates over 2800 Large / Mid-sized corporations having **Working Relationships** with one/more SBIR involved small firms: partnering, licensing to/from, investing in and acquiring
- Over life of program, this has involved some 7500 SBIR-STTR firms – some 30% of all participating firms
- All indications are that among currently active awardees that percentage is **increasing significantly** perhaps already at some 35%

SBIR-STTR: Tech Seeker Collaborations:
For reasons that can be discussed at the hearing if there is time/interest, a striking development of the past 15-20 years has been the important shift in extent and manner by which Major/Mid-sized Corporations (US & international) now relate to small, technology-based corporations. Though not peculiar to the SBIR community, as perhaps the most readily identifiable population of technology-verified competent small firms the extent of this Tech Seeker involvement with SBIR Awardees has become a major factor in how many do business.

SBIR Employment impact

Finally, no data analysis involving the SBIR-STTR Program would be complete without some indication of the major high-quality job creation. For the purpose of this Hearing, we are focused on

- Who do the population of US based Engineers and Scientists work for
- STEM Job data
  - For the United States
  - That specific to Massachusetts and New York
  - That data most likely relevant to Member of the House Small Business Committee

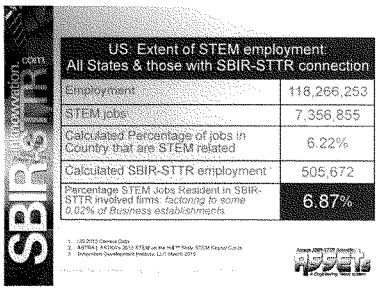


At the time of development of the SBIR enabling legislation- early eighties - the data showed that some 15% of graduate levels engineers and scientists in the United States were employed by small firms. The argument continued that small firms were collectively were in receipt of - I think I recall – some 2% of the federal R&D dollar.

SBIR, we argued urgently, was a means to even up that score at least a tad; that we were squandering that resource by denying the country better access into that talent pool.

The percentage of federal R&D dollar going to small business has crept up a couple of points in the interim but that percentage of graduate level engineers and scientists that, according to NSF data now work for small firms has increased substantially to some 37%.

- By 1996, NSF data showed, there were more graduate level engineers and scientists working for small firms than all the academic and non-profit institutions added together
- By 2000, there were more graduate level engineers and scientists working for small firms than all the Large US Corporations added together
- Today, that level of small business employed graduate level engineers and scientists has reached 37% … and growing.



US: Extent of STEM employment: All States & those with SBIR-STTR connection	
Employment	118,266,253
STEM jobs	7,356,855
Calculated Percentage of jobs in Country that are STEM related	6.22%
Calculated SBIR-STTR employment	505,672
Percentage STEM Jobs Resident in SBIR-STTR involved firms: *factoring to some 0.02% of Business establishments*	6.87%

It would be difficult from our own systems to determine what percentage of that 37% are SBIR-connected but using STEM related data the following compilations prepared by idi would suggest that, though different by state, it isn't small.

Note particularly that folded into the chart – last line – is the calculation of SBIR establishments as the percentage of all businesses in area of focus. In this US as a whole slide, that means

- STEM jobs represent 6.22 % of all US jobs
- 6.87% of STEM jobs have an SBIR-connection
- with SBIR firms factoring to only 0.02% of business establishments.

A remarkable SBIR contribution (ROI) by any standard of reckoning – particularly when applying the commonly cited (but not readily attributable) adage that the creation of one-high paying (STEM-type) job in a community have a significant multiplying job creation impact (5-7). Music to the ears of areas of the country struggling with less than optimal, quality job employment rates.

Massachusetts: Extent of STEM employment: All State & those with SBIR-STTR connection	
Employment in State	3,070,703
STEM jobs in State	269,561
Calculated Percentage of jobs in State that are STEM related	8.78%
Calculated SBIR-STTR employment	54,580
Percentage State STEM Jobs Resident in SBIR-STTR involved firms: *factoring to some 1.33% of State's Business establishments*	20.25%

New York: Extent of STEM employment: All State & those with SBIR-STTR connection	
Employment in State	7,688,492
STEM jobs in State	419,770
Calculated Percentage of jobs in State that are STEM related	5.46%
Calculated SBIR-STTR employment	21,129
Percentage State STEM Jobs Resident in SBIR-STTR involved firms: *factoring to some 0.26% of State's Business establishments*	5.03%

Applying the same interpretative analysis to MA and to NY shows that

- in Massachusetts, a full 20.25% of STEM job in this State have an SBIR connection
- with that achievement made by what calculates to only 1.33% of business establishments
- while in New York, though with substantially higher STEM job levels, only 5.03% have an SBIR connection with SBIR awardees being only 0.26% of business establishments

US House of Representatives Small Business Committee:
By Member State SBIR employment impact

State	Total Employment	STEM Employment	% STEM Related	SBIR Employment	% Stem Jobs SBIR related	SBIR % of State Firms
MA	3,070,703	269,561	8.80%	54,580	20.20%	1.33%
VA	3,131,723	329,716	10.50%	39,519	12.00%	0.73%
CA	13,401,863	968,826	7.20%	112,814	11.60%	0.66%
NJ	3,492,216	236,751	6.80%	15,940	6.70%	0.35%
OH	4,587,136	256,644	5.60%	14,740	5.70%	0.40%
HI	502,530	23,369	4.70%	1,242	5.30%	0.40%
NY	7,688,492	419,771	5.50%	21,129	5.00%	0.25%
MI	3,535,685	241,733	6.80%	11,068	4.60%	0.35%
NV	1,047,657	35,109	3.40%	1,516	4.30%	0.18%
FL	7,134,644	318,692	4.50%	13,474	4.20%	0.17%
NC	3,421,195	200,171	5.90%	7,973	4.00%	0.32%
IA	1,305,216	61,425	4.70%	2,223	3.60%	0.20%
MO	2,355,336	124,781	5.30%	3,698	3.00%	0.18%
MS	902,638	33,979	3.80%	756	2.20%	0.13%
KS	1,150,401	68,941	6.00%	1,080	1.60%	0.17%
US Total	118,266,253	7,356,855	6.20%	505,672	6.87%	0.40%

At-hearing Talking points. …*realizing the value of SBIR: Full value drawdown initiatives*

- Lessons from VC and Tech Seeker playbooks: managing portfolio.
- The limiting condition of stove-pipe program management
- Reduced(ing) risk tolerance: impacts and reaction
- Loss of mid-sized firms 25-50 employees

- Legislatively enabling SBIR access into agency demonstration dollars
- Permit - encourage - creative engagement by PM of the wealth of demonstrated SBIR talent e.g teamed projects
- Empower SBIR-STTR Program Managers: e.g. 5% discretionary funding a la ERISA
- Encourage new ways of enabling SBIR awardees to generate revenue streams: out-licensing very common among VC funded firms.

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