



The Small Business Technology Council

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**Small Business Innovation Research (SBIR):
Leveraging American Business Growth and Jobs**

***SBIR: Entrepreneur-Driven R&D
to Support American Economic Revitalization***

A White Paper

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Executive Summary: *SBIR Offers a Lever for Economic Revitalization*

Congress and President Reagan created the Small Business Innovation Research (SBIR) program in 1982 to mobilize small business entrepreneurship and innovation to bridge a technology gap eroding American competitiveness and jobs. SBIR solely funds R&D meeting agency objectives, but the follow-on economics are dramatic: SBIR leverages America's entrepreneurs and small business technical skill to innovate solutions to important American challenges while creating new products and jobs transforming American industry. Today, facing uneven economic growth and aging infrastructure, we can strengthen SBIR/STTR¹ investment, unleashing small business energy and jobs in a new wave of 21st century American-made products and services.

Despite <1.7% of overall Federal R&D funding, SBIR/STTR is a primary driver of American economic strength. SBIR R&D projects are our technology seed corn. High quality R&D met Federal needs while seeding new startups and driving the growth of small businesses with their new technology products and services. Global giants such as Qualcomm, Symantic, Biogen, iRobot, Genzyme, Illumina, and Genentech emerged from SBIR funding. Meanwhile, SBIR businesses and technologies were also sold or licensed, energizing older industries while cutting costs and generating entire new divisions and new jobs located here in America. Follow-on new product investment and sales have totaled hundreds of billions of dollars.

SBIR firms produced life-changing breakthroughs in defense, energy, communications, information and bioscience - new tech building blocks for American manufacturing. Agency mission objectives were accomplished. DOD strengthened capabilities while cutting costs. The Air Force saved over \$500M on the F-35 aircraft. A Navy project saved over \$1M per hull on the Virginia Class submarine. University/small business collaborations converted basic science into products and services, with 30-60% of SBIR technologies involving current or former faculty. With less than 1.7% percent of Federal R&D, SBIR/STTR firms have created over 20 percent of America's major innovations, and as many patents as all universities combined.

America's basic science is a primary national strength, but converting that science to American innovations and jobs faces increasing international competition. **The SBIR/STTR program funds the seed corn for this challenge, combining private enterprise with American ingenuity to enable new innovations while building new products and businesses.** SBIR asks our nation's small businesses, employing 38% of our scientists and engineers and led by American entrepreneurs, to convert American science into new scientific breakthroughs and useful innovations for commercial use, and to use that tech to build their businesses. SBIR firms must be American-based and owned small businesses, with all work done in the U.S. The new technology, products and services advance agency missions, meet market and societal needs, and create new sustainable high quality, high paying manufacturing and service jobs while raising living standards.

The data supports this impact, and suggests doing more can increase the success. 17 National Academy of Sciences studies concluded SBIR met its goals and showed SBIR/STTR Phase II awards commercializing at rates from 45-70 percent, a remarkably high result. Recent economic impact studies

¹ Congress passed and George H. W. Bush signed Public Law No: 102-564, which created a smaller, companion Small Business Technology Transfer (STTR) program in 1992, for academic partnering.



by the Air Force and Navy SBIR/STTR programs detail job and wealth creation with broad regional benefits, plus provide data on taxes and revenue paybacks. The SBIR/STTR program clearly provides a big bang for the federal R&D dollar.

- Both Air Force and Navy found high SBIR returns, e.g. the Navy found every dollar invested in the Navy SBIR/STTR programs led to over \$6 of new product sales and over \$19 of total American economic output just within a 14 year period. Tax income in the period more than repaid the SBIR R&D funding. Job quality was high, with average income of \$68,535.
- The studies did not capture the large sales and economic effects from technologies sold or licensed. Over 13% of the Air Force small businesses had been acquired for their SBIR technology by larger firms and an additional 10% of the technologies were licensed to other firms, energizing the defense contractors that acquired or licensed the technologies and creating the base for new business divisions.
- Federal tax calculations show the SBIR/STTR program more than repays the government investment: \$1.46 in increased Federal taxes for every dollar spent on SBIR. State and local taxes add another 71¢, for a total return of 217%, just in taxes.

SBIR/STTR outreach to underserved states and groups is broadening the impact and strengthening national STEM results. SBIR/STTR is leveraging the nation's dramatic spread of "innovation hubs" in geographically disenfranchised regions, led by regional industry/academic/government partnerships, and redefining STEM. New products meeting important American STEM challenges are energizing new generations looking for meaning in work. Increased heartland investment in SBIR/STTR, with technology mining by large firms committed to public infrastructure revitalization, can become a keystone of the Rustbelt's manufacturing revival.

Long-deferred American public infrastructure revitalization offers the same opportunity for improved performance via SBIR/STTR innovation and new STEM architectures that has transformed the defense, energy, bioscience, communication, and information industries. SBIR/STTR infusion offers the potential for simultaneous performance improvements and dramatic cost reductions throughout our economy as we reinvigorate our infrastructure.

As we consider how to sustainably grow America's economy with new products and jobs capable of fully engaging and employing America's workforce with high quality jobs, **SBIR/STTR offers a highly-efficient proven innovation lever for American economic revitalization that creates new technology and jobs within existing R&D budgets.** With 35 years of Congressional support for small business innovation as an unmatched economic growth engine, small firms already generate over 20% percent of America's top technologies and ~40% of tech employment.

We should build on programs that work in creating economic strength, and make them stronger. The new Administration and the 115th Congress have an opportunity to improve the impact of American skill and entrepreneurship building on America's scientific strength, with the SBIR/STTR program as the fulcrum for creating new innovations and better jobs.

Recommendations:

1. Grow the SBIR/STTR allocation to create more new technology, businesses and jobs.
2. Continue to grow America's long term investment in R&D to support our high value economy.
3. Ensure agencies follow SBIR/STTR policies, including for Phase III support.
4. Reduce paperwork/administrative burden relating to proposals, contract admins and accounting.
5. Focus DOD's Rapid Innovation Fund to SBIR. Develop similar programs at other agencies.
6. Maintain strong intellectual property protections for these new technologies and businesses.

DISCUSSION

1. SBIR/STTR: Innovation-focused R&D for New Products, Services and High-Quality Jobs

With repeated favorable, detailed assessments by the National Research Council, Government Accountability Office, and Office of Management and Budget since the 1990's, the SBIR/STTR Program has emerged as a very productive component of Federal R&D, delivering high-quality science and engineering solutions for American use. SBIR/STTR innovations convert basic science into products and services to transform the American economy, and create new high-quality jobs.

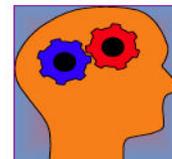
Through early SBIR/STTR work and its commercialization focus, thousands of firms have started and prospered while not a few garage R&D startups (Qualcomm, iRobot, etc.) have become global tech giants. Many other SBIR technologies have been licensed or sold to other American businesses, re-energizing older industries while cutting costs and generating countless new 21st century jobs.

Planned by Congress to ensure American R&D competitiveness, the program has a simple three-phase structure (Figure 1), with competition as its keystone: just one in eight Phase I proposals is awarded, and only one in 20 go on to Phase II. Annually, about 30 percent of awardees are new to SBIR/STTR.

Figure 1 – Source: Dept. of the Navy SBIR/STTR Program

SBIR/STTR: 3-Phase Competitive Program

- **PHASE I**
 - Feasibility Study
 - ~\$150K, 6-months (SBIR)
 - ~\$150K up to 12-month (STTR)
- **PHASE II**
 - Full Research/R&D Prototyping
 - ~\$1M, 2-year Award
 - Sequential Phase II, up to \$1M
- **PHASE III - Key Goal of Program**
 - Commercialization Stage
 - Funded with non-SBIR/STTR Funds
 - Funded by Agency and/or Private Sector



Phases I and II are funded within large agency R&D budgets, targeted to meeting agency mission objectives, in a disciplined, highly competitive structure. Phase III describes follow-on activity outside of SBIR funding, wherein the newly created innovations enter the economy either through commercial sales or follow-on R&D. The Phase I/II SBIR R&D dollars are leveraged by the follow-on R&D and sales, as well internal investment and energy from the small business. Around 14 percent of all SBIR firms have eventually received venture capital and one of every eight dollars invested by VCs is to an SBIR/STTR involved firm. Many large companies have acquired smaller growing firms driven by SBIR technology, for both the products and the technology, transforming themselves with the infusion of the new technology.

Now, a new wave of SBIR/STTR studies² is documenting profound economic impact measured by job creation, high wages, tax revenues, and innovation networks throughout regional economies with resident SBIR/STTR entrepreneurs. From 2000-2013, for example, the Naval SBIR/STTR Program invested \$2.3B in Phase II awards estimated to create \$44B in economic activity over the period while generating \$3.35B in federal taxes – effectively paying for the investment, not counting the longer term effect on jobs and quality of life. As America struggles to level the playing field of economic inequality, SBIR/STTR provides promise and direction, innovating new solutions and combining these with entrepreneurial energy to build new businesses and jobs to replace those lost to industrial obsolescence and foreign competition.

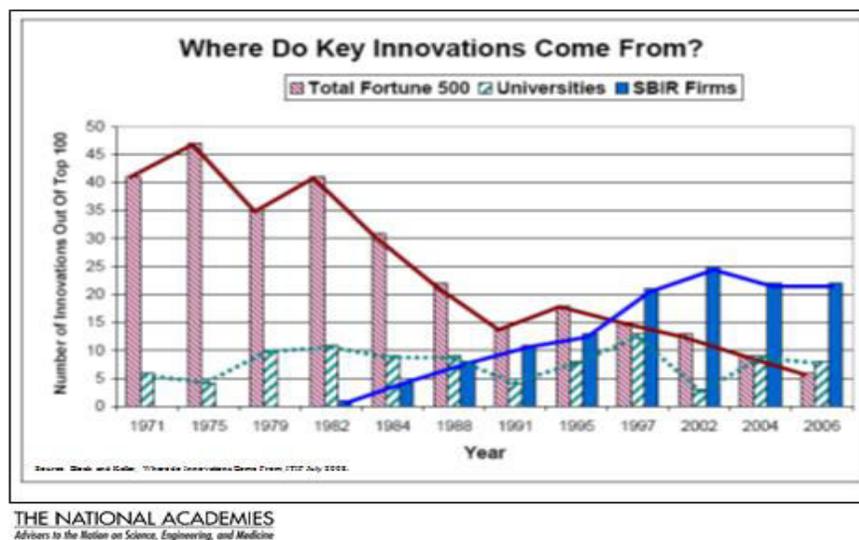
From this Navy study, we see that every dollar invested in SBIR creates \$1.46 in Federal taxes, a 46% return. Thus, we have a program which creates tax dollars, not spends them. Further, the SBIR program generates another 71 cents in state and local taxes for every dollar invested in SBIR.

1.1 Program Objective Achievements

Congress learned in a January, 2016 hearing on SBIR³ that when Arthur Obermayer, one of the founders of the SBIR program, was inducted into SBIR Hall of Fame at the White House, he stated that next to the GI Bill after WWII, SBIR was one of the most significant pieces of legislation ever passed by Congress. Information provided to the Senate Small Business Committee included two vital facts:

- a. The SBIR/STTR Program has been copied by 17 nations around the world.
- b. With less than 1.7 percent of the Federal R&D budget, SBIR/STTR has created 22 percent of America’s key innovations (Figure 2).

Figure 2 – SBIR Role in American Innovation



Source: Fred Block and Matthew R. Keller, “Where Do Innovations Come From? Transformations in the U.S. National Innovation System, 1970-2006”, THE INFORMATION TECHNOLOGY & INNOVATION FOUNDATION, July 2008, pg. 15

² TechLink center at Montana State University-Bozeman, in collaboration with the Bureau Research Division of the University of Colorado-Boulder, completed studies of the [Air Force SBIR/STTR Program](#) (2015) and the Naval SBIR/STTR Program (2016). TechLink engaged with the Dept. of Defense Office of Small Business Programs in 2016 to study economic impact of other DOD entities.

³ Jere Glover Testimony “ Reauthorization of the SBIR/STTR Programs – The Importance of Small Business Innovation to National and Economic Security “ before the Committee on Small Business and Entrepreneurship, U.S. Senate; January 28, 2016, http://www.sbc.senate.gov/public/?a=Files.Serve&File_id=57625744-A72A-424D-8B0B-90E3385108EF.



Committee members also learned that the National Academy of Sciences and its National Research Council's (NRC) 17 reports on SBIR/STTR found that the program meets principal Congressional objectives for SBIR/STTR: (1) to stimulate technological innovation, (2) use small businesses to meet federal R&D needs, and (3) increase the private sector commercialization of innovations derived from federal R&D.

SBIR Over-Achievers: From the Garage to the Globe

Recognizing that Congress seeks tangible evidence of SBIR success, Jere Glover, Executive Director of the Small Business Technology Council, part of the National Small Business Association, produced a signature sample of firms, "... making this the most successful innovation commercialization program in America. Successful alumni of the SBIR program are firms like: **Qualcomm** (cell phone communications), **Symantec** (computer security), **Genzyme** (biotech therapies), **Affymatrix** (GeneChip), **Amgen** (biopharmaceuticals), **Jarvick Heart** (artificial heart), **Titan Corp** (information and communications), **Chiron** (pediatric vaccines), **ATMI** (semi-conductor materials and environmental system) (**AMTI** (advanced materials, radars), **Amorworks** (military armor), **Biogen** (Idec, neurological, autoimmune therapies), **American Biophysics** (mosquito control), **Millennium Pharma** (gene databases), **Geron** (telomerase inhibitors for cancer treatment), **Neocrine Bioscience** (neurological and endocrine pharmaceuticals), **ABIOMED** (world's smallest heart pump), **Aerovironment** (unmanned aircraft), **A123 Systems** (lithium-ion batteries), **FuelCell Energy** (fuel cells), **iRobot** (unmanned robotic vehicles and domestic robots), **JDS Uniphase** (fiber optics, lasers, software), **Stem Cells Inc.** (cell based therapies for CNS and liver disorders), **Intra Lasek** (optical surgery), **Illumina** (genomics) and **Nanosys** (quantum dot displays)."

With global graduates in a pool of more than 700 publicly-traded big firms, the SBIR/STTR program is a formidable jobs engine – especially as firms leave SBIR/STTR incubation, or join 1,975 others in being acquired by larger firms, according to the Innovation Development Institute of Swampscott, MA.

National Academy of Sciences: Repeated Stamps of SBIR Approval

While the Government Accountability Office and Office of the Inspector General have scrutinized and reported on SBIR/STTR Program mechanics more than 25 times since 2000, NRC made a definitive SBIR assessment in a series of reports from 2004 to 2009, comprising thousands of pages, on the SBIR programs at the Department of Defense (DoD), National Institutes of Health (NIH), National Aeronautics and Space Administration (NASA), Department of Energy (DoE), and National Science Foundation (NSF)—the five agencies responsible for 96 percent of SBIR operations.

"The core finding of the study," NRC wrote, "is that the SBIR program is sound in concept and effective in practice."⁴ NRC grouped SBIR program results across federal agencies into four categories, with 380 pages of supporting data:

- Stimulating Technological Innovation
- Increasing Private Sector Commercialization of Innovations
- Using Small Business to Meet Federal Research and Development Needs
- Fostering Participation by Minority and Disadvantaged Persons in Technological Innovation

⁴ *An Assessment of the SBIR Program*; National Research Council; April, 2008; pp. 3-7



In repeated appearances before Congressional committees of the House and Senate discussing SBIR reauthorization between 2004 - 2011, NRC science and technology studies director Dr. Charles Wessner advocated strongly for SBIR/STTR expansion and administrative strengthening, especially to enable more outreach to economically disadvantaged areas such as America’s Rust Belt, and to women entrepreneurs.

National Academy of Sciences: STTR Partners with SBIR to Advance American R&D

NRC complemented its SBIR assessment sequence in 2016 with *STTR: An Assessment of the Small Business Technology Transfer Program*. “STTR is meeting its congressional objective of fostering cooperation between small business concerns and research institutions, and does so in some respects to an extent that SBIR does not,” NRC wrote⁵ in this data-driven study. Noting significant agency application differences between STTR programs, NRC found that “To a considerable extent, STTR fosters private sector commercialization of innovations derived from federal R&D.” What NRC explored, in SBIR or STTR assessments, is **technology commercialization, finding rates of between 45 to 70 percent** depending on the agency, and direct university collaboration between 33 and 63 percent of SBIR awards.

1.2 Different Agency Missions, Different Agency Outcomes

Because the SBIR/STTR statute defines the programs as Federal extramural R&D, expressed at the agency level⁶ in their annual budgets, ownership of SBIR and STTR budgets – and program management, therefore – is vested in the assessed agencies. Consequently, each agency’s SBIR/STTR program takes formal notice of that agency’s mission, giving the SBIR/STTR program across 11 agencies a remarkably diverse character. SBIR/STTR is tailored by each agency, with results tracked and reported. The diversity also leads to opportunities for comparative evaluations towards continually improving best practices.

Missions and SBIR/STTR Topics: Diverse by Definition

Consider, for example, the formal missions of two agencies with prominent SBIR/STTR programs:

- “The mission of the **Navy** is to maintain, train and equip combat-ready naval forces capable of winning wars, deterring aggression and maintaining freedom of the seas.”⁷
- “To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense; and for other purposes. **National Science Foundation** (NSF) envisions a nation that capitalizes on new concepts in science and engineering and provides global leadership in advancing research and education.”⁸

SBIR/STTR topics reflect these different missions. Agencies that don’t procure advanced technologies may publish SBIR/STTR topics written generally to accord with their basic R&D interests on the leading edge of innovation – such as NSF or the National Institutes of Health within the Dept. of Health & Human Services. On the other hand, Dept. of Defense (DOD) agencies seek high quality R&D solutions for defense challenges, and issue precisely written topics with potential follow-on purchases of products and services designed to ensure that American warfighters are equipped for success in emerging battlefields.

⁵ *An Assessment of the Small Business Technology Transfer Program*; National Research Council; June, 2016; pp. 4-6

⁶ By statute, and the accompanying *SBIR/STTR Policy Directive* published by the Small Business Administration, the SBIR assessment is taken for each Federal agency with an extramural R&D budget above \$100M. The STTR assessment is taken for each Federal agency with an extramural R&D budget above \$1B. The *Directive* provides detailed instruction on tracking and reporting.

⁷ <https://www.navy.com/about/mission.html>

⁸ https://www.nsf.gov/pubs/2014/nsf14002/pdf/02_mission_vision.pdf



Agencies such as the Dept. of Energy, which doesn't procure innovation but is focused on American energy needs, publish topics designed to guide innovation and extend promising applied research from DoE's national laboratories such as Los Alamos NM and Oak Ridge TN. NRC, in its SBIR and STTR assessments, has regarded such diversity as the program's backbone, and insurance that SBIR/STTR makes a broad, deep and practical contribution to American R&D. NRC studies have chronicled substantial SBIR/STTR commercialization at non-procuring agencies, evidence of the commercial vitality of SBIR/STTR technology solutions.

Missions and SBIR/STTR Commercialization Assistance: Diverse by Design, and Statute

Similarly, agencies have tailored assistance to SBIR/STTR awardees since 1999 in strengthening their small businesses to accord with entrepreneurial needs to achieve commercialization. Congress first mandated this in 2002 SBIR/STTR reauthorization by emphasizing the importance of project commercialization plans in evaluating SBIR/STTR proposals. But Congress went on to expand the commercialization focus significantly in 2011, authorizing agency pilot plans to accelerate SBIR/STTR commercialization for agencies other than the Dept. of Defense. Now all SBIR/STTR awardees have the option of using some award funds to hire technology commercialization experts.

Agencies that procure advanced technologies, led by DoD military departments, offer commercialization assistance that facilitates small business transition to DoD, including production capability and requisite certifications. Such DOD practices resonate with increasing warfighter and acquisition command acceptance of SBIR/STTR. Best practice examples include two Naval documents, *Tapping Into Small Business In a Big Way* – guidance issued in January 2015 by the Assistant Secretary of the Navy for Research, Development and Acquisition – and the *Dept. of the Navy SBIR/STTR Phase III Guidebook for Program Managers and Contracting Officers*, a 2014 Naval desk reference in standard use throughout Naval Systems Commands, and elsewhere in DoD organizations.⁹

Agencies that don't procure also select SBIR awards based upon anticipated benefit and commercialization potential. As these agencies achieve their missions when SBIR technologies reach the commercial marketplace, they also offer assistance to help small business identification of potential markets and customers and can further support successful SBIR projects through their regular agency R&D awards. The SBIR program currently only uses a very small fraction of agency external R&D – the remainder (some 97%) is spent with large businesses, national labs and universities on R&D. Yet some 38% of the nation's scientists and engineers work in small business, with high skill given the high levels of success. The non-procuring agencies could decide to further their mission achievement by opening up their regular R&D awards to the highest performing of their SBIR projects, the ones determined most promising to best support the agencies' missions. These agencies are also required by the 2011 reauthorization to make Phase III awards to the SBIR innovators "to the greatest extent practicable" to accelerate commercialization of SBIR/STTR technologies for domestic markets. Some agencies and departments have been slow to implement the provisions of the law.

While assessments of SBIR/STTR technical assistance curricula has varied, the consensus is that about 70% of all DoD and NSF SBIR/STTR projects receive non-SBIR/STTR commercialization investment or sales revenues, as do about 49% of all SBIR/STTR projects funded by NIH, NASA and DoE.¹⁰

⁹ Both documents are found at <http://navysbir.com>.

¹⁰ *An Assessment of the SBIR Program*; National Research Council; April, 2008; pp. 59-60



Amidst years of Congressional efforts to improve American R&D commercialization – including the Bayh-Dole Act among several pieces of legislation – SBIR/STTR has a continuous and steadily-improving record of successful technology commercialization.

1.3 Strengths and Improvement Areas

Principal strengths of SBIR/STTR are found in many areas:

- **Seed funding:** With per project funding of up to \$3M available to its awardees across a wide swath of Federal agencies, SBIR/STTR is a unique **seed fund for American technological innovation**, investing at the earliest stages in technologies that are pre-commercial and prior to stages at which Venture Capital is interested. Awards are strictly merit-based in this highly competitive program with only 1 in 20 proposals reaching Phase II, and the program’s success supports American economic revitalization.
- **Uniquely American approach to draw on the energy of technology entrepreneurs:** The SBIR program taps American entrepreneurs and the 38% of our scientists and engineers employed by small business to solve Federal agencies’ most important long range technology challenges and opportunities, and to create new products and services in the small businesses that create most of America’s new jobs.
- **Jobs driver:** With the current studies of agency SBIR economic impact, this program emerges as a very **significant jobs-and-wages engine** for regional economies nationwide, where the multiplier effects of the new products and services create ripples of growth as dollars turn over within that region.
- **American manufacturing on-ramp:** Congressional emphasis on delivering SBIR/STTR innovation to warfighters and domestic user alike, SBIR/STTR enables small business to experiment with prototype development from promising R&D, followed by scale-up to actual product manufacture. Further, SBIR/STTR has links to key Federal advanced manufacturing and additive manufacturing programs.
- **Intellectual property development:** Intellectual property is the bedrock for good American jobs, and the number one indicator of regional wealth. The SBIR program is focused on developing IP.
- **High impact R&D program:** With commercialization of innovative R&D as an SBIR/STTR objective, a high commercialization rate, and a history of growing tech firms with global clout, the program invests ~\$2.5B annually in **practical R&D, creating new industries such as robotics, MEMS, additive manufacturing, and new medical devices**, in addition to revitalizing old industries. Although SBIR/STTR is less than 3.5 percent of Federal external R&D, it’s proven capable of delivering useful innovation in the form of products and services. Further, such practical R&D is the work of an otherwise underutilized American asset: small business science/engineering skill.
- **Technology-driven cost-savings:** With economies in cost, prototype scale-up and production, SBIR/STTR can generate **critical cost savings** – as has been noted by the American defense sector¹¹:
 - **F-35 Lightning II fighter plane**, according to Air Force Lt Gen Chris Bogdan, has realized more than \$500M in cost savings to date through use of SBIR/STTR technology and manufacturing solutions – a bright spot in an otherwise gloomy fiscal picture.
 - The **MRAP vehicle** that saved lives in Iraq and Afghanistan, according to Army and Marine Corps sources, realized a 90% savings in live-fire testing through use of SBIR/STTR technology.
 - The **Virginia-class submarine**, according to Naval Sea Systems sources, realizes cost savings and avoidance of ~\$1M per hull by using one SBIR project’s technology in the boat’s communications system alone, and millions more with SBIR/STTRs in additional submarine systems.
- **New startup formation and technical business help:** SBIR/STTR is a **virtual incubator for entrepreneurs** in remote rural areas, dense inner cities, and anywhere else economic revitalization is needed. SBIR/STTR administrative funding encourages such new entrepreneurship. **Innovation partnerships:**

¹¹ Cost saving/avoidance detail for DoD ACAT Programs is available from appropriate MILDEP SBIR/STTR Program Offices on request, and from the Secretary of Defense (OSD) Office of Small Business Programs.



With its links to government, university, laboratory and industry partners, SBIR/STTR is a unique **venue for collaborations of regional or national R&D stakeholders** – the seed corn for domestic economic vitality.

- **Competition:** With rigorous emphasis on innovation and competition at Phases I and II, SBIR/STTR levels the playing field between experienced R&D practitioners and fresh “garage-stage” entrepreneurs. Year in and year out, about 30 percent of SBIR/STTR awardees are first-time winners, NRC found.

Areas for SBIR/STTR improvement touch on six frequently discussed issues¹²:

- **American small business employs 38 percent of our scientists and engineers, but receives only five percent of the Federal 135 billion dollar R&D budget, with the SBIR/STTR programs comprising only 1.7%.** This misses the historically-demonstrated American potential for technology and jobs growth represented by our entrepreneurs and small businesses, and compares poorly competitively with the European Union’s current 16.9 percent direct award of EU R&D work to small business. As basic science has grown more complex and innovation has increasingly required both high levels of technical skill and entrepreneurship, our continuing underutilization of America’s small business engineers, innovators and job creators in Federal R&D misses a primary opportunity to strengthen our economy.
- **Updating and streamlining of the Federal Acquisition Regulation** is needed to simplify the SBIR process.
- **Small business R&D goals required in the law need to be implemented and enforced.**
- **Non-DoD domestic agencies, given Phase III authority and commercialization encouragement by 2011 SBIR/STTR authorization, should consider how to further development of their most successful SBIR/STTR projects.** While DOD has opened up its non-SBIR R&D programs for follow-on projects to successful SBIR Phase IIs funded with their large regular R&D budgets, the non-DoD agencies in general have not supported such follow-ons. The data suggests this may be short-sighted, especially as venture capital remains focused on more advanced technologies that have near term commercial potential. Naval and Air Force success with SBIR/STTR Phase IIIs, plus the success of the Rapid Innovation Fund and its high number of applicants, have demonstrated the effectiveness of available sources of Federal follow-on funding for advancing SBIR/STTR technologies.
- Statute authority for **DoD components to promote Phase III awards “to the greatest extent practicable”¹³** should be implemented through a combination of better education of acquisition personnel¹⁴, better reporting of Phase III awards including capture of non-Federal investment, performance monitoring by the Government Accountability Office, and incentives to core acquisition personnel. Expediting of required sole source contracting of Phase III projects will save costs by both Government and small business contractors by eliminating time wasting inefficiencies.
- The Government-Industry Advisory Panel should work to **ensure data rights and patent protections for small business inventions.** This includes Panel work regarding rights in technical data, the validation of proprietary data restrictions, and the regulations implementing such sections. Protecting this intellectual property will help stop the bleeding of important American inventions and associated jobs to foreign nation competitors. Any requirements of Broad Agency Announcements (BAA) requiring relinquishment of these data and patent rights should be prohibited.

¹² *How Congress Can Help SBIR Companies Create Jobs*; Small Business Technology Council; June, 2014, <http://sbtc.org/wp-content/uploads/2014/06/SBTC-White-Paper-June-25-How-Congress-Can-Help-SBIR-Companies-Create-Jobs-6-20-2014.pdf>

¹³ Section 638, title 15, United States Code (15 U.S.C. § 638 [2012]), 1 subsection r(4)

¹⁴ See, for example, *SBIR and STTR Phase III Guidebook for Program Managers, Contracting Officers and Small Business Professionals*; Naval SBIR/STTR Program Office; May 2016.

- **The shrinking of the Federal R&D base also causes the jobs-creating SBIR allocation to decrease proportionately.** Combined with the 2011 inflation catchup boost in the size of Phase I and II awards, this has led to a decrease in the number of awards. With a relatively steady over time 1 in 8 Phase I proposals selected for a proof-of-concept award, and only 1 in 20 advancing to Phase II, together with rapidly increasing proposal costs for meeting increasing proposal administrative requirements and arbitrary financial restrictions raising business costs, the number of proposals has also decreased proportionately with the awards. There appears to be substantial innovation capacity in the nation for many more high quality proposals if the SBIR budget could be increased and red tape could be cut.
- **American technological competitiveness is based upon entrepreneurship and R&D, and should be ensured through increased R&D and SBIR/STTR funding.** R&D funding as a percentage of GDP shows a decline of over 60% percent over the last four decades, as seen in **Figure 3**, below. Federal R&D spending has fallen about 70 percent as a percentage of the Federal budget in the last 50 years, as seen in **Figure 4**. Importantly, this decline may correlate with the troubling downtrend trend of participation by new companies in the nation’s high-tech sector, seen in **Figure 5**. Because it’s now a given that small business is the American jobs engine, this downtrend is of special concern. Investment in R&D is a critical priority we can have for high quality job and wealth creation as patents are the number one indicator of high wage jobs and regional wealth.¹⁵

In an age of increased global competition, including competition with increasingly capable allied nations as well as a world of developing nations offering lower wage costs, America cannot afford an R&D and innovation deficit among our best job creators. SBIR clearly provides more bang for the Federal R&D buck than any other innovation program.

¹⁵ See Federal Reserve Bank of Cleveland, “Altered States: A Perspective on 75 Years of State Income Growth,” *Annual Report 2005*. For more detail, see Paul Bauer, Mark Schweitzer, Scott Shane, *State Growth Empirics: The Long-Term Determinants of State Income Growth*, Working Paper 06-06, Federal Reserve Bank of Cleveland, May 2006, <https://www.clevelandfed.org/en/Newsroom%20and%20Events/Publications/Working%20Papers/2006%20Working%20Papers.aspx> and then Click on the PDF for WP-06-06 by Bauer *et. al*.

See also, Patenting Prosperity: Invention and Economic Performance in the United States and its Metropolitan Areas Jonathan Rothwell, José Lobo, Deborah Strumsky, and Mark Muro. Being in a high patent region adds \$4,300 per worker to annual income, which is \$8,600/year for a two worker household. <http://www.brookings.edu/~media/research/files/reports/2013/02/patenting-prosperity-rothwell/patenting-prosperity-rothwell.pdf> page 15.

• **Figure 3 – Federal R&D Funding as a Percentage of Gross Domestic Product**

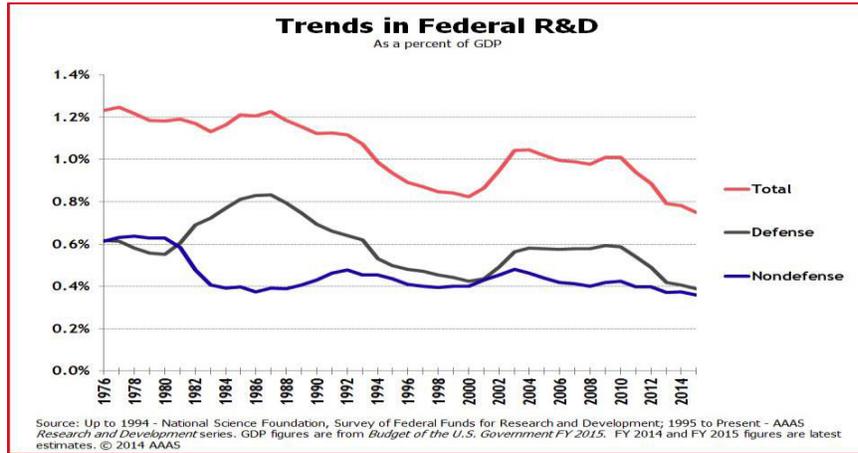


Figure 4 – Federal R&D Funding as a Percentage of the Federal Budget

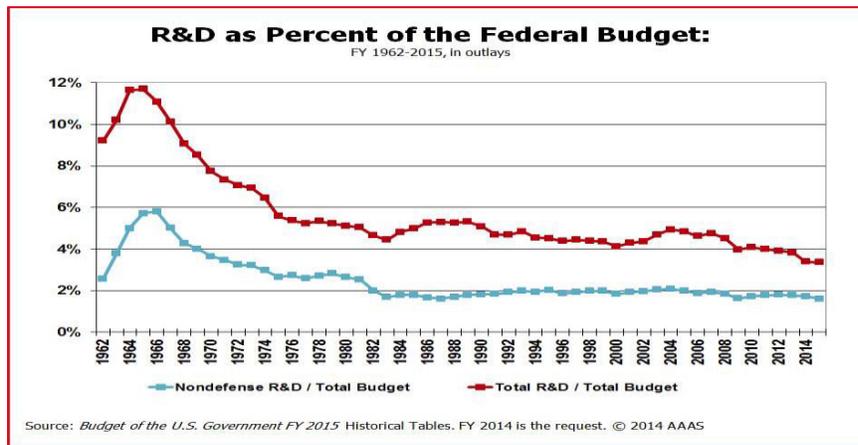
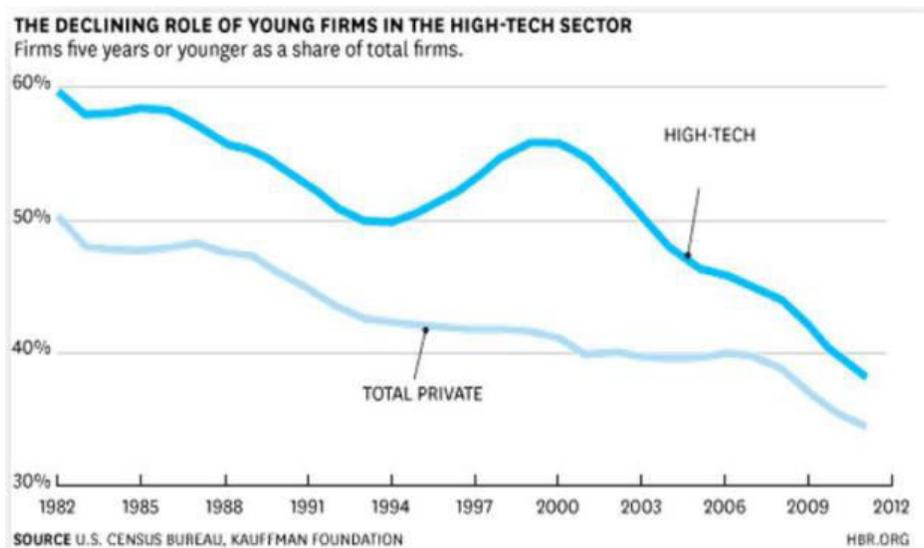


Figure 5 – Declining Role of New Technology Companies

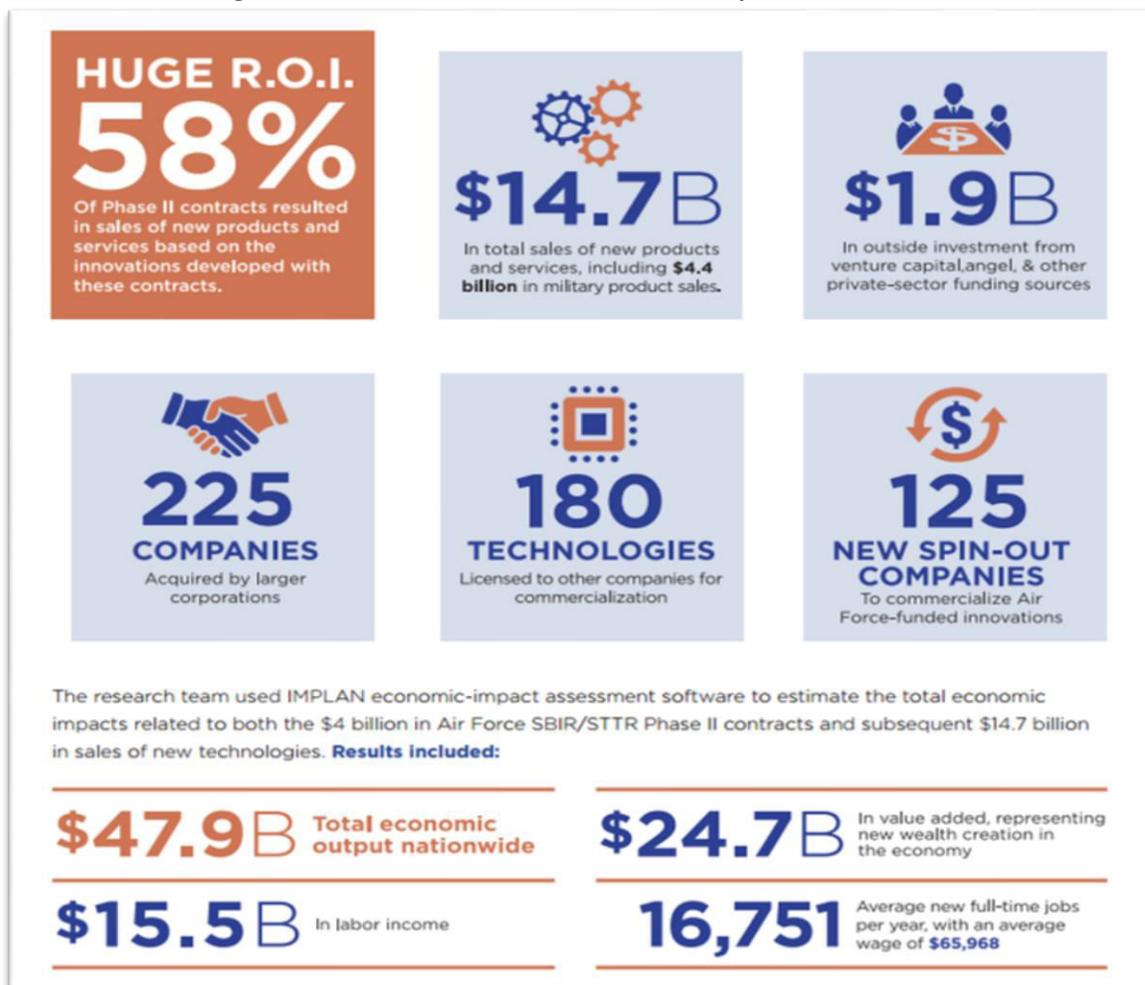


1.4 Economic Impact

SBIR/STTR programs of the Army, Navy/Marine Corps and Air Force began in the late 1990's to assess success and publish short "success stories" of SBIR/STTR technologies transitioning into DoD platforms and systems¹⁶. Typically, these have averaged one per month, and non-DoD agencies including the Small Business Administration have emulated such publication as a performance measure.

In 2014, however, the Air Force SBIR/STTR Program took the unprecedented step of commissioning an assessment of the economic impact of its Phase II investments over the period 2000 – 2013: a performance measure of significance for American economic revitalization. The extraordinary results, depicted below in **Figure 6**, an infographic from the study¹⁷, immediately came to Congressional attention. (Note: the results below are understated in that they do not capture the sales and jobs effect that Air Force SBIR/STTR technologies had on licensees or acquirers of these technologies.)

Figure 6 – Air Force SBIR/STTR Economic Impact, 2000 – 2013



¹⁶ See, for example, <http://www.navysbir.com>, or <http://www.afsbirsttr.com>, or <https://www.armysbir.army.mil>

¹⁷ *The Air Force Impact to the Economy Via SBIR-STTR*; US Air Force SBIR/STTR Program Office; 2015, <https://www.sbir.gov/sites/default/files/USAF%20SBIR-STTR%20Economic%20Impact%20Study%20FY2015.pdf>

After publication of this revelatory study, the Dept. of the Navy SBIR/STTR Program engaged the same research firm to apply a refined data analytics model to its own record of Phase II investment for the same period, 2000 – 2013. While the Naval and Air Force SBIR/STTR Programs are not exactly comparable, the Navy results¹⁸ (Figure 7) showed the same profound economic impact of job creation, high wages, and multiplier effects in regional economies – plus Federal tax revenue data showing that Naval SBIR/STTR Phase II investment of \$2.3M returned \$3.5M in taxes to the US Treasury – suggesting that SBIR/STTR Phase II investment paid for itself with a hefty cash return on the investment, in addition to the impacts of the technologies on performance and costs and the jobs/wages benefit. Also, by generating more than \$0.71 in state and local taxes for every dollar invested by SBIR, it strengthens the local communities where SBIR investments are made.

Figure 7 – Naval SBIR/STTR Economic Impact, 2000 – 2013



¹⁸ *Small Business > Big Impact: Naval SBIR/STTR Investment 2000-2013*; Dept. of the Navy SBIR/STTR Program Office; 2016



Both the Air Force and Naval SBIR studies had a higher response rate (>90%) from queried small firms than did any of the NRC studies. Further, these two studies developed broader and more meaningful metrics in showing the value of SBIR commercialization and job creation.

With additional Federal agencies looking at SBIR/STTR's economic impact, President Trump and the 115th Congress can expect to see data arguing that the SBIR/STTR contribution to American R&D is more than great technology: it is jobs, high wages and strong regional impact to support economic revitalization.

2. SBIR/STTR: Dramatic, Lasting Impact on the American Economy

Technology drives opportunities for sustainable economic advantage and offers a path to preserve America's high value jobs and wealth. The 21st century economy is driven by technology, and jobs and fortunes will be made or lost based upon the flows of technology. The 2016 American elections highlighted America's economic tensions as we work to preserve our standard of living while much of the world seeks to raise its standards. To sustain America's strength we need to continue to invest in R&D and to innovate new technologies. SBIR/STTR provides a demonstrated capability to do fulfill the larger promise of American R&D, via national economic revitalization. The 115th Congress, as it takes up SBIR/STTR improvement and the larger issue of R&D revitalization, can be expected to view this landmark, high-achieving program through a new lens of opportunity for American defense/security, American energy, and American public infrastructure.

2.1 Driving Role of Technology in the Economy

The story of post-1945 global trade shows successive waves of nations rising to challenge older economies, partly through lower labor costs but mostly through integration of technologies that hiked productivity, lowered manufacturing costs, and accelerated product delivery.¹⁹ While new science such as robotics eliminates older assembly jobs, new technology jobs at higher wages are created²⁰.

What SBIR/STTR has done already to buoy the defense, space, energy, IT and bioscience industries, it can do for other American industries such as infrastructure construction – with robust economic benefits.

2.2 From Basic Science to Innovation, Jobs and Products

Practical innovation – a good working definition of SBIR/STTR – is necessary to transform basic science into useful products and services. With his light bulb innovation, Thomas Edison took electrical current science to a life-changing level. SBIR/STTR topic problems, whether from the Dept. of Agriculture or the National Cancer Institute or other agencies, challenge entrepreneurs to apply science and engineering skills to development of innovative “form/fit/function” solutions. SBIR/STTR, through its seed funding, technological mentoring and commercialization assistance, provides the juice for such solutions.

These American-bred solutions, born of basic science through R&D, lead to substantial well-paying American jobs, and to the revenues that keep American regional economies spinning and growing. While the SBIR/STTR statute is silent on regional economic benefit, small businesses see themselves as local players linked to local economies to provide goods and services essential to business growth, and to universities or similar STEM talent sources to provide employees. An SBIR business's jobs also tend to stick to the regions where they were created.

¹⁹ *Making America 1953 Again*; Washington Post; December 29, 2016

²⁰ <https://techcrunch.com/2016/05/13/robots-wont-just-take-jobs-theyll-create-them>



SBIR fills a key gap in America's innovation economy, the often-long and risky path from fundamental science to products. America's universities are excellent at developing fundamental basic science and research, using some 35% of Federal external R&D. But converting basic science to innovations for new products and services and jobs is a bottleneck in the pipeline. VCs and major companies tend to not tackle early stage innovations, seeking product opportunities with most of the technology risk removed. This leaves an innovation gap, between basic science and marketable products.

Bank lending to small business remains severely depressed: since 2008 lending to small business has declined by \$99B, with many big banks that received TARP recession recovery funding abandoning small business lending. Venture capital investment for seed funding, and investment beyond Silicon Valley, has decreased dramatically. Since 2008 venture capital has declined for first-round financing in particular, and for early stage investment generally. In 2015, venture capital only made 185 seed-round deals; Contrast this with the SBIR/STTR program that makes almost 5,000 awards each year. Also, venture investments are principally made in two states, California and Massachusetts, and are concentrated in very few industries. 85 percent of VC funding is provided to just five states, and 60 percent of the total funding goes to California. For most small business in most of the nation, then, venture capital is not a realistic option to grow and commercialize their inventions.

Other countries have taken advantage of our imbalance to reduce America's technology lead, driven by more directed STEM-driven economic development mandates, lower labor costs, and building on American science. For example the European Union has now increased to over 16.9% the target R&D proportion provided directly to small businesses, about five times America's overall 3% of Federal R&D expenditures (the majority from SBIR). Seventeen other countries have copied the SBIR program in their countries. The Federal SBIR program seeks to release our innovation pipeline imbalance, unleashing entrepreneurial drive to create future jobs. SBIR combines agency-identified mission priorities with small business entrepreneurially-driven innovation, led by risk-taking entrepreneurs and private sector research leaders (often from universities or other large research organizations), and advancing our nation's basic science into novel applications and products.

The SBIR program targets this current bottleneck in America's innovation pipeline. Results have shown the high payoff from focusing a very small portion of the Federal R&D budget upon agency-identified challenges to unleash the entrepreneurially-driven energies of our small businesses. These businesses are led by risk-taking small business entrepreneurs and research leaders, often originally from universities or other large research organizations. 60% of SBIR projects involve at least one founder with a university background, and formal small business-university SBIR collaborations are growing, now at 35-50% depending upon agency. All STTR projects involve collaborations between small businesses and research institutions. Our small high tech businesses are driven to commercialize and grow, and efficiently convert science into innovation and jobs needed for our tech economy. The result is SBIR's high innovation productivity: using only 3.4% of the external R&D budget (1.7% of the budget overall) to produce 22-25% of the major innovations, 5500 patents/year, and a stream of new products, services, and high quality jobs.

The U.S. needs more small business-driven innovation to help build a stronger America that can continue to out-compete the world. Small businesses by their entrepreneurial private sector nature do this well, creating over two-thirds of the net new jobs in the past 15 years. America needs more SBIR awards to transition more science and technology to innovations, patents, products and high quality jobs.



2.3 SBIR/STTR and Collaborative Economics

If Silicon Valley gave the world the winning concept of “collaborative advantage”, it’s fair to say that SBIR/STTR takes that concept operational nation-wide through a collaborative model that links small and large business, government labs, universities and other technology stakeholders. These collaborations on SBIR/STTR projects address current and future American technology needs while establishing a vibrant regional root structure of productive and well-paying STEM-derived jobs and revenues, supporting American economic vitality. And the attainment of significant Phase III outcomes relies upon the entrepreneurial energy and investments of the small businesses in advancing their SBIR results towards commercial sale.

2.4 Broadening the Impact:

Sensing that SBIR/STTR benefits weren’t equitably distributed throughout America, Congress acknowledged this in its 2011 SBIR/STTR reauthorization, mandating outreach to underserved populations and regions and related improvements to ensure greater SBIR/STTR commercialization outcomes consistent with continued reliance upon merit decisions in selecting proposals.

In response, SBIR/STTR used special administrative funding from the statute to launch “SBIR Road Tours: Seeding America’s Future Innovations” in nearly 20 states, in a concerted effort to spread program benefits nation-wide. In parallel, the Dept. of Commerce launched 35 tech-focused “Rapid Innovation Clusters” – many in greater Rust Belt regions. And numerous universities began forging regional partnerships to commence “innovation institutes” to navigate STEM entrepreneurs through the startup “Valley of Death”. Further, in some Rust Belt states where the return of traditional blue-collar manufacturing jobs is problematic, “innovation corridors” are springing up to grow emerging industry opportunities in new fields such as robotics, additive manufacturing and bioscience that offer high value jobs for the future.

This outreach is still new, but is showing potential for broadening the impact of SBIR across all of America. While the issue is partly the result of the general STEM issue, opportunities offered by the SBIR/STTR program together with improved outreach can also be used to help advance America’s STEM initiatives.

3. Recommendations

Federal legislative and agency action could remove roadblocks restraining full achievement of SBIR/STTR potential, and prepare the path forward to American economic revitalization. The small business community, which creates most American new jobs and makes up 99.7% of U.S. firms, asks Congress to take the following actions to strengthen American competitiveness and jobs and to maximize the SBIR/STTR effectiveness:

A. Substantially increase the SBIR/STTR allocation of Federal R&D. This will increase innovation development and increase the impact on the economy, at no increase to the Federal R&D budget.

B. Keep America in the forefront of high technology by growing America's long term investment in R&D.

C. Insist that the SBIR/STTR statute's Phase III emphasis (and SBA Policy Directive implementation guidance) be fully implemented by all federal agencies with SBIR/STTR programs.

1. Ensure that all agencies have policies supporting the SBA Policy Directive on SBIR/STTR, promulgating Congress's intent under SBIR legislation.
2. Modify 15 USC 638 to require full implementation of SBIR/STTR Phase III rules, to further reinforce the "to the greatest extent practicable" requirement.
3. Federal agencies' Phase III actions should be taken as required by law – "to the greatest extent practicable", and should be tracked fully, in real-time, and reported by agencies and prime contractors.
4. The Federal Acquisition Regulations, FAR agency supplements, procurement manuals and procedures should be revised to implement the 2011 SBIR/STTR statute, with training and oversight procedures developed and executed to ensure implementation.
5. Create goals and make incentives available to agency Program Managers, Contracting Officers, ACOs, Contracting Officer Representatives, prime contractors and others to ensure proper recognition and pursuit of SBIR/STTR objectives.
6. Revise the law to require that at least 25 percent of the members of the Defense Business Board represent small businesses.
7. Require that the military departments use part of their 3% money to provide expedited security clearances for SBIR companies during early (pre-classified) research programs to prepare new small firms for classified work and accelerate incorporation of new technologies into weapons programs.

D. Reduce paperwork/administrative burden relating to proposals, contract administration and accounting, and reconsider financial restrictions placed on SBIR awardees.

1. Proposal requirements are becoming increasingly time-consuming and inflexible, boosting costs while creating administrative hurdles separate from the primary purpose of seeking high quality innovation.
2. Contract requirements are heavily burdensome especially for small SBIR businesses. Requirements streamlining will access a broader range of potential innovators while reducing red tape and paperwork burdens on the work.
3. Increasingly SBIR awardees are facing financial restrictions in the forms of requirements for meeting large company accounting rules and at some agencies in overhead restrictions set to exclude the highly capable and integrated small businesses that characterize advanced innovation. Acceptance of simplified but accurate accounting procedures and contract vehicles as well as eliminating overhead caps will help meet the rapid pace of modern innovation while better focusing on the work itself.

E. Retain the DoD Rapid Innovation Fund (RIF) program exclusively for its original purpose of DoD SBIR Phase III transition, and develop similar programs for other agencies.

1. Continue the originally proposed \$500M in RIF funding solely for SBIR Phase III work.
2. Initiate a new stimulus program for “Fly-Over” non-VC states, funding an additional \$1B stimulus to SBIR companies in non-VC dominant states (other than California, Massachusetts, New York, Texas, Washington State, and Washington DC) for 500 - \$2M Phase III SBIR programs.
3. Since every \$1 invested in SBIR returns \$1.46 back in Federal taxes, it should be clear that SBIR is a net addition to the tax base and thus an overall reducer of the deficit and national debt.
4. More generally, reconsider non-procurement agency practices that fail to track Phase III success metrics, provide inadequate Phase III policy or transition follow-up, and discourage small business participation in non-SBIR regular R&D programs, such as barriers to contracting, high administrative burdens on proposals and contracts, and cost-sharing requirements.

F. Maintain strong intellectual property protection for SBIR/STTR innovations throughout Phases I-III.

1. With intellectual property a primary small business asset, patent law changes to support patent development and issuance to innovators as well as patent valuations will help justify increased entrepreneur and outside investment. Patents protect American jobs, and patent reform must ensure that small business innovation is not crushed by the interests of large businesses. Small business innovation and its resulting patents are core drivers for America’s high value production and standard of living. The small business technology sector must be given a voice in the development of such laws.
2. Protect the proper allowability of patent expense in SBIR awards.

G. Require the agencies create small business goals for their Federal R&D expenditures.

H. Allow agencies currently not currently included in SBIR (e.g. the VA, iARPA) to join the program.



America remains the world’s powerhouse of science, entrepreneurship and innovation. But the world is at our heels, seeking also America’s economic dream, and competing hard to gain it with increasing investments in education, R&D and industrial development, and from a much lower wage base. For America to hold and grow its position, we need to reinvigorate our investment in our economic effectiveness and in the drivers that have built our economy: science, R&D, a highly educated workforce, entrepreneurship, innovation, intellectual property, and private enterprise. The SBIR/STTR program offers a well-tested and demonstrated base addressing national technology challenges and enlisting American small business entrepreneurs, scientists, engineers and STEM workers to convert our strong basic science into innovations to re-energize our core industrial and service industries. The recent studies show this effectiveness, and start to quantify the remarkably strong response it is causing in our economy, building new businesses, creating new products and services, and growing high quality jobs. We invite Congress to build upon this entrepreneurial Federal program to help further build America.



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