CHAPTER 11
The U.S. Small Business Innovation Research (SBIR) Program: A Comparative Assessment

BY

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Like many other nations around the world, the United States aggressively pursues technological innovations that contribute to its continuing economic and strategic success. The U.S. government's procurement system enables the government to use multiple methods to develop and procure technology. One method is the Small Business Innovation Research (SBIR) program, which funds small businesses to develop these innovative solutions. The SBIR program was in important ways an inspiration for the European Union's 'innovation partnerships', which similarly fund research and development through European procurements in a three-phase process.(1)

The U.S. Congress established the SBIR program 35 years ago specifically to foster small business participation in technological research and development (R&D), and Congress funds the SBIR program by 'taxing' the major R&D budgets at other agencies. SBIR participants proceed through three phases, during which the participants foster an idea from a small-scale prototype, to stable product, and eventually to a tailored technology solution suiting the government's (and the commercial market's) needs. To support small businesses participating in the program, the SBIR program takes a uniquely liberal approach to competition requirements and data rights in procurements involving technology developed under the program, compared to typical procurement methods. Currently, eleven federal agencies participate in the

(1) *See*, e.g., EC, "Innovation Partnerships Keep Public Services Up to Date", 3 March 2016, ec.europa.eu/growth/content/8699-innovation-partnerships-keep-public-services-date_en; M. ANDHOV, "Innovation Partnership in the New Public Procurement Regime – A Shift of Focus from Procedural to Contractual Issues?", 24 *Pub. Proc. L. Rev.*, 2015, p. 18, available at ssrn.com/abstract = 2910911.

SBIR program, among them the Department of Defense (DoD), which spends over $1 billion per year funding technology projects in the first two phases.

To offer a case study for other countries' 'innovation partnerships', this paper focuses specifically on the DoD's use of the SBIR program and the challenges the Defense Department faces in demonstrating success in the third phase, during which SBIR technologies transition into military systems for use in the defense mission. This paper seeks to identify measures of the SBIR program's success, and to offer preliminary conclusions as to whether the SBIR program presents useful contracting methods to increase small business participation in research and development, and whether the SBIR program provides meaningful transition of new technologies to DoD projects.

1. Introduction

The United States Small Business Innovation Research (SBIR) program dedicates a portion of its website, www.sbir.gov, to its success stories. Procurement programs worldwide have copied tenets of the program, advocates for small business declare its economic importance, and federal agencies assert that the program has afforded important cost savings and value to U.S. innovation. But are these claims alone sufficient to conclude that the program is successfully delivering innovative technology into the hands of government users?

Over the past 35 years, the SBIR program, established through statute and executive order, has emerged as a leading method to foster small business participation in research and development (R&D) in the U.S. federal government. The U.S. Small Business Administration (SBA) administers the program and is responsible for ensuring its success. (The SBA's *Policy Guidance* for the SBIR program sets forth the program's central legal requirements). The SBIR program includes three phases, during which program participants advance an innovation from a small-scale prototype in Phase I, to a stable product in Phase II, and eventually to a tailored technology solution suitable for government (and often commercial) use in Phase III.

Currently a large number of federal agencies – those with R&D budgets over $100 million per year – participate in the SBIR program: the Department of Agriculture, the Department of Commerce (including the National Institute of Standards and Technology (NIST), and the National Oceanic and Atmospheric Administration (NOAA), the Department of Defense (DoD), the Department of Education, the Department of Energy, the Department of Health and Human Services (HHS), the Department of Homeland Security (DHS), the Department of Transportation (DOT), the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), and the

National Science Foundation (NSF). Each agency with an R&D budget over $100 million must contribute, by law, at least 3.2% of its R&D budget to the SBIR program.(2) Because of the DoD's large R&D budget, DoD agencies are leading users of the SBIR program.

The SBIR program has always been a source of controversy, in part because of the enforced 'taxation' which funds the program (and draws resources from more traditional R&D projects), and in part because of the special preferences (discussed below) for technologies that emerge from the program.(3) As recently as January 2018, two agencies of the U.S. government published sometimes conflicting perspectives on the SBIR program's effectiveness. The first report was from the Section 809 Panel, a blue-ribbon panel commissioned by Congress in Section 809 of the National Defense Authorization Act of 2016(4) to study opportunities to improve DoD acquisitions by updating the DoD's procurement rules. Volume I of the Section 809 Panel's report recommended that the Defense Department leverage the SBIR program's successes to "advance warfighting capabilities and capacities", and further suggested permanent policy changes to incentivize use of the SBIR program. The Section 809 Panel referenced reports of 'positive outcomes', noting that the government has received "high quality and innovative proposals" and that small business participants are receiving venture capital to further subsidize their innovations.(5) The Section 809 Panel report was not entirely positive, however. The panel also concluded that the SBIR program "lacks speed, agility, and flexibility", and that the "program's processes are increasingly onerous".(6)

The second mixed report was from the U.S. Government Accountability Office (GAO), an agency within the legislative branch which audits and investigates government agencies on behalf of Congress. This report summarized the SBIR program and determined that due to "challenges in collecting and verifying the accuracy of data", it was unclear if the program was meeting its own benchmarks. The report sharply concluded that although "federal agencies have awarded billions of dollars to small businesses to help these businesses

(2) U.S. Small Business Administration, "About SBIR", www.sbir.gov/about/about-sbir.

(3) *See*, e.g., I.M. Silverman, J.M. Dawicki-McKenna, D.W. Frederick, C. Bialas, J.R. Remsberg, N.L. Yohn, N. Sekulic, A.B. Reitz and D.M. Gross, "Evaluating the Success of the Small Business Innovation Research (SBIR) Program: Impact on Biotechnology Companies in Pennsylvania", *Tech. Transfer & Entrepreneurship*, 4, 2015, p. 5: "It remains controversial whether this form of private enterprise stimulation is a productive use of federal funding that might be better spent supporting university-based research. Additionally, there is growing concern that changes to the law allowing for majority venture-backed companies to compete for SBIR awards could crowd out companies that lack other sources of funding", pdfs.semanticscholar.org/7957/1a1e078b85930bf3bc8f80e466ef004cc566.pdf.

(4) Public Law No. 114-92, 114th Cong., 1st Sess., 129 Stat. 726, 2015.

(5) Section 809 Panel, *Report of the Advisory Panel on Streamlining and Codifying Acquisition Regulations*, Vol. 1, January 2018, pp. 182-184, section809panel.org/wp-content/uploads/2018/04/Sec809Panel_Vol1-Report_Jan18_REVISED_2018-03-14.pdf.

(6) *Ibid.*, p. 4.

develop and commercialize innovative technologies [...] assessments have been based on inaccurate or incomplete data".(7)

There is no doubt that technological innovation is key to achieving the Defense Department's mission, and supporting that innovation through procurement is an essential process. To those ends, this paper will describe the foundational aspects of the SBIR program, review and identify by what measures the SBIR program has been successful, compare the program with the 'innovative partnership' initiative in the European Union (EU), and assess whether the SBIR program is merely a useful means of leveraging procurement to increase small business participation in R&D, or a more meaningful means of transitioning new technology to Defense Department projects.(8)

2. The SBIR Program: Description

To gain admission to the SBIR program, small businesses develop proposals to conduct experimentation, analyses, and early-stage development of technology ideas that may be useful to U.S. government agencies and/or commercial industry. Rather than relying merely on internal funds or investor venture capital to pursue these technically risky endeavors, small businesses receive federal funding to cover these 'Phase I' costs. Technology projects typically experience funding shortfalls, colloquially called the 'Valley of Death', during the period between initial development and commercialization of a technology.(9) One goal of the SBIR program is to bridge this gap for small businesses by providing more stable federal funding, compared to private investor funding. Nevertheless, as is discussed below, foundering in this 'valley' is still a frequent occurrence in the SBIR program for firms between award phases.

The SBIR program also allows participating businesses to retain intellectual property (IP) rights to the ideas and products they generate during the program; these IP rights are critical to selling the final products. The first two phases are funded via federally-provided SBIR contracts as the products take shape. The final phase is reserved for tailored development of nearly-production-ready products to suit the specific and verified needs of DoD customers, paid for by the receiving organization.

(7) U.S. Government Accountability Office, "Small Business Research Programs: Agencies Need to Take Steps to Assess Progress Toward Commercializing Technologies", *GAO 18-207*, 2018, www.gao.gov/products/GAO-18-207.

(8) Because of the size and strategic importance of the U.S. Department of Defense's SBIR program, this paper will focus on that agency.

(9) *See*, e.g., Y. Osawa and K. Miyazaki, "An Empirical Analysis of the Valley of Death: Large-Scale R&D Project Performance in a Japanese Diversified Company", 14 *Asian J. Tech. Innovation*, 2006, p. 93.

To understand the SBIR program's value, it is important to understand its purpose and structure. This section describes the program's codification, its phased approach to maturing innovations, and measurements of its success transitioning those innovations to DoD projects.

2.1. Governing Statutes and Policies

The SBIR Program is codified at Section 9 of the Small Business Act, 15 U.S.C. § 638.(10) The statute requires that all federal agencies with R&D budgets exceeding $100 million must not only participate in, but also allocate at least 3.2% of their R&D budgets to the program.(11) The DoD, which receives substantial R&D funding from Congress, is a major participant in the SBIR program.(12)

Congress' goals in establishing the program were grounded in the assumption that small businesses are the 'engine' for U.S. economic development, and that therefore nurturing technologies developed by small businesses is a sound national policy. The SBIR program is intended to increase small business participation in R&D, which traditionally was mostly in the hands of large institutions. Through the SBIR program – which is part of a broader framework of preferences and programs under the Small Business Act – Congress seeks to spur small businesses' development of new technologies, to encourage disadvantaged and minority-owned small businesses to participate, and to increase the number of government R&D projects that become commercially viable products.(13) To be successful in this program, small businesses generate innovative solutions to some of the government's biggest challenges. The ultimate goal of any SBIR initiative is commercialization, which is defined as "the process of developing products, processes, technologies, or services and the production and delivery (whether by the originating party or others) of the products, processes, technologies, or services for sale to or use by the Federal government or commercial markets".(14) The 2014 SBIR/STTR Interagency

(10) For historical background on the Small Business Act, *see*, e.g., M.V. Kidalov, "Small Business Contracting in the United States and Europe: A Comparative Assessment", 40 *Pub. Cont. L.J.*, 2011, pp. 443, 450; *see* also, C.W. Wessner, (ed.), *An Assessment of the Small Business Innovation Research Program*, National Research Council, 2007, available at www.ncbi.nlm.nih.gov/books/NBK9609/pdf/Bookshelf_NBK9609.pdf.

(11) 15 U.S.C. § 638; *see* Small Business Administration, "Small Business Innovation Research (SBIR) Program – Policy Directive", 24 February 2014, p. 3, www.sbir.gov/sites/default/files/sbir_pd_with_1-8-14_amendments_2-24-14.pdf.

(12) SBIR/STTR, "Dashboard", www.sbir.gov/awards/annual-reports (reports may be generated by agency).

(13) Small Business Innovation Development Act of 1982, Pub. L. No. 97-219, § 2, 1982.

(14) 15 U.S.C., § 638(e)(10); *see* also Program Interagency Policy Committee, *Report to Congress on Small Business Innovation Research (SBIR) Small Business Technology Transfer (STTR) Commercialization*, 15 September 2014, available at www.sbir.gov/sites/default/files/2_commercialization-ipc_report_to_congress.pdf.

Policy Committee Report to Congress regarding commercialization outlined the following goals for successful SBIR commercialization, which confirmed that the program's goals reach well beyond merely developing innovative technology:(15)

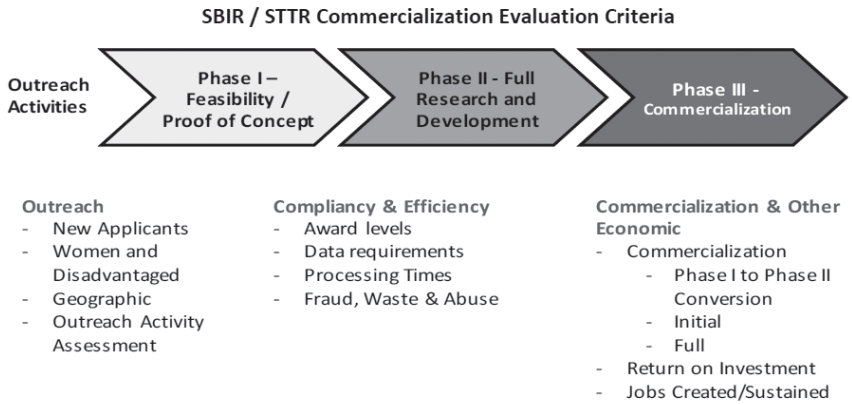

Figure 1. Best Practice Recommendations for SBIR Commercialization (16)

In a market dominated by capital-heavy large businesses, it is clear that the SBIR program provides an important avenue for small businesses, including disadvantaged businesses, to participate in technology development and create high-tech jobs. Is establishing that avenue enough, though, to deem the SBIR program a success? Summarizing the defense acquisition marketplace, the Section 809 Panel emphasized the need for outcomes to ensure the nation's security: "To stay ahead in a dynamic, ever-changing environment, DoD needs a new approach to acquisition. Rather than focusing on price and process to measure success, DoD's acquisition system should focus on outcomes".(17) In keeping with this suggestion, the following section describes the SBIR program's structured process and suggests ways to analyze its success in providing innovative solutions to the Defense Department's needs.

(15) Program Interagency Policy Committee, *Report to Congress on Small Business Innovation Research (SBIR) Small Business Technology Transfer (STTR) Commercialization*, *op. cit.*, 12, 4.

(16) *Ibid.*

(17) Section 809 Panel, *Report of the Advisory Panel on Streamlining and Codifying Acquisition Regulations*, *op. cit.*, pp. 4, 6.

2.2. Description of SBIR Phases I, II, and III

The SBIR program uses a uniform, three-phased process to foster technological advancements at various stages of development.(18) The www.SBIR.gov Web site summarizes the three phases.

Phase I. The objective of Phase I is to establish the technical merit, feasibility, and commercial potential of the proposed R/R&D (research/research and development) efforts and to determine the quality of performance of the small business awardee organization prior to providing further Federal support in Phase II. SBIR Phase I awards normally do not exceed $150,000 total costs for six months.

Phase II. The objective of Phase II is to continue the R/R&D efforts initiated in Phase I. Funding is based on the results achieved in Phase I and the scientific and technical merit and commercial potential of the project proposed in Phase II. Only Phase I awardees are eligible for a Phase II award. SBIR Phase II awards normally do not exceed $1,000,000 total costs for two years.

Phase III. The objective of Phase III, where appropriate, is for the small business to pursue commercialization objectives resulting from the Phase I/II R/R&D activities. The SBIR program does not fund this phase. Phase III may involve follow-on non-SBIR funded R&D or production contracts for products, processes or services intended for use by the U.S. Government.(19)

In addition to the anecdotal 'Success Stories' provided on the sbir.gov website, the SBA has included a database of Phase I and Phase II SBIR awards dating back to 1983, which is presented as an Awards Dashboard.(20) Most recently in 2018, the database included records for 433 DoD SBIR awards, comprised of 252 Phase I and 181 Phase II awards.(21) This public database provides opportunities to conduct quantitative analyses of SBIR awards through the years. The following section will provide several measurements that assess the extent to which SBIR technologies have been successful in fostering innovation in DoD projects.

(18) Small Business Administration, "Small Business Innovation Research (SBIR) Program – Policy Directive", *op. cit.*, p. 9.

(19) About SBIR, Three-Phase Program, available at www.sbir.gov/about/about-sbir.

(20) SBIR/STTR, "Dashboard", *op. cit.*, p. 10.

(21) *Ibid.*

3. Measuring SBIR Program Success

As a contracting vehicle, the SBIR program is successful at executing awards. Alongside its sister Small Business Technology Transfer (STTR) program, the SBIR program has made over 162,000 contract awards exceeding $46 billion since 1982.(22) By these measures, it is clear that the program is supporting small businesses and fostering technological development. Nonetheless, the data in the sbir.gov Web site on the number of SBIR contract awards and funding shows a steadily downward trend beginning 2010.(23)

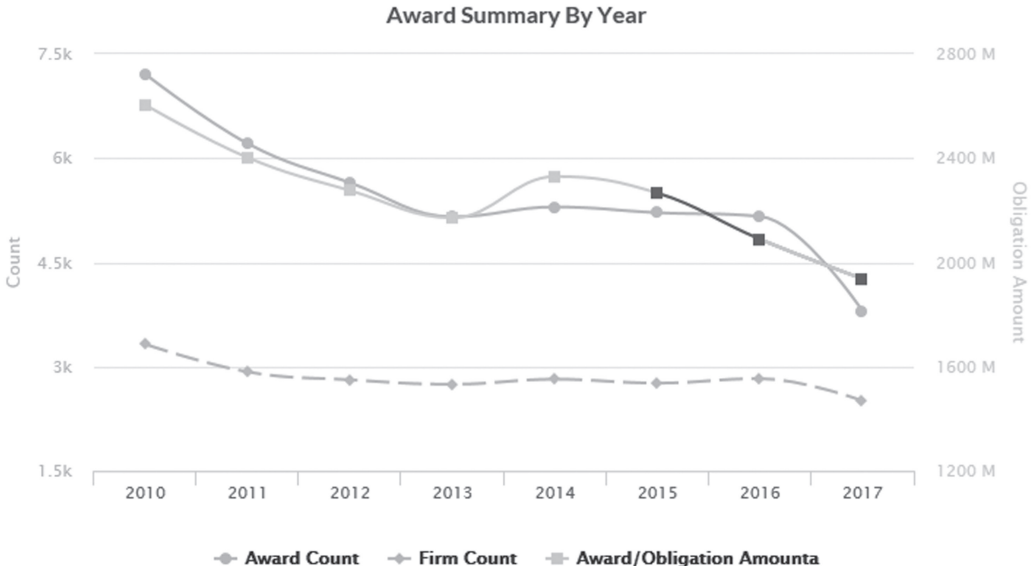

Figure 2. SBIR Award Trends 2010-2017(24)

Perhaps this trend reflects uncertainty that SBIR investments are producing meaningful, transition-ready innovations for DoD projects. Since the first statute launched the SBIR program, Congress has updated the law to require tracking, measuring, and reporting against benchmarks at each Phase. Effective with the 2011 reauthorization act, the SBIR programs must track and report on two benchmarks meant to increase the probability that development efforts will result in commercial-ready products. The first benchmark, Transition Rate Benchmark, requires that over the past five years (not including

(22) U.S. Government Accountability Office, "Small Business Research Programs: Agencies Need to Take Steps to Assess Progress Toward Commercializing Technologies", *op. cit.*, p. 6.

(23) SBIR/STTR, "Dashboard", *op. cit.*, p. 10.

(24) *Ibid.*

the last year), a company must transition one quarter of its Phase I efforts into Phase II. The second, Commercialization Benchmark, requires that over the past ten years (not including the last two years), companies with over 15 Phase II awards must receive at least an average of $100,000 in sales/investments per Phase II award. Companies that do not meet these benchmarks are ineligible for future SBIR awards.(25)

Due to the diverse and decentralized funding sources for Phase III, there is no consolidated data source listing Phase III SBIR awards. In response to this information gap and to foster improvements in Phase III transitions, the SBIR and STTR Reauthorization Act of 2012 established the Commercialization Readiness Program (CRP). This program requires U.S. defense and military organizations to identify SBIR projects "that have the potential for rapid transitioning to Phase III and into the acquisition process".(26) In response, when the DoD released the FY14 Annual Report on CRP in November 2017, it summarized transition successes from the Air Force, Army, and Navy. Table 1 includes a summary of these successes.

Table 1. FY14 CRP Transition Success Summary(27)

Service	FY14 SBIR CRP Projects	Total Projects since CRP Inception	Overall Benefit
Air Force	20	63	Each project meets the technology needs of at least one Air Force system with total cost savings estimated at over $1 Billion
Army	30	101	While too early to provide specifics of success, Army SBIR expects at least a 5:1 return on investment (~$250M) within the next five years.
Navy	29	273	Cumulatively, the DON has invested over $504 million in SBIR funding to CRP projects, which includes funding for the acceleration of transition efforts.

According to this annual report, the Air Force's anticipated cost savings from SBIR successes roughly exceeded all of the Defense Department's SBIR

(25) Small Business Administration, "Small Business Innovation Research (SBIR) Program – Policy Directive", *op. cit.*, p. 9.

(26) 15 U.S.C., § 638, Research and development.

(27) Department of Defense, *Fiscal Year 2014 Report Submission on Commercialization Readiness Program (CRP)*, March 2015, 5, pp. 23-26, available at www.sbir.gov/sites/default/files/FY14%20CRP%20Report.pdf.

costs for a year.(28) The Army was projecting significant returns from its investments, as well.(29) Finally, the Navy was leading the way in using the program to identify, develop and inject modern capabilities through the acquisition lifecycle.(30)

Combining this commercialization data with the Defense Department's SBIR award data available in the online sbir.gov award dashboard, in Table 2 we can draw some meaningful insights regarding 'transition successes' in the program.

Table 2. SBIR Awards(31) *and CRP Projects*(32)

Year	Total DoD SBIRPhase I and II Awards	DoD Phase I Awards	DoD Phase II Awards	DoD Commercialization Projects (from FY14 report)
FY13	2,157	1318 (61%)	838 (39%)	
FY14	2,014	1299 (65%)	715 (35%)	79
FY15	1,996	1262 (63%)	734 (37%)	

Based upon this table, the trend shows that a little more than a third of DoD SBIR performers successfully transition to Phase II R&D contracts. However, the evidence also shows that Phase II awardees reach a steep cliff at the end of their SBIR-funded contracts. If we assume that the 79 reported FY14 commercialization transitions were FY13 Phase II projects, it would seem that over 90% had died in the 'Valley of Death' – the chasm between development and commercialization – over that year. Even compared to the commercial industry high-technology space, these DoD transition statistics are low.

In response to lackluster Phase III successes, the 2014 SBIR/STTR Interagency Policy Committee Report to Congress offered some best practices related to commercialization success – though those suggested best practices are only partially actionable. The first best practice merely observed that depending on the market or sector, capabilities will mature on different timelines, impacted by 'financially intensive readiness' and other technology factors. The second best practice recommended Commercial Assistance Programs (CAPs), which provide mentoring and training opportunities to small businesses specifically

(28) *Ibid.*, p. 23.
(29) *Ibid.*, p. 26.
(30) *Ibid.*, pp. 23, 17.
(31) SBIR/STTR, "Dashboard", *op. cit.*, p. 10.
(32) Department of Defense, *Fiscal Year 2014 Report Submission on Commercialization Readiness Program (CRP)*, *op. cit.*, p. 23.

for navigating the SBIR phased process. The final recommendation for commercialization suggested using "Post Phase II Bridge funding (e.g. Phase II-B/II-E/II-X)" to secure funding and avoid the 'Valley of Death' capital drought at any phase.(33)

Policy makers in the U.S. government hope that benchmarks and commercialization support initiatives will prevent chronically ineffective technology developers from continuing to receive SBIR funding. More reliable award data would shed light on the small business performers' health and effectiveness. Meeting Congress' required benchmarks will not guarantee an improvement in transition success statistics. Still, without the benchmark data, after spending $1 billion per year, it is impossible to quantify whether the SBIR program is indeed successful deploying innovative technologies to DoD projects, or merely successfully at using defense funding to bolster small businesses economically. And yet even with this significant metric for success still an open question – with relative success in bringing SBIR projects to the commercial marketplace still not definitively proven – procurement systems worldwide, such as the European initiative discussed in the following section, have begun to mimic the SBIR program.

4. European Union (EU) Innovation Program

As in the United States, European economies depend upon continuous technology sector growth. In response, the EU has crafted an overarching 'Single Market' strategy that focuses on identifying the breadth of societal needs, creating policies and standards that enhance collaboration and inclusiveness, expanding fair competition throughout the EU procurement system, and recognizing the importance of Small and Medium-sized Enterprises (SMEs).(34) This holistic approach focuses on the problem first, and then ensures the right tools are applied to solve it. Through the Innovation Union, the EU focuses on becoming a 'world class science performer', preventing market obstacles to delivering ideas quickly, and fostering partnerships between EU government organizations and businesses.(35)

To achieve these innovative ends, the EU established a seven-year, €75 billion program called Horizon 2020 in 2014. It focuses on areas to enhance EU innovation, with a special focus on addressing societal issues. This program is not exclusive to small- and medium-sized enterprises

(33) Program Interagency Policy Committee, *Report to Congress on Small Business Innovation Research (SBIR) Small Business Technology Transfer (STTR) Commercialization*, *op. cit.*, 12, 10.

(34) EU, *State of the Innovation Union: Taking Stock 2010-2014*, Luxembourg, POEU, 2014.

(35) EU, *Innovation Union, A Pocket Guide on a Europe 2020 Initiative*, Luxembourg, POEU, 2013.

(SME's). To support innovation by SME's, however, the EU established a concept called the SME Instrument to foster participation by these small- and medium-sized companies.(36) According to the Horizon 2020 Information Guide published in 2014, the SME Instrument was 'inspired' by the U.S. SBIR program.(37) The SME Instrument is a competitively awarded program which includes three phases, similar to the U.S. SBIR program. Phase 1 contracts support 'Concept & Feasibility Assessment', span fewer than six months, and are awarded on the basis of a brief business plan conveying the small business' business concept. Phase 2 contracts support Research and Development (R&D) Innovation, which takes place over 12-24 months, and is awarded on the basis of a more mature, detailed business plan describing the innovation. Finally, Phase 3 promotes 'Commercialisation' through training, networking, and facilitating the small business' access to private financing. The EU does not fund Phase 3 activities. Unlike the U.S. SBIR program, SME's may participate in only one project (in Phase 1 or 2) per year.(38)

While very similar in structure to the U.S. SBIR program, the Horizon 2020 SME Instrument seems to take less responsibility for the sponsoring government's use of the innovations in the program, and instead focuses on fostering small business' commercial success after the program. The Horizon 2020 Information Guide includes the following graphic, which draws on the SBIR program to depict the funding evolution for ideas in the innovation cycle, from public to private, as they mature through the R&D process and eventually enter the commercial market. The 'V' shape demonstrates the funding 'Valley of Death' commonly experienced by technology companies, but also reiterates that the SBIR funding is meant only to sustain a company during development, and that funding is to be surpassed by private investments in the future.

(36) EC, "What is Horizon 2020? Horizon 2020 – Work Programme 2018-2020 General Introduction", 27 October 2017, available at ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-intro_en.pdf.

(37) Art. 31 of the EU's primary public procurement Dir., 2014/24/EU, permits a uniquely flexible and phased procurement process for 'innovation partnerships'. For a discussion of how Art. 31 and innovative partnerships had been transposed into the United Kingdom's procurement law, *see* J. Bennett, "Innovation partnership – does it offer a genuine breakthrough?", 22 April 2015), available at publicsectorblog.practicallaw.com/innovation-partnership-does-it-offer-a-genuine-breakthrough/. Other European initiatives which reflect strong parallels with the U.S. SBIR program are the United Kingdom's Small Business Research Initiative (SBRI) initiative, *see* https://sbri.innovateuk.org/, and the European Defense Fund, which would fund European research and development in defense materiel, to support long-term production in the European defense industry, *see*, e.g., C.R. Yukins, "European Commission Proposes Expanding the European Defence Fund – A Major Potential Barrier to Transatlantic Defense Procurement", 60 *Government Contractor*, 27 June 2018, par. 196, available at ssrn.com/abstract=3204844.

(38) EU, *State of the Innovation Union: Taking Stock 2010-2014*, *op. cit.*, p. 38.

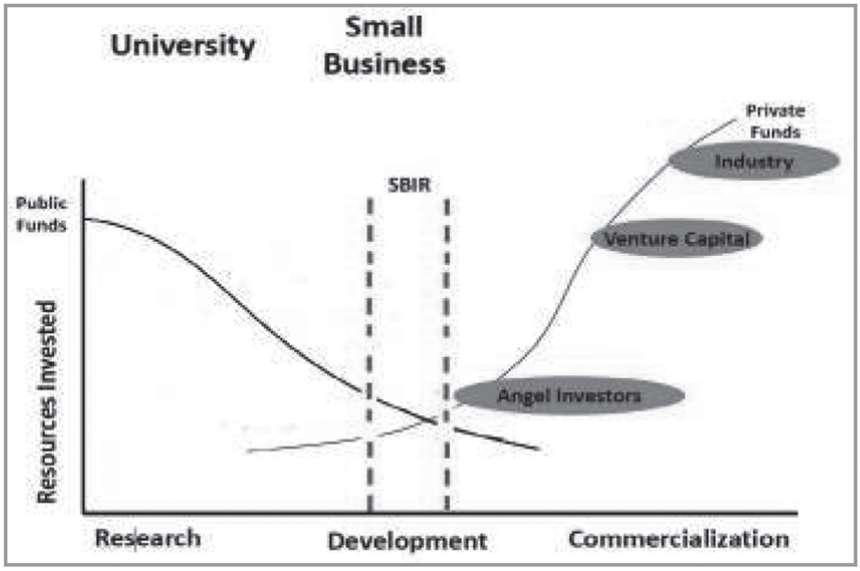

Figure 3. EU Horizon 2020 SME Instrument(39)

Having borrowed the three-phased U.S. SBIR structure, but adapted to reflect EU societal priorities, the Horizon 2020 program is reportedly meeting its goals, with a few exceptions. In its 2014-2016 Horizon 2020 results brochure, the European Commission noted that the SME Instrument funded 2,319 grants, 78% for Phase 1 and 22% for Phase 2 activities. The Commission provided statistical results which spanned all of the Horizon 2020 initiatives and reflected proposal success metrics, country participation, and societal impact areas. The Commission did not, however, provide any data regarding the SME Instrument's Phase 3 commercialization.(40) It appears, therefore, that the U.S. SBIR program may not be alone in having difficulty measuring measure success in this final stage.

As the foregoing discussion showed, governments have had uneven success in nurturing emerging technologies into the commercial marketplace. The following section describes several of the U.S. SBIR program's unique features which contribute to both its successes and its challenges.

(39) EC, *Horizon 2020 Information guide: SME opportunities for EU-US collaboration in Horizon 2020*, Luxembourg, POEU, February 2014, available at ec.europa.eu/research/iscp/pdf/policy/sme_opportunities_h2020_feb2014.pdf.

(40) EC, *Horizon 2020 in Full Swing – Three Years On – Key facts and figures 2014-2016*, Luxembourg, POEU, 2018, available at ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/h2020_threeyearson_a4_horizontal_2018_web.pdf.

5. *Defining Features of SBIR Contracts*

5.1. Award Preferences

To be eligible for an SBIR Phase I or II contract award, a business must be for-profit, geographically located in the United States, legally organized, more than 50% owned by individuals or small businesses that are U.S. citizens/permanent resident aliens, and employ fewer than 500 persons.(41) While it is tempting to rely on Congress' assertion that small businesses are better at innovating than large businesses, all companies' innovations depend upon their incentives to pursue them. Incentivizing small business as a means to distribute wealth, Congress established the SBIR program in 1982 specifically to support these enterprises, and to "foster and encourage participation by minority and disadvantaged persons" in the technology development process.(42) For DoD SBIR Phase I and II awards, this program serves as a $1 billion opportunity for small businesses in the United States. However, the SBIR program is struggling to achieve some of its major objectives related to preferences.

While the program overall is successful in funding small businesses, it is lagging in its support for minority-owned and disadvantaged companies. The 2014 report to Congress found that despite industry outreach efforts, during 2013 minority-owned companies had earned only 4.57% of the SBIR awards and women-owned companies had earned only 9.22%.(43) One factor that could explain this shortfall is that the program strongly favors more established companies with diverse and consistent revenue streams. Phase II awards may lag months or years behind Phase I awards, and similarly Phase III awards may come only after a significant delay. Retaining a workforce ready to execute highly technical, innovative SBIR projects during these funding gaps is nearly impossible for most small business owners. Across the Defense Department, George Washington University doctoral candidate Ronnie Schilling noted, small businesses are not consistently staying in the DoD marketplace. His research spanned 11 years, 1997-2008, and demonstrated that by the end of

(41) Small Business Innovation Research (SBIR) Small Business Technology Transfer (STTR), "U.S. Department of Defense SBIR STTR: Getting Started", 31 March 2018, available at www.acq.osd.mil/osbp/sbir/sb/getting-started-phase-1.shtml.

(42) United States Congress, Pub. L. 97-219, *Small Business Innovation Development Act of 1982*, United States Code, U.S. Government Publishing Office, 22 July 1982. There has been criticism, though, from the Section 809 Panel, *see supra*, notes 5-6 and accompanying text, that the "Small Business Act, as it stands today, does not state a goal for government agencies to leverage small businesses as a means to enhance or support mission execution. The statute includes a reference that the American economic system of private enterprise and competition is essential to the 'security of this Nation,' but contains no direct references to agency missions or national defense".

(43) Program Interagency Policy Committee, *Report to Congress on Small Business Innovation Research (SBIR) Small Business Technology Transfer (STTR) Outreach*, 15 September 2014, p. 7.

the study period fully 44% of the small companies were no longer conducting DoD business at all, and only 1.9% of all the companies had worked consistently with the DoD throughout the period.(44) These statistics suggest that small business' incentives to use the SBIR program are more often focused on near-term, rather than long-term, goals. Nevertheless, since the 1980's many entrepreneurs have used Phase I and II SBIR awards as a foundation to build successful technology companies, demonstrating that the preference incentive may be worthwhile.

In contrast, Phase III awards are not limited to small businesses. As the SBIR guidance published by the U.S. SBA explains, former SBIR Phase I and II awardees that have graduated from the small business size standard are eligible to receive Phase III funding. Further, as is discussed below, the policy authorizes *sole source* Phase III contract awards to those that have won prior Phase I and II awards.(45) This policy can tie government purchasers to Phase III technology that was developed years earlier, when the likely future trajectory of the technology was only hazily understood by the officials approving Phase I and Phase II awards. In practice, Phase III awards may be made to small or large businesses via subcontracts, which make them all the more difficult to track or measure. Altogether, these competition policies provide support to small businesses primarily during Phases I and II, though the more enabling incentives in Phase III (discussed below) may be a driving force for transitioning mature technologies to government and commercial uses. But without additional quantifiable data to assess these transitions, measuring success is elusive.

5.2. Data Rights

Another defining feature of SBIR contracts is that although the government pays for technology development in all phases, the government does not acquire unlimited rights (normally the rights the government demands for work it funds) in the SBIR work product, whether technical data or computer software.(46)

The U.S. SBA defines SBIR Technical Data Rights as "the rights an SBIR awardee obtains in data generated during the performance of any SBIR Phase I, Phase II, or Phase III award that an awardee delivers to the Government during or upon completion of a Federally-funded project, and to which

(44) R. SCHILLING, "Survey of Small Business Barriers to Department of Defense Contracts", *Defense ARJ*, Vol. 24, No. 1, 2017, pp. 2-29.

(45) Small Business Administration, "Small Business Innovation Research (SBIR) Program – Policy Directive", *op. cit.*, pp. 9, 13.

(46) *See* Defense Federal Acquisition Regulation Supplement (DFARS) Subparts 227.71 - 227.72, 48 Code of Federal Regulations Subparts 227.71 - 227.72.

the Government receives a [royalty-free] license".(47) Under the terms of the SBA's SBIR guidance, the government must protect the small business' data from non-government entities, including competitors; must continue to protect the data for at least four years after receipt of the final product; must provide these protections through all three Phases, unless the business agrees to other terms; and, must not coerce the business into releasing data rights for SBIR products. The SBA directive also warns that "SBA will report to the Congress any attempt or action by an agency to condition an SBIR award on data rights, to exclude the appropriate data rights clause from the award, or to diminish such rights". Small businesses are incentivized to participate in the SBIR program because the federal government carries the cost burden and risk during technology development, while the business also establishes potential long-term opportunities to sell the product in the commercial marketplace. Theoretically, as a result of this incentive, the government has greater access to more innovative products from the small business industry base. In practice, the DoD has difficulty realizing this benefit.

The realization challenge arises in part because DoD agencies must follow acquisition guidance, *DoD Instruction (DODI) 5000.02, Operation of the Defense Acquisition System*, which prescribes a process to design, develop, field, and maintain systems and subsystems for military use.(48) Successful implementation of this process depends upon defense managers' long-term acquisition strategies, and upon the system architecture being sequenced efficiently. For a non-commercial product developed exclusively with government funds, the DoD generally expects to retain rights to use and modify the product in perpetuity. When a product is developed using mixed funding, the Defense Department normally gains rights to use the technology for government purposes.(49) Specifically, the Defense Federal Acquisition Regulation Supplement states: "[Contractors] may not restrict the Government's rights in items, components, or processes developed exclusively at Government expense (unlimited rights) without the Government's approval. When an item, component, or process is developed with mixed funding, the Government may use, modify, release, reproduce, perform, display or disclose the data pertaining to such items, components".(50) The SBIR program stands as a major exception

(47) Small Business Administration, "Small Business Innovation Research (SBIR) Program – Policy Directive", *op. cit.*, pp. 9, 7.

(48) Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics, "Operation of the Defense Acquisition System", DoD Instruction 5000.02, Washington, DC: USD(AT&L), January 2015.

(49) *See*, e.g., Defense Information Systems Agency (DISA), "Data Rights", disa.mil/about/legal-and-regulatory/datarights-ip/datarights.

(50) Defense Federal Acquisition Regulation Suplement (DFARS), 48 C.F.R. ch 227.713-4 License Rights, 2012.

to these policies, and runs contrary to most defense managers' training and assumptions about data rights.

To support continued maintenance of any system, subsystem, or component, a defense manager is interested not only in the specific hardware items or software executables, but also in the tangential know-how and documentation. As the systems age, they require updates. As a cost control measure, defense managers often plan and execute competitive contracts for these updates, which becomes difficult when the government holds a license to use, but no data rights to modify or share, a product. DoD Instruction 5000.02 provides specific guidance for what are known as 'IP Strategies', which are a statutory requirement for defense managers in planning and executing major weapons systems development. DoD Instruction 5000.2 notes that Intellectual Property Strategies must describe "how program management will [...] acquire competitively whenever possible, the intellectual property deliverables and associated license rights necessary for competitive and affordable acquisition and sustainment over the entire product life cycle".(51) SBIR data rights protections, which heavily favor the private developers, may disrupt the government's rights during defense systems' maintenance and update phases if a defense manager has not adequately accommodated the SBIR limitations in the project's intellectual property strategy.

Recognizing the challenge of integrating intellectual property that bears distinct private rights (such as SBIR data rights) into major acquisition programs, DoD published guidance in 2014 to facilitate intellectual property strategies. The DoD guidance noted that proprietary technology may impact a defense manager's ability to conduct full and open competition, but suggests two significant factors for a successful integration of technical components without full data rights. The first factor is time. The guidance suggests that the sooner a manager identifies and documents a system, subsystem, or component to which the government has limited data rights, the better the manager can plan for competition issues. The second factor is related to system design. The guidance suggests the use of an 'Open Architecture' with a highly segregated components structure, so that limited data rights for one portion of the system do not hamper competition for development or maintenance of the entire system.(52) To use restricted data in a DoD system successfully while using best-practice competition for procurements, a defense manager must assimilate these limitations into both the project's acquisition plans and the system design itself.

(51) Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics, "Operation of the Defense Acquisition System", *op. cit.*, p. 49.

(52) Department of Defense Open Systems Architecture Data Rights Team, "Intellectual Property Strategy Brochure", Defense Acquisition University (DAU), August 2014.

A final data rights challenge exists with regards to Phase III awards made to large prime contractors performing on behalf of the DoD, for example Lead Systems Integrators (LSI). Under the Small Business Administration's guidance for the SBIR program, subcontracts awarded under these large prime contracts are to be treated as Phase III awards, and thus afford the private parties greater data rights than normal subcontracts. The prime contractors incorporating these technologies have, however, a strong incentive to integrate the SBIR technology into their own base of technical know-how, which may have the effect of increased use of the emerging technology on the government's behalf. On the other hand, incorporating this SBIR-funded intellectual property into projects run by large prime contractors may dilute the salutary effect that the SBIR program normally has in nurturing the small business industrial base. These are further examples of how the SBIR initiative in practice may pose a challenge to Defense Department acquisition programs – and to its own goals – because of the conflicting incentives and guidance related to intellectual property and data rights.

5.3 Competition

One of the most prominent values held by the U.S. procurement community is its faith in competition. When he offered the U.S. acquisition workforce common-sense approaches to procurement policy, Mr. Frank Kendall, then the Under Secretary of Defense for Acquisition, Technology and Logistics (AT&L), noted: "Competition and the threat of competition provide the most effective incentive".(53)

On its face, the SBIR program seems to embrace competition. Phase I and II performers must demonstrate the merits of their solutions before moving forward in the SBIR process, and many fail. On the assumption that these two initial, competitive phases are sufficient, the SBA's policy supports sole-source awards to Phase III performers. It states: "The competition for SBIR Phase I and Phase II awards satisfies any competition requirement of the Armed Services Procurement Act, the Federal Property and Administrative Services Act, and the Competition in Contracting Act". Further, the SBA policy states that an SBIR Phase III project may be cited in a Justification and Approval (J&A)(54) for a sole-source (technically, an other than full-and-open competition) award under Federal Acquisition Regulation (FAR) 6.302-5, so long as the project "is derived from, extends, or completes efforts made under prior SBIR funding agreements and is authorized under 10 U.S.C. 2304(b)(2) or 41

(53) F. Kendall, "Better Buying Power Principles: What Are They?", *Defense Acquisition, Technology, and Logistics (AT&L) J.*, January 2016, pp. 2-4.

(54) 48 Code of Federal Regulations 6.302-5.

U.S.C. 3303(b)".(55) Under the policy, this sole-source option is available years into the future, which in practice can create a long-term sheltered marketplace for SBIR-funded research and development.

It is not clear that the limited competition imposed by the SBIR program leads to optimal results. While the SBIR program uses competition, there is evidence that its methods do not necessarily identify the best innovations in the marketplace to support the DoD mission.

A first weakness related to the competition policy is that small businesses must have a strong understanding of the DoD marketplace and specific customer needs to win SBIR work. In his survey of small businesses seeking DoD contracts, Ronnie Schilling noted: "We did find statistical evidence to support the idea that businesses with less defense business experience perceive defense business to be more challenging than those with extensive defense experience. We also found support for smaller small businesses perceiving defense business to be more challenging than those larger businesses that still qualify for small business contracts". Breaking into the DoD market is very difficult. Schilling noted that though this perceived experience/knowledge gap was not the most significant barrier, it was among the reasons that small businesses avoid pursuing DoD business, which strongly influences the competitive environment in favor of the most experienced, mature small businesses.(56)

To facilitate their entry into the government market, the SBIR Web site provides guidance to small businesses pursuing SBIR opportunities, which includes step-by-step instructions and training materials related to the application process.(57) However, these instructions do not provide information to assist these innovators in understanding specialized military operations and functionality gaps, let alone the acronym-heavy technical language used to describe them.

Unless they hire consultants, small businesses in the high-tech, commercial market may not have insight into the DoD's current goals, and so may struggle to identify relevant innovations. Apparently this problem has disproportionately impacted socio-economically disadvantaged businesses, as well as those companies geographically distant from DoD acquisition commands. The 2011 SBIR/STTR Reauthorization Act called for a focus on industry outreach to address this issue, but as recently as 2014, the Policy Committee report demonstrated that women-owned and disadvantaged companies were

(55) Small Business Administration, "Small Business Innovation Research (SBIR) Program – Policy Directive", *op. cit.*, pp. 9, 13.

(56) R. SCHILLING, "Survey of Small Business Barriers to Department of Defense Contracts", *op. cit.*, p. 46.

(57) Small Business Innovation Research (SBIR) Small Business Technology Transfer (STTR), "U.S. Department of Defense SBIR STTR: Getting Started", *op. cit.*, p. 43.

still lagging in awards. Additionally, during the period 2010-2013, companies located in Virginia, Maryland, the District of Columbia, California, New York, and Massachusetts – geographic centers of the Defense Department's work in research and development – had won over 50% of the SBIR awards.(58) The evidence suggests that the competitive pool favors businesses with existing experience and proximity to DoD projects, which may leave out important innovators in the commercial small business marketplace.

A second weakness in the SBIR competitive process is momentum. Award data in the online sbir.gov dashboard shows that winning companies statistically continue winning, buoyed by the new benchmarks, while those less successful at technology transitions are trimmed from the competitive pool. In 2017, among the total 614 Phase I and II DoD SBIR awards, 86 companies (20%) won two or more awards, while 326 companies (80%) won only one award. That metric does not appear problematic, until one observes the proportion of contracts that these repeat awardees are winning. In this regard, the dashboard shows that repeat awardees received a total of 288 (47%) awards that year, demonstrating that although they comprise only a fifth of the provider group, these companies are winning nearly half of the work.(59) In the online dashboard's 2017 awards list, two firms stood out as the most successful. Physical Optics Corporation (POC) received 17 SBIR awards totaling $7.9 million, and Charles River Analytics received 11 SBIR awards totaling $6.8 million.(60)

Small businesses employ numerous tactics to remain competitive in the SBIR program. Spinning off companies is a common practice in federal contracting which allows small, successful portions of businesses to continue pursuing opportunities in the small business market rather than growing as a cohesive large business. Physical Optics Corporation's website noted that over the prior decade the firm had "created six spinoff companies and ha[d] provided a technology base for two additional joint venture companies. These companies were all based on POC technology, and were once divisions within POC".(61) One of those spin-offs won a small Phase I award in 2017. Between the benchmarks and disproportionately strong companies in the program,

(58) Program Interagency Policy Committee, *Report to Congress on Small Business Innovation Research (SBIR) Small Business Technology Transfer (STTR) Outreach*, *op. cit.*, p. 44. The Section 809 Panel, *see supra*, note 5, observed in its January 2018 report that many "companies that are not small, but far from large, struggle to compete for government contracts against large, well-established companies without set-aside programs and other support… This structure incentivizes small companies to adopt strategies that may be inconsistent with DoD's interests and small business programs' goals".

(59) SBIR/STTR, "Dashboard", *op. cit.*, p. 10.

(60) *Ibid.*

(61) Physical Optics Corporation, "POC Corporate Overview: Spinoffs", 31 March 2018, available at www.poc.com/corporate-overview/spinoffs/.

these practices effectively skew competition in favor of those companies that can best respond to the SBIR program's unique regulatory requirements.

The third weakness in the SBIR program's claim that it enhances competition relates to the assumption that the SBIR process nurtures the most capable innovative solutions on the market, over the many years from a Phase I award to a Phase III contract. Well-known theories in high technology, such as Moore's Law, posit that technology advances exponentially fast, perhaps doubling every two years.(62) Even without significant funding gaps, due to the proposal, contracting, and execution periods associated with Phases I and II in the SBIR program, a small business may not be ready to launch into Phase III until more than three years after writing the initial proposal. Comparing the SBIR timeline with the much sharper upward trajectory of normal technological progress, it is entirely conceivable that over these three years companies outside the SBIR program may have developed innovative solutions that far surpass the original concept funded in SBIR Phase I. For this reason, tying government customer agencies to sole-source Phase III awards may be a dangerous presumption, in effect limiting DoD's access to emerging technologies. And worse, without a way to collect and measure the Defense Department's use of technology which has advanced to Phase III, policy makers will lack the data necessary to assess this issue.

6. Conclusion and Recommendations

By all accounts, the Department of Defense's SBIR program is noble in its aim to support small businesses and to encourage innovation in the DoD marketplace. Anecdotal evidence suggests that the program has been successful in several ways, including the following:

- Providing funding to small businesses to conduct innovative Phase I and II research, which affords vital investment to sustain otherwise risky R&D projects.
- Producing transition-ready hardware and software to support emerging DoD acquisition needs.

On the other hand, the data also indicates that the DoD's use of the SBIR program has become less effective over the last decade. Reduced participation in Phase I and II initiatives suggests that new performance benchmarks, lackluster outreach campaigns, and tepid Phase III technology transitions have eroded DoD managers' confidence in the program.

(62) Intel, "Moore's Law and Intel Innovation", 1 May 2018, available at www.intel.com/content/www/us/en/history/museum-gordon-moore-law.html.

This paper posits that the program's unique features, including the following, may explain the SBIR program's limitations in fostering innovation in Defense Department procurement:

- Small businesses face barriers to entry and challenges sustaining DoD business, which hamper the SBIR program's ability to meet rapidly evolving defense requirements.
- Small businesses that do remain in the DoD R&D market can skew the competitive field by becoming highly proficient at leveraging the SBIR process.
- Although the SBIR program is at its heart a small business preference, SBIR Phase III contracts may be awarded to large businesses.
- The SBIR data rights policy is out of synch with DoD acquisition guidance, which introduces design constraints, forces additional planning in maintenance and operations, and requires additional training for defense acquisition managers.
- The SBIR program's three-phased process can be so lengthy that innovations occurring outside the SBIR program may provide more timely and more advanced solutions to DoD requirements.

SBIR program officials and proponents offer vivid success stories as evidence of the program's soundness, but those stories are often dispersed across the initiative, are mostly anecdotal, and can be difficult to quantify in light of the DoD's annual $1 billion SBIR investment. As a whole, the DoD is unable to track its progress transitioning innovations born from the SBIR program. Without these metrics, the program is vulnerable to criticism that it is largely a 'tax' to DoD projects to fund small businesses.

There remains a serious and unresolved risk that the SBIR program's first focus on a small business preference does too little to incentivize transition-ready technology development. To address these issues, the DoD may benefit from a more holistic model that includes a culture of innovation based upon updated acquisition guidance; draws on input from innovators across the agencies, laboratories, and industry; and establishes an enterprise-level process to identify the best strategies to pursue innovation. As part of this process of holistic reform, capturing quantitative data for DoD Phase III projects will allow the Defense Department to assess the program's impact as an innovation tool. When the DoD prioritizes Phase III transition success as highly as meeting small business goals, it will be better able to capture the full value of innovation in the SBIR program.