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Assessing the Effectiveness of Defense-Sponsored Innovation Programs as a Means of Accelerating the Adoption of Innovation Force Wide

Amanda Bresler—serves as Chief Strategy Officer for PW Communications Inc. She runs the company’s Future Capabilities Practice, focused on helping the Department of Defense improve its ability to identify, access, and retain innovative solutions providers. Prior to joining PW Communications, she served as Chief Operating Officer for Maurice Cooper Brands. She serves on the board of directors of PW Communications; St. Dalfour SAS, a French food company; Chatham International Inc.; and AlmaLinks. She graduated cum laude from Georgetown University’s McDonough School of Business. [abresler@pwcommunications.com]

Alex Bresler—serves as Chief Data Officer for PW Communications Inc. Bresler is a data-driven technologist, investor, and advisor to world-class high-tech companies. He is an expert data scientist and programmer with experience supporting clients in defense, financial services, law, real estate, and sports. He graduated from the Wharton School at the University of Pennsylvania. [alexbresler@pwcommunications.com]

Abstract

The Department of Defense (DoD) invests billions of dollars into innovation programs every year. One primary objective of these programs is to accelerate the adoption of critical new technologies force wide. This paper assesses the extent to which companies funded through defense-sponsored innovation programs (“program participants”), specifically the DoD Small Business Innovation Research (SBIR) program, subsequently deliver their capabilities to the warfighter. By analyzing millions of contracting and subcontracting actions associated with thousands of program participants, we demonstrate that the DoD awards most SBIR funding to a small subset of program participants. Furthermore, companies in receipt of the greatest share of overall program funding are among the least likely to transition their technologies to the warfighter. We analyzed the structure of DoD SBIR to identify potential causes for this poor rate of inter-government technology transition. We determined that this outcome results from misaligned incentives, antiquated policies and regulations, anticompetitive solicitation processes, and the absence of thoughtful, standardized metrics for defining and measuring programmatic success. In conclusion, we offer a series of concrete recommendations to address these issues and position DoD SBIR to more effectively deliver capabilities to the warfighter.

Introduction

The Department of Defense (DoD) invests billions of dollars annually into innovation programs with the stated objective of enabling and/or accelerating the adoption of cutting-edge technologies. However, the DoD does not consistently track how companies engaged in these innovation programs (program participants) perform in the defense market, subsequent to program completion. Our research aimed to fill this gap by evaluating the extent to which program participants’ capabilities were subsequently procured by the DoD, either directly or indirectly.

While the DoD funds dozens of innovation programs, we focused our research on the Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) program for several reasons. One primary goal of the SBIR/STTR program is to “support scientific excellence and technological innovation through the investment of Federal research funds in critical American priorities to build a strong national economy and accelerate capabilities to the warfighter” (*DoD Small Business Innovation Research / Small Business Technology Transfer, n.d.*). Other program objectives include investing in research



and development (R&D) that has the potential for commercialization and encouraging “participation in innovation and entrepreneurship by women and socially or economically disadvantaged persons” (*About, n.d.*). The DoD receives more than 50% of the entire more than \$4 billion SBIR/STTR budget annually, making it the largest DoD innovation initiative.

Transitioning state-of-the-art capabilities to the warfighter must be the priority of the DoD SBIR/STTR program. In decades past, the DoD was at the forefront of technological innovation and exported *its* technologies to the commercial sector. Today, companies outside of the traditional defense industrial base are driving advancements in areas critical to our national defense. The DoD must identify, engage, and retain these suppliers. Furthermore, as noted by former Secretary of Defense James Mattis in the 2018 National Defense Strategy, “Success no longer goes to the country that develops a new technology first, but rather to the one that better integrates it and adapts its way of fighting” (DoD, 2018). It is not enough for the DoD to simply invest in cutting-edge capabilities; it must integrate these capabilities force wide as quickly and seamlessly as possible.

From a research perspective, SBIR/STTR awards are explicitly identified in procurement data, enabling us to quantitatively analyze a wide range of information about program participants—including subsequent defense business—in great detail. By comparison, no consistent, publicly-available data exists to indicate whether a company participated in other DoD innovation programs.

Analyzing the SBIR//STTR Program

To assess the extent to which investments in the SBIR/STTR program have resulted in new capabilities reaching the warfighter, we first needed to isolate a data set of entities that won defense-funded SBIR/STTR awards for analysis (SBIR companies, DoD SBIR companies). To do so, we aggregated SBIR/STTR contract award data from the Federal Procurement Data System (FPDS), the centralized, real-time database for government procurement transactions. We then filtered the data to include defense-funded Phase I/Phase II SBIR awards from fiscal year (FY) 2012 through FY 2021.

We determined that there were 52,746 defense-funded Phase I/Phase II SBIR/STTR awards totaling approximately \$13.1 billion from FY 2012–FY 2021. Table 1 provides a breakdown of the count and total dollar value of DoD-funded Phase I/Phase II awards annually.

Table 1. Sizing the DoD SBIR/STTR Program Annually

FY	Count of Distinct DoD-Funded PI/PII SBIR/STTR Awards	Total DoD-Funded PI/PII SBIR/STTR Funding
2012	4973	\$1,090,143,968.02
2013	4901	\$988,818,482.23
2014	4796	\$1,082,209,915.19
2015	4832	\$1,040,778,157.84
2016	4971	\$1,105,200,418.39
2017	5190	\$1,260,999,327.89
2018	5251	\$1,240,980,063.70
2019	5796	\$1,691,062,982.31
2020	6046	\$1,905,575,032.16
2021	5990	\$1,711,005,800.94
Total	52,746	\$13,116,774,148.67



Next, we filtered the award data by Unique Entity Identifier (UEI) in each year to calculate the unique number of recipients of Phase I/Phase II awards annually.¹ We excluded entities with less than \$50,000 in DoD-funded Phase I/Phase II awards. Doing so produced a cleaner data set that eliminated potential administrative errors or otherwise unexplainable data—namely, companies associated with SBIR/STTR funding below the standard \$50,000 minimum award value.

We determined that the 52,746 DoD-funded Phase I/PII awards in our data set were distributed across 4,703 unique entities. These 4,703 companies (SBIR companies, DoD SBIR companies) became our analysis data. Table 2 breaks-down the number of unique companies that received DoD funded Phase I/II SBIR/STTR awards each year.

Table 2. Unique SBIR Companies Annually

FY	Count of Distinct DoD-Funded PI/PII SBIR/STTR Awards	Count of Distinct Entities in Receipt of DoD-Funded PI/PII SBIR/STTR Awards
2012	4973	1584
2013	4901	1627
2014	4796	1609
2015	4832	1648
2016	4971	1625
2017	5190	1695
2018	5251	1660
2019	5796	1999
2020	6046	2276
2021	5990	2190

Multiple Award Winners

The count of distinct contract awards is significantly higher than the number of distinct SBIR companies, indicating that certain SBIR companies receive multiple awards in each year (“multiple award winners [MAWs]”). This finding aligns with earlier research we published, highlighting the fact that certain companies not only win multiple SBIR/STTR awards annually, but also participate in the program year over year. For instance, we determined that from FY 2010–FY 2019, 90% of DoD Phase I funds were awarded to existing DoD vendors. Over that same period, the top 5% of DoD SBIR companies with the most in DoD Phase I/Phase II awards received 51% of all DoD SBIR/STTR Phase I/Phase II funding (Bresler & Bresler, 2020). There is a major difference between a DoD SBIR company with decades of program experience and tens of millions of dollars or more in Phase I/Phase II funding, and a company new to the program with one or two awards. Given the share of SBIR/STTR funding awarded to MAWs, and given that they are well versed in navigating the government ecosystem, transition rates among MAWs should differ from less

¹ In April 2022, UEIs replaced DUNS numbers as the identifier provided by the System for Award Management (SAM)



experienced SBIR companies. To evaluate this, our analyses considered transition rates not only SBIR-wide, but also among MAWs as a group.

Defining Transition

Neither the SBIR/STTR program nor the DoD offer a standard taxonomy or set of metrics to define intragovernmental transition rate. Thus, to conduct this research we first needed to establish a working definition for transition rate along with a set of corresponding quantitative metrics. We define “transition” as a company developing a set of capabilities through Phases I and/or II of the SBIR program and subsequently delivering these capabilities to end-users in the DoD.

We focused on three metrics as a proxy for transition:

- 1) **Phase III awards attributed to a DoD-funded SBIR/STTR company.** The SBIR/STTR program is divided into three phases. Whereas Phases I and II provide funding for companies to conduct research and development (R&D), Phase III awards are contracts for work that “derives from, extends, or completes an effort made under prior SBIR funding agreements, but is funded by sources other than the SBIR Program” (Boyer, 2017). Phase III awards are identified in FPDS, making them the most explicit indicator that a company’s SBIR/STTR innovations were subsequently procured by the DoD.
- 2) **Non-Phase III DoD-funded procurement awards attributed to a DoD-funded SBIR/STTR company.** Some procurement contracts awarded to SBIR/STTR companies should be marked as Phase IIIs in the data but are not. While there is no way to know if a subsequent contract related to a company’s SBIR/STTR research if it was not coded as a Phase III, for the purposes of our analyses we wanted to consider the possibility that the SBIR/STTR program delivers capabilities to the warfighter via non-Phase III contracts. For each company, we considered non-SBIR DoD procurement awarded subsequent to the first DoD-funded SBIR/STTR Phase I/Phase II award during our analysis period.
- 3) **DoD-funded subcontract awards attributed to a DoD-funded SBIR/STTR company.** Given the complexity and costs associated with pursuing government contracts, some SBIR/STTR companies have neither the ability nor the desire to contract with the DoD directly. Instead, they may deliver their capabilities to the DoD by subcontracting to a prime contractor. While there is no way to know if a subsequent DoD-funded subcontract award related to a company’s SBIR/STTR research, we wanted to consider the possibility that some SBIR companies transition their capabilities to the warfighter through a prime. As such, we considered DoD-funded subcontract awards attributed to each SBIR company, subsequent to the first DoD-funded SBIR/STTR Phase I/Phase II award they received during our analysis period.

Research Limitations and Future Research

It is possible that a SBIR/STTR company was wholly or partially acquired by a prime contractor, and that the prime contractor then integrated the SBIR company’s capabilities into a DoD contract that it held. We did not have access to a reliable set of commercial acquisitions data, so we were unable to consider this metric. To the extent this information can be compiled in the future, it would be valuable to incorporate into subsequent research.



Our most significant research limitation was the fact that we could not distinguish between which non-SBIR DoD procurement contracts and DoD subcontracts related to a SBIR company’s SBIR/STTR work, and which did not. Because we treated all subsequent non-SBIR DoD procurement contracts and DoD subcontracts as indicators that SBIR/STTR capabilities transitioned to the warfighter, we gave the program more than its due credit. Future research could leverage advanced text analysis to compare a company’s SBIR/STTR project description with text describing a subsequent contract/subcontract award, to evaluate the possibility that the two are related. Subsequent contracts/subcontracts that appear unrelated to SBIR/STTR work could be excluded. However, the most effective way to reduce false attributions would be to require more comprehensive reporting for Phase III contracts and thereby eliminate the need to analyze non-Phase III procurement contracts entirely. Similarly, the government should establish formal criteria for “Phase III subcontract awards,” create a code in USASpending to denote Phase III subcontract awards, and require that they be reported by relevant stakeholders from government and industry. Doing so would make it easier to track when SBIR/STTR capabilities transition to the warfighter indirectly. In light of these limitations, conclusions drawn from this research should place a greater emphasis on coded Phase III transition metrics because of their significantly higher efficacy.

Calculating Transition by Metric

To analyze transition rate across our three metrics, we leveraged procurement data from FPDS and subcontracting data from USASpending. First, we aggregated procurement data from FPDS and filtered it for FY 2012–FY 2021. Next, we isolated DoD Phase III awards attributed to the 4703 SBIR companies in our analysis group. We repeated this process for non-SBIR DoD procurement contracts and subsequent DoD-funded SBIR/STTR Phase I/Phase II awards during the analysis period.

To identify DoD-funded subcontracts awarded to the SBIR companies, we aggregated subcontract award data from USASpending. We filtered the data for DoD-funded subcontracts awarded to the 4703 SBIR companies in our analysis group from FY 2012–FY 2021. We then isolated DoD-funded subcontracts subsequent to their first SBIR/STTR Phase I/Phase II award.

Table 3 provides a breakdown of the total funding amount and number of SBIR companies that transitioned capabilities to the warfighter, based on three increasingly broad ways of measuring transition:

- 1) Companies that transitioned via Phase III award(s)
- 2) Companies that transitioned via Phase III award(s) and/or subsequent non-SBIR DoD Procurement contracts
- 3) Companies that transitioned via Phase III award(s) and/or subsequent non-SBIR DoD Procurement contracts, and/or subsequent DoD-funded subcontracts

Table 3. DoD SBIR/STTR Program Transition Rate by Metric

Total SBIR Companies	Total DoD PIII Funding to SBIR Companies	SBIR Companies w/ PIII Award(s)	% SBIR Companies w/ PIII Award(s)	Total DoD PIII + Non-SBIR DoD Procurement to SBIR Companies	SBIR Companies w/ PIII Award(s) and/or non-SBIR DoD Procurement	% SBIR Companies w/ PIII Award(s) and/or non-SBIR DoD Procurement	Total DoD PIII + Non-SBIR DoD Procurement + DoD Subcontracts to SBIR Companies	SBIR Companies w/ PIII Award(s) and/or non-SBIR DoD Procurement and/or DoD Subcontracts	% SBIR Companies w/ PIII Award(s) and/or non-SBIR DoD Procurement and/or DoD Subcontracts
4703	\$10,276,728,376	748	16%	\$60,004,772,641	2731	58%	\$118,726,886,820	2949	63%



Over the last decade, only 16% of DoD SBIR companies won Phase III awards. The transition rate noticeably improved when considering non-SBIR procurement and subcontracts, but as discussed previously it is difficult to draw conclusions about the nature of these awards.

Assessing the Distribution of Transition Funding

Next, we were interested in assessing the distribution of transition funding across the SBIR companies. Specifically, for the SBIR companies that transitioned, we wanted to determine the extent to which they generated more in subsequent defense revenue across these three metrics, relative to the amount of non-dilutive Phase I/Phase II funding they were awarded. For each SBIR company that transitioned, we compared the total amount of funding they received in DoD Phase I/Phase II awards against the total amount of revenue they generated across these three metrics:

- 1) Phase III awards
- 2) Phase III awards and/or subsequent non-SBIR DoD procurement contracts
- 3) Phase III awards and/or subsequent non-SBIR DoD procurement contracts, and/or subsequent DoD-funded subcontracts

Ratio of Phase I/Phase II Funding to Phase III Awards

As shown in Table 4, of the 748 SBIR companies that transitioned via Phase III awards, only 39% generated more in Phase III contract dollars than they were awarded in Phase I/Phase II non-dilutive funding. Taken as a percentage of the overall DoD SBIR program, just 6% of all SBIR companies generated more in Phase III contracts than they were awarded in Phase I/Phase II funding.

Table 4. Phase III Funding vs. Phase I/Phase II Funding

DoD SBIR Companies	SBIR Companies w/ PIII Award(s)	SBIR Companies w/ more in PIII than DoD PI/PII Funding	% PIII Companies with More in PIII Funding than PI/PII Funding	% All SBIR Companies w/ More in PIII Funding than PI/PII Funding
4703	748	293	39%	6%

Ratio of Phase I/Phase II Funding to (Phase III Awards + non-SBIR Procurement)

As shown in Table 5, nearly half of companies that transitioned via Phase III and/or non-SBIR procurement contracts consumed more in Phase I/Phase II funding than they generated in transition revenue. Taken as a percentage of the overall DoD SBIR program, just 29% of all SBIR companies generated more in Phase III funding and/or non-SBIR procurement contracts than they were awarded in Phase I/Phase II funding.

Table 5. (Phase III + Non-SBIR Procurement Funding) vs. Phase I/Phase II Funding

DoD SBIR Companies	SBIR Companies w/ PIII Award(s) and/or non-SBIR DoD Procurement	SBIR Companies w/ more in PIII and/or non-SBIR procurement than DoD PI/PII Funding	% PIII + Procurement Companies with More in PIII and/or Procurement Funding than PI/PII Funding	% All SBIR Companies w/ More in PIII and/or Procurement Funding than PI/PII Funding
4703	2731	1382	51%	29%



Ratio of Phase I/Phase II Funding to (Phase III Awards + non-SBIR Procurement + DoD Subcontract Awards)

Adding DoD-funded subcontract awards to the calculation, 42% of companies that transitioned via one or more transition metric consumed more in Phase I/Phase II funding than they generated in subsequent transition revenue, as shown in Table 6. Taken as a percentage of the overall DoD SBIR program, just 36% of all SBIR companies generated more in Phase III awards and/or non-SBIR procurement contracts, and/or DoD-funded subcontracts than they were awarded in Phase I/Phase II funding.

Table 6. Phase III + Non-SBIR Procurement Funding + DoD Subcontract Funding vs. Phase I/Phase II Funding

DoD SBIR Companies	SBIR Companies w/ PIII Award(s) and/or non-SBIR DoD Procurement and/or DoD Subcontracts	SBIR Companies w/ more in PIII and/or non-SBIR procurement and/or DoD Subcontracts than DoD PI/PII Funding	% PIII + Procurement Companies with More in PIII and/or Procurement Funding and/or DoD Subcontracts than PI/PII Funding	% All SBIR Companies w/ More in PIII and/or Procurement and/or DoD Subcontracts than PI/PII Funding
4703	2949	1705	58%	36%

Grading Transition Rate: The Jury is Out

Our analysis revealed that a substantial portion of DoD SBIR companies failed to transition their capabilities to the warfighter by any metric, and nearly all that transitioned still consumed more in Phase I/Phase II funding than what they generated in subsequent non-SBIR defense revenue. However, we could not draw conclusions about the success or failure of the SBIR program based on these metrics alone. Investing in early stage R&D means, to some extent, investing in ideas that will fail. If all Phase I/Phase II projects produced usable capabilities, it would signal that the DoD SBIR program was too risk averse. One could also argue that it is worth investing billions into companies that failed to transition if that investment also produced even a small number of capabilities that truly transformed the warfighter.

Additionally, these metrics alone offered no insight into specific factors inhibiting transition rate. Lawmakers and DoD officials often use the term “valley of death” to “[refer] to how many defense technologies fail to transition from prototypes into actual products for the military,” citing “the Pentagon’s bureaucracy”—the complexity of pursuing and winning DoD contracts—as its primary cause (Luckenbaugh, n.d.). However, our data shows that a subset of DoD SBIR companies won tens of millions of dollars or more in Phase I/Phase II awards annually. If the valley of death is caused primarily by companies lacking resources or expertise, there should be noticeable differences between the transition rates among these MAWs, relative to DoD SBIR companies with less experience. To draw more insightful conclusions about the DoD SBIR/STTR program as a means of delivering capabilities to the warfighter and to begin to understand why certain participants may fail to transition, we coupled our analysis of transition rates across program participants in general with an analysis of transition rates among MAWS specifically.



Assessing the Top SBIR Companies

Our data set includes hundreds of MAWs. For example, the top 5% of DoD SBIR companies in our analysis group with the most in Phase I/Phase II awards—about 235 companies—collectively received 49% of all Phase I/Phase II funding. However, to meaningfully analyze the features and transition rates of MAWs at an individual company level, we focused on a smaller data set. Specifically, we isolated the 25 DoD SBIR companies in receipt of the most Phase I/Phase II funding during our analysis period. As shown in Table 7, the top 25 SBIR companies cumulatively received 18% of all DoD Phase I/Phase II funding—more than \$2.3 billion—from FY 2012–FY 2021.

Table 7. Top 25 DoD SBIR Companies' Phase I/Phase II Funding Totals, FY 2012–FY 2021

Company	Total DoD PI/PII Funding, FY 2012–FY 2021	% of Total DoD PI/PII Funding, FY 2012–FY 2021
PHYSICAL OPTICS CORPORATION	\$198,222,973	1.51%
INTELLIGENT AUTOMATION INC	\$172,174,305	1.31%
PHYSICAL SCIENCES INC	\$168,520,875	1.28%
CREATE INCORPORATED	\$158,034,669	1.20%
CHARLES RIVER ANALYTICS INC	\$153,639,314	1.17%
TRITON SYSTEMS INC	\$121,816,610	0.93%
LUNA INNOVATIONS INCORPORATED	\$115,727,487	0.88%
CFD RESEARCH CORPORATION	\$103,029,444	0.79%
LYNNTECH INC	\$95,715,220	0.73%
TOYON RESEARCH CORPORATION	\$92,398,212	0.70%
ARETE ASSOCIATES	\$86,856,904	0.66%
PROGENY SYSTEMS CORPORATION	\$76,422,839	0.58%
SA PHOTONICS INC	\$75,002,150	0.57%
MAINSTREAM ENGINEERING CORPORATION	\$70,653,705	0.54%
APTIMA INC	\$70,561,859	0.54%
CORVID TECHNOLOGIES LLC	\$64,965,146	0.50%
SOAR TECHNOLOGY INC	\$67,302,292	0.51%
CORNERSTONE RESEARCH GROUP INCORPORATED	\$59,984,693	0.46%
ENGINEERING AND SOFTWARE SYSTEM SOLUTIONS INC	\$57,145,087	0.44%
TDA RESEARCH INC	\$56,439,024	0.43%
INTELLISENSE SYSTEMS INC	\$55,685,545	0.42%
MAXENTRIC TECHNOLOGIES LLC	\$55,054,742	0.42%
OCEANIT LABORATORIES INC	\$54,091,626	0.41%
FIRST RF CORPORATION	\$53,791,669	0.41%
SYSTEMS TECHNOLOGY RESEARCH LLC	\$52,631,563	0.40%
Total	\$2,335,867,952	18%

To capture a more complete picture of the Phase I/Phase II funding attributed to MAWs, for each of these top 25 companies we expanded the analysis time frame to calculate their total DoD Phase I/Phase II funding, from their first DoD Phase I/Phase II award through the date we ran the analysis (March 29, 2023). Table 8 shows the total amount of DoD Phase I/Phase II funding each company received over its lifetime.



Table 8 Lifetime DoD Phase I/Phase II Funding—Top 25 DoD SBIR Companies

Company	FY of Initial DoD PhI/PhII Award	FY of Most Recent DoD PhI/PhII Award	Lifetime Total DoD PI/PII Award Funding
PHYSICAL OPTICS CORPORATION	1997	2023	\$359,325,897
PHYSICAL SCIENCES INC	1997	2023	\$321,023,208
CREARE INCORPORATED	1997	2023	\$274,156,442
INTELLIGENT AUTOMATION INC	1997	2023	\$269,444,012
CHARLES RIVER ANALYTICS INC	1997	2023	\$260,141,162
TRITON SYSTEMS INC	1997	2023	\$243,888,188
CFD RESEARCH CORPORATION	1997	2023	\$213,364,011
LUNA INNOVATIONS INCORPORATED	1997	2023	\$199,301,561
LYNNTECH INC	1997	2023	\$158,497,089
TOYON RESEARCH CORPORATION	1997	2023	\$153,759,374
APTIMA INC	1997	2023	\$152,596,850
ARETE ASSOCIATES	1997	2023	\$139,482,615
PROGENY SYSTEMS CORPORATION	1997	2023	\$133,489,054
TDA RESEARCH INC	1997	2023	\$106,391,125
CORNERSTONE RESEARCH GROUP INCORPORATED	1998	2023	\$105,438,088
MAINSTREAM ENGINEERING CORPORATION	1997	2023	\$102,005,756
SOAR TECHNOLOGY INC	2000	2023	\$101,166,814
SA PHOTONICS INC	2003	2023	\$98,359,670
INTELLISENSE SYSTEMS INC	2018	2023	\$84,704,547
FIRST RF CORPORATION	2003	2023	\$84,536,933
CORVID TECHNOLOGIES LLC	2005	2023	\$80,279,823
OCEANIT LABORATORIES INC	1997	2023	\$76,722,560
ENGINEERING AND SOFTWARE SYSTEM SOLUTIONS INC	2007	2023	\$75,206,735
MAXENTRIC TECHNOLOGIES LLC	2005	2023	\$71,623,153
SYSTEMS TECHNOLOGY RESEARCH LLC	2011	2022	\$53,419,184
TOTAL			\$3,558,997,955

All but one of the top 25 companies have received DoD Phase I/Phase II SBIR/STTR awards for more than 10 years, and 20 of the top 25 companies have been awarded DoD Phase I/Phase II funding for more than 20 years.

Transition Rate Among MAWs

For each of the top 25 DoD SBIR companies, we calculated the total amount of Phase III, non-SBIR DoD Procurement, and DoD subcontract revenue generated between



FY 2012–FY 2021. We then compared each metric to the company’s total Phase I/Phase II funding during the analysis period to generate a ratio of transition revenue to total Phase I/Phase II funding. As shown in Table 9, only four of the top 25 DoD SBIR companies generated more in DoD Phase III contracts than they received in non-dilutive Phase I/Phase II awards.

Adding non-SBIR DoD procurement to the transition calculation, the majority of the top 25 DoD SBIR companies still received more in Phase I/Phase II funding than they generated in subsequent Phase III and/or non-SBIR DoD contracts. By the most liberal transition metric—subsequent DoD Phase III funding, and/or non-SBIR DoD procurement, and/or DoD-funded subcontract awards—just over half of the top 25 DoD SBIR companies generated more in transition revenue than they were awarded in Phase I/Phase IIs.

Table 9. Transition Metrics for FY 2012–FY 2021, Top 25 DoD SBIR Companies

Company	Total DoD PI/PII \$	Total PIII \$	Ratio PIII \$ vs. PI/PII \$	Total PIII + non-SBIR \$	Ratio PIII + non-SBIR \$ vs. PI/PII \$	Total PIII + non-SBIR + DoD Subcontract \$	Ratio PIII + non-SBIR + DoD Subcontract \$ vs. PI/PII \$
PHYSICAL OPTICS CORPORATION	\$198,222,973	\$296,550,639	150%	\$506,752,621	256%	\$543,835,766	274%
INTELLIGENT AUTOMATION INC	\$172,174,305	\$14,607,362	8%	\$68,236,490	40%	\$86,709,123	50%
PHYSICAL SCIENCES INC	\$168,520,875	\$10,303,411	6%	\$74,941,384	44%	\$101,913,061	60%
CREARE INCORPORATED	\$158,034,669	\$53,366,123	34%	\$85,743,425	54%	\$88,505,471	56%
CHARLES RIVER ANALYTICS INC	\$153,639,314	\$15,930,109	10%	\$206,213,710	134%	\$241,430,984	157%
TRITON SYSTEMS INC	\$121,816,610	\$6,430,752	5%	\$35,544,912	29%	\$36,091,069	30%
LUNA INNOVATIONS INCORPORATED	\$115,727,487	\$3,616,872	3%	\$32,884,666	28%	\$36,422,619	31%
CFD RESEARCH CORPORATION	\$103,029,444	\$450,378	0%	\$21,122,072	21%	\$53,267,339	52%
LYNNTECH INC	\$95,715,220	\$3,849,136	4%	\$20,586,029	22%	\$20,742,065	22%
TOYON RESEARCH CORPORATION	\$92,398,212	\$19,174,422	21%	\$129,289,686	140%	\$228,169,816	247%
ARETE ASSOCIATES	\$86,856,904	\$125,140,457	144%	\$179,414,186	207%	\$231,727,064	267%
PROGENY SYSTEMS CORPORATION	\$76,422,839	\$875,436,015	1146%	\$1,326,867,356	1736%	\$2,068,581,929	2707%
SA PHOTONICS INC	\$75,002,150	\$11,267,031	15%	\$82,407,497	110%	\$205,665,144	274%
MAINSTREAM ENGINEERING CORPORATION	\$70,653,705	\$143,565	0%	\$26,159,461	37%	\$51,320,790	73%
APTIMA INC	\$70,561,859	\$82,468,290	117%	\$193,482,868	274%	\$276,564,268	392%
CORVID TECHNOLOGIES LLC	\$64,965,146	\$26,602,284	41%	\$112,915,222	174%	\$201,785,024	311%
SOAR TECHNOLOGY INC	\$67,302,292	\$5,760,555	9%	\$104,177,240	155%	\$213,942,061	318%
CORNERSTONE RESEARCH GROUP INCORPORATED	\$59,984,693	\$4,820,260	8%	\$20,992,906	35%	\$27,303,828	46%
ENGINEERING AND SOFTWARE SYSTEM SOLUTIONS INC	\$57,145,087	\$66,924,136	117%	\$177,492,020	311%	\$178,879,990	313%
TDA RESEARCH INC	\$56,439,024	\$610,100	1%	\$17,383,352	31%	\$18,439,670	33%
INTELLISENSE SYSTEMS INC	\$55,685,545	\$15,624,644	28%	\$31,418,599	56%	\$58,408,779	105%
MAXENTRIC TECHNOLOGIES LLC	\$55,054,742	\$6,290,024	11%	\$22,033,549	40%	\$27,717,398	50%
OCEANIT LABORATORIES INC	\$54,091,626	\$22,630,526	42%	\$52,124,554	96%	\$53,565,949	99%
FIRST RF CORPORATION	\$53,791,669	\$33,006,900	61%	\$70,982,752	132%	\$468,983,023	872%
SYSTEMS TECHNOLOGY RESEARCH LLC	\$52,631,563	\$49,937,790	95%	\$594,811,635	1130%	\$677,348,738	1287%



We were interested in seeing how these top 25 companies ranked in terms of the amount of Phase III contract dollars they received, compared to the other companies in our analysis group that received Phase IIIs. We ranked the 748 companies from our analysis group that received Phase III awards, where “1” denoted the company with the most in Phase III funding and “748” denoted the company with the least in Phase III funding. Table 10 shows where each of the top 25 DoD SBIR companies ranked. Only nine of the top 25 companies fell in the top 10% of DoD SBIR companies receiving the most Phase III contract dollars.

Table 10. Ranking of Top 25 SBIR Companies, Based on Phase III Funding Amount

Company	Company Ranking, Based on Total DoD Phase III Funding
PHYSICAL OPTICS CORPORATION	6
INTELLIGENT AUTOMATION INC	112
PHYSICAL SCIENCES INC	147
CREARE INCORPORATED	40
CHARLES RIVER ANALYTICS INC	104
TRITON SYSTEMS INC	207
LUNA INNOVATIONS INCORPORATED	273
CFD RESEARCH CORPORATION	585
LYNNTECH INC	266
TOYON RESEARCH CORPORATION	91
ARETE ASSOCIATES	18
PROGENY SYSTEMS CORPORATION	1
SA PHOTONICS INC	136
MAINSTREAM ENGINEERING CORPORATION	653
APTIMA INC	27
CORVID TECHNOLOGIES LLC	68
SOAR TECHNOLOGY INC	223
CORNERSTONE RESEARCH GROUP INCORPORATED	247
ENGINEERING AND SOFTWARE SYSTEM SOLUTIONS INC	30
TDA RESEARCH INC	555
INTELLISENSE SYSTEMS INC	106
MAXENTRIC TECHNOLOGIES LLC	210
OCEANIT LABORATORIES INC	80
FIRST RF CORPORATION	56
SYSTEMS TECHNOLOGY RESEARCH LLC	42

The data revealed no consistent relationship between the amount of Phase I/Phase II funding a company received and the extent to which it delivered capabilities to the warfighter. In fact, some MAWs continued to receive a disproportionate share of overall DoD



Phase I/Phase II funding, yet had below average rates of transition. Their inability to transition cannot be attributed to a lack of resources or wherewithal—after all, they have decades of experience in the defense market and tens of millions in non-dilutive contract awards. Instead, the inconsistent and often poor transition rates among MAWs revealed a disconnect between both the stated objectives of the program and the role the program should play, in light of today’s threat environment; and how the program functions in actuality.

The DoD SBIR program awards a disproportionate share of Phase I/Phase II funding to a set of companies that, based on extensive past performance data, are unlikely to deliver capabilities to defense end-users. That the most active DoD SBIR companies are not necessarily those with the greatest potential for transition indicates that they are selected for Phase I/Phase II awards based on other, unrelated criteria. As such, “the valley of death” is not simply the result of companies struggling to navigate the bureaucracy associated with transitioning from R&D into a DoD program of record. By continuing to disproportionately fund companies that, based on their extensive past performance, will not transition, the DoD SBIR program effectively guarantees the existence of a “valley of death.”

Small By What Standards?

The data related to MAWs brought to light another fundamental issue related to the SBIR program. While the SBIR/STTR program was established to serve small businesses, companies can win tens of millions of dollars or more annually in non-dilutive R&D grants and still qualify by program standards as small. In fact, Phase I/Phase II awards represent only a snapshot of MAWs’ overall revenue—many generate tens of millions of dollars or more in government revenue annually from other sources, as demonstrated in Table 9; in addition to commercial revenue. Some, like Luna Innovations, are publicly-traded.

Companies can qualify as “small” by SBIR/STTR size standards irrespective of how much revenue they generate, as long as they have fewer than 500 employees (*DOD Small Business Innovation Research / Small Business Technology Transfer, n.d.*). A significant share of Phase I/Phase II funds are not simply awarded to companies unlikely to transition their capabilities to the warfighter; they are awarded to companies that most reasonable Americans would never consider to be “small businesses.”

Additionally, MAWs win Phase I/Phase II awards for projects that span a wide range of unrelated topics. We searched a subset of the top 25 companies by name on the SBIR Award Database website, <https://www.sbir.gov/sbirsearch/award/all>, to better understand the nature of some of their DoD Phase I/Phase II awards. We found that Charles River Analytics received Phase I/Phase II funding for projects including, but not limited to, data analytics for ship maintenance, decision support systems to assist Army soldiers with career planning, wearable sensors for Navy divers, algorithms to enhance robotic caregivers, the development of “smart fabrics” that incorporate sensors and communication networks, and more. Physical Optics received Phase I/Phase II funding to develop artificial intelligence for unmanned systems, coatings for missiles, cyber detection and attack tools, remote unmanned refueling systems, night vision cameras and more. Progeny won Phase I/Phase II awards to develop cyber security for unmanned aerial systems, self-serve kiosks to display human performance information, platforms to manage food service on Navy ships, augmented reality displays for submarine command teams, and more.

Furthermore, from our earlier research we know that most MAWs not only win DoD Phase I/Phase II awards, but also participate in the SBIR/STTR program across multiple non-defense agencies. To capture a picture of their experience in other agencies’ SBIR programs, we linked all Phase I/Phase II SBIR/STTR award data associated with each of



the top 25 companies from FPDS and USASpending, irrespective of funding agency. As shown in Table 11, all but one of the top 25 DoD SBIR/STTR companies generated Phase I/Phase II funding from non-DoD sources.

Table 11. Top 25 DoD SBIR/STTR Companies' Lifetime Phase I/Phase II Funding, DoD and non-DoD Sources

Company	Lifetime Total DoD PI/PII Funding	Lifetime Total PI/PII SBIR/STTR Funding
PHYSICAL OPTICS CORPORATION	\$359,325,897	\$384,534,627
PHYSICAL SCIENCES INC	\$321,023,208	\$355,985,614
CREARE INCORPORATED	\$274,156,442	\$330,887,539
INTELLIGENT AUTOMATION INC	\$269,444,012	\$313,815,023
CHARLES RIVER ANALYTICS INC	\$260,141,162	\$281,737,900
TRITON SYSTEMS INC	\$243,888,188	\$249,656,762
CFD RESEARCH CORPORATION	\$213,364,011	\$240,851,455
LUNA INNOVATIONS INCORPORATED	\$199,301,561	\$238,795,534
LYNNTECH INC	\$158,497,089	\$176,441,321
TOYON RESEARCH CORPORATION	\$153,759,374	\$165,561,850
APTIMA INC	\$152,596,850	\$156,214,311
ARETE ASSOCIATES	\$139,482,615	\$141,259,857
PROGENY SYSTEMS CORPORATION	\$133,489,054	\$136,432,764
TDA RESEARCH INC	\$106,391,125	\$129,951,953
CORNERSTONE RESEARCH GROUP INCORPORATED	\$105,438,088	\$124,861,304
MAINSTREAM ENGINEERING CORPORATION	\$102,005,756	\$113,875,803
SOAR TECHNOLOGY INC	\$101,166,814	\$103,579,056
SA PHOTONICS INC	\$98,359,670	\$99,259,498
INTELLISENSE SYSTEMS INC	\$84,704,547	\$88,161,845
FIRST RF CORPORATION	\$84,536,933	\$85,129,445
CORVID TECHNOLOGIES LLC	\$80,279,823	\$80,653,711
OCEANIT LABORATORIES INC	\$76,722,560	\$78,712,745
ENGINEERING AND SOFTWARE SYSTEM SOLUTIONS INC	\$75,206,735	\$76,722,560
MAXENTRIC TECHNOLOGIES LLC	\$71,623,153	\$73,821,632
SYSTEMS TECHNOLOGY RESEARCH LLC	\$53,419,184	\$53,419,184

It is hard to imagine how any company, let alone a small business, can be at the cutting-edge of innovation in dozens of unrelated fields. Rather, these companies are experts in navigating the SBIR program. Despite the stated objectives of the program, DoD SBIR program managers are primarily measured by whether or not they award the requisite amount of total funding to eligible firms every year; and whether or not these recipient firms



comply with program rules over the course of their projects. Based on this criterion, companies with expertise submitting SBIR proposals, rather than companies with the best ideas, are the likely recipients of Phase I/Phase II funding. The sheer amount of SBIR/STTR funding attributed to MAWs across the entirety of the program further underscores that poor transition rates cannot be attributed exclusively to a lack of resources. Simply allocating more money to SBIR companies does not address the “valley of death.” SBIR program managers must begin to evaluate a company’s potential for transition as the primary criterion for award.

For decades, MAWs have comfortably won tens of millions of dollars or more in non-dilutive R&D funding, year in and year out. In spite of the stated objectives of the program and that now more than ever it is critical for the military to harness innovations stemming from the private sector, neither the DoD SBIR program managers nor the participating companies are held accountable for ensuring these investments benefit the warfighter. When making award decisions in relation to MAWs, SBIR program managers must be required to factor the ratio of previous Phase I/Phase II awards to a company, compared to the subsequent Phase III/Phase III subcontracts generated. Additionally, Congress must establish clear Phase III transition requirements for DoD SBIR program offices—specifically, a formal goal for the minimum number of companies awarded Phase III contracts and/or Phase III subcontracts annually. Doing so will direct more SBIR resources to non-MAWs, and/or will force the most active participants in the DoD SBIR program to focus on delivering capabilities to DoD end-users.

Transition Challenges for Smaller SBIR Companies

Clearly, large-scale improvements to the transition rate among DoD SBIR companies will require creating new incentives, changing the eligibility criteria for participants, and changing the metrics for evaluating DoD program offices. That said, we also wanted to consider the unique challenges smaller DoD SBIR companies face when navigating the defense market. Unlike MAWs, smaller companies with less experience in the DoD market often pursue the SBIR/STTR program with the expectation that, if they perform well, it will lead to follow-on defense business. However, the DoD SBIR program rarely positions them for success in the broader defense market for a variety of reasons.

We have interacted with and surveyed dozens of DoD SBIR companies and DoD SBIR program offices over the last five years, both in conjunction with earlier research papers published through the Naval Postgraduate School and as part of work we have undertaken—with Phase I/Phase II funding from the Navy, the Air Force, and the Defense Technical Information Center—to develop solutions to improve defense stakeholders’ ability to leverage capabilities funded and fielded through innovation programs.

Through this qualitative research, we identified several specific factors keeping DoD SBIR companies from serving the needs of the warfighter subsequent to program completion (Bresler & Bresler, 2021):

- SBIR companies are not educated on how or where to identify DoD opportunities, and they are unlikely to succeed if and when they attempt to bid on them.
 - The design and archaic search functionality of the website where DoD solicitations are marketed (SAM.gov) make it near impossible for companies to find relevant opportunities.
 - If a company manages to identify a relevant opportunity, the submission deadline makes it nearly impossible to prepare and submit a bid. Our analysis of more than 1 million DoD solicitations from 2002 through 2020 found that



70% required companies to respond within 21 days of when they were posted, and 30% required responses within 10 days or less.

- DoD solicitations are not written clearly. Evaluating the readability of the description fields associated with more than 1 million DoD solicitations using the Flesch-Kincaid Readability and Grade Level scores, we found that fewer than 3% of solicitation descriptions were written in “plain English.”
- Government stakeholders do not coordinate their requirements, despite often seeking the same capabilities. For instance, on a single day in October 2020, there were 132 open requirements related to UAVs. Small companies new to the defense market cannot reasonably respond to dozens or hundreds of potentially relevant opportunities, and they lack the insider knowledge to effectively prioritize them.
- The individual that oversees Phase I/Phase II contract work typically does not have the authority and/or resources to fund a follow-on contract/program of record directly. And he/she may not have knowledge of or access to those who do. As a result, in the absence of investing in lobbyists or business development consultants, companies have no way of connecting with their potential DoD customers—regardless of their Phase I/Phase II performance.
- The DoD SBIR program offers no clear instructions to companies regarding internal systems (accounting, cybersecurity, etc.) that may be required to qualify for follow-on contracts. Small companies not only walk away from the defense market because they cannot justify the investment, but also because they simply cannot get clear information on what the required level of investment will be.
- The DoD SBIR program does not effectively market participants’ capabilities to the broader armed services community. One of the most frequent comments from DoD stakeholders over the last five years was that they received very few briefings on the projects funded by their own branch, and almost never received information on capabilities funded by other branches. As a result, rather than leveraging existing investments made through the DoD SBIR program, DoD stakeholders either continuously invest in redundant market research or fail to modernize altogether.

Conclusion and Recommendations

On the whole, the DoD SBIR program has failed to incubate capabilities that go on to serve DoD end-users. This poor rate of transition can be attributed to multiple factors. SBIR program managers are not held accountable for funding companies with the greatest promise for transition. Instead, they have directed the majority of Phase I/Phase II funds to companies that have cultivated an expertise in how to navigate the SBIR program. Regardless of SBA size standards, these MAWs look and act like large businesses. They effectively submit winning proposals and deliver compliant milestones. Their institutional knowledge of processes is more relevant than the innovativeness of their solutions. Because these companies can win tens of millions of dollars annually in non-dilutive funding, they have no incentive to transition. In fact, they are incentivized to continue to focus their resources and attention on pursuing *more* SBIR awards, rather than undertake the complex process of pursuing non-SBIR contracts.

Additionally, companies that participate in the DoD SBIR program with the goal of continuing to support the DoD thereafter are not well-positioned to do so. The SBIR program fails to educate them on the requirements associated with pursuing traditional defense contracts. While the SBIR program affords participants with sole-source justification within



scope, it does not facilitate connections between SBIR companies and viable DoD customers. To successfully capture defense business after Phase I/Phase II project completion requires a significant investment. Many small, innovative companies—particularly those with viable commercial revenue streams—choose to abandon the defense market altogether, rather than “pay to play.”

To address these issues and position the SBIR program to more effectively deliver capabilities to the warfighter, we offer the following recommendations:

- Require more comprehensive reporting for Phase III contracts to eliminate the need to analyze non-Phase III procurement contracts when measuring transition.
- Create a code in USASpending specifically for Phase III subcontract awards, to denote when a subcontract award relates to a company’s SBIR work.
- Overhaul SBA size standards so that the SBIR program benefits *truly* small businesses.
- Establish clear Phase III transition requirements for DoD SBIR/STTR program offices. Specifically, there should be a formal goal for the minimum number of companies awarded Phase III contracts and/or Phase III subcontracts annually.
- When a company submits a Phase I/Phase II SBIR proposal, the ratio of its total Phase I/Phase II funding relative to the amount of revenue it has generated in Phase III contract and subcontract awards should be an important evaluation criteria. Firms with \$10 million or more in cumulative Phase I/Phase II DoD SBIR awards must meet minimum Phase III transition thresholds in order to remain eligible for additional Phase I/Phase II funding.
- Incentivize DoD stakeholders to integrate capabilities funded and fielded through the SBIR/STTR program. The incentive program can mirror existing set-aside programs that require DoD stakeholders to award a certain percentage of contract awards to various company types (woman-owned small business, 8a, etc.). There should be goals for awarding a percentage of contracts annually as Phase IIIs or Phase III subcontract awards, to encourage the DoD to leverage investments made through the SBIR/STTR program. Additional credit should be given when a DoD stakeholder awards a Phase III contract or subcontract to a company funded and fielded by a different agency.
- Incentivize prime contractors to integrate capabilities funded and fielded through the SBIR/STTR program. Much like prime contractors have goals for awarding a certain share of subcontracting business to various set-aside companies, they should receive additional credit—beyond what would count towards their small business set-aside goals—when subcontracting for capabilities funded and fielded through SBIR/STTR.
- Make it easier for companies to identify and bid on DoD solicitations. Specifically, redesign SAM.beta to improve search functionality; require solicitations to have a response time of more than 30 days unless a justification is provided; require solicitation descriptions to be written in plain English; and require government stakeholders with similar requirements to coordinate their outreach and communication efforts.



It is essential for our national security that the DoD have access to the most promising new technologies. As the largest and most long-standing defense innovation initiative, the DoD SBIR program must adapt with this imperative in mind. With strong leadership and a thoughtful restructuring of resources and incentives, the DoD SBIR program has the potential to channel its multibillion-dollar budget into solutions that could revolutionize the military.

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ACQUISITION RESEARCH PROGRAM
DEPARTMENT OF DEFENSE MANAGEMENT
NAVAL POSTGRADUATE SCHOOL
555 DYER ROAD, INGERSOLL HALL
MONTEREY, CA 93943

WWW.ACQUISITIONRESEARCH.NET