

Testimony of Amanda Bresler
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House Committee on Small Business
Subcommittee on Economic Growth,
Tax, and Capital Access

“Exploring SBA Programs: Reviewing
the SBIC and SBIR Programs' Impact
on Small Businesses”

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Background & SBIR Expertise

Chairman Williams, Ranking Member Velazquez, Subcommittee Chairman Meuser, and Ranking Member Landsman, thank you for the opportunity to testify today. My name is Amanda Bresler, and I am the Chief Strategy Officer for PW Communications. Over the last 7 years, I have published five independent research reports through the Naval Postgraduate School (NPS) that analyze the impact of federal procurement policies, including the Small Business Innovation Research (SBIR) program, on small businesses. These reports have been cited by the Defense Innovation Board, the Commission on Planning, Programming, Budgeting, and Execution (PPBE) Reform, Contract Management Magazine, Bloomberg Government, the Ronald Reagan Institute, Defense News, and others. A key research recommendation from my 2018 paper also resulted in Section 220 of the 2019 NDAA: *The Establishment of the Innovators Information Repository in the Department of Defense*.

Since 2019, my firm has also participated in the SBIR program. We have won a Phase I and two subsequent Phase II awards sponsored by the Department of Defense (DoD), to develop a capability called SHELDON. SHELDON is a data-driven advisory firm that provides stakeholders in the federal government with transparent data and analytics products to facilitate better adoption of government-funded capabilities, reduce duplicative research and development efforts, enable greater situational awareness of the available market for goods and services in the public sector, and more. At the direction of our customers from the U.S. Navy and the U.S. Air Force, we have analyzed the composition and performance of SBIR portfolios; and conducted hundreds of surveys of SBIR program participants.

As such, the perspective and recommendations I offer today are the result of a comprehensive understanding of the program gained through independent research and analysis; firsthand experience navigating the program as a SBIR company; and as someone building tools designed to improve the adoption of federally-funded technologies across the government. This written testimony includes references to analyses undertaken as part of our NPS research. For more detailed information on how we conducted these analyses, including the data sets we used, please see the full reports, which are included in the Appendix.

The Top of the Funnel: Small Businesses & The SBIR Program

The SBIR program is marketed as a way for innovative small businesses to break into the public sector. However, the majority of SBIR participants are entrenched government contractors. For instance, in our 2020 NPS paper, analyzing data from fiscal years (FY) 2010-FY2019, we determined that **more than 90% of DoD Phase I funding was awarded to existing government contractors**.

Task a group of the world's most accomplished entrepreneurs with identifying and responding to a Phase I SBIR proposal, and you will understand why. The process for identifying, preparing, and submitting a Phase I/Phase II proposal is so arcane and complex

that, irrespective of IQ or business acumen, it is nearly impossible for someone outside of the traditional government industrial base (“nontraditionals”) to navigate. Proposal preparation instructions can be 50+ pages long, and—as we encountered when we prepared our Phase I submission—often contain contradicting sets of instructions. They are rife with jargon and requirements that are incomprehensible to nontraditionals.

Many innovative small businesses forgo the SBIR program entirely. Others hire insiders, in the form of “SBIR advisory firms,” to help them navigate the process in exchange for a percentage of the award funding. From our research, the typical fee structure for a SBIR Advisory Firm approximates to:

- i) Contract Value (CV) <\$2 million: Fee = 5% (total contract value)
- ii) CV \$2 million to <\$5 million: Fee = (CV-2 million)*1.67%+\$100K
- iii) CV \$5 million+: Fee = (CV-5 million)*0.6%+ \$150K *maximum fee of \$500K*

In addition to this share of the award funding, SBIR Advisory Firms typically charge an additional retainer, in the range of \$3,000-\$7,500. Ultimately, the complexity of the process levies a tax on the innovator. **They are forced to redirect a significant share of funding that is designated for research and development, into paying a gatekeeper.**

The early phases of the SBIR process come with other challenges. For instance, even after receiving notice that the government intends to award your Phase I/Phase II contract, contracting officers are not required to adhere to a set, “post-award” timeline. As a result, official award timelines are opaque and ever-changing.

These delays can be materially damaging for small companies, something we learned firsthand: PW Communications’ follow-on Phase II contract award was delayed nearly a full year, as a result of a government contracting officer incorrectly inputting our “firm-fixed price” contract as “cost-plus fixed fee.” Rather than correcting the error, she not only subjected us to an unnecessary Defense Contract Audit Agency (DCAA) audit, but also became completely unresponsive to subsequent inquiries regarding an estimated award date. Over the course of these delays, some of our key engineers and other members of our team—who had expected to begin work—were forced to pursue other opportunities. Eventually, after our CEO expended significant time and energy to elevate the issue, the contract was reassigned to a new contracting officer. This individual processed it within a matter of days, allowing the work to move forward. The fact that the issue was resolved quickly by a different contracting officer illustrates that the system *can* work properly and efficiently, depending on the circumstances.

Our experience is not the exception. Several SBIR program offices have acknowledged that complex solicitations and prolonged award timelines make it difficult for small firms to compete. For instance, in 2018, to address these challenges, the Air Force SBIR program established the “Open Topic” program and “Pitch Days.” While the results of these initiatives have been mixed thus far, they are intended to streamline SBIR proposal submission

requirements and accelerate award timelines, as a means of helping the Air Force better attract innovative new companies.

Entrenched SBIR Companies

The fact that it is so difficult for nontraditionals to break into the SBIR program also explains why such a significant share of SBIR funding is awarded to a small subset of companies. In our 2023 NPS research report, we determined that **the top 5% of companies with the most DoD-funded Phase I/Phase II awards from FY2012-FY2021—about 235 companies—collectively received 49% of all DoD Phase I/Phase II funding.**

As shown in Figure 1, **the 25 DoD SBIR companies that received the most Phase I/Phase II funding from FY2012-FY2021 cumulatively received \$2.3 billion—or 18% of all DoD Phase I/Phase II funding—during that period.** Similarly, a GAO report released in March of 2024 revealed that 22 companies—representing fewer than 1% of all SBIR participants—received more than \$3 billion in SBIR funding—roughly 10% of the entire SBIR budget— from FY2011-FY2020.

Figure 1: Top 25 SBIR Companies’ DoD Phase I/Phase II Funding, FY2012-FY2021

Company	Total DoD PI/PII Funding, FY2012-FY2021	% of Total DoD PI/PII Funding, FY2012-FY2021
PHYSICAL OPTICS CORPORATION	\$198,222,973	1.51%
INTELLIGENT AUTOMATION INC	\$172,174,305	1.31%
PHYSICAL SCIENCES INC	\$168,520,875	1.28%
CREARE 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%

SBIR Participants: Small by What Standards?

Although the SBIR program is designated for small businesses, the Small Business Administration (SBA) allows certain companies to qualify as “small” irrespective of revenue, as long as they have fewer than 500 employees. In the case of these entrenched SBIR companies, some generate hundreds of millions in government contracting revenue annually, and some are publicly-traded.

Many of these companies win Phase I/Phase II awards for projects that span a wide range of unrelated topics.

One firm 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.

Another 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.

A third 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.

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. Based on publicly-available information about these entrenched SBIR companies, it is unclear how they manage to compete for and win research and development (R&D) contracts for such wide-ranging projects. It appears that some of these entrenched SBIR companies function as integrators for small/independent research entities that do not have the resources or wherewithal to pursue SBIRs directly. The entrenched SBIR company takes a share of the award funding, in exchange for managing the process. In other cases, entrenched SBIR firms seem to pivot their capabilities internally to align with the latest government priorities. Ultimately, these ostensibly large companies' greatest competitive advantage is having the resources and expertise required to effectively navigate the SBIR program.

Transition Rate

In our 2018 and 2023 NPS papers, as well as under the auspices of our Phase I/Phase II contract work, we have analyzed the extent to which companies funded through the SBIR program subsequently deliver their capabilities to government end-users ("transition"). We found that a significant share of SBIR-funded capabilities do not transition.

For instance, in our 2023 NPS paper, we analyzed the extent to which 52,746 defense-funded Phase I/Phase II awards from FY2012-FY2021 ("analysis group") were subsequently leveraged, directly or indirectly, by defense end-users ("intragovernmental transition rate," "transition rate"). Because the SBIR program does not adhere to a standard taxonomy or set of metrics to define intragovernmental transition rate, we formulated our own definition that includes three metrics:

- 1) **Phase III awards** attributed to the companies in our analysis group, subsequent to our analysis date. Phase III awards are identified in the Federal Procurement Data System (FPDS), making them the most explicit indicator that a company's SBIR-funded capabilities were subsequently procured by the USG.
- 2) **Non-SBIR DoD-funded procurement contracts** attributed to the companies in our analysis group, subsequent to our analysis date. 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, if it was not coded as a Phase III, was related to a company's SBIR project, we wanted to consider the possibility that participants transitioned via non-Phase III contracts.
- 3) **DoD-funded subcontract awards** attributed to the companies in our analysis group, subsequent to our analysis date. Given the complexity and costs associated with pursuing government contracts, some SBIR 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 definitively if a subsequent DoD-funded subcontract award was related to a company's SBIR/STTR

research, we wanted to consider the possibility that some SBIR companies transition through a prime.

Due to limitations in how the publicly-available data is coded, we treated all subsequent non-SBIR DoD procurement contracts and DoD subcontracts as indicators that SBIR/STTR capabilities transitioned to the warfighter. Consequently, we gave the program more than its due credit.

As shown in Figure 2, only 16% of DoD SBIR companies in our analysis group won Phase III awards. While the transition calculation improved when including non-SBIR procurement and subcontracts, as previously mentioned, it is difficult to draw conclusions about the nature of these awards.

Figure 2: DoD SBIR Intragovernmental Transition Rate by Metric

Total SBIR Companies	SBIR Companies w/ PIII Award(s)	% SBIR Companies w/ PIII Award(s)	SBIR Companies w/ PIII Award(s) and/or non-SBIR DoD Procurement	% SBIR Companies w/ PIII Award(s) and/or non-SBIR DoD Procurement	SBIR Companies w/ PIIIs and/or non-SBIR DoD Procurement and/or DoD Subcontracts	% SBIR Companies w/ PIIIs and/or non-SBIR DoD Procurement and/or DoD Subcontracts
4703	748	16%	2731	58%	2949	63%

For each SBIR company that transitioned, we then compared their total transition funding (the amount of revenue they generated across our three transition metrics), to the total amount of DoD Phase I/Phase II funding they received.

- Of the companies that won Phase IIIs, only 39% generated more in Phase III contract dollars than they were awarded in non-dilutive Phase I/Phase II funding. Taken as a percentage of our overall analysis group, just 6% of SBIR companies generated more in Phase III contracts than they were awarded in Phase I/Phase II funding.
- 49% 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 analysis group, 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.
- 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. Taken as a percentage of the overall analysis group, 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

Calculating transition revenue and the ratio of Phase I/Phase II funding to subsequent non-SBIR contracts for the top 25 SBIR companies with the most in Phase I/Phase II funding, as shown in Figure 3, **we found no consistent relationship between the amount of Phase I/Phase II funding a company receives, and transition rate.** The recent GAO report similarly concluded that the 22 firms they analyzed—collectively in receipt of the most in government-wide SBIR funding—did not necessarily transition at rates higher than companies with fewer awards.

Figure 3: Transition Metrics for the Top 25 DoD SBIR Companies, FY2012-FY2021

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	\$59,984,693	\$4,820,260	8%	\$20,992,906	35%	\$27,303,828	46%

INCORPORATED							
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%

This inconsistent and sometimes poor rate of transition among entrenched SBIR firms reveals a disconnect between the stated objectives of the program, and how the performance of SBIR program offices is measured. SBIR program offices are not held accountable for meeting specific intragovernmental transition goals. Rather, they are held accountable for awarding the requisite amount of total funding to “eligible” firms every year; and for ensuring program participants deliver compliant milestones over the course of their projects. Measuring the program by these standards not only results in a small number of entrenched SBIR companies receiving a significant share of funding, but also incentivizes entrenched SBIR companies to focus their resources on pursuing *more* SBIR awards, rather than transitioning.

Transition Challenges for Nontraditionals

Unlike entrenched SBIR companies, many nontraditionals view the SBIR program as a means of breaking into the federal market. They invest the time and resources required to win a SBIR with the expectation that good performance will lead to follow-on government contracts. However, they are rarely positioned for success in the broader government market for a variety of reasons:

- The SBIR program does not follow a standard protocol for connecting program participants with prospective government customers. The government stakeholder overseeing their SBIR project may not have the funding or the authority to award a follow-on contract; and may not have relationships with the government stakeholders that do.
- Sam.gov, the site where government stakeholders are required to post open requirements, is impossible to navigate. If you manage to find the landing page designated for open opportunities, the search functionality is extremely limited. For instance, search results only include matches where the exact terms

searched are contained in the title and/or description fields of an opportunity. SAM.gov does not search for matched terms in attachments, despite the fact that attachments often contain the most critical and detailed information about the needs of the government customer. Also, queries do not return opportunities that contain synonyms for the terms searched; i.e., searching the term “DRONE” will not produce results that include “UAV.”

- Government solicitations are not written clearly. In our 2021 paper, we analyzed the text contained in the description fields of more than one million archived solicitations using a Flesch-Kincaid Score for readability and grade level. **We found that fewer than 4% of descriptions were written in plain English.**
- Many solicitations omit critical information, such as contract value (estimated or actual); or performance period. This information is essential for a small business to determine if an opportunity is feasible and/or worth the expense of submitting a proposal.
- Government stakeholders are not required to coordinate their requirements, which results in significant duplication of efforts, as well as an overwhelming number of demand signals for small firms to manage. For instance, on a single day in October 2020, we identified 132 open requirements related to UAVs. SBIR companies with little experience in the public sector cannot reasonably respond to dozens, or potentially hundreds, of relevant opportunities; and they lack the insider knowledge to effectively prioritize them.
- Nontraditionals do not have ample time to prepare and submit proposals. Of the more than one million solicitations we analyzed in 2021, 70% required responses within 21 days of when they were posted, and 30% required responses within 10 days or less. In the absence of existing relationships with the customer or knowledge of the solicitation prior to its release, it is nearly impossible for small firms to complete.

The limitations of SAM.gov are one reason that dozens of firms have built a business around charging for repackaged SAM.gov data. The existence of a secondary market for publicly-available government data testifies to the fact that SAM.gov fails to serve as a viable resource for this information.

Ultimately, to successfully capture government business after completing a SBIR Phase I/Phase II requires significant investment. Many nontraditionals— particularly those with viable commercial revenue streams—choose to abandon the public sector altogether, rather than “pay to play.”

Furthermore, the SBIR program offers no clear instructions to companies regarding internal systems—such as cybersecurity systems and/or new accounting systems—that may be required to qualify for follow-on contracts. Small companies not only walk away from the government 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.

Compounding these challenges is the fact that the SBIR program does not effectively market participants' capabilities to potential government customers. One of the most frequent comments we have heard from government stakeholders over the last 7 years is that they rarely receive information about the SBIR-funded projects within their own branch, and almost never receive information about the capabilities being funded elsewhere in the government. **You cannot expect capabilities to transition, if prospective transition partners do not know they exist.**

The fact that information about participants' capabilities remains siloed has negative consequences for both the small businesses and the government. Rather than leveraging existing investments, government stakeholders conduct redundant market research, or fail to modernize altogether. Meanwhile, small businesses fail to realize their full potential in the government market.

Recommendations

To address these issues and better align the SBIR program with its stated objectives, I offer the following recommendations.

- Overhaul the SBIR submission process to make it easier for small, nontraditional companies to compete.
- Mandate that a share of Phase I funding be awarded to companies with no prior government business.
- Make it easier for companies to identify and bid on government contracts. Specifically, redesign SAM.gov; improve SAM.gov search functionality; require solicitations to have a response time of at least 30 days; require solicitations to be written in plain English; and require government stakeholders with similar requirements to coordinate their outreach and communication efforts.
- Limit the SBIR program to companies with a maximum of \$40 million in total annual revenue. If the SBIR program is intended to serve small businesses, eligible companies should in fact *be* small.
- Codify a formal definition for “intragovernmental transition”; require that sufficient data be reported to track these metrics, including a specific code to indicate if a company's subsequent non-SBIR contract and/or sub-contract relates to prior SBIR work; and establish clear intragovernmental transition metrics for SBIR program offices.
- Ensure that when a company submits a Phase I/Phase II SBIR proposal, the ratio of its total prior Phase I/Phase II funding relative to the amount of direct and/or indirect intragovernmental transition revenue it has generated is an important evaluation criteria. Firms with \$10 million or more in cumulative Phase I/Phase II SBIR funding must meet minimum intragovernmental transition thresholds, in order to remain eligible for additional Phase I/Phase II funding.
- Incentivize government stakeholders and prime contractors to integrate capabilities funded and fielded through the SBIR program. Specifically, establish a “proven innovators” set-aside program.

- SBIR companies would undergo a rigorous assessment of technical merit upon completion of their Phase II. Based on this assessment of technical merit, a subset of companies would be deemed “Proven Innovators.” Much like existing set-aside programs require government stakeholders and prime contractors to award a certain percentage of contracts to historically-disadvantaged businesses, they should be required to allocate a certain share of contract dollars annually to these “proven innovators.” There should be an even greater incentive to integrate a capability initially funded by a different branch.
- Companies would be required to renew their “proven innovator” set-aside, via a rigorous assessment of technical merit, every 12-24 months, depending on the nature of the technology.

Of note, these recommendations must be implemented in concert with one another. Implementing *some* but not all of these recommendations will fail to address the underlying issues at play. It could also create conditions for the most entrenched SBIR companies to capture even greater market share, at the expense of truly small companies.

Conclusion

America has thrived by encouraging entrepreneurship and rewarding the best ideas, and these are the merits that the SBIR program claims to uphold. Yet our findings illustrate that there is a disconnect between the stated objectives of the program, and how it functions in reality: it rewards knowledge of the system above technical merit.

Taken collectively, our recommendations stand to reorient the program towards its stated purpose. These recommendations will benefit small businesses and the government. They will make the program more open and competitive, allowing it to attract innovative commercial companies that, thus far, have been deterred by the bureaucracy; and they will encourage wider adoption of SBIR-funded capabilities. Thank you again, Chairman Williams, Ranking Member Velazquez, Subcommittee Chairman Meuser, and Ranking Member Landsman, for the opportunity to speak today.

Appendix

Attached herein are copies of five research reports, published through the Naval Postgraduate School Acquisition Research Symposium.



Calhoun: The NPS Institutional Archive
DSpace Repository

Acquisition Research Program

Acquisition Research Symposium

2018-04-30

Bridging the Gap: Improving DoD-Backed Innovation Programs to Enhance the Adoption of Innovative Technology Throughout the Armed Services

Bresler, Amanda

Monterey, California. Naval Postgraduate School

<https://hdl.handle.net/10945/58736>

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**PROCEEDINGS
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FIFTEENTH ANNUAL
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**WEDNESDAY SESSIONS
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GRADUATE SCHOOL OF BUSINESS & PUBLIC POLICY
NAVAL POSTGRADUATE SCHOOL

Bridging the Gap: Improving DoD-Backed Innovation Programs to Enhance the Adoption of Innovative Technology Throughout the Armed Services

Amanda Bresler—serves as Vice President of Business Development for PW Communications, Inc. (www.pwcommunications.com). She launched and manages the company's strategic initiative focused on democratizing the U.S. federal marketplace for innovative solutions providers. Prior to joining PW Communications, she served as COO for Maurice Cooper Brands. Bresler is passionately involved in numerous philanthropic causes and currently serves on the board of The Bresler Family Foundation and AlmaLinks. She is a member of the prestigious Milken Young Leaders Circle and Business Executives for National Security (www.BENS.org). She graduated cum laude from Georgetown University's McDonough School of Business. [abresler@pwcommunications.com]

Abstract

For over 60 years, Department of Defense (DoD)–backed innovation programs have played an outsized role in the narrative surrounding military innovation. While these programs provide valuable benefits, this paper specifically evaluates their effectiveness as a means of enhancing the adoption of innovative new technology throughout the armed forces. To assess how companies that participated in DoD-backed innovation programs performed in the defense sector subsequent to program completion, we compiled a data set of more than 1.29 million defense contract awards over seven years and analyzed the distribution of these awards across a data set of more than 8,000 DoD-backed innovation program award recipients. The results demonstrated that nearly half of participants achieved no meaningful growth in their defense business after program participation; and the small, innovative companies that did successfully bridge program participation into additional DoD business rarely contracted with customers outside of their initial branch sponsor. Through surveys and interviews of key stakeholders, we identified several causes for the low rate of adoption of participants' technology across the armed forces, and we present concrete recommendations for how the Department can address these problems to better leverage DoD-backed innovation programs as a means of enhancing force readiness.

Introduction

America emerged from World War II as the world's leading economic, political, and technological superpower, and this position remained largely uncontested for the duration of the 20th century. Post 9/11, however, the global landscape began to shift. Intensified competition with rival powers, including Russia and China, the advent of information warfare and a proliferation of threats, and the Global War on Terror and conflicts in the Middle East now pose acute challenges for both American hegemony as well as national security. Additionally, while in decades past Department of Defense (DoD) research often produced revolutionary technological breakthroughs for the civilian sector, commercial innovation now increasingly outpaces the DoD. The Department must therefore attempt to modernize as a whole, while it simultaneously competes to identify and integrate the most cutting-edge technological innovation. Furthermore, as elucidated by Defense Secretary 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). To maintain a strategic overmatch demands mission planning and execution across the forces and requires unprecedented levels of Department-wide cooperation and communication. Just as innovation can serve as a force multiplier, it can also severely degrade military productivity and lethality if it is siloed within a single service



branch or command structure. The DoD, therefore, faces a dual challenge today: it must not only identify and attract innovative and modernizing solutions providers, but also integrate revolutions in military technology across the forces as quickly and seamlessly as possible.

The DoD has widely acknowledged that the prowess and success of America's armed services demand ongoing, supported collaboration with private sector innovators, and increasingly so in light of 21st-century military and national security challenges. For more than 60 years, DoD-backed innovation programs have played an outsized role in the narrative surrounding military innovation. They consume billions of taxpayer dollars annually; enable thousands of disruptive technologies to enter the highly adaptive, risk-averse DoD ecosystem every year; and produce a network of companies with a rare combination of innovative prowess and DoD past performance.¹ Given that a competitive advantage in today's mission environment demands rapid, force-wide integration of innovative technologies, it is essential that these programs also connect the capabilities that they foster to as many prospective DoD customers as possible. However, while these programs implicitly and explicitly market themselves as "points of entry" for small, innovative companies into the overall DoD market, limited scholarship exists to evaluate how participant companies perform in the defense sector in the years following program completion, and if their capabilities are leveraged by the military at large. Our research sought to fill this gap; specifically, we were interested in understanding if and how DoD-backed innovation programs have evolved to ensure that the military remains flexible, agile, and advanced in an environment where rapid integration is essential.

DoD Innovation Programs

To evaluate DoD-backed innovation programs as a means of enhancing the adoption of new technology across the forces, it is important to first understand their history, how the largest are structured, and where they fit within the broader landscape of DoD innovation. The history of America's DoD-backed innovation programs begins in 1957, when the Soviet Union's surprise launch of Sputnik left the American people and its leaders fearful that the United States had lost its technological edge. President Eisenhower responded by creating the Advanced Research Projects Agency (later renamed the Defense Advanced Research Projects Agency, or DARPA) the following year. According to the DARPA website, it has a "singular and enduring mission: to make pivotal investments in breakthrough technologies for national security." Today, DARPA runs over 250 research and development (R&D) programs, all designed to further their core mission (DARPA, n.d.). DARPA is unique in the DoD innovation community as it exists as a stand-alone research agency that funds innovative research within industries and also conducts its own research. DARPA uses contracting authorities to solicit solutions directly and participates in the Small Business Innovation Research program (SBIR) and the Small Business Technology Transfer program (STTR) to fund research conducted by small businesses.

¹ In the Department of Defense's Fiscal Year 2019 Budget Request, \$13.6 billion has been earmarked by the DoD for Science and Technology research in FY19. Over \$286 billion has been requested for modernization efforts across the Department (Office of the Under Secretary of Defense, 2018).



The Small Business Administration (SBA) launched the SBIR program in 1977 to “support innovation through the investment of federal research funds in critical American priorities to build a strong national economy” (Small Business Association, n.d.-a). It established its identically-structured sister program, the STTR program, in 1992, designed to help further scientific research with potential for broader commercial benefit. SBIR/STTR programs run in three phases, all of which are restricted to small businesses.² In Phase I, companies establish the technical merit, feasibility, and commercial potential of their project over the course of one year in exchange for \$150,000 in federal funding. For Phase II, participant companies continue to grow and develop their technology with additional funding not to exceed \$1 million over a two-year period. A product with “commercial potential” may then proceed to Phase III. SBIR/STTR does not fund Phase III directly, but many federal agencies with SBIR/STTR authority provide follow-on contracts or funding to support this additional development. Phase III is intended to be the primary means of transitioning new technologies into the broader service branches or agencies that need them. The armed services and defense agencies each run their own SBIR/STTR programs and define the topics for which they are seeking small business applicants.

Based on the success of SBIR/STTR and the need to accelerate the fielding of innovative technology, the DoD created the Rapid Innovation Fund (RIF) in 2011, marketed on the DoD’s Defense Innovation Marketplace site as “a collaborative vehicle for small businesses to provide the Department with innovative technologies that can be rapidly inserted into acquisition programs that meet specific defense needs.” Much like SBIR/STTR, the armed services and various defense agencies run their own RIF programs and define their own project specifications. However, unlike SBIR/STTR, and despite its mission statement, RIF permits companies of any size to participate. The RIF process starts with a Broad Agency Announcement (BAA) and the request for companies to submit a white paper. The sponsoring agency reviews all submissions and invites shortlisted companies to submit a full-scale proposal. The company with the most competitive proposal receives the RIF award. One of the primary objectives of RIF is to better and more rapidly connect research and technologies developed in the SBIR/STTR program to a wider audience within the DoD. As such, from 2011 to 2015, RIF awarded more than half of its \$1.4 billion in contract awards to companies that had previously participated in SBIR/STTR (Bujewski & Purdy, 2017).

In 2015, Secretary of Defense Ash Carter established Defense Innovation Unit Experimental (DIUx) in support of the Third Offset Strategy initiated by Chuck Hagel in 2014. DIUx, like its predecessors, is designed to fund innovative companies with the purpose of solving national defense problems. It determines project specifications and areas of interest in concert with DoD entities. Companies of any size can respond to a DIUx solicitation by submitting a solution brief. According to DIUx’s website, briefs are typically evaluated within 30 days, and shortlisted companies are then invited to submit a full-scale proposal and begin negotiations for a pilot contract. Unlike the other DoD innovation programs, however, DIUx utilizes “Other Transaction Authority” (OTA), a contract vehicle that streamlines the funding process and according to the DIUx website, enables them to fund projects in 90 days or fewer. According to U.S. Code 10 2371b, OTA funds include a designation for

² The SBIR size compliance guide defines a *small business* as “a business with 500 employees or fewer.”

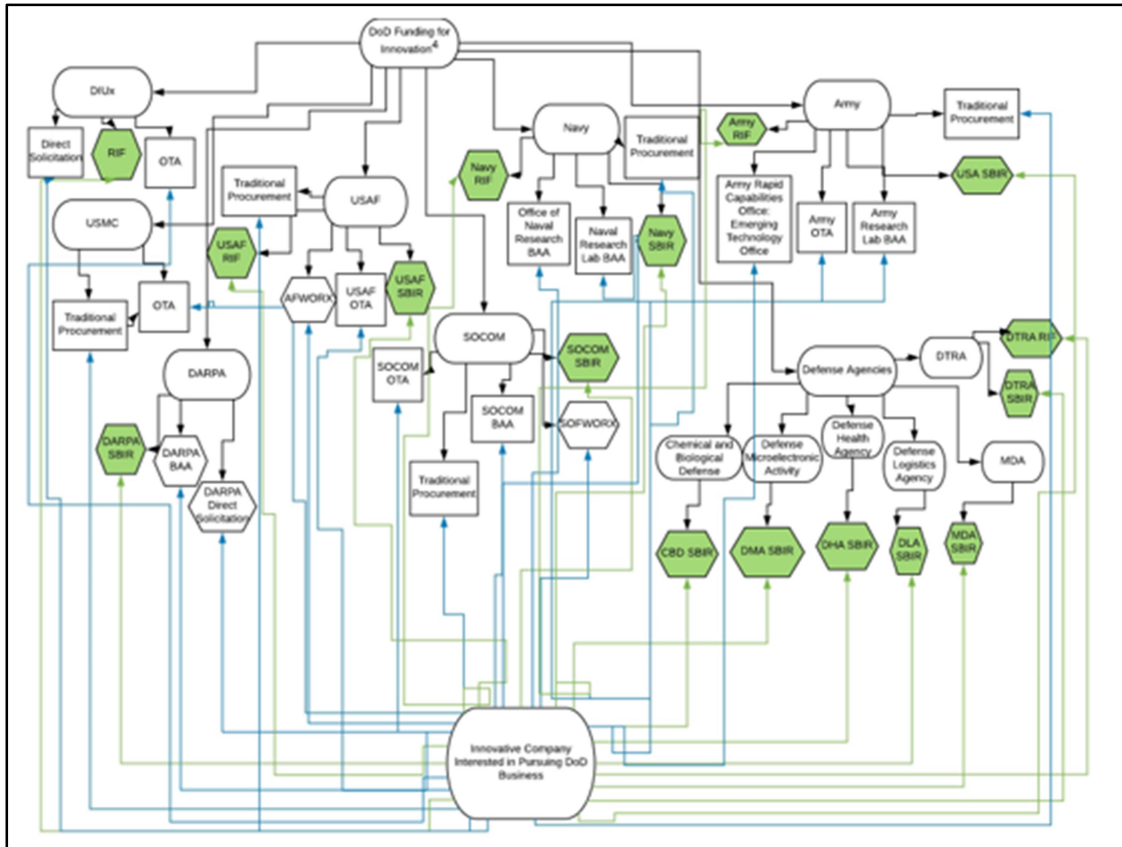


prototype projects deemed critical to enhancing the mission effectiveness of the military or to improve systems already in use by the armed forces. The armed services may contract up to \$250 million annually for projects that meet OTA criteria, provided the primary awardee for a given project represents a “nontraditional defense contractor” or a small business. As such, OTA also affords DIUx greater latitude in allocating funding, making it more agile and more appealing to nontraditional solutions providers.

In addition to these five DoD-backed innovation programs, the DoD has approximately 50 additional external funding programs, 20 of which are designed to rapidly integrate technology (Small Business Technology Council, 2014). The DoD also continuously stands up new DoD-backed innovation programs and utilizes OTA funds independently to support internal innovation efforts.³ This process compounds across the DoD, and innovative companies interested in pursuing the defense market—and the service branches and Departments that seek to collaborate with them—face a paralyzingly complex web of prospective routes and access points, as shown in Figure 1.

³ Since January 2015 alone, the DoD has created DIUx, the Warfighting Lab Incentive Fund, AFWERX (an Air Force innovation initiative), SOFWERX (SOCOM’s innovation initiative) among others (Gibbons-Neff, 2016; Kaplan, 2015; West, 2018).





Note. Programs reflected in our data set are highlighted in green.

Figure 1. Access Points for Innovative Companies into the DoD

This bloated, hyper-bureaucratic system also elucidates the Department’s crippling risk-averse culture, one of the most acute obstacles thwarting DoD innovation efforts. Paralyzed by a “fear of failure,” decision-makers are unwilling to experiment, collaborate, and take risks. This culture has resulted in countless “stove-piped” initiatives that are developed without cross-communication and operate in parallel. Given the Department’s ongoing struggle to modernize and remain innovative, it should invest in building robust, long-term relationships with the innovative companies that do manage to navigate this web successfully and achieve proven DoD past performance. Consequently, rather than evaluating the effectiveness of innovation programs as a means of addressing singular, branch-specific requirements, our research sought to evaluate if and how the largest and most prominent DoD-backed innovation programs improve the rate of adoption of innovative technology force-wide.

Program Participants

In order to determine whether the companies fostered in DoD-backed innovation programs achieved force-wide adoption, we first looked at how those companies performed in the defense sector after program completion. Although there is no data available to determine the results of these programs in general, one indicator of a company’s DoD performance is the number of defense contracts that it wins. Thus, we began by examining the number of defense contracts won by DoD-backed innovation program participants in the years following program participation. We focused our quantitative research on SBIR/STTR and RIF for several reasons: they are the largest of the DoD-backed innovation programs

and the only hubs that publish complete lists of their program participants, which made it possible for us to gather a significant data set; and because all branches of the armed forces and all defense agencies participate in both SBIR/STTR and RIF, the data set is not only large but also comprehensive.

We first combined the publicly available lists of RIF project award recipients between 2011 and 2015 (103) and DoD-sponsored SBIR/STTR award recipients between 2013 and 2016 (8,158) from the SBA database. Both RIF and SBIR/STTR are rife with serial users, which means there were dramatically fewer unique companies in this ecosystem relative to total awards. For instance, from 2013–2016, the Physical Optics Corporation received 236 DoD sponsored SBIR/STTR awards, and Charles River Analytics received 129. Intelligent Automation received 138 SBIR awards from 2013–2016 and won seven RIF contracts from 2011–2015.⁴ As such, we adjusted the 8,261 total awards to control for repeat usage and isolate unique companies, which resulted in a data set of “Program Participants” that contained 1,140 companies.

In order to understand how these 1,140 companies performed in the defense sector subsequent to their program participation, we scraped and filtered more than seven years’ worth of publicly available defense contract award data from FBO.gov from January 1, 2011–January 15, 2018.⁵ Because FBO.gov publishes only unclassified prime contract awards, our data did not include classified contracts or information about companies’ performance as a subcontractor or teaming partner on DoD contracts. Nevertheless, the set contained more than 1.29 million defense contract awards, which we then filtered to isolate the defense contracts specifically awarded to the 1,140 companies in our Program Participant data set: a total of 13,449 defense contracts.

⁴ While the SBA system is rife with flaws in how it reports and names companies, our data tool controlled for these errors to an extent by removing duplications and recognizing slight differences in company names to avoid errors in contract attribution (Cordell, 2018).

⁵ These timeframes were selected to enable analyses of complete data sets. At the time this information was compiled, RIF awards were publicly available from program inception in 2011 through 2015. SBIR awards are all publicly available but the most recent, complete data is from 2013–2016.



Supplier Retention

The distribution of these 13,449 contracts across the 1,140 Program Participant companies in our data set produced striking results, as shown in Figure 2.

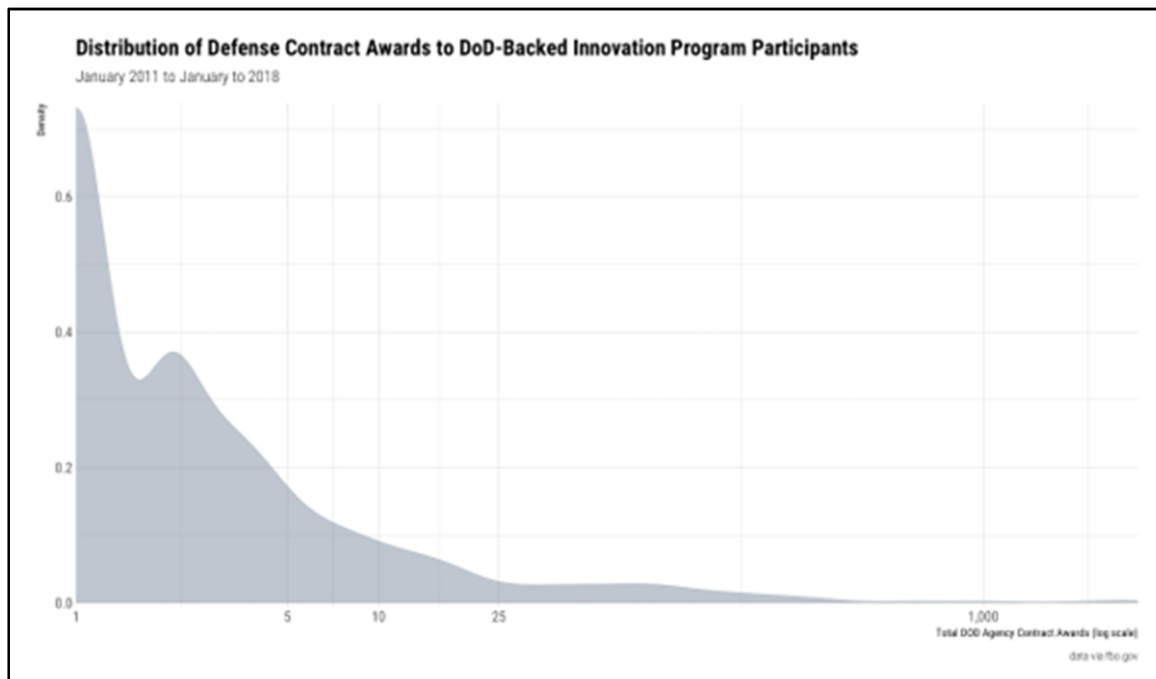


Figure 2. Distribution of DoD Contracts to Companies That Participated in a DoD-Sponsored SBIR/STTR Program or RIF Program (2013–2016 and 2011–2015, Respectively)

It is immediately apparent that a majority of participant companies won few if any follow-on defense contracts, as demonstrated by the concentration of companies on the left-tail of the distribution.

In fact, we determined that a startling 26% of the companies in our vast data set (~296 Program Participant companies) won zero defense contracts after completing their DoD-backed innovation programs.⁶ Another 22% of companies in our set (~250 Program Participant companies) won only one single defense contract following their RIF/SBIR/STTR award. In other words, nearly half of the program graduates (48%) received fewer than 2% of the total 13,449 defense contract awards.

The format of publicly available data limited our ability to control for specific timeframes, as contract award data was fixed from January 1, 2011 to January 15, 2018 (per the parameters of the “scraper” we used). We assessed the entire data set of participant companies over this period of time; thus a company that completed SBIR/STTR or RIF in 2011 was evaluated over seven years, while a company that graduated in 2016

⁶ ~296 companies exist as one contract in our data, but that contract is their award from SBIR/STTR or RIF.

was evaluated over two years. However, all companies in the data set had at least 13 months to win defense contracts, and given the size of our overall data sets and the overwhelming share of companies that failed to win DoD contracts following program participation, it is unlikely that the timeframe limitation significantly affected our results. Additionally, we recognize that small, innovative companies often lack the capacity and infrastructure to bid/perform as Prime contractors and instead subcontract or team with large Strategic Integrators (SIs) to expand their defense business. Unfortunately, we could not examine innovation hub participants' performance as subcontractors or teaming partners because no large, publicly available data sets exist containing that information. Presumably, a portion of program participants that won few or no defense contracts as a Prime did achieve some growth in their defense business indirectly. However, the significant and stark results of our data incontrovertibly reveal a trend and thus remain deeply troubling. Namely, that a significant share of participant companies went through the involved and drawn-out process of applying for an innovation hub, proved their relevance to a branch-specific requirement and received an award, and expended significant resources to develop the capabilities requested by their branch sponsor; and these efforts failed to bridge into any meaningful growth in their direct defense business. The implications are perhaps most concerning with respect to force readiness. The capabilities of these ~547 companies were honed by initial branch sponsors based on critical requirements for which private sector collaboration was deemed essential. For almost 300 of these companies, their capabilities were never procured directly by other defense customers, or from within the sponsor branch, or from other branches, and the other ~200 companies faced essentially the same fate.

The distribution of the 13,449 contracts across the 1,140 companies also made it clear that a small subset of companies won a disproportionate share of the remaining 98% of contracts in our data set. While RIF describes itself as a "vehicle for small businesses," the Participant Data data set includes names like 3M, BAE Systems, General Dynamics, Raytheon, and other experienced contractors. To better understand the effects of these outliers on our data, we isolated companies from our Participant Data data set that had won 50+ DoD contracts from January 1, 2011 to January 5, 2018. Forty companies in our data set fit those criteria.

These 40 companies, or approximately 3.5% of our total Program Participant data set, collectively received a staggering 80% of the defense contract awards in our overall defense contract award data set, as depicted in Figure 3.



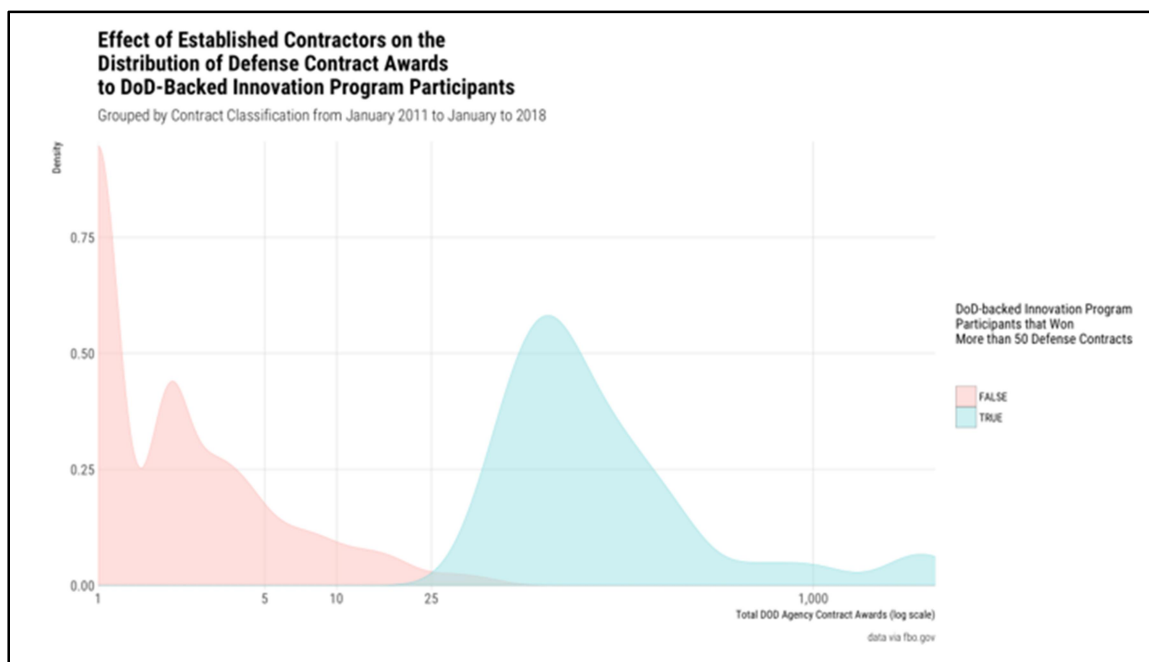


Figure 3. Distribution of DoD Contracts to DoD-Sponsored SBIR/STTR Participants and RIF Participants (2013–2016 and 2011–2015, Respectively) by Company Size

Removing these outlier companies from the data set, the percentage of the remaining 1,100 companies that won zero defense contracts after their SBIR/STTR or RIF participation also jumped by 10%, from 26% to 36%.

For the companies that stand to gain the most benefit from these programs, the reality—that the programs contributed to no meaningful growth in participants’ direct defense business—is even more acute. Furthermore, these programs are designed to provide the forces with greater access to emerging technologies, whereas our forces are otherwise limited to the technologies that the established DoD contractors present to them. Our data suggests that these innovation hub programs have in fact become yet another channel for legacy contractors to gain DoD market share.

Customer Diversity

While our initial analyses demonstrated that innovation hubs fail to convert a large portion of participants into viable DoD suppliers, we also sought to examine, for emerging technology companies that did manage to survive the transition from DoD-backed innovation program into the defense market, how broadly their capabilities were integrated across the forces. To do so, we examined whether participants won contracts with defense customers other than their initial sponsor branch. Limitations to the functionality of our data analytics tools meant that we could not examine customer diversity for our entire data set, so we created a subset of our Participant Data to include companies that won between two and 12 defense contracts subsequent to program completion: 360 companies, or 32% of our Participant data set. As 48% of participants won zero or one defense contract after program completion and 3.5% of participants accounted for a startling 80% of all defense contract awards, the data left a narrow subset of companies that fell somewhere in the “middle”—that is, non-entrenched contractors that had successfully bridged the gap from program participation into a healthy, modest defense contracting business. By focusing on

companies that won between two and 12 contracts, we were able to test customer diversity using a sizable data set from this narrow middle.

Our research found that, for a striking 76% of companies in this subset, all of their defense contract awards came from their initial sponsor branch.

In other words, 76% of these companies achieved no customer diversity, suggesting that even when the DoD manages to retain a supplier honed in an innovation hub, it largely fails to integrate the company's capabilities across the forces.

DIUx: Micro-Analysis

DIUx has garnered widespread attention as an especially promising approach to the DoD's innovation problem (Kaplan, 2016; Maucione, 2018; Williams, 2017). Its funding is slated to increase by more than 70% in Fiscal Year 2019, and Secretary Mattis recently lauded it, saying, "There is no doubt in my mind that DIUx will not only continue to exist, it will actually ... grow in its influence and its impact on the Department of Defense" (Lanier-Chappellet, 2017). Although DIUx data was too limited to include in our broad quantitative analyses and despite the more acute impact of limitations on a small sample size, we felt it nevertheless important to determine if DIUx retains and disseminates its participants' capabilities more effectively than its predecessors.

We created a "DIUx Participants" data set using the company names marketed on the DIUx website as of Q4 2017 (31 companies). We then filtered our DoD contract data set to isolate DoD contracts awarded to these 31 companies from January 1, 2015 (the year DIUx was founded) through January 15, 2018: a total of 440 defense contracts. We immediately recognized that entrenched government contractors have utilized DIUx as well, which profoundly affected the results. Specifically, Rockwell Collins was one of the 31 companies in our "DIUx Participants" data set. The company is a legacy DoD contractor; thus unsurprisingly it won 408 of the 440 total defense contract awards from our FBO award data set. The distribution of the remaining 32 contracts across the 30 other DIUx participants in our data set reflected the same troubling trends we identified in our SBIR/STTR/RIF analyses:

Four DIUx participants won between three and six DoD contract awards after program completion, and the remaining 26 companies—or 81% of DIUx participants in our set—won zero or one DoD contract.

Despite its laudatory attention, DIUx, like its predecessors, does not appear to position private sector innovators for long-term success in the defense sector. Rather, DIUx engages with participants solely to address singular, branch-specific projects and does not disseminate supported capabilities to other prospective DoD customers thereafter.



Surveys Methods

While we concluded that DoD-backed innovation programs are not effective distribution channels for small, innovative companies into the broader defense market through our quantitative analyses, to better understand potential causes of these program failures, we conducted surveys and interviews with individuals from three key stakeholder groups:

- Representatives from DoD-backed innovation programs
- Representatives from companies that participated in a DoD-backed innovation program
- Members of the DoD community

We developed unique survey and interview questions for each of these stakeholder groups and contacted a total of 159 prospective respondents. While our quantitative analyses were limited to SBIR/STTR and RIF data and a small set of DIUx data, our qualitative research encompassed the broader landscape of DoD-backed innovation programs. We received a total of 20 responses: seven representatives who work for a DoD-backed innovation program, three of whom elected to participate in an in-depth follow-on interview; five representatives from participant companies, one of whom elected to participate in an in-depth follow-on interview; and 10 individuals from the general DoD community, three of whom elected to participate in an in-depth follow-on interview.

Survey & Interview Feedback

The anecdotal evidence consistently pointed to the same programmatic failures we identified in our quantitative analyses and most significantly, helped us better understand the reasons for these problems. The key issues revealed by our survey and interview data include the following:

- *DoD-backed innovation programs do not educate participants on how to succeed in the broader defense sector.*

The majority of participants surveyed noted that their innovation program offered no instructions/education for how to identify or bid on government contracts after program completion. They also indicated that the program did not prepare them to support a broad base of DoD customers. Likewise, when program managers were asked how their program helps a participating company identify other relevant DoD requirements, it was clear that no formal, institutionalized process exists. For instance, one program manager explained, “We naturally become aware of [relevant opportunities] from our contractors, conferences, even our customers sometimes,” and another stated that they rely on “collaborative conversations” to find additional DoD opportunities for participants with promising capabilities. Similarly, when asked how they would improve the DoD innovation program, one respondent recommended, “Provide some sort of bridge to help small business survive the gap between the end of the ‘innovation contract’ and the follow on sustainment work.” Given that the innovation programs do not educate participants on how to find and bid on government contracts, it is therefore not surprising that, as indicated by our quantitative data, nearly half of program participants fail to win defense contracts after program participation.

- *DoD-backed innovation programs do not market participants’ capabilities to the broader armed services community.*



More than half of the program managers that provided feedback indicated that their programs have no formal process for circulating information about participants' capabilities to the broader armed services community. One of the most frequent comments from members of the DoD community was that they receive very few briefings on the projects their own branch funds and almost never receive information on the capabilities of companies funded by other branches. When members of the DoD do learn about the capabilities of companies that have participated in a DoD-backed innovation program, it is not because the programs are marketing them effectively. According to those surveyed, at best they might hear about a company through a random, one-off initiative like a "quarterly update" mailer that references an innovative technology, or "infrequent[ly] hosted industry days." Usually, they learn about the technology through a chance meeting with a colleague who is familiar with it. Our quantitative results are further explained by the fact that the innovation programs do little if any marketing of participants' capabilities to the broader DoD community. Simply put, a customer cannot buy something it does not know exists.

- *DoD-backed innovation programs do not track the performance of participant companies in the years following program completion.*

Our qualitative research confirmed the troubling fact that DoD-backed innovation programs do not follow a systematic, consistent process for tracking the performance of participant companies after program completion. Many DoD-backed innovation programs do not track program participants at all; others may track some companies inconsistently or on an ad hoc basis. Without tracking participants, DoD innovation programs cannot discern how these companies fare in the defense sector or at large. They do not see changes in a company's performance year to year; they do not receive updates on a company's capabilities developments; and if a company changes its name, changes its leadership, or moves its headquarters, that information is not recorded in a central database. Perhaps most concerning, they do not monitor the long-term effectiveness of significant investments of public funds into DoD-backed innovation programs. The absence of a formal process for tracking the long-term performance of participants is the equivalent of a venture capital firm not tracking the performance of its portfolio companies. It elucidates these programs' egregious supplier retention problems and signals that these programs are not concerned with the long-term success of the companies that they fund.

- *A company's failure to win DoD contracts after program participation does not necessarily correlate to a lack of demand for that company's capabilities.*

Our survey and interview feedback also demonstrated that, while in some cases innovation program participants may not achieve widespread adoption across the DoD due to the specificity of a sponsor project, a company's failure to win DoD contracts after program participation does not necessarily correlate to a lack of demand. For example, we interviewed the CEO of Monterey Technologies Incorporated (MTI), a company that develops mission planning software systems and has been an active defense contractor since 1984. MTI received one Navy-sponsored RIF award in 2012 and six Navy-



sponsored SBIR awards between 2013 and 2016, and between January 1, 2011 and January 15, 2018, MTI won three defense contracts, all from Navy customers. While MTI has only won Navy contracts, there have been 144 DoD contracts awarded for “mission planning services” over the past five years alone, signaling Department-wide demand for their solution. The CEO shared that recently an Army Airborne officer serendipitously learned about MTI through a Navy contact. The Army had been handling mission planning by hand, and MTI had the potential to address this ongoing problem. He called MTI’s CEO directly, and as a result of the ad hoc outreach they are now collaborating on a pilot project. This example demonstrates not only bona fide demand for MTI, but also the inadequacy of current communication channels across the services.

The interview also offered valuable insights relative to how small, innovative companies attempt to stay competitive in the defense sector. In addition to their own disparate business development efforts, MTI pays a business intelligence firm to compile a monthly report of relevant federal opportunities. MTI then undertakes an involved process to qualify relevant opportunities, many of which are designed for larger contractors. As such, after identifying a relevant opportunity, MTI must then develop a strategy to identify and engage with the appropriate teaming partners. Large integrators, from MTI’s experience, do not give preference to companies that have participated in DoD-backed innovation programs. While their program participation has provided them with valuable funding and strategic customer opportunities within the Navy, SBIR/STTR and RIF have not offered them unique leverage in the defense market.

The experience of another company in our Participant data set, “Enomalies,” tells a similar story. In 2016, Enomalies participated in Phase II of an SBIR project and, like many DoD-backed innovation program participants, has not won a single defense contract since. Enomalies specializes in advanced imaging and field-ready prototyping, and the Navy sponsored its SBIR project to further develop a Rapid Synthetic Environment Tool (Small Business Association, n.d.-b). The tool scans an area and quickly creates a 3D model that strategists and planners can walk through and interact with. Enomalies’s tools also have the ability to rapidly scan objects and print prototypes on 3D printers (Enomalies, n.d.). Despite the fact that Enomalies has not won any follow-on defense contracts, since 2016 alone, there have been 26 defense contract awards for 3D printing systems and four for 3D scanning services. According to their website, Enomalies supports a broad range of commercial customers and appears to remain a viable company. Presumably, then, it is neither a lack of demand nor an inability to perform that has kept Enomalies from winning a defense contract since its SBIR award. Instead, it suggests that DoD innovation programs fail to adequately connect their participants to prospective DoD customers.



Further Analysis & Recommendations

The fact that DoD-backed innovation programs fail to market their participants to prospective DoD customers has myriad consequences. It results in lost revenue for the innovative companies who, as our data illustrated, do not become robust DoD suppliers. Perhaps more concerning, however, are the consequences for the strength and readiness of our forces at large. If the armed services are not made aware of the capabilities supported in DoD-backed innovation programs, they cannot adopt them—instead, they either do not modernize, or they conduct redundant market research. Furthermore, these programs introduce private sector innovators into the defense ecosystem, provide them with past performance, and then fail to nurture them as long-term suppliers. These results are costly, and they also damage the reputation of the Department: innovative suppliers undertake the complex, expensive, and time-consuming process of participating in a DoD-backed innovation program only to find that it does not contribute to meaningful growth in their defense business. They are expected to undertake full life-cycle sales processes for each individual DoD customer, in contrast to how large commercial customers operate (where new vendors typically undergo a vetting period and if successful, their product or service is distributed across the organization's broader portfolio). If these problems are not addressed, innovative companies will increasingly forgo public sector opportunities altogether, and innovation programs will both fail to attract top innovators and fail to realize their full potential as force multipliers. However, with the proper reforms, DoD-backed innovation programs do have the potential to drive vast improvements in the readiness of our armed forces. As stewards of significant tax dollars, the defense sector should focus on maximizing their investments in innovation and R&D over the long term. To do so first and foremost requires that DoD-backed innovation programs maintain consistent, clean, and accessible records about their projects and program participants.

As such, we first and foremost recommend creating an “innovators database”—a central, searchable database containing information about all DoD-backed innovation program participants.

The innovators database would be populated by innovation hub program managers and the companies themselves, and would contain company basics, information about the company's capabilities, and details about the projects that the company has supported for both government and commercial customers. A company would be required to maintain updated records in the database or face penalties. Likewise, program managers would be held accountable for maintaining these records for the five to 10 years following a company's program completion. The innovators database would enable DoD-backed innovation programs to easily share information with stakeholders across the armed forces on the capabilities of their participant companies. These stakeholders could access the database directly and search its rich pool of proven solutions providers to identify prospective suppliers. It would reduce redundancy in market research and requirements development and improve the likelihood of broader, more rapid integration of proven capabilities. Furthermore, the money saved by eliminating redundancy could be reallocated across the Department. A version of the innovators database would be made available to Prime Contractors and SIs as well, to help facilitate teaming arrangements.

For an entity as rigid and adaptive as the DoD, simply making more information available to key stakeholders will not drive change. The Department must encourage key stakeholders to better leverage DoD-backed innovation programs.

Specifically, we recommend that the DoD implement an incentive program that requires defense contracting entities and large defense contractors to allocate a set



percentage of business to “Proven Innovators,” or companies that have graduated from a DoD-backed innovation program.

This incentive program would be similar to existing set-aside programs designed to increase opportunities in the federal market for various historically disadvantaged groups. Proven Innovators would earn their “set-aside” status upon completion of their DoD-backed innovation program. Like the existing cadre of set-aside programs, contractors and contracting officers would be required to achieve minimum engagement levels with Proven Innovators and would be motivated to do so through tax incentives and other benefits. This system would force broader adoption of leading technologies across branches, as the different branches (and the contractors that serve them) would be required to stay abreast of various sponsors’ projects by using the innovators database, and it would force collaboration and cross-communication in an otherwise siloed environment. This incentive program would also add tremendous value to participant companies, lending them a concrete advantage in the broader contracting environment. Participants would see an increase in their federal business overall and an increased willingness on the part of large integrators to support and engage with them.

To that end, in addition to these initiatives, DoD innovation hubs must also educate their participants on the fundamentals of the defense contracting sector—how to identify and bid on contracts, how to find and team with other firms, how to register for set-asides, etc.—in order to make them more competitive.

Innovation hubs could potentially partner with the SBA, which already offers similar training. The more benefits DoD-backed innovation programs can offer, the better positioned they are to attract and serve the most discerning, talented technology companies.

Conclusions and Future Work

While the aforementioned recommendations are crucial first steps toward improving the efficiency and functionality of DoD-backed innovation programs, further research is required to fully understand participants’ experience in the defense sector after program completion. First and foremost, additional research is required to further analyze the large data sets we compiled. A more sophisticated analytics tool would enable us to draw additional and more extensive conclusions, such as if and how non-DoD agencies leverage the technologies fostered by DoD-backed innovation programs and the impact of the rampant serial usage on the effectiveness of these programs as a whole. Additional data and analyses are also needed to evaluate participants’ performance as subcontractors and teaming partners on defense contracts. Relative to our recommendations, further research is also required to determine how best to structure the “Innovators Database” as well as the set-aside incentive program to enhance supplier retention and broad integration.

Once DoD-backed innovation programs are reformed and improved, additional research is needed to understand the most effective ways to market-to and attract the best and brightest innovators into these programs. Additional research is also needed to better understand opportunities for streamlining, merging, or eliminating redundant or ineffective entities throughout the vast, complex DoD innovation landscape, including the individual, specialized innovation programs within each branch and combat command. From the vantage points of both national security and efficiency, it is also critical that cutting-edge capabilities are integrated throughout the whole of the government. Therefore, further research is required to determine how to position participants in DoD-backed innovation programs for success as suppliers to both DoD and non-DoD customers.



It is essential for America's national security that the armed services have access to the best and brightest new technologies, and the continuous investment in DoD-backed innovation programs over the last 60+ years has resulted in a vast infrastructure of programs and access points for new, cutting-edge solutions. DoD-backed innovation programs provide both participants and the Department with valuable benefits. Participant companies benefit tremendously from the funding these programs provide, which allows them to grow their business, develop new research and prototyping, and commercialize. The programs also introduce participants to the various idiosyncrasies of the contracting space and to the unique challenges facing the armed forces. However, today's adversaries and threat environment demand unprecedented synchronicity and collaboration across the armed forces. It is, therefore, essential that all branches of the military adopt revolutions in technology as quickly and seamlessly as possible to ensure consistent standards in warfighting capabilities; to ensure fighters across the services can communicate and share information; and to ensure that the Department leverages its full potential and buying power to appeal to the small, private sector innovators it so desperately seeks to attract and retain. Unfortunately, DoD-backed innovation programs have failed to serve as viable entry-points for emerging capabilities into the broader defense sector and have failed to enhance the integration of these emerging capabilities across the forces. A superior military not only serves domestic national security interests, but also enables the United States to fulfill its role in safeguarding peace, prosperity, and freedom. As such, the DoD must stop at nothing to keep the forces agile, modern, and at the forefront of new technologies, and that includes adapting its existing resources—in this case, its vast network of innovation hubs—to be as effective as possible.

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Creating Synergy for Informed Change**

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ACQUISITION RESEARCH PROGRAM:
CREATING SYNERGY FOR INFORMED CHANGE

The Effect of Defense-Sponsored Innovation Programs on the Military's Industrial Base

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Abstract

The Department of Defense (DoD) spends billions of dollars annually to fund innovation programs, rapid acquisition programs, and small business outreach programs ("innovation initiatives") with the stated or implicit objective of attracting innovative commercial companies outside of the traditional defense industrial base. However, by analyzing publicly-available DoD contract award data from 2010 through 2019 and government records for thousands of participants in DoD innovation initiatives, this paper demonstrates that the majority of companies that participated in innovation initiatives over the last decade had existing ties to the defense market. In addition to quantitatively analyzing the types of companies that leveraged these programs, this paper also explores the history of the DoD's innovation initiatives, how the department markets these programs, and why these programs have largely benefited firms already entrenched in the federal market. We also make a series of concrete recommendations for how the DoD can better market and structure these programs to attract and engage new, innovative companies.

Introduction

The rapid pace of technological development in the private sector, coupled with today's threat environment, has forced the Department of Defense (DoD) to rethink how it sources and funds new technologies. While policies of containment and counterterrorism dominated military and foreign policy post-9/11, over the last five years, the United States has reoriented its national security and defense strategies toward an explicit focus on exigent threats posed by China and Russia. Whereas in decades past, the DoD was at the forefront of technological innovation and exported its technologies to the commercial sector, today that paradigm has shifted to a point where many companies outside of the military's traditional suppliers increasingly drive advancements in areas of critical importance to national defense.

It is vital for the DoD to attract and integrate the technological innovations emanating from the private sector not only to preserve our own military superiority, but also as a proactive measure to slow the flow of these technologies overseas, particularly to China. China has prioritized gaining access to promising American dual-use technology companies as part of its multifaceted plan to displace the United States and has employed a variety of nefarious strategies to do so. As one such example, China has made it easy and financially attractive for these companies to transact with investors and/or customers tied directly or indirectly to the Chinese Communist Party, with the purpose of stealing their intellectual property and exploiting their capabilities for military and economic gain. While the U.S. government has recently taken measures to curb China's predatory behavior, the DoD is uniquely positioned to support these efforts. To the extent that the military can leverage its own resources, buying power, and



legitimate need for innovative new technologies to make it easier and more appealing for these companies to do business with the DoD, these companies would have less of a need to seek capital and/or customers from China—or from any overseas partners. As the DoD evolves its strategies in response to present realities and risks, it must take these factors into consideration and make a concerted effort to engage companies that have not previously worked with the DoD.

Over the years, the DoD has tried to accelerate the adoption of innovative commercial technologies through continuous investment in dozens of innovation programs, rapid acquisition programs, small business outreach programs and accelerators (“DoD innovation initiatives” or “initiatives”). However, limited scholarship exists to determine whether these initiatives have proven effective at attracting newcomers with no prior DoD experience into the defense market, versus the extent to which they are leveraged by existing DoD vendors. Our research aimed to fill this gap by evaluating the number and composition of new vendors that have entered the defense market annually, along with the number and composition of new versus existing vendors that have participated in different DoD innovation initiatives over the last decade.

Sizing the Defense Industrial Base

To analyze the effectiveness of innovation initiatives as a means of attracting new vendors into the DoD, we explored the composition of the defense industrial base, in general, over the last decade. We focused our research on the period from 2010 through 2019 because it encompassed the recent shifts in military strategy described previously. This 10-year period was also one of relative economic stability and excluded the substantial outlying factors we would have had to consider using data from 2008–2009. Furthermore, USASpending data became more complete around 2010.

First, we sought to determine the overall size of the DoD’s supplier base in each of the last 10 years. Then, we could analyze how many vendors in each year were doing business with the DoD for the first time, compared to the number of vendors with existing DoD revenue. We began by acquiring publicly available data on government expenditures from 2010 through 2019 from the Federal Procurement Data System (FPDS) and USASpending. We then isolated the data for contracts awarded by the DoD.¹ Next, we filtered the data by fiscal year (FY) and, for each year, isolated the total number of contract actions, or instances in which the DoD is required to enter an action into FPDS (“DoD contract actions”).² Annually, the number of DoD contract actions is significantly higher than the number of vendors because many vendors win multiple contracts. Therefore, we needed to determine the number of unique vendors associated with the overall number of contract actions. To do so, we grouped each contract action by its associated Data Universal Numbering System (DUNS) number and calculated the tally of unique DUNS numbers contained in the data each year.³ For companies with multiple vendor DUNS numbers, we resolved back to the parent DUNS number.⁴ The total count of distinct DUNS numbers each year became our parent universe of DoD vendors, which can also be understood as the DoD’s annual base of suppliers. *As demonstrated in Figures 1 and 2, the*

¹ Contracts awarded by the DoD include contracts awarded and funded by the DoD and contracts awarded by DoD with other funding partners. DoD awards are categorized with CGAC code 097 or 97.

² Contract events include a broad range of activities, including instances in which the government awards a new contract, funds a new or existing contract or modifies a contract (https://www.fpds.gov/wiki/index.php/FPDS-NG_FAQ February 25, 2020).

³ Every contract action in FPDS contains a field for the DUNS number.

⁴ The exception was for government entities such as state universities, where we kept vendor DUNS numbers independent of the parent.



number of suppliers to the defense department over the last decade has declined dramatically, even as the number of DoD contract actions has grown.

Budget Year	DOD Contract Actions	Unique DOD Vendors
2010	1,525,150	79,993
2011	1,506,404	77,195
2012	1,419,824	71,884
2013	1,299,282	64,685
2014	1,317,268	62,080
2015	2,985,513	61,095
2016	3,417,134	59,101
2017	3,430,958	57,165
2018	4,490,945	54,535
2019	4,315,586	51,239

Figure 1: Count of DOD Contract Actions & Unique DOD Vendors by Year
(PW Communications, n.d.)

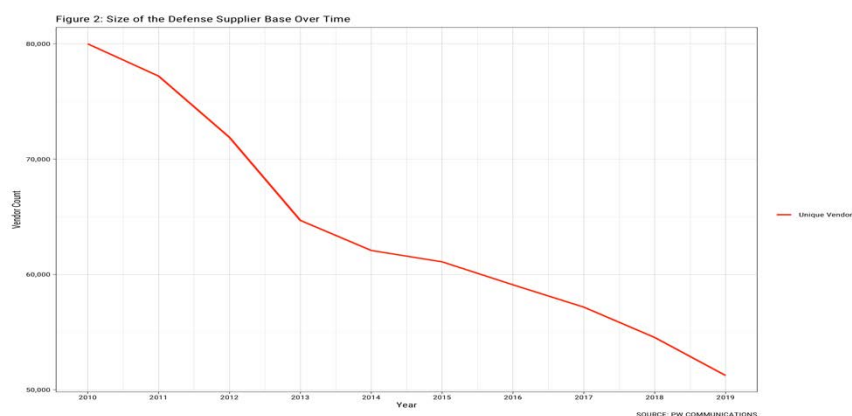


Figure 2: The Shrinking Defense Industrial Base

Right-Sizing the Defense Industrial Base

A number of factors have contributed to the consolidation of the DoD supplier base, which began in the early 1990s, including uncertainty in government spending and procurement, a shortage of skilled labor, and a desire among the largest prime contractors to achieve greater economies of scale (Tirpak, 2008). Furthermore, as noted in *Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States*, prepared by the Office of the Under Secretary of Defense for Acquisition and Sustainment in 2018, “Many of the current policies and practices of the U.S. Government, and DoD in particular, strain the industrial base and reduce incentives to supply to DoD” (p. 32). There are advantages and disadvantages to a smaller supplier base. It potentially affords the customer with more leverage, better pricing, and fewer suppliers to manage. Conversely, it may increase risks as the operational health of the military becomes dangerously intertwined with the health and performance of a small number of companies. We recognize that the overall size of the



defense supplier base should reflect a balance between these pros and cons. However, strategic consolidation in certain categories should be offset by the introduction of new vendors in areas where the commercial sector drives technological leadership—the ostensible purpose of DoD innovation initiatives. As such, we were interested in understanding how many companies entered the defense market for the first time each year (“first time vendors”), what capabilities these first time vendors possessed, and the extent to which innovation initiatives helped the DoD attract innovative commercial firms with no prior defense experience.

Calculating First Time Vendors

To calculate the number of first time vendors that entered the defense market each year, we isolated the year in which each unique DUNS number contained in our total universe of DoD vendors had its first recorded DoD contract action, dating back to the 1950s.⁵ If the first recorded contract action for a given DUNS number was 2010, the entity associated with that DUNS number was classified as a “first time vendor” in 2010. Conversely, if a DUNS number contained in the 2010 vendor data was associated with a DoD contract action in an earlier year, it was classified as an existing vendor. Likewise, for 2011, DUNS numbers that were not contained in DoD contract data in 2010 or earlier were classified as first time vendors, and the remaining DUNS numbers were classified as existing vendors, and so forth. *Figure 3 shows the breakdown of existing versus new vendors in each year, demonstrating a substantial decline in new vendors year to year over the last decade. Additionally, as demonstrated in Figure 4, in seven of the last 10 years, the number of first time vendors relative to total vendors each year experienced an even sharper decline.*

Budget Year	Unique Vendors	Existing Vendors	New Vendors
2010	79,993	64,761	15,232
2011	77,195	66,356	10,839
2012	71,884	63,466	8,418
2013	64,685	58,382	6,303
2014	62,080	55,726	6,354
2015	61,095	54,898	6,197
2016	59,101	53,270	5,831
2017	57,165	51,792	5,373
2018	54,535	49,634	4,901
2019	51,239	46,981	4,258

Figure 3: Composition of the Defense Industrial Base, By Year
(PW Communications, n.d.)

⁵ USASpending data begins in 2001. The FPDS contains partial data dating back to the 1950s and substantial data dating back to the 1970s.



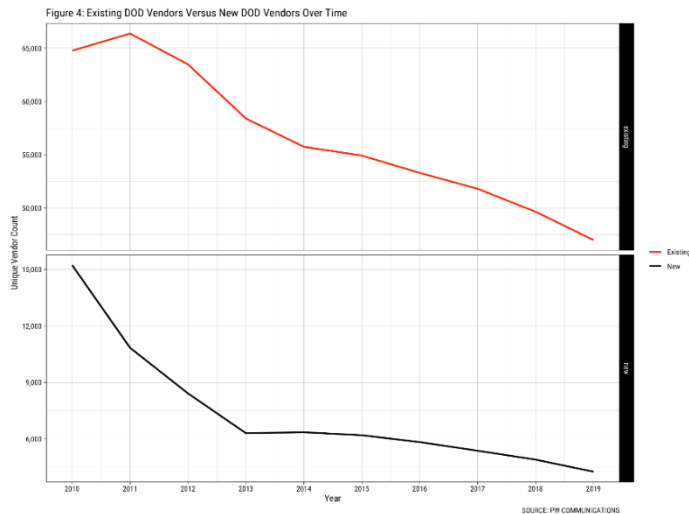


Figure 4: Dramatic Decline in New Vendors Over Time

As stated in a 2014 Defense Business Board (DBB) report, “considerable technology leadership critical to our nation’s defense has moved from within the Department and the Defense Industrial Base to companies outside the traditional base” (p. 9). Because the DoD can no longer rely on its traditional suppliers to deliver the innovation required to preserve America’s military superiority, the number of new vendors entering the defense market should be rising accordingly. Consequently, a decline in new vendors may suggest the DoD is not accessing the innovative capabilities it needs to remain competitive.

Composition of New Vendors

The implications of this downward trend are considerably greater, given that first time DoD vendors are not strictly innovative commercial technology companies. For example, contracting with a new hotel for overnight travel, buying commodities from a new supplier, or leasing a new building from 2010 through 2019 counted in our data as a new first time vendor. *By linking detailed records from USASpending and FPDS about the first time vendors in our data set and analyzing the Product and Service (PSC) codes associated with their initial contract actions, we determined that the majority of first time vendors over the last decade were not innovative commercial technology companies.*⁶

Categorizing a PSC as unlikely to be associated with an innovative nontraditional supplier is subjective. However, by taking into consideration only the most obvious “non-innovative” PSCs represented in our first time vendors’ initial contract actions, it was clear that over 50% of first time vendors were contracted for goods or services unrelated to commercial innovation. For instance, 5.5% of first time vendors corresponded to the code for “Utilities and Housekeeping.” Another 4.9% of first time vendors corresponded to “Maintenance, Repair, Rebuild - Equip;” 1.5% corresponded to “Lease/Rent Equipment” or “Lease/Rent Facilities;” and 4.9% corresponded to “Transport, Travel, Relocation.” Many other first time vendors corresponded to PSC codes such as “Medical Services,” “Social Services,” “Construction of Structures/Facilities,” and “Musical Instruments.” The composition of first time vendors indicated not only that the number of new vendors has declined year to year, but also that the majority of these new vendors were not innovative commercial technologies.

⁶ The government uses thousands of PSC codes to describe the goods and services it procures.



Joint Ventures/Special Purpose Vehicles

As we continued to explore the features of first time vendors' initial contract actions, we also noticed that 40 first time vendors had initial contract awards in excess of \$100 million. Looking at the contract action details more closely, we realized that an existing government supplier can form a Joint Venture (JV) or Special Purpose Vehicle (SPV) and register it as a completely independent entity.

For example, one company in our 2018 new vendor data set was Fluor Marine Propulsion, with an initial contract of more than \$1.2 billion. While Fluor Marine Propulsion is not linked to Fluor Corporation's parent DUNS number, we were able to determine through additional research, including verifying that the two entities share the same mailing address, that Fluor Marine Propulsion is a subsidiary of Fluor Corporation, a large legacy government contractor. Despite Fluor Marine's relationship to Fluor Corporation, based on our computational approach, it was counted as a new vendor. Another example was a first time vendor with an initial contract of \$479,000,000 that, upon further analysis, corresponded to "Balfour Beatty/DPR/Big-D, A Joint Venture." Based on records in the FPDS, individually Balfour Beatty, DPR, and Big-D have each been contracting with the government for more than a decade. Their collective JV, however, registered in our system as a new entity.

Our research is concerned with understanding how the DoD attracts and engages companies with no prior defense experience. It is clear that JVs and SPVs can create the appearance of a new vendor entering the supply chain, while in fact serving as a tool for legacy contractors to gain additional market share. The majority of these 40 outliers appeared to correspond to a JV/SPV; however, for this research, we were unable to analyze each arrangement individually to determine if it involved one or more existing DoD vendors. Likewise, we were unable to identify and resolve other instances in which an entity appeared to be a first time vendor but was affiliated with an existing government contractor through a JV/SPV. This research limitation caused some degree of inflation to our count of first time vendors and suggests that an even smaller share of them were innovative commercial technology companies.

Research Limitations

Our macroeconomic analyses, as well as our forthcoming analyses of innovation initiatives, are subject to two additional research limitations. First, we had no access to classified contract data. If we had the ability to consider classified vendors, the overall size of the DoD's supplier base and the number of new vendors annually might change. However, we do not believe this limitation substantially impacted our results because contractors that performed on both classified and unclassified DoD contracts were counted. Additionally, we had no access to subcontracting data. We recognize that innovative commercial companies may engage with the DoD for the first time through a subcontracting arrangement with an existing prime contractor. While these instances are excluded from our data, we do not feel that this limitation materially impacts the efficacy of our findings given the starkness of the trends we identified.

Defense Innovation Initiatives: A Source of New Suppliers?

Based on our analyses of the overall composition of the defense industrial base over the last decade, we concluded that the total size of the DoD supplier base has been shrinking year to year, and the number of new vendors entering the defense market has been shrinking year to year. Furthermore, most new vendors over the past decade were not innovative commercial technology companies. In the face of these concerning trends, we sought to determine if, at the microeconomic level, DoD innovation initiatives have proven more effective at attracting new vendors into the defense market versus the extent to which they have benefited existing DoD



suppliers. Our research focused on three DoD tools/initiatives: the Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) program, Other Transaction Agreements/Other Transactions (OTAs or OTs), and Prize/Challenge Competitions. We selected these three because they consume billions in DoD funding annually and they share a set of fundamental objectives: to help the DoD stimulate innovation and research and development (R&D), to engage innovative nontraditional or small businesses to help solve critical national security and defense challenges, to accelerate the identification and adoption of leading commercial technologies forcewide, and to help the DoD appeal to innovative commercial companies that, historically, have been deterred from working with the government (AcqNotes, 2019; General Services Administration [GSA], n.d.; SBIR, n.d.).

SBIR/STTR

SBIR and STTR are among the government's oldest and most well-funded innovation programs. The Small Business Administration (SBA) launched SBIR in 1977 to "support innovation through the investment of federal research funds in critical American priorities to build a strong national economy"—specifically, by investing these funds into small businesses with dual-use potential (SBA, n.d.-a). In 1992, it established STTR as an identically-structured sister program designed to help further scientific research with potential for broader commercial benefit. The SBIR/STTR program is divided into three phases. In Phase I, companies are awarded funding to establish the technical merit, feasibility, and commercial potential of their project. In Phase II, companies are awarded funding to continue the efforts initiated in Phase I (SBIR, n.d.). Solutions with commercial potential can proceed to Phase III, which "refers to 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). Because Phases II and III are generally limited to companies that previously won a Phase I, we focused our analyses on Phase I recipients.⁷

SBIR/STTR awards are explicitly identified in contract data. Therefore, to determine how many new vendors entered the DoD through the SBIR/STTR program, we returned to our data set containing all first-time vendors from 2010 through 2019 and their corresponding initial contract actions. We then isolated instances in which initial contract actions indicated a DoD-sponsored SBIR/STTR Phase I award. *Figure 5 shows the count of first time vendors that leveraged a Phase I SBIR/STTR award to enter the defense market, annually, over the last 10 years ("SBIR/STTR gateway vendors").*

⁷ In 2011, SBIR/STTR initiated a "Direct to Phase II" program that allowed the DoD and other agencies to award Phase IIs to companies that had not completed a Phase I. The pilot program expired in FY2017 and was relaunched in 2019 (<https://www.sbir.gov/tutorials/program-basics/tutorial-4>). We excluded this data to keep our analyses consistent.



Budget Year	Gateway SBIR/STTR Vendors
2010	223
2011	176
2012	148
2013	123
2014	112
2015	115
2016	109
2017	128
2018	122
2019	408

Figure 5: First Time Vendors that Leveraged SBIR/STTR to Enter the Defense Market, By Year
PW Communications (n.d.)

Comparing the count of SBIR/STTR gateway vendors to the total number of first time DoD vendors each year, as shown in Figure 6, it is clear that the vast majority of new vendors over the last decade did not leverage the SBIR/STTR program to enter the defense market. This finding is consistent with our previous analyses, insofar as the vast majority of new vendors were not innovative commercial companies with dual-use potential—the stated audience of the DOD SBIR/STTR program.

Budget Year	Total New Vendors	Gateway SBIR/STTR Vendors	% New Vendors that Leveraged SBIR/STTR
2010	15,232	223	1.46%
2011	10,839	176	1.62%
2012	8,418	148	1.76%
2013	6,303	123	1.95%
2014	6,354	112	1.76%
2015	6,197	115	1.85%
2016	5,831	109	1.87%
2017	5,373	128	2.38%
2018	4,901	122	2.49%
2019	4,258	408	9.43%

Figure 6: Share of New Vendors that Entered DOD Through SBIR/STTR
PW Communications (n.d.)

Total Universe of DoD SBIR/STTR Companies

Next, we sought to evaluate the overall composition of the SBIR/STTR program, namely, to what extent SBIR/STTR has benefited companies with no previous defense experience versus experienced DoD suppliers. To do so, we first needed to determine the total number of companies awarded DoD-sponsored Phase I SBIR/STTRs annually. Then, for each year, we could subtract the number of gateway SBIR/STTR vendors from the total and compare the results. To establish the total number of DoD-sponsored Phase I SBIR/STTR companies, we aggregated complete historical SBIR award data from USASpending and filtered the data to isolate Phase I SBIR/STTR awards that were funded and awarded by the DoD from FY2010 through FY2019. We then filtered the award data to isolate unique DUNS numbers, resolving to a parent DUNS number as needed. **Figure 7 shows the total number of DoD Phase I SBIR/STTR participants by year.**



Budget Year	Count of Phase I Companies
2010	1287
2011	1262
2012	1158
2013	1045
2014	1014
2015	991
2016	973
2017	983
2018	949
2019	1354

Figure 7: Total Unique Phase I DOD SBIR/STTR Participant Companies, By Year
PW Communications (n.d.)

For each year, we then subtracted the gateway SBIR/STTR vendors from the total to calculate the number of SBIR/STTR participants that had existing defense business (“existing SBIR/STTR vendors”). As shown in Figure 8, the vast majority of SBIR/STTR participants every year had existing defense business.

Budget Year	Total DOD Phase I SBIR/STTR Companies	Count of Existing Vendors	Count of Gateway Vendors	% Existing Vendors	% Gateway Vendors
2010	1287	1064	223	82.67%	17.33%
2011	1262	1086	176	86.05%	13.95%
2012	1158	1010	148	87.22%	12.78%
2013	1045	922	123	88.23%	11.77%
2014	1014	902	112	88.95%	11.05%
2015	991	876	115	88.40%	11.60%
2016	973	864	109	88.80%	11.20%
2017	983	855	128	86.98%	13.02%
2018	949	827	122	87.14%	12.86%
2019	1354	946	408	69.87%	30.13%

Figure 8: Gateway Versus Existing SBIR/STTR Vendors, By Year
PW Communications (n.d.)

Next, we linked the award values into our data set to explore how the funding was distributed between gateway and existing vendors. As shown in Figure 9, SBIR/STTR participants with existing defense business received the vast majority of DoD Phase I SBIR/STTR funding.



Budget Year	DOD Phase I SBIR/STTR \$	\$ to Existing Vendors	\$ to Gateway Vendors	% Existing Vendors	% Gateway Vendors
2010	\$255,683,405	\$232,785,007	\$22,898,397	91.04%	8.96%
2011	\$264,218,019	\$244,559,237	\$19,658,782	92.56%	7.44%
2012	\$259,796,590	\$240,817,498	\$18,979,092	92.69%	7.31%
2013	\$231,966,167	\$216,416,149	\$15,550,018	93.30%	6.70%
2014	\$229,929,835	\$215,293,300	\$14,636,535	93.63%	6.37%
2015	\$213,344,281	\$197,160,681	\$16,183,600	92.41%	7.59%
2016	\$191,459,321	\$177,139,330	\$14,319,991	92.52%	7.48%
2017	\$219,760,816	\$202,491,532	\$17,269,285	92.14%	7.86%
2018	\$188,905,420	\$171,659,902	\$17,245,518	90.87%	9.13%
2019	\$278,207,223	\$241,677,692	\$36,529,531	86.87%	13.13%

Figure 9: Share of DOD SBIR/STTR Phase I Funding Allocated to Existing vs. Gateway Vendors
PW Communications (n.d.)

The SBIR/STTR Program: Big Business

Analyzing the details of the contract actions associated with the universe of existing SBIR/STTR vendors, we recognized that some vendors won hundreds of Phase I SBIR/STTR awards worth tens of millions of dollars over the last decade. In other words, rather than deriving substantial defense revenue by transitioning their products or services into programs of record, they derived it from continuously winning SBIR/STTRs. **Figure 10 highlights the four companies that won the greatest number of SBIR/STTR Phase I awards over the last decade.** These findings suggest that, despite its stated objective, SBIR/STTR has largely failed to serve as a gateway for new vendors to enter the DoD, has disproportionately benefited companies with existing defense business, and permits serial usage.

Vendor	Total Count of Phase I Awards	Total Value of Phase I Awards
PHYSICAL OPTICS CORPORATION	472	\$62,310,358
INTELLIGENT AUTOMATION, INC	288	\$40,134,060
PHYSICAL SCIENCES INC	238	\$34,729,760
CHARLES RIVER ANALYTICS INC	228	\$32,065,168

Figure 10: Summary of SBIR/STTR Awards for the 4 Largest Serial Winners, 2010-2019
PW Communications (n.d.)

2019 SBIR/STTR Analysis

Despite these overall trends, for 2019, we noticed a significant increase in the number of gateway SBIR/STTR vendors, along with a relative increase in the share of funding allocated to gateway SBIR/STTR vendors. *Isolating the 2019 gateway SBIR/STTR vendor data and exploring the features in more detail, we found that approximately 85% were sponsored by the Air Force, as shown in Figure 11.*



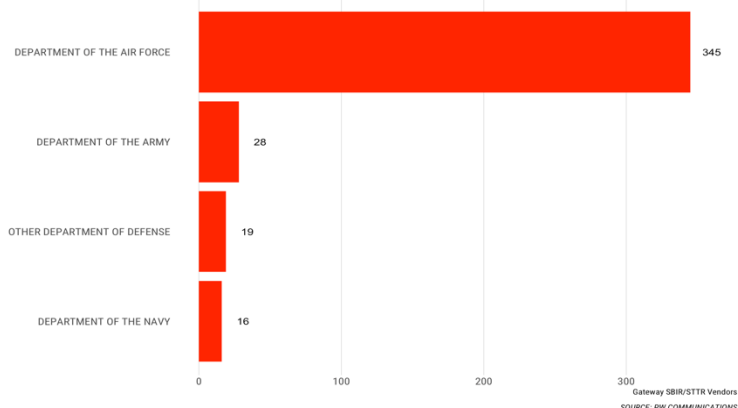


Figure 11: 2019 SBIR/STTR Gateway Vendors, by Branch Sponsor

In 2019, the Air Force’s innovation team (AFWERX) launched two new initiatives within the framework of the Air Force SBIR/STTR program: the SBIR/STTR Open Topic model and Pitch Days. Both initiatives modify certain aspects of the traditional SBIR/STTR program with the goal of making it easier, faster, and more appealing for innovative technology companies to engage with the Air Force (AFWERX, n.d.). We were interested in exploring whether these initiatives caused the spike in gateway SBIR/STTR vendors in 2019, but due to limitations in the data, we were unable to quantitatively distinguish between traditional Air Force SBIR/STTR awards and Open Topic/Pitch Day awards. The SBIR/STTR data does not explicitly indicate whether an award corresponded to Pitch Day/Open Topic, and the Air Force has not published a list of Open Topic and Pitch Day participants. Furthermore, many contract identification numbers and DUNS numbers were omitted or reported incorrectly in the 2019 Air Force SBIR/STTR data. Nevertheless, we manually explored the project descriptions associated with the 2019 Air Force gateway SBIR/STTR vendors, searching for the terms “Open Topic,” “Special Topic,” and “Pitch Day.” At least 25% of Air Force gateway SBIR/STTR vendors appeared to be associated with Pitch Day or Open Topic. While we cannot conclusively attribute the growth in new vendors to these AFWERX initiatives, based on these general findings and the timing of the rise, we can infer that they had some effect.

SBIR/STTR Conclusions

It could benefit other DoD stakeholders to study and consider adopting AFWERX’s approach. In fact, other branches have launched Pitch Days and the Open Topic model for 2020. However, we recommend that the DoD consider the number of awards made to companies with no previous DoD experience as one explicit measure of success for Pitch Days and Open Topic. Otherwise, these initiatives risk becoming channels for existing DoD suppliers to expand their DoD market share. Likewise, we recommend that all DoD SBIR/STTR programs require a minimum number of Phase Is be awarded to companies with no prior defense business annually. Further research is required to determine the appropriate number. We also recognize that the commercial market is more robust in certain fields of interest to the DoD than others—for example, cyber security versus hypersonic missiles. It would be appropriate to vary the allocation of awards to new vendors, depending on the field.

Other Transaction Authority

After completing our SBIR/STTR analysis, we next analyzed how many new vendors entered the DoD through OTAs. An OTA is a legally binding contract generally exempt from some of the most onerous aspects of traditional federal procurements (Schwartz & Peters,



2019). OTAs first appeared in 1958, when the United States established the National Aeronautics and Space Administration (NASA). The intention at the time was to provide NASA with the “necessary freedom to carry on research, development, and exploration ... to insure the full development of these peaceful and defense uses without unnecessary delay,” specifically by granting them the authority to “enter into and perform such contracts, leases, cooperative agreements, or other transactions as may be necessary” (Schwartz & Peters, 2019, p. 1). Authority to use OTAs expanded to the DoD over the course of FY1990 and FY1991, and this authority was expanded further in the 2016 National Defense Authorization Act (DiNapoli, 2019). Richard Dunn, former general counsel for the Defense Advanced Research Projects Agency (DARPA), championed the efforts to allow defense agencies to utilize OTAs and ultimately wrote the statute that expanded OTA authority to the DoD in the early 1990s. He explained to us in an interview on March 9, 2020, that the intention had been to help the DoD overcome its prevailing “costs too much, takes too long” system, to in turn increase efficiency, better attract nontraditional innovators that would otherwise be unwilling or unable to comply with traditional procurement regulations, and create a more open system (R. Dunn, personal communication, March 9, 2020).

In order to explore the degree to which OTAs attracted new vendors into the DoD over the last decade, we first needed to isolate contract actions from 2010 through 2019 that corresponded to an OTA. While USASpending data does not contain a field for OTAs, OTAs are designated in FPDS data through a field called “Nontraditional Government Contractor participation” (NGC).⁸ As such, we aggregated FPDS data from 2010 through 2019, filtered the data to include transactions classified as NGC, and isolated NGCs funded and/or awarded specifically by the DoD. To determine the number of unique vendors represented in the OTA data, we filtered and grouped the transactions by DUNS number, resolving back to a parent DUNS number as needed. *Figure 12 shows the count of unique OTA vendors by year.*

Budget Year	Total Unique OTA Vendors
2010	22
2011	33
2012	42
2013	36
2014	41
2015	39
2016	54
2017	123
2018	221
2019	420

Figure 12: Unique OTA Vendors By Year
PW Communications (n.d.)

To determine how many OTA vendors each year had no prior defense business, we searched each OTA vendor’s DUNS number in our FPDS/USASpending database to identify its

⁸ We concluded that NGC corresponds to OTAs by analyzing the features of NGC contracts. We determined that they align with the requirements of an OTA, as all NGC transactions contained additional fields to denote which OTA requirements were satisfied, such as if the transaction was associated with a prototype, whether there was cost sharing, and/or whether the recipient was a nontraditional or not-for-profit entity.



first DoD contract action. Entities with no DoD contract actions prior to their first DoD OTA between 2010 and 2019 were classified “gateway OTA vendors,” and entities with DoD contract actions prior to their first OTA award between 2010 and 2019 were classified as “existing OTA vendors.” As shown in Figure 13, more than 75% of OTAs were awarded to existing OTA vendors every year, and even as use of OTAs expanded, the majority of contracts were awarded to companies with existing defense business.

Budget Year	Total OTA Vendors	Gateway OTA Vendors	Existing OTA Vendors	% Gateway Vendors	Distinct OTA Contracts	# of Contracts Awarded to Gateway Vendors	% of Contracts to Gateway Vendors
2010	22	5	17	22.73%	23	5	21.74%
2011	33	4	29	12.12%	36	4	11.11%
2012	42	7	35	16.67%	46	8	17.39%
2013	36	5	31	13.89%	39	5	12.82%
2014	41	4	37	9.76%	47	4	8.51%
2015	39	7	32	17.95%	47	7	14.89%
2016	54	11	43	20.37%	68	11	16.18%
2017	123	32	91	26.02%	148	36	24.32%
2018	221	33	188	14.93%	296	33	11.15%
2019	420	84	336	20.00%	685	93	13.58%

Figure 13: Gateway Versus Existing OTA Vendors By Year
PW Communications (n.d.)

Next, we linked in the contract values to explore the amount of funding that was allocated to gateway versus existing OTA vendors. As demonstrated in Figure 14, nearly all DoD OTA funding was awarded to existing OTA vendors over the last decade, and even as the number of gateway OTA vendors increased year to year, existing OTA vendors continued to receive the vast majority of OTA funding.

Budget Year	Total OTA Obligations	Obligations to Existing OTA Vendors	Obligations to Gateway OTA Vendors	Share of Funding to Existing OTA Vendors	Share of Funding to Gateway OTA Vendors
2010	\$201,449,780	\$192,409,666	\$9,040,114	95.51%	4.49%
2011	\$371,869,569	\$362,413,408	\$9,456,161	97.46%	2.54%
2012	\$467,005,596	\$452,882,912	\$14,122,684	96.98%	3.02%
2013	\$340,559,773	\$307,429,862	\$33,129,910	90.27%	9.73%
2014	\$522,839,408	\$521,082,772	\$1,756,636	99.66%	0.34%
2015	\$694,883,318	\$683,122,982	\$11,760,336	98.31%	1.69%
2016	\$1,432,545,330	\$1,410,981,232	\$21,564,098	98.49%	1.51%
2017	\$2,096,054,328	\$1,901,940,280	\$194,114,048	90.74%	9.26%
2018	\$4,031,138,879	\$3,984,702,929	\$46,435,949	98.85%	1.15%
2019	\$7,385,238,011	\$7,158,073,697	\$227,164,313	96.92%	3.08%

Figure 14: Share of OTA Funding Awarded to Existing vs. Gateway Vendors by Year
PW Communications (n.d.)



Large Primes Leveraging OTAs

One potential explanation of these findings is the fact that the DoD has authority to award OTAs to large legacy government contractors if at least one nontraditional defense contractor is participating in the project to a significant extent or if there is a cost sharing arrangement in which at least one-third of the cost of the OTA comes from non-federal sources (AcqNotes, 2019). As shown in Figure 15, by linking the vendor names into the data set, we found that the five largest DoD contractors have derived millions of dollars in OTA revenue over the last decade.

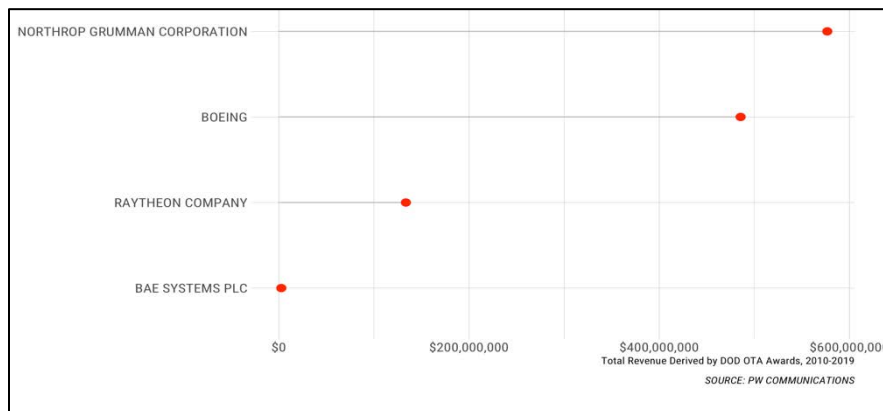


Figure 15: DOD OTAs Awarded to the 5 Five Largest DOD Contractors, 2010-2019

It is important to note that the statutory definition of “nontraditional defense contractor” is “an entity that is not currently performing and has not performed, for at least the one-year period preceding the solicitation ... any contract or subcontract for the Department of Defense that is subject to the full coverage under the cost accounting standards prescribed pursuant to Section 1502 of title 41 and the regulations implementing such section” (AcqNotes, 2019). Small business exemptions from CAS are irrespective of the share of revenue these businesses derive from the government (GSA, 2020). Thus, requiring nontraditional participation does not guarantee that the arrangement provides the government access to innovative capabilities that have previously remained out of their reach.

Given the implications of this arrangement on how OTA funds have been used, we recommend that the government modify the definition of nontraditional participation for OTAs to mean companies that have derived no revenue from the defense market in the previous five years. Doing so would put the onus on large legacy contractors to enhance outreach efforts in commercial communities of interest, beyond the scope of the traditional defense industrial base. Furthermore, the policy would be enforceable: as demonstrated through this research, sufficient publicly available data exists to easily determine if a firm has previous defense business.

Consortium Management Firms: The Multibillion-Dollar Black Box

OTAs can also be structured in a variety of different ways, including as joint ventures or partnerships, with multiple agencies joining together to fund an agreement encompassing multiple providers, or, as is most common, through a consortium (Schwartz & Peters, 2019). A consortium is an organized group of companies, academic organizations, or nonprofits that specialize in a particular technology area. They pay membership fees to join the consortium, which is typically managed by a not-for-profit consortium management firm (CMF) that serves as the intermediary between the members and the government. Although our data treats each CMF as a unique vendor, the CMF does not actually conduct the research or prototyping; it



administers subcontracts to its members, much like a traditional prime contractor–subcontractor relationship. CMFs operate in a black box because they are not required to report which members receive the subcontract awards. While they claim to serve as a “single entry point to hundreds of innovative organizations, many that traditionally do not do business with the government,” due to the lack of transparency in the data, we could not verify this claim (Dolan, 2019).

To gauge the potential implications of this lack of transparency on our results, we isolated the OTAs associated with CMFs in our data and calculated the share of total OTA funding they represented. To do so, we searched the features of our OTA data to identify mentions of “consortium” in the vendor name or the contract action description and cross referenced a publicly available list of CMFs from the MITRE website (AiDA - MITRE Corporation, 2020). We determined that 14 of the unique vendors in our OTA data set were CMFs. As shown in Figure 16, by linking the contract values associated with these 14 CMFs, we concluded that 67% of the total DoD OTA dollars over the last decade were allocated through a consortium. The fact that the majority of OTA dollars were funneled through CMFs meant we had no ability to audit the recipients of the majority of OTAs.

Type	Total OTA Funding	Unique Contracts
Consortium Management Firm	\$11,738,265,037	165
Non-Consortium Management Firm	\$5,805,318,954	712

Figure 16: OTA Funding Awarded to CMF vs. Non-CMF Vendors, 2010-2019

PW Communications (n.d.)

Consortia: Redundant Technological Priorities

A lack of transparency was not our sole concern regarding consortia. Reviewing the list of consortia and their priority technology areas on the MITRE website, we also found that many CMFs share many of the same priority technology areas (AiDA - MITRE Corporation, 2020). For example, Figure 17 provides a snapshot of consortia that listed *Artificial Intelligence/Machine Learning, Sensors, and/or Analytics* as technological priorities as of February 20, 2020.

Topic Area	Supply Chain Consortium Initiative (SCCI)	Consortium for Command, Control, and Communications in Cyberspace (CS)	Naval Surface Technology and Innovation Consortium (NSTIC)	Undersea Technology Innovation Consortium (UTIC)	Sensors, Communications and Electronics Consortium (SCEC)	Space Enterprise Consortium (SpEC)	Engineer, Research, and Development Center (ERDC) Consortium	Information Warfare Research Project (WRP)
Artificial Intelligence/ Machine Learning	X	X	X	X				
Sensors		X		X	X	X	X	
Analytics	X	X	X				X	X

Source: MITRE

Figure 17: Redundant Technological Priorities in Consortia

This redundancy raises questions. If an innovative commercial company sees that its capabilities align with multiple consortia, how does it decide which to join? Is it expected to join multiple, which requires both money and time? Commercial companies outside of the traditional defense ecosystem are largely unfamiliar with how the government conducts market research in general; why does the DoD assume that the nuances of the consortium process are somehow better understood? Furthermore, membership in a consortium does not guarantee a company



will be awarded government funding; the company is still required to bid on opportunities made available through the CMF. Even to the extent innovative commercial companies are aware of the consortium process, can the DoD assume that the opportunity is appealing, particularly for companies with robust private sector revenue streams?

Consortium Conclusions

We recommend the DoD revises the consortium model. First and foremost, CMFs must be required to report how funds are awarded. In the absence of this transparency, it is impossible to evaluate the extent to which CMFs facilitate government access to the best and brightest innovative technology firms versus the extent to which they simply benefit firms affiliated with a CMF who may or may not possess the most applicable or advanced capabilities. The intended purpose of OTAs is to make it faster, easier, and less cumbersome for companies to do business with the government, yet the majority of OTAs were funneled through bureaucratic entities that essentially levy a tax on the innovator. To ensure OTAs achieve their primary objectives, until the composition of CMF members can be verified, we recommend the DoD requires that the majority of OTAs awarded annually are awarded to non-CMF entities.

Non-CMF OTAs

Our research did reveal a substantial increase in non-CMF OTA vendors, both gateway and existing, from 2017 through 2019. Non-CMF OTA award data is far more transparent than CMF data, as it includes the names of specific vendors performing the work as well as a description of the intended purpose of the project. *To explore factors that may have contributed to the rise, we began analyzing the contracting office codes and contracting office names associated with the OTAs awarded to non-CMF vendors from 2017 through 2019, as shown in Figure 18.*

Contracting Office ID	Contracting Office Name	Total Non-CMF OTA Vendors	Non-CMF Existing OTA Vendors	Non-CMF Gateway OTA Vendors
W15QKN	W6QK ACC-PICA	196	142	54
HR0011	DEF ADVANCED RESEARCH PROJECTS AGENCY WASHINGTON	142	127	15
HQ0034	HEADQUARTERS SERVICE	47	36	11
W911QY	W6QK ACC-APG NATICK	43	40	3
FA8649	USAF SBIR STTR CONTRACTING	35	24	11
N00014	OFFICE OF NAVAL RESEARCH	21	17	4
W52P1J	W4MM USA JOINT MUNITIONS CMD	20	16	4
M67854	COMMANDER	15	13	2
W900KK	W6QK ACC – ORLANDO	15	14	1
FA8650	WSAF AFMC AFRL PZL RAK RXK	9	4	5
W909MY	ACC-ABERDEEN PROVIDNG GROUNDS CONT C	8	6	2
S2206A	DCMA BOSTON	7	7	0

Figure 18: Non-CMF OTA Awards by Source, 2017-2019

PW Communications (n.d.)



While the vast majority of vendors from 2017 through 2019 continued to be those with existing defense business, we noticed that the greatest number of non-CMF OTAs were awarded by two offices: W15QKN/W6QK ACC-PICA, and HR0011/Defense Advanced Research Projects Agency (DARPA). We could explicitly see from the contracting office name that the second-largest source of non-CMF gateway OTA vendors entered the DoD through DARPA, which suggests that DoD stakeholders could benefit from learning more about, and potentially adopting features of, DARPA’s approach to marketing and administering OTAs. To better understand the gateway OTAs that correspond to W15QKN/W6QK ACC-PICA, we linked and explored the contract requirement descriptions. *As highlighted in Figure 19, these contract descriptions referenced “Defense Innovation Unit” (DIU), formerly known as the Defense Innovation Unit Experimental (DIUx).*

Contracting Office	Contract Description
W6QK ACC-PICA	PROJECT AWARD IN SUPPORT OF THE DIUX CSO PROGRAM IS ENTITLED AUTONOMOUS TACTICAL AIRBORNE DRONE.
W6QK ACC-PICA	BASE OTA AWARD FOR SAILDRONE, INC IN SUPPORT OF DIUX AND NAVAL SPECIAL WARFARE. SUPPORTING R&D EFFORTS FOR UNMANNED MARTITIME SURFACE VESSEL RELEVANT TO ENHANCING THE MISSION EFFECTIVENESS OF MILITARY PERSONNEL
W6QK ACC-PICA	PROJECT AWARD IN SUPPORT OF DIUX PROGRAM ENTITLED US NAVY EXPLOSIVE ORDNANCE DISPOSAL
W6QK ACC-PICA	OPEN ARCHITECTURE DATA MANAGEMENT AND ADVANCED ANALYTICS IN SUPPORT OF DIUX
W6QK ACC-PICA	AWARD UNDER DIUX AOI HARDWARD TO SOFTWARE TRANSFORMATION
W6QK ACC-PICA	THE PURPOSE OF THIS ACTION IS TO AWARD AN OTHER TRANSACTION AGREEMENT OTA, W15QKN-18-9-2002, BETWEEN THE UNITED STATES ARMY CONTRACTING COMMAND – NEW JERSEY PREVALENT, INC. IN SUPPORT OF THE DEFENSE INNOVATION UNIT DIU
W6QK ACC-PICA	THE PURPOSE OF THIS ACTION IS TO AWARD AN OTHER TRANSACTION AGREEMENT OTA, W15QKN-18-9-2002, BETWEEN THE UNITED STATES ARMY CONTRACTING COMMAND AND STRATEGY ROBOT, INC. IN SUPPORT OF THE DEFENSE INNOVATION UNIT DIU
W6QK ACC-PICA	THE PURPOSE OF THIS MODIFICATION IS TO PROVIDE CLARIFICATION TO THE DIU STRATEGY ROBOT SOW. THE VALUE AND PERIOD OF PERFORMANCE REMAIN UNCHANGED.
W6QK ACC-PICA	AWARD OF DIU PROTOTYPE PROJECT TO AIRMAP UNDER GROUP 1 UNMANNED ARCHITECTURE
W6QK ACC-PICA	THE PRINCIPLE PURPOSE OF THIS OTA IS TO PROVIDE DRAGONEYE STABILIZED MICRO EO/IR CAMERA SYSTEMS FOR ALL UNMANNED AERIAL SYSTEMS SUAS IN SUPPORT OF THE DEFENSE INNOVATION UNIT DIU
W6QK ACC-PICA	AWARD OF SHORT RANGE RECON PROTOTYPE PROJECT IN SUPPORT OF DIU AND PEO AVIATION
W6QK ACC-PICA	PROTOTYPE PROJECT UNDER THE DEFENSE INNOVATION UNIT DIU SMALL RESPONSIVE LAUNCH SRL
W6QK ACC-PICA	EXTEND POP TO OTA WITH SRI INTERNATIONAL IN SUPPORT OF DIU AOI HARDWARD TO SOFTWARE TRANSFORMATION
W6QK ACC-PICA	MODIFICATION TO OTA TO VOLANS-I IN SUPPORT OF DIU AOI CRITICAL SUPPLY DELIVERY – PHASE 4 AND OPTION PHASE 5

Figure 19: Snapshot of Contract Description, W15QKN/W6QK ACC-PICA
PW Communications (n.d.)

DIU Microanalysis & OTA Conclusions

DIU was established in 2015 with a stated mission similar to that of AFWERX: to strengthen national security “by accelerating the adoption of leading commercial technology



throughout the military and growing the national security innovation base” (DIU, n.d.). According to its website, DIU utilizes Other Transaction authority to award prototype contracts in 90 days or less. Prototype projects typically run from 12–24 months, and upon completion, successful prototypes may transition to follow-on production OTAs or FAR-based contracts (DIU, n.d.). While W15QKN appeared to correspond to DIU, DIU does not publicly report its award data. Consequently, we were unable to verify if all W15QKN vendors in fact participated in the DIU program, or if DIU administered OTAs through other contracting offices. Nevertheless, we could infer that W15QKN corresponded to DIU and based on that assumption, concluded that DIU was the largest source of non-CMF gateway OTA vendors from 2017 through 2019. While DoD stakeholders might benefit from studying and potentially adopting aspects of DIU’s approach, it is important to consider that, when comparing the share of W15QKN vendors that were gateway versus existing vendors, only 28% of DIU vendors from 2017 through 2019 had no prior defense business. These findings suggest that if the DoD keeps expanding the use of OTAs without adjusting how they are marketed and administered, they will continue to be disproportionately leveraged by existing DoD suppliers.

Prize Competitions & Challenges

In addition to the SBIR/STTR program and OTAs, the DoD also uses Prize Competitions/Challenges to incentivize innovation and to engage problem solvers (Gallo, 2020). Congress provided DARPA with Competition authority in FY2000 and extended it to other military departments in FY2007 (Gallo, 2020). The authority states that the DoD can award monetary prizes “in basic, advanced, and applied research, technology development, and prototype development that have the potential for application to the performance of the military missions of the Department of Defense” (Gallo, 2020, p. 5). As a result of the America COMPETES Reauthorization Act, which expanded the authority for agencies including the DoD to conduct Prize Competitions, use of Prize Competitions has grown substantially since 2010 (Gallo, 2020). According to a White House Report on Federal Prize implementation, DoD prize investment increased from \$6.75 million in 2016 to \$18.8 million in 2018 (White House Office of Science and Technology Policy, 2019).

Although we were interested in evaluating the extent to which Prizes attracted new vendors into the defense market, the government classifies them as grants rather than procurements. As a result, they are not subject to consistent reporting requirements, and we were precluded from obtaining a comprehensive data set of participants. While we could not analyze Prizes at scale over the 2010–2019 period, we elected to conduct a microanalysis of one DoD Prize initiative, the Army’s Expeditionary Technology Search Prize, or xTechSearch. We selected xTechSearch because we were able to acquire a list of 24 xTechSearch finalists from 2019 through the xTechSearch website (xTechSearch, n.d.). Additionally, the Army website describes xTechSearch as a “contest for small businesses to develop and demonstrate new and emerging technologies that will help solve the Army’s modernization challenges,” launched as a way to transform how “the Army attracts and encourages innovation.” It was our intention, through this microanalysis, to determine whether the Army had met this objective.

A Note About the Microanalysis

The small sample size of the xTechSearch participant data set allowed us to explore features of xTechSearch companies that we were unable to consider in our broader quantitative analyses. Specifically, when we analyzed the overall DoD supplier base, SBIR/STTR participants, and OTA recipients, the size of the data sets precluded us from considering a company’s previous contracts from government customers outside the DoD. Additionally, we only considered a company’s prior *contract* awards; we could not explore non-contract federal funding (known as federal assistance), which includes federally-funded research and



development grants, prize awards, and non-DoD SBIR awards. Excluding these features from our broader analyses, we could not distinguish between companies that were truly engaging with the DoD for the very first time from companies that had not received a previous DoD contract or DoD-sponsored SBIR, but had received prior DoD grant/assistance funding. Furthermore, the essence of our research sought to better understand how the DoD attracts companies that have remained out of reach. There is a difference between a company that does business with the DoD for the first time but has years of experience supporting other federal customers compared to a company with no prior government experience whatsoever.

With 24 companies, we could consider whether a company had received any previous federal funding, including non-DoD contracts and/or federal assistance. While doing so introduced some inconsistencies between how we analyzed xTechSearch data relative to the other innovation program data, it allowed us to more comprehensively evaluate the program's ability to attract new vendors. It also allowed us to test an approach that could be replicated across the broader data in conjunction with follow-on research at a future date.

xTechSearch

To analyze the composition of the xTechSearch participants, we identified and linked the DUNS numbers for each of the 24 companies. We then searched each DUNS number against our FPDS and USASpending data to identify all related contract actions, regardless of the contracting agency. Lastly, we linked Assistance data from USASpending and searched the DUNS numbers for prior Assistance awards.

We found that 13 of the 24 companies had prior government business. Two of the companies had been doing business with the government for more than 10 years, five had generated more than \$10 million in government revenue, and an additional four had generated between \$1 million and \$9.9 million in government revenue. Three of the 24 companies had initial contract actions in 2019, and the features of these contracts align with the terms of the xTechSearch prize (dollar amount and date of award). Therefore, we could infer that these three companies had no prior defense or government business before participating in xTechSearch. For eight of the 24 companies, we found no records of them in FPDS or USASpending. In other words, according to publicly available data, these companies had received no funding from the federal government. This finding contradicts the list of finalists on the xTechSearch website and is likely the result of the inconsistent and/or nonexistent reporting requirements for prize awards. Although we could infer that they had no prior government contract awards, as those would have produced DUNS matches in FPDS or USASpending, we were unable to ascertain whether or not they had previous grants or assistance.

While further research is required to determine if the composition of xTechSearch participants is consistent with other DoD prize initiatives, these results, while limited, indicate that despite their stated mission, Prizes, like the SBIR/STTR program and OTAs, have disproportionately benefited existing vendors. Additionally, these results indicate that it is critical for the government to implement consistent reporting standards for prize/challenge data to ensure that program outcomes can be tracked and that recipients of grant funding, in general, can be included in analyses of the government's industrial base.

Conclusions & Recommendations

Despite the fact that DoD leadership has articulated an urgent need to engage commercial technology companies outside of the traditional defense industrial base, the macroeconomic data demonstrates a continuous decline in new vendors year to year. While further research is required to analyze the composition of other DoD innovation initiatives including Army Futures Command, SOFWERX, and an expanded data set of AFWERX and



Prize participants, our analyses of SBIR/STTR, OTAs and the xTechSearch prize yielded conclusive results. Rather than expanding the defense industrial base, the DoD's continuous investment in innovation initiatives has enabled entrenched defense suppliers to expand their market share. In addition to the program-specific recommendations offered previously, we suggest the DoD takes the following measures to improve its ability to attract new vendors:

- **Add a “First Time Vendor” field to SAM profiles.** DoD stakeholders cannot be held accountable for increasing the number of first time vendors they engage if they have no easy way to determine if a company has previous DoD experience. As demonstrated through our analyses, the DoD already collects much of the data required to distinguish a company as new versus existing. As such, we recommend that a company's SAM profile automatically update to indicate the date it first receives federal funding and the date it first receives DoD funding, and update two “First Time Vendor” fields accordingly—one to indicate companies with no prior federal business, and one to indicate no prior defense business.
- **Require consistent reporting standards for assistance/grant data and consortium data, as discussed previously.**

New Vendor Gateway

As demonstrated in our research, efforts to streamline the regulatory requirements and accelerate award timelines fail to mitigate the underlying factors that have thwarted the growth of the defense industrial base. We strongly recommend that the DoD establishes a “New Vendor Gateway”—a single gateway for innovative commercial technology companies with no prior defense business—that, if structured appropriately, would allow the DoD to better attract, access, and integrate the technologies of innovative new suppliers. Companies with no previous DoD experience are largely unfamiliar with how the government posits demand, and despite some media buzz related to AFWERX and DIU, information about the DoD's innovation initiatives rarely reaches audiences with no previous connection to the DoD market. As a result, these firms remain unaware that there may be demand for their products/services in the public sector. The new vendor gateway would allow disparate DoD stakeholders with similar requirements to pool their marketing resources/efforts and direct potential vendors to a single initial resource.

If and when an innovative technology company becomes aware that demand for its products or services exists in the defense market, it faces additional obstacles—including the number of disparate and seemingly redundant DoD innovation initiatives. There are no clear instructions for how companies should determine whether to join a consortium related to their technology, apply for a SBIR/STTR related to their technology, or apply for a DoD Prize related to their technology. Out of sheer frustration and confusion, companies will abandon the defense market altogether, in which case the fact that one program offered a streamlined submission process or an accelerated award timeframe had no bearing. The New Vendor Gateway would allow DoD stakeholders to help direct a company to the most appropriate opportunity using a variety of criteria. Additionally, a chat-bot system would allow the companies to ask clarifying questions.

Furthermore, even for the DoD's newest innovation initiatives that boast streamlined submission processes, the application process remains complex, confusing, and time-consuming. For instance, PW Communications undertook the Phase I and Phase II AFWERX submission processes and encountered multiple inconsistencies in the proposal instructions, delays in the timelines, and a general lack of clarity on expectations of the project. These issues dissuade companies, particularly those with robust private sector opportunities, from pursuing



business with the DoD. The New Vendor Gateway could include additional support tools/resources for companies in certain technology areas deemed critical to the DoD to help them navigate the submission process.

Because the process of identifying a relevant opportunity and successfully submitting a proposal is complicated, the programs ultimately favor companies that have already gone through the process. In other words, the more familiar a company is with the process, the more they can take advantage of these opportunities. A company's institutional knowledge of the process therefore becomes more relevant than the innovativeness of their solution. As mentioned previously, the DoD must institute minimum new vendor requirements for innovation initiatives, and the New Vendor Gateway will be a valuable tool to help the DoD achieve these thresholds.

Conclusions

It is more essential than ever for America's economic and national security that the DoD has access to the most state-of-the-art technologies. With strong leadership and a well thought-out restructuring of its resources and approaches, we believe the DoD can become "the customer of choice" among the nation's leading commercial innovators.

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**Why Marketing Matters: Strengthening the Defense
Supplier Base Through Better Communication with
Industry**

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GRADUATE SCHOOL OF DEFENSE MANAGEMENT
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Why Marketing Matters: Strengthening the Defense Supplier Base Through Better Communication with Industry

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Abstract

This paper demonstrates that the Department of Defense (DoD)’s primary methods of marketing requirements and soliciting information from prospective suppliers inhibit the military’s access to innovative nontraditional companies. To conduct this research, we leveraged qualitative and quantitative research techniques, including assessing the features of more than one million DoD solicitations from <https://beta.sam.gov> and surveying small businesses on the readability of DoD requirements. Our results concluded that DoD solicitations are not conducive to attracting nontraditional suppliers because they are difficult to discover, lack ample response time frames, are not easy to read or understand, and lack critical information. These and other factors deter innovative, nontraditional companies from participating in the DoD’s market research process, in turn limiting the pool of suppliers available to the military. We offer recommendations for how the DoD can improve the way it writes and markets solicitations to attract and engage innovative, nontraditional companies more competitively.

Introduction

Over the last 2 decades, companies outside of the U.S. military’s traditional industrial base—rather than entrenched defense contractors—have increasingly driven advancements in areas of critical importance to national defense. This paradigm shift has forced the Department of Defense (DoD) to rethink how it sources and funds new technologies and has prompted continuous investment—to the tune of billions of dollars annually—in innovation initiatives and rapid acquisitions programs whose stated purpose is to accelerate the adoption of commercial technologies. In spite of these efforts, we demonstrated in research we published in 2020 that the vast majority of DoD suppliers, including participants in DoD innovation programs, continue to be legacy contractors (Bresler & Bresler, 2020). We posited that one reason why the DoD does a poor job of attracting innovative new vendors (“nontraditionals”) is its failure to adequately market its requirements to communities outside of the traditional defense industrial base (DIB). This research aims to explore that hypothesis in more detail. Specifically, we sought to analyze how the composition and marketing of DoD requirements impacts the military’s efforts to attract innovative, nontraditional suppliers.

Research Approach

This paper begins by providing an overview of the DoD’s current methods of marketing open requirements (“opportunities” or “requirements”) and soliciting information from prospective suppliers (“supplier outreach”), including the Federal Acquisition Regulation (FAR),



which dictates these procedures. Next, employing quantitative and qualitative research techniques, we analyzed the extent to which these methods enable the DoD to engage innovative, nontraditional companies outside of the DIB. We primarily focused our analyses on the following criteria:

- **discoverability:** the extent to which nontraditionals can find relevant DoD opportunities
- **response time:** the number of days between when an opportunity is posted and when responses are due
- **content:** the extent to which requirements are written in a clear and readable fashion and the extent to which requirements contain the information needed for nontraditionals to adequately evaluate them
- **redundancy:** the extent to which multiple DoD/government entities are simultaneously seeking similar solutions and how redundancy may affect nontraditionals' ability to prioritize relevant opportunities

In each section, we demonstrate that the DoD's methods of marketing its requirements and conducting supplier outreach substantially inhibit the military's access to companies outside of the DIB. This finding offers important context relative to our 2020 research results insofar as it makes clear a driving factor behind the DoD's failure to introduce a significant number of innovative new suppliers into the defense market over the last decade. Throughout the paper, we offer concrete recommendations for how the DoD can improve the way it communicates with industry to reach and engage a broader and more diverse audience of potential suppliers, thereby ensuring that the warfighter has access to the cutting-edge technologies necessary to fight and win.

How the DoD Markets Requirements: Federal Acquisition Regulation

The primary ways in which the DoD markets requirements and conducts supplier outreach in the procurement process are dictated by Federal Acquisition Regulation (FAR). These regulations create a set of rules that government stakeholders must comply with when procuring products and services. Certain exceptions exist within contract administration that allow contracting personnel to employ non-FAR contract strategies, such as Other Transactions, Procurements for Experiments, and Research and Development (R&D) Agreements (Defense Acquisition University, n.d.). However, the majority of contracts are FAR based, and non-FAR contracts are not always precluded from the marketing-specific requirements most relevant to this research.

For the purposes of this research, it is important to understand FAR Part 5, Part 6, and Part 10. FAR Part 5 requires contracting officers to "disseminate information on proposed contract actions ... expected to exceed \$25,000, by synopsis in the Governmentwide Point of Entry (GPE)" (FAR 5.1, 2021). The website <https://beta.sam.gov> (hereafter referred to as *beta.sam*), which replaced legacy site FedBizOpps in 2019, serves as the GPE. Thus, to comply with the FAR, all contract actions are made public on beta.sam, and the archived and active data on the site serves as a primary resource for our quantitative analyses. FAR Part 6 requires "with certain limited exceptions, that contracting officers shall promote and provide for full and open competition in soliciting offers and awarding Government contracts" (FAR 6.1, 2021) and

contracting officers shall provide for full and open competition through use of the competitive procedure(s) contained in [the FAR] subpart that are best suited to the circumstances of the contract action and consistent with the need to fulfill the Government's requirements efficiently. (FAR 6.1, 2021)



In short, FAR Part 6 requires government stakeholders to ensure that opportunities are marketed competitively.

Additionally, and of particular import, FAR Part 10 explicitly addresses the “policies and procedures for conducting market research to arrive at the most suitable approach to acquiring, distributing, and supporting supplies and services” (FAR 10, 2021). These policies dictate that government stakeholders must follow a number of steps during the market research process, including but not limited to the following:

- **Conduct market research appropriate to the circumstances-**
 - Before developing new requirements documents for an acquisition by that agency; ...
 - On an ongoing basis, take advantage (to the maximum extent practicable) of commercially available market research methods in order to effectively identify the capabilities of small businesses and new entrants into Federal contracting that are available in the marketplace for meeting the requirements of the agency.
- **Use the results of market research to-**
 - Determine if sources capable of satisfying the agency’s requirements exist;
 - Determine if commercial items or, to the extent commercial items suitable to meet the agency’s needs are not available, nondevelopmental items are available that-
 - Meet the agency’s requirements;
 - Could be modified to meet the agency’s requirements; or
 - Could meet the agency’s requirements if those requirements were modified to a reasonable extent;
 - Determine the extent to which commercial items or nondevelopmental items could be incorporated at the component level; ...
- **When conducting market research, agencies should not request potential sources to submit more than the minimum information necessary. (FAR 10, 2021)**

While the intention of these and other FAR clauses may be to foster competition, we sought to analyze, in practical terms, the extent to which these objectives are met. Furthermore, the importance of broadly marketing requirements and fostering healthy competition go beyond regulatory requirements. As we mentioned previously, now more than ever, the military needs innovative capabilities originating outside of the DIB, yet the DoD has continued to fall short in the critical mission of engaging these types of firms. This trend has persisted in spite of the FAR requirements and in spite of substantial investments into defense-sponsored innovation initiatives.

Discoverability

Beta.Sam Awareness

In our 2020 research, we argued that one reason why legacy contractors continue to receive the vast majority of DoD contracts is because there is a general lack of awareness among companies outside of the DIB on the basics of how to identify and engage with military customers (Bresler & Bresler, 2020). While the majority of this paper is concerned with whether or not specific features of DoD opportunities inhibit the military’s ability to engage nontraditionals, it is first important to consider whether or not nontraditionals can discover DoD opportunities at all. Simply put, are nontraditionals aware of beta.sam, and do they know how to leverage it to identify prospective opportunities?

We do not have access to information about website traffic to beta.sam, precluding us from quantitatively assessing the reach and composition of the site’s audience. However, we



can tell from site embeddings that the government does track critical data, such as overall site traffic, the number of unique visitors, the locations of visitors, and more. We encourage the DoD to make use of this information to assess the effectiveness of its marketing initiatives and to shape the development of future marketing and search engine optimization (SEO) strategies.

In the absence of site traffic data, we nevertheless have reason to believe that many nontraditionals are unfamiliar with beta.sam and/or struggle to navigate it. For instance, in addition to the multibillion dollar lobbying and consulting industry centered around helping firms navigate the defense market, companies such as GovWin, Bloomberg Government, and GovShop charge firms a subscription fee in exchange for repackaged opportunity data from beta.sam. The existence of a secondary market for publicly available government opportunity data suggests that beta.sam fails to serve as a viable resource for this information. The result of this “pay to play” paradigm is that the DoD does not see companies with the most cutting-edge capabilities. Rather, the military’s requirements primarily reach only those companies willing to pay for access. While service providers and relationships will always play a role in navigating an organization as large and bureaucratic as the DoD, it is important that basic information about the military’s requirements be accessible to a wide and diverse audience.

While the remainder of our analyses make the assumption that nontraditionals can successfully reach beta.sam, there is clearly a need to market the site better overall. Further research is required to determine the appropriate level of investment the DoD should make to broaden awareness of the site, along with how to allocate those resources. For starters, we suggest that they invest in SEO to ensure that beta.sam is returned at the top of all search engine searches for queries related to selling products/services to the government. Additionally, we suggest that the DoD engage a marketing firm to develop a strategy for promoting the site in places heavily trafficked by nontraditionals, like *Bloomberg Businessweek*, *Crunchbase*, *LinkedIn*, *The Wall Street Journal*, and more.

Site Design

Assuming companies successfully reach beta.sam to explore potential DoD opportunities, they face yet another obstacle: how to navigate the site. It is clear from the landing page, a snapshot of which is provided in Figure 1, that it is not designed with supplier outreach in mind. Rather, it explicitly states that it is “for people who make, receive, and manage federal awards” (General Services Administration, n.d.). These distinct stakeholder groups have markedly different purposes for visiting the site and have markedly different levels of familiarity with government data and terminology.



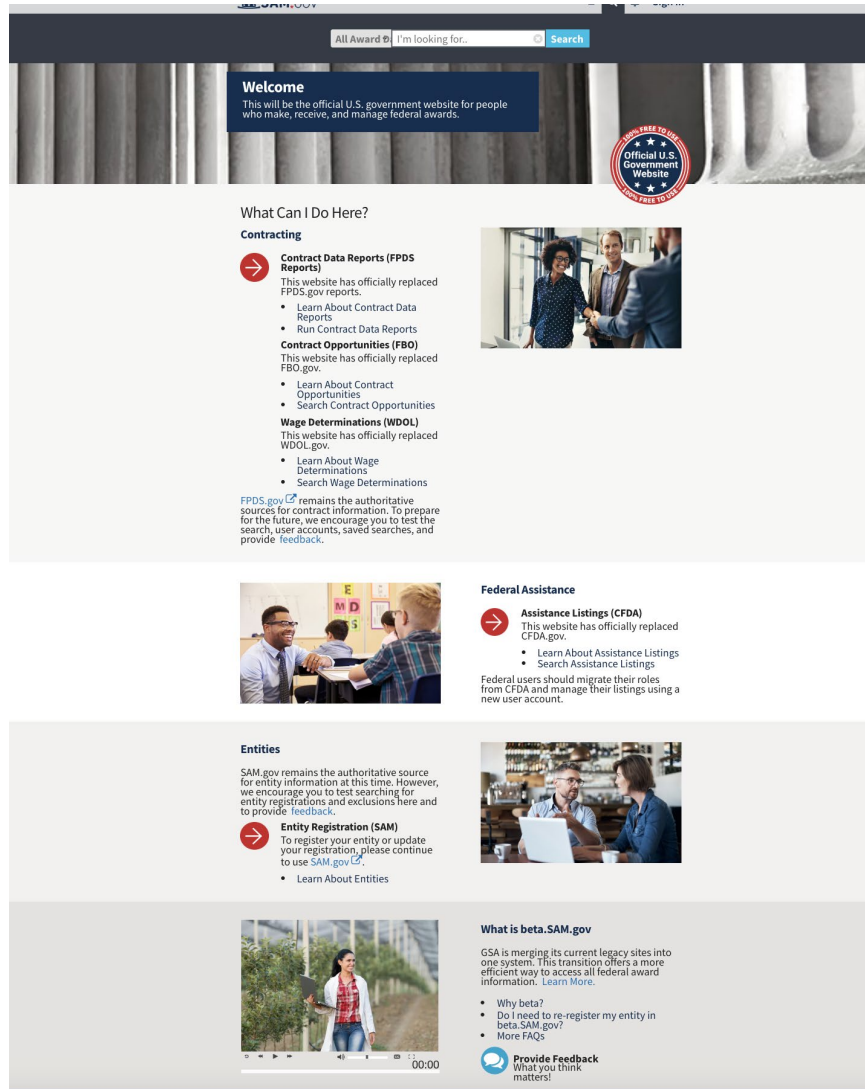


Figure 1. Beta.Sam Landing Page

Nontraditional face an immediate challenge of trying to decipher the wide array of links and drop-down menu options to determine what content is relevant to them. References to topics such as “Wage Determinations” and “Contract Data Reports” confuse and intimidate companies unfamiliar with the government market. Furthermore, there is no explicit call to action on the homepage for companies interested in learning more about selling their products/services to the government—only a drop-down menu that allows a user to select “Contract Opportunities” and small text towards the bottom of the page that says “Learn More” followed by “Contract Opportunities (FBO).”

Rather than relying on a single site to serve multiple distinct stakeholder groups, we recommend that the federal government create a separate site specifically for suppliers. The site would speak directly to prospective and current suppliers using simple, clear, and straightforward language. It could be linked to the “New Supplier Portal” we recommended in our 2020 research paper—a resource specifically for companies with no prior experience selling to the government (Bresler & Bresler, 2020). There would be a prominent search feature with an explicit call to action to the effect of “Interested in Selling Your Products/Services to the



Government? Search for Open Opportunities Here.” Additionally, we suggest that investments made by the DoD to market beta.sam be specifically focused on marketing this offshoot, supplier-specific site.

Search Functionality

If and when users reach the landing page associated with “Contract Opportunities,” they can input keywords to conduct Boolean searches for relevant opportunities. Two significant limitations to this search functionality include:

- When inputting a search term, beta.sam only returns matches that reference the exact term searched; it does not stem the search term to generate matches for related terms. For instance, if a company searches “UAV,” they will not see matches for “drone” (unless the “drone” opportunity also contains the term UAV). As it stands, the scope of relevant opportunities presented to a company is substantially limited, which in turn limits the pool of prospective suppliers that participate in a given DoD opportunity. We recommend that the federal government at large, including the DoD, incorporate related terms to beta.sam’s search function. They can leverage resources such as the Defense Technical Information Center (DTIC) thesaurus to do so in a consistent fashion.
- Beta.sam only searches for the input term in the title and description of that opportunity—it does not search for the term in the attachment data. DoD customers often outline their needs in attachments rather than in the description, particularly in calls for market research. As it stands, companies who rely solely on beta.sam searches miss out on many potentially viable opportunities. We recommend that the DoD either mandate stakeholders to outline their needs areas in the description field or enable queries to search attachment data.

Of note, identifying too many opportunities can also be problematic, so it is important that the opportunities presented are easy to assess and understand. These nuances are addressed in greater detail in the Readability and Redundancy sections below.

Response Time

Acknowledging that a lack of awareness of beta.sam, coupled with challenges posed by the design of the site, greatly inhibit the DoD’s ability to reach a broad audience, we now shift our focus to assess the features of DoD opportunities. These analyses make the assumption that companies know beta.sam exists and are using it to search for potential DoD opportunities. The first feature we explored is the length of time a company has to prepare and submit a response from when an opportunity is made public to when submissions are due. Response time is an important metric for competitiveness because companies need adequate time to identify an opportunity, to evaluate whether the opportunity is worth pursuing, and to prepare and submit a compliant response.

To quantitatively analyze the response time frames associated with DoD solicitations, we aggregated the archived solicitation data from beta.sam in each year from 2002 through 2020, starting in 2002 because the data sets become more complete in that year. After joining and cleaning 18 years’ worth of data, we filtered the data to isolate solicitations issued by the DoD. To ensure we counted only distinct solicitations, we also filtered the data to include just the most recent solicitation listing associated with a particular solicitation identification (solicitation ID) and title. Additionally, we excluded solicitations that contained no text in the name or the solicitation description and/or listed a response date that occurred prior to the publishing date.

We also excluded



- Solicitations associated with notice types for “Sale of Surplus Property,” “Modification/Amendment/Cancel,” and “Foreign Government Standard”
- “Award Only” notices
- “Justifications”

We excluded these listings because they contain features inconsistent with the majority of the data and are generally unrelated to the market research process.

Our resulting data set of total DoD solicitations for analysis was 1,050,933. Figure 2 shows the total number of DoD solicitations by year.

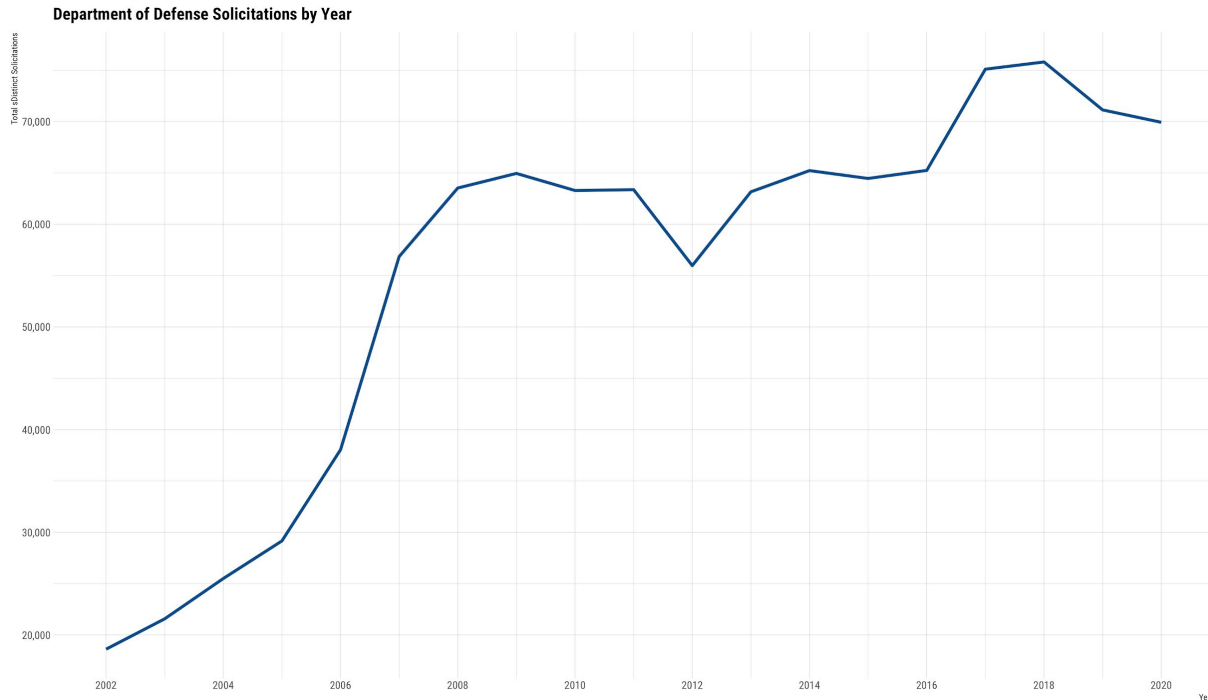


Figure 2. Total DoD Solicitations by Year

We then determined the response time frame for each solicitation by calculating the number of days between the date the solicitation was published and the date by which a response was due, both of which are standard data fields. As shown in Figure 3, every year from 2002 through 2020, 22% to 35% of all DoD solicitations had a response time of 10 days or less, and 45% to 87% of all DoD solicitations had a response time of 21 days or less. In each year over the last decade, 70% or more of all DoD solicitations had a response time of 21 days or less; and with the exception of 2020, at least 30% of all solicitations annually required responses within 10 days.



Department of Defense Solicitation Response Time by Year						
Year	Total Distinct Solicitations	Count Response Time <= 10 Days	Count Response Time 11-21 Days	% Response Time <= 10 Days	% Response Time 11-21 Days	% Response Time <= 21 Days
2002	18,612	4,255	4,487	22.86%	24.11%	46.97%
2003	21,569	4,818	4,994	22.34%	23.15%	45.49%
2004	25,496	5,742	6,289	22.52%	24.67%	47.19%
2005	29,157	6,915	9,734	23.72%	33.38%	57.10%
2006	38,042	9,793	15,905	25.74%	41.81%	67.55%
2007	56,854	14,783	26,043	26.00%	45.81%	71.81%
2008	63,532	15,918	28,197	25.06%	44.38%	69.44%
2009	64,953	19,384	26,445	29.84%	40.71%	70.56%
2010	63,289	19,501	26,483	30.81%	41.84%	72.66%
2011	63,368	18,804	28,692	29.67%	45.28%	74.95%
2012	55,975	16,212	26,666	28.96%	47.64%	76.60%
2013	63,162	18,656	31,058	29.54%	49.17%	78.71%
2014	65,229	22,079	31,486	33.85%	48.27%	82.12%
2015	64,462	22,288	28,515	34.58%	44.24%	78.81%
2016	65,248	23,126	29,963	35.44%	45.92%	81.36%
2017	75,106	25,152	35,897	33.49%	47.80%	81.28%
2018	75,808	26,460	33,793	34.90%	44.58%	79.48%
2019	71,139	23,218	30,287	32.64%	42.57%	75.21%
2020	69,933	18,533	42,253	26.50%	60.42%	86.92%

Figure 3. DoD Solicitation Response Time by Year

While these turnaround times may not violate the FAR, it is unreasonable to expect that companies with little or no experience in the public sector will have ample time to participate in the market research process for opportunities open 21 days or less, and a time frame of 10 days or less is that much more challenging. Furthermore, as the data show, the problem has become progressively worse over the last 2 decades. This trend is especially concerning since, over that same time frame, the military has become increasingly reliant on technologies being developed outside of the traditional DIB. In other words, as the need to engage nontraditionals has grown, the process for companies to do so has become more anticompetitive.

Response Time by Notice Type

According to the DoD *Guidebook for Publicizing Notices in Contract Opportunities*, government stakeholders are required to publish notices for “proposed contract actions valued at more than \$25,000,” which include “announcements through official solicitations in the pre-award process, and up through award” (DoD, 2020, p. 3). As such, each opportunity corresponds to a specific notice type, depending on the purpose of the particular contract action. Each of the 1,050,933 opportunities in our data set corresponded to one of the following notice types, as defined by the *Guidebook for Publicizing Notices in Contract Opportunities* (DoD, 2020, p. 5):

- **Special Notice:** To increase competition and broaden industry participation, a special notice may be used to announce small business conferences, business fairs, long-range procurement estimates, pre-bid or preproposal conferences, meetings, and the availability of draft solicitations or draft specifications for review.
- **Sources Sought:** Use the sources sought notice type for Requests for Information (RFI) and other types of market research. An RFI is used when the Government does not presently intend to award a contract, but wants to obtain price, delivery, other market information, or capabilities for planning purposes. Responses are information only and shall not be used as an offer or proposal.



- **Presolicitation:** In appropriate cases, use a presolicitation notice to advise suppliers on the scope and purpose of the acquisition and to invite potential offerors to submit information. This allows the Government to advise the offerors about their potential to be viable competitors. Responses are information only and shall not be used as an offer or proposal. The FAR requires that a presolicitation notice be published in advance of a solicitation notice unless the combined synopsis/solicitation is used.
- **Solicitation:** Requests for proposals (RFPs) are used in negotiated acquisitions to communicate Government requirements to prospective contractors and to solicit proposals.
- **Combined Synopsis:** Use a combined Synopsis/Solicitation when the procurement meets the applicable conditions outlined in the FAR to reduce the time required to solicit and award contracts for the acquisition of commercial items. This notice type combines the synopsis and the issuance of the solicitation into a single document.

The purpose of Special Notices, Sources Sought, and Presolicitations is to allow the DoD to collect information from a broad range of suppliers about what capabilities they possess and how they would approach solving the DoD’s stated problem(s). The DoD then uses the feedback gathered to shape and inform future requirements. It is especially important that nontraditionals participate in these types of information exchanges. Otherwise, the military’s view of how problems can be solved is shaped exclusively by entrenched suppliers, which is inherently limiting as they do not always possess the most cutting-edge capabilities and may not be incentivized to encourage the DoD to consider new approaches. As such, we were interested in understanding how response times varied across these different notice types, and—in particular—for Special Notices, Sources Sought, and Presolicitations.

As shown in Figures 4 and 5, the vast majority of Special Notices and Sources Sought, and nearly half of all Presolicitations, have a turnaround of 21 days or less. Based on response time alone, suppliers unfamiliar with the DoD’s supplier outreach methods are effectively closed off from participating in these critical calls for market research.

Department of Defense Solicitations, by Notice Type and Response Time

Notice Type	Count Response Time <= 10 Days	Count Response Time 11-21 Days	Count Response Over 21 Days
COMBINED SYNOPSIS/SOLICITATION	197,454	332,578	35,559
PRESOLICITATION	72,472	99,069	208,678
SOURCES SOUGHT	32,431	28,144	18,857
SPECIAL NOTICE	10,818	5,444	2,564
SOLICITATION	2,462	1,952	2,452

Figure 4. Response Time by Notice Type



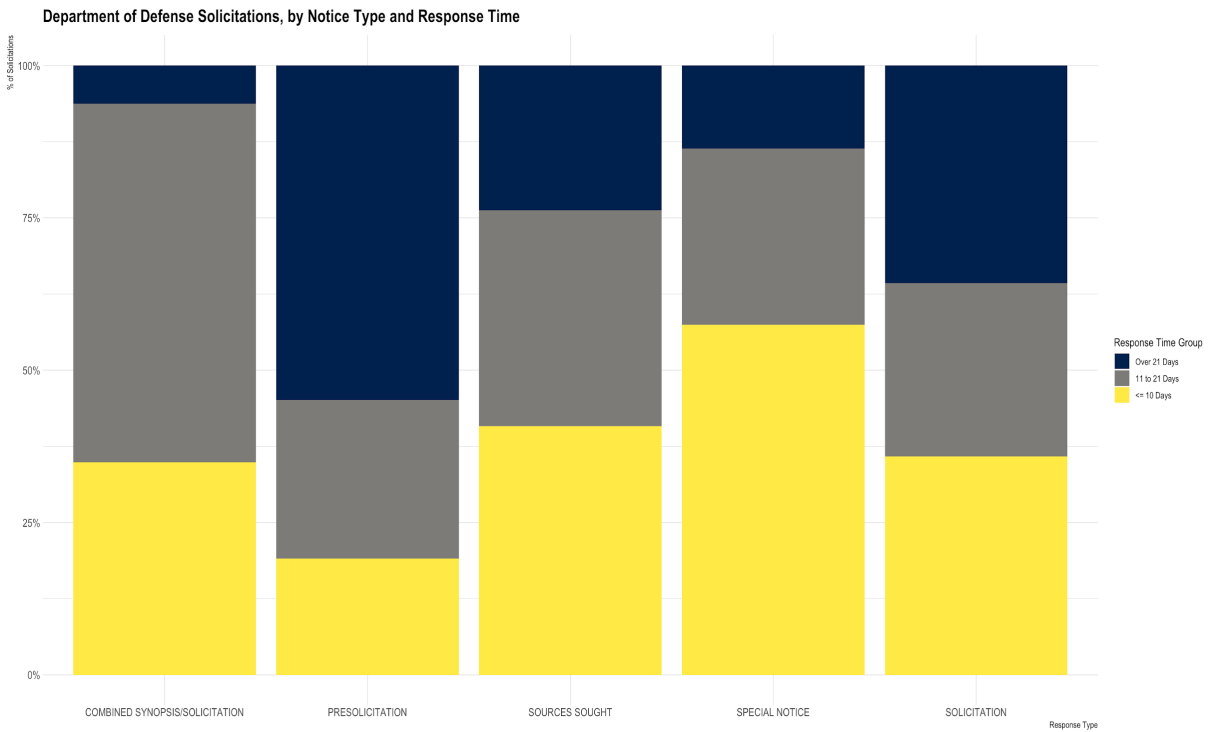


Figure 5. Percentage of DoD Solicitations, by Response Time and Notice Type

While technically speaking, the DoD may comply with FAR Parts 5 and 6 by making these opportunities public, one could argue they fail to meet the objective of FAR Part 10 by virtue of these short turnaround times. Furthermore, DoD opportunities with aggressively short turnaround times are often referred to in industry as “wired” (Walinskas, 2017). A wired opportunity is one where the customer has already identified its vendor, and the formal bid process exists only for compliance purposes. The odds of another supplier winning a future contract are effectively zero.

We recognize the importance of DoD stakeholders being able to engage with suppliers swiftly—in fact, allowing companies to contract quickly is critical for attracting innovators. However, the volume of opportunities with anticompetitive turnaround times indicates a disconnect between the intent of the regulatory standards and how they are employed in practice. To the extent that DoD stakeholders are making opportunities public for 21 days or less as a loophole to award contracts to suppliers they have already identified illustrates that there is a need to allow DoD stakeholders the ability to quickly engage certain suppliers, without doing so at the expense of the military’s overall marketing and outreach strategies. Specifically, we recommend that DoD stakeholders be required to make solicitations active for at least 30 days or be able to formally justify circumventing this requirement to bring a supplier on more quickly, similar to the use of sole-source justifications. If no such justification exists, a suitable response window—coupled with aggressively marketing the DoD requirements in general, as previously discussed—is essential to ensuring that the military has the ability to reach and engage nontraditionals.



Content

Readability: Reading-Ease & Grade Level

In order to ensure fair competition, opportunities not only need a reasonable response time but also must be written clearly so that potential suppliers can understand the requirements. Directly to this point, we sought to evaluate the content of DoD solicitations to determine the extent to which they are readable and easily understood by a wide audience.

To do so, we utilized the Flesch–Kincaid (F–K) readability tests. The two F–K tests, the F–K Reading-Ease test and the F–K Grade Level test, weigh features such as total words, total sentences, and total syllables to indicate how difficult a passage is to understand (“Flesch–Kincaid readability tests,” n.d.). For the F–K Reading-Ease test, a low score indicates that a passage is difficult to read, while a high score indicates that a text is easier to read. The F–K Grade Level test scores text based on U.S. grade levels or the number of years of education generally required to understand the text. The scores correspond to one another, insofar as text that is classified as “Difficult to Read” is equivalent to the “College” grade level, “Very Difficult to Read” is equivalent to “College Graduate” grade level, and so forth. Figure 6 lists each F–K Readability Group and its corresponding F–K Grade Level.

To calculate the F–K scores of the 1,050,933 solicitations in our data set, we assessed the text contained in each solicitation description. As shown in Figure 6, which presents the breakdown of the solicitations by F–K Reading-Ease and Grade Level, the majority of solicitation descriptions analyzed were “Difficult” or “Very Difficult” to read. Nearly 59% of all solicitations require some college-level education, and another nearly 20% of solicitations are suited for individuals that graduated from college. By comparison, fewer than 3% of solicitations are written in plain English.

Department of Defense Solicitations, Scored by Reading-Ease & Grade Level			
Flesch Readability Group	Flesch-Kincaid Grade Level	Total Solicitations	% of Total Solicitations
DIFFICULT TO READ	COLLEGE	617,516	58.76%
VERY DIFFICULT - READABLE COLLEGE GRADUATES	COLLEGE GRADUATE	209,471	19.93%
FAIRLY DIFFICULT TO READ	10TH TO 12TH GRADE LEVEL	124,176	11.82%
PLAIN ENGLISH - READABLE 13-15	8TH & 9TH GRADE LEVEL	24,111	2.29%
EXTREMELY DIFFICULT - READABLE DOMAIN EXPERTS	DOMAIN EXPERT	23,933	2.28%
EXTREMELY DIFFICULT - READABLE COLLEGE GRADUATES	PROFESSIONAL	18,825	1.79%
FAIRLY EASY TO READ	7TH GRADE LEVEL	17,950	1.71%
EASY TO READ - CONVERSATIONAL ENGLISH	6TH GRADE LEVEL	8,440	0.80%
EASY TO READ - READABLE UNDER 11	5TH GRADE LEVEL	3,834	0.36%
UNSCORED	UNSCORED	2,678	0.25%

Figure 6. DoD Solicitations, Scored by Reading-Ease and Grade Level

Figure 7 provides three examples of solicitation descriptions that were classified as “Difficult to Read,” according to the F–K test. They contain esoteric acronyms and range from including excessive information to including almost no information at all.



Description [View Changes](#)

3d Dental Battalion/USNDC Okinawa (3D DENBN/USNDC) has a requirement for Dental Implants used in patient treatment. This is a combined synopsis/solicitation prepared in accordance with FAR Subpart 12.6, as supplemented with additional information included in this notice. This announcement constitutes the only solicitation; quotations are being requested. The North American Industry Classification System (NAICS) code is 339114. This acquisition is non-restricted. The incorporated provisions and clauses are those in effect through Federal Acquisition Circular 05-38. The following provisions and clauses apply plus any addenda: FAR 52.212-1 Instructions to Offerors - Commercial Items; 52.212-2 Evaluation - Commercial Items; 52.212-3 Offeror Representations and Certifications --Commercial Items; 52.212-4 Contract Terms and Conditions - Commercial Items; and 52.212-5 Contract terms and Conditions to Implement Statutes or Executive Orders - Commercial Items. The requirements includes the following schedule of supplies: CLIN 0001, BF 12 (12 HOWARD BONE FILE) QTY 8; UNIT PRICE _____, CLIN 0002, CM18 (#18 MCFARLAND BI BEVEL CHISEL) QTY 2; UNIT PRICE _____, CLIN 0003, E77 (SERRATED ELEVATOR #77) QTY 40; UNIT PRICE _____, CLIN 0004, F150K (150 PEDODONTIC FORCEPS) QTY 15; UNIT PRICE _____, CLIN 0005, F151K (151K PEDODONTIC FORCEPS) QTY 15; UNIT PRICE _____, CLIN 0006, F17 (#17 HARRIS FORCEPS) QTY 13; UNIT PRICE _____, CLIN 0007, FAF150 (APICAL FORCEPS 150) QTY 15; UNIT PRICE _____, CLIN 0008, FAF151 (APICAL FORCEPS 1514) QTY 28; UNIT PRICE _____, CLIN 0009, FAF74N (74N EUROPEAN STYLE APICAL FORCEPS) QTY 12; UNIT PRICE _____, CLIN 0010, FX13 (#13 EUROPEAN STYLE FORCEP TOOTH EXTRACT) QTY 15; UNIT PRICE _____, CLIN 0011, R4A QTY 36; (4A CLEVELAND RONGEURS) UNIT PRICE _____. F.O.B. Destination pricing requested, the contractor shall include the price of shipping into the cost of each CLIN. The contractor shall accept fax or emailed prescriptions from 3D DENBN/USNDC to be filled. Delivery and acceptance point shall be US Naval Hospital Okinawa, PSC 482 BOX 248, FPO AP 96362-1695 seven days after receipt of order. The Government will award a Firm-Fixed Price (FFP) contract resulting from this combined synopsis/solicitation to the responsible contractor whose quote conforming to the solicitation will be most advantageous to the Government, price and other factors considered. The following factors shall be used to evaluate offers: (1) Technical capability of the item quoted to meet the Government requirement (including submission of descriptive literature); (2) Past Performance and (3) Price; (4) Delivery; all to be submitted with quotation. Contractors are responsible for obtaining any and all amendments or additional information. Quotes and all pertinent data (descriptive literature, specifications, etc.) must be received by March 10, 2010 at 0900 (9:00 a.m. Japan Standard Time (JST)). Include company name, point of contact, address, phone number, Duns Number, CAGE Code, and Tax ID. As a basis for contract award, contractors must be registered with Central Contractor Registration. [Note: Lack of registration in the Central Contractor Registration will make a Contractor ineligible for award] Registration is available via the Internet at www.ccr.gov. Responses shall be submitted via e-mail in Word, Excel, or PDF format to the POC, Yumi Robb, at yumi.robb@med.navy.mil or faxed to 011-81-989-92-8575. Telephone inquiries or requests will not be accepted.

Description [View Changes](#)

The purpose of this announcement is to provide notification of upcoming Industry Days for a potential Cockpit Selectable Output Weapon (SOW) Future Naval Capability (FNC) Broad Agency Announcement (BAA). Industry day discussions and the potential BAA will be limited to technology development in the area of warheads, bombs, kill mechanisms and damage mechanisms. The intent of the potential BAA would not be to improve or develop new weapon to aircraft interfaces, or sensors, or guidance, or control systems. The Naval Air Weapons Center Weapons Division (NAWCWD) will host Industry Days for the potential SOW FNC at the Naval Air Weapons Station Conference Center on 2 March 2010 thru 4 March 2010 in China Lake, CA. The primary purpose of this event is to provide information to industry on the status of NAWCWD's SOW efforts and current planned path forward after review of responses to the Request for Information N6893609R0015. NOTES: 1. The Government does not plan to hold Industry Days at any other geographic location at this time. 2. If you have access to JPAS, the SMO Code is 605306 and the POC is Linda Chambliss (760-939-2412). In order to receive the necessary badges and attend industry day, each participant's full name, company affiliation, social security number (last four digits), date and place of birth must also be sent to Celeste Moore (celeste.moore@navy.mil, phone: 760-939-5979, fax: 760-939-7190) by close of business February 16, 2010. The email, fax or phone call should also indicate if the participant is a U.S. citizen. 3. If the visitor does not have access to JPAS, a copy of the visitor's security clearance should be sent to Linda Chambliss (phone: 760-939-2412, fax: 760-939-0306). In order to receive the necessary badges and attend industry day, each participant's full name, company affiliation, full social security number, date and place of birth must also be sent to Celeste Moore (celeste.moore@navy.mil, phone: 760-939-5979, fax: 760-939-7190) by close of business February 16, 2010. The email, fax or phone call should also indicate if the participant is a U.S. citizen. 4. If the visitor does not have a security clearance, the visitor's full name, company affiliation, full social security number, date and place of birth must be sent to Celeste Moore (celeste.moore@navy.mil, phone: 760-939-5979, fax: 760-939-7190) by close of business February 16, 2010. The email, fax or phone call should also indicate if the participant is a U.S. citizen. 5. Attendance is limited to DOD Personnel and DOD contractors only. 6. Attendance is limited to two (2) representatives per company. 7. Attendance is limited to U.S. citizens only. 8. Contact Celeste Moore (760-939-5979) to schedule a meeting between Individual Contractor Teams and the Government. The individual meetings should last less than 1 hour each. Industry Days Program (subject to change): 2 March 2010: 8:00 am - 8:30 am Welcome, Introductions, Meeting Objectives, Meeting Guidelines; 8:30 am - 9:30 am Update on NAWCWD & ONR SOW efforts; 9:30 am - 9:40 am Break; 9:40 am - 11:00 am SOW FNC Status; 11:00 am - 1:00 pm Lunch (On your own); 1:00 pm - 4:30 pm Meetings between Individual Contractor Teams and Government; 3 March 2010: 8:00 am - 11:00 am Meetings between Individual Contractor Teams and Government (continued); 11:00 am - 1:00 pm Lunch (On your own); 1:00 pm - 4:30 Meetings between Individual Contractor Teams and Government (continued); 4 March 2010: 8:00 am - 11:00 am Meetings between Individual Contractor Teams and Government (continued); 11:00 am - 1:00 pm Lunch (On your own); 1:00 pm - 4:30 Meetings between Individual Contractor Teams and Government (continued) Questions and Answers Q: Does the two-person per company restriction apply to the Contractor/Government sidebars as well? A: Yes. Q: Can teammates be in the sidebar meeting with Government members? A: Yes however, teammates are considered part of the two-person per company restriction. NOTE: All requirements for attendance still apply.

Description

Call for White Paper under Broad Agency Announcement W911NF-17-S-0003, Topic 6; Human Sciences Campaign, subtopic f: CCE-HS-3 Training.

Figure 7. Sample "Difficult to Read" Solicitation Descriptions

To attract a broad audience, requirements must be written in concise, accessible language. Requirements that consist of complex, incomprehensible language limit competition because companies become frustrated by the challenges and effort needed to decipher the text. Furthermore, these poorly written requirements run contrary to the DoD Plain Writing Act of 2010. The act requires federal agencies to write "clear Government communication that the public can understand and use" and stipulates guidelines for compliance that require the DoD to write new documents in "plain language" (Washington Headquarters Services, n.d.).

We recommend that the DoD require all solicitation descriptions to be written in plain English, suitable for an 8th- to 9th-grade reading level. To implement this policy, the government can incorporate a feature on the back end of beta.sam that automatically reads the text of every new solicitation inputted by a DoD stakeholder and calculates its F-K scores. If the scores do not meet the recommended reading level, the system automatically recommends simpler replacement language that the stakeholder can review and approve. Only once the appropriate levels of readability are met can the solicitation be published. We also recommend that text on



all public-facing DoD websites, including beta.sam, as well as text in DoD collateral materials meant for public distribution, be written in plain English.

Readability: Supplier Feedback

In addition to analyzing the readability tests on the 1,050,933 solicitations in our data set, we also surveyed 23 small businesses to gather their feedback on government solicitations. The 23 firms are nontraditional dual-use companies that are currently participants in the Air Force's Small Business Innovation Research (SBIR) program. For each company, we utilized publicly available information, including their SBIR award description and related keywords, to establish a basic understanding of their capabilities. We then identified opportunities via beta.sam that appeared to relate to their capabilities, shared the links to the relevant opportunities with a designated company point of contact using Survey Monkey, and asked them to offer feedback on each match. Because they are SBIR participants, they are inherently more familiar with navigating the DoD's solicitation processes than companies with no prior defense business, which would imply a greater comfort level with deciphering additional DoD opportunities presented to them. On the contrary, the companies were frustrated by how challenging it was to decipher the solicitations. Specific feedback included:

- "I cannot tell from the (Areas of Interest) (AOI) what they are asking"
- "I'm struggling mightily to find the AOIs that say what the DoD really wants."
- "Super annoying that I had to comb through attachments to find the AOI's topic."
- "(Broad Agency Announcements) (BAAs) are complex"
- "These BAAs take quite a while to go through and communicate."
- "That was SUPER painful ... because of the opacity with which those SAM postings are written. There are a couple—even AFTER downloading the documents from SAM—that remain mysterious."

To competitively attract and engage nontraditionals, opportunities must be written clearly and provide the detailed information necessary for a company to evaluate whether or not the opportunity is worth pursuing. The aforementioned feedback highlights another problem with the DoD's marketing and outreach methods: critical information is often buried in cumbersome attachments or omitted altogether. Having to sift through complex files to understand the requirements does not inspire a company to respond to a solicitation. Accordingly, in addition to ensuring that the description text of an opportunity is written in plain English, we also recommend that all opportunity descriptions explicitly state the customer's primary areas of interest.

Requisite Information

By assessing the features of the data contained in our solicitation data set and reviewing publicly available opportunities on beta.sam, we found that the DoD often omits critical pieces of information from opportunity listings altogether. Specifically, there are no structured fields requiring DoD stakeholders to indicate on the landing page of beta.sam the value of the opportunity (estimated or actual) or the performance period (estimated or actual).

We recognize that providing specific contract values or performance periods for all notice types is a challenge for DoD stakeholders, because the market research process is intended to help shape the requirements. However, nontraditionals, especially those with robust private sector revenue streams, are unlikely to invest time and resources to explore an engagement with a DoD customer without some sense of the potential upside and/or when the work might begin.

We suggest that the DoD be required to provide an estimated contract value/range for all opportunities. An algorithmic approach can be employed to generate the estimates, including



aggregating and weighing factors such as average contract size awarded by the corresponding contracting office over the last 5 years; average contract size for the particular product or service the opportunity corresponds to (for instance, if the opportunity relates to drones, calculating the average size of drone contracts in DoD over the last 5 years); budget estimates for that particular product/service as provided by the Office of Management and Budget (OMB); and other related data points. The solicitation would state that the information provided is an estimate and subject to change. While the process for calculating the estimate requires further research and refinement, we believe it is essential for the DoD to invest in providing this data point as part of its marketing and communication efforts. Companies, particularly nontraditionals attempting to scale with limited resources, also need some sense of performance period to prioritize which opportunities to pursue. DoD stakeholders should, therefore, be required to provide an estimated period of performance as well.

Redundancy

Another challenge that companies face when trying to prioritize DoD opportunities is that many of the same technologies are in high demand by stakeholders across all service branches. The DoD's 2020 modernization priorities, for example, emphasize the importance of "the development and procurement of high priority systems—such as artificial intelligence, directed energy, small satellites, hypersonics, a 5G network and unmanned aerial systems" (Vergun, 2020) for the whole of military.

For companies with applicable capabilities, a large addressable market may make investing in the defense sector more appealing. However, as discussed throughout this paper, to capitalize on the market, companies must have the ability to navigate it. In cases where multiple DoD stakeholders are seeking similar solutions ("redundancy"), the challenges we have highlighted are compounded by the fact that a company must identify and decipher the relevant opportunities and then decide which ones to pursue. To assess the scope of this redundancy problem, we sought to explore the extent to which multiple DoD stakeholders are simultaneously seeking capabilities related to two of the military's modernization priorities, unmanned aerial vehicles (UAVs) and artificial intelligence (AI).

Redundancy Analysis

To calculate how many DoD solicitations corresponded to UAVs and/or AI, we employed a more computationally intensive approach that required us to utilize a smaller data set. We focused our analysis on a data set of 69,933 solicitations from the year 2020. Next, we leveraged the DTIC thesaurus to expand the set of terms we used to describe UAVs and AI. The DTIC thesaurus allows for the provision of an input term, such as "unmanned aerial vehicle," and returns a set of related keywords with varying degrees of proximity to the original term. For the purposes of this research, we limited the results to related terms, which can be understood as synonyms.¹ Next, we algorithmically searched for incidences of these terms in

¹ Keyword Corpus: AI APPLICATIONS, AI COMPUTING, APPLIED COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE, ARTIFICIAL INTELLIGENCE COMPUTING, ARTIFICIAL INTELLIGENCE SOFTWARE COMPUTATIONAL PROCESSES, COMPUTER VISION, COUNTER-DRONE TECHNOLOGY, COUNTER-UAS COUNTER-UAV TECHNOLOGY, COUNTER-UNMANNED AERIAL SYSTEMS, DEEP LEARNING, DEEP STRUCTURED LEARNING, DRONE, DRONE CONTROL AIRCRAFT, DRONE SWARMS, DRONES, EXPERT SYSTEMS, HEAVY FUEL ENGINES, HEAVY FUEL UAV ENGINES, HIERARCHICAL LEARNING, INFERENCE ENGINES, INTELLIGENT PERSONAL ASSISTANTS, INTELLIGENT SYSTEMS, LAMP RAY ROV, MACHINE LEARNING, MACHINE PERCEPTION, MICRO AIR VEHICLE, NATURAL LANGUAGE PROCESSING, NATURAL LANGUAGE PROCESSING SOFTWARE, NEURAL NETWORKS, REMOTELY PILOTED AIRCRAFT, SEMI-SUPERVISED LEARNING, SMALL UNMANNED AIRCRAFT SYSTEM, SOFTWARE AGENTS, SUPERVISED LEARNING, SUPERVISED MACHINE LEARNING, SURVEILLANCE DRONES, SWARM INTELLIGENCE, SWARMING DRONES, SWARMING TECHNOLOGIES, SWARMS OF FIXED WING DRONES, TARGET DRONES,



the description, ID, and title for each solicitation. A matched term indicated that an opportunity corresponded to a UAV and/or AI requirement. With this methodology, we identified 42 DoD opportunities in 2020 that corresponded to UAVs and/or AI.

As previously discussed, the DoD often buries critical information, including the areas of interest, in attachments. To more accurately calculate the number of solicitations related to UAV/AI capabilities would, therefore, require searching for the terms in the attachment data. Solicitations can have dozens or even hundreds of pages of attachments across multiple files and file types, and because supporting documents are formatted inconsistently, it was not feasible to incorporate the text and data from attachments for all 69,933 solicitations. Instead, to enhance the search, we decided to incorporate a small subset of attachment data.

Specifically, we first filtered the data to isolate opportunities that corresponded to either a Sources Sought or a Broad Agency Announcement (BAA). While BAAs are not a specific notice type, they—like the DoD’s other methods of conducting market research—request “scientific or research proposals from private firms concerning certain areas of interest to the government” (AcqNotes, 2021) and may lead to contract awards. The DoD relies on BAAs to communicate with industry and gather critical market research. For instance, the DoD’s SBIR topics are issued as BAAs. To identify BAAs in our 2020 data set, we searched for the terms “Broad Agency Announcement” and “BAA” in the contract ID, solicitation name, and solicitation description. We then combined the BAAs with the opportunities corresponding to a Sources Sought notice type, excluding any Sources Sought that were already counted as BAAs. In total, we identified 2,519 opportunities in 2020 that were either Sources Sought or BAAs. For these 2,519 opportunities, we incorporated the text and data contained in their attachments and utilized optical character recognition (OCR) and other methods of text extraction to search this data for UAV/AI terms.

With this methodology, we identified an additional 22 DoD opportunities in 2020 that corresponded to UAVs and/or AI, bringing the total to 64. In other words, utilizing OCR and text-extraction on just 3.6% of the solicitation data increased the number of matched opportunities by more than 50%. Based on these results, one can assume that the total number of DoD stakeholders that posited demand for UAV/AI capabilities in 2020 was substantially more than 64.

Demand Outside of DoD

Furthermore, our analyses did not include solicitations from federal stakeholders outside of the DoD. When assessing the challenges companies face in trying to prioritize DoD customers, it is worth considering the potential effects of demand from non-DoD customers—particularly because, with the beta.sam process, companies discover DoD and non-DoD opportunities simultaneously. We recommend further research to explore the DoD-level findings we have addressed in this paper across the entirety of government, and we recommend that this further research incorporate attachment data to the best extent possible.

In the interim, we conducted a microanalysis to explore the potential impact of non-DoD demand on our research results. To do so, we aggregated all open federal opportunities—DoD and non-DoD, including attachment data—from a single day—October 8, 2020—and searched

UAS, UAV, UGV, UNDERWATER DRONES, UNINHABITED AIRCRAFT VEHICLE, UNMANNED AERIAL, UNMANNED AERIAL SYSTEMS, UNMANNED AERIAL VEHICLE, UNMANNED AEROSPACE VEHICLE, UNMANNED AIR SYSTEMS, UNMANNED AIRCRAFT, UNMANNED AIRCRAFT SYSTEMS, UNMANNED AIRCRAFT VEHICLE, UNMANNED GROUND SYSTEMS, UNMANNED GROUND VEHICLE, UNMANNED GROUND VEHICLE SYSTEMS, UNMANNED SYSTEMS, UNSUPERVISED LEARNING, UNSUPERVISED MACHINE LEARNING



for UAV terms across this data set. As shown in Figure 8, on that single day, 132 open opportunities corresponded to UAVs.

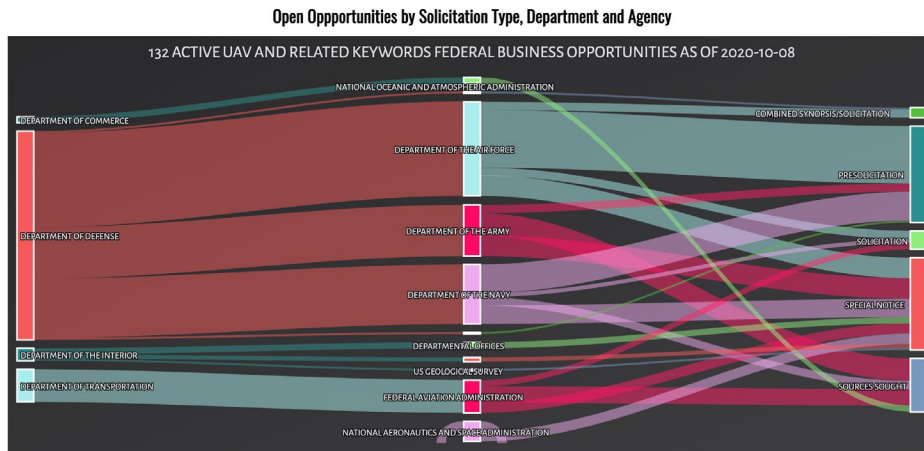


Figure 8. Open Solicitations Related to UAVs on October 8, 2020

Assessing redundancy using any one of the aforementioned methodologies, it is clear that companies with high-priority capabilities can encounter anywhere from dozens to hundreds of prospective DoD and non-DoD opportunities. Therefore, if and when a company identifies and deciphers relevant opportunities, realistically it cannot participate in all of them. The DoD’s failure to coordinate its outreach and communication efforts results in negative consequences for both nontraditional and the warfighter. DoD customers only receive feedback from a small number of firms and are not guaranteed to receive feedback from firms with the most applicable capabilities. As a result, they have a myopic view of how their problems can be solved. Companies interested in serving the needs of government have to decide which customer(s) to engage with the information they have at hand. As a result, they are not necessarily choosing the customers whose use cases align most seamlessly with their capabilities, and they are not necessarily choosing the customers with the most urgent need for their capabilities.

Better intra-government communication would benefit the supplier and the government; thus, it is essential that military stakeholders coordinate their outreach and communication efforts to maximize exposure of their requirements. For priority verticals, we recommend that DoD stakeholders issue joint requirements in the market research/outreach phases. Further research is required to determine the best way to implement this concept, including how to appropriately incentivize DoD stakeholders to take the necessary actions. We suggest that prior to release, the DoD circulate requirements related to priority verticals to designated offices within each service branch. This action will allow DoD stakeholders to incorporate related requirements into the solicitation. In addition to helping the DoD gather information from a wider range of potential suppliers and steer them in different directions more effectively, this approach would allow companies to market their capabilities to multiple prospective customers simultaneously—a major advantage over the current stovepiped system.

Conclusion

In spite of billions in investment for innovation initiatives and unremitting rhetoric from senior leadership about the DoD’s commitment to a culture of innovation, our 2020 research proved that the military has failed to attract and engage a significant number of new suppliers over the last decade, which puts the warfighter at risk (Bresler & Bresler, 2020). In this paper, we employed qualitative and quantitative research techniques to illustrate that *how* and *where*



the DoD communicates with industry have contributed to this problem. We identified a series of conditions that must be met in order for the DoD's requirements and messaging to reach suppliers outside of the traditional DIB:

- Companies need to know where to go to search for DoD opportunities, and the search process must be user-friendly and intuitive.
- Companies need enough time to identify, assess, and respond to an opportunity.
- Companies need to easily understand what DoD customers are asking for.
- To determine whether or not an opportunity is worth pursuing, companies need certain pieces of critical information, including the potential contract size.
- The DoD needs to coordinate its marketing and outreach efforts, especially for capabilities in high demand across the government.

The absence of any one of these conditions not only fails to meet the objective of the FAR but also creates a bottleneck that limits industry participation in the market research process. The military, in turn, operates with an incomplete picture of how its problems could be solved and what capabilities exist to solve them. The recommendations outlined throughout this paper are intended to help the DoD address each of these bottlenecks as efficiently as possible and to make the process of engaging with the military more seamless for nontraditionals accustomed to operating in the private sector. Ultimately, the military needs access to the best and brightest suppliers to preserve the strength of the warfighter—and to attract best suppliers, the DoD must behave like a better customer.

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NAVAL POSTGRADUATE SCHOOL

Analyzing the Composition of the Department of Defense Small Business Industrial Base

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Abstract

This paper explores the composition of the Department of Defense (DoD) small business (SB) industrial base by analyzing public records for companies registered to do business with the government and publicly available DoD contract and subcontract award data from 2015 through 2021. We demonstrate that although the amount of money DoD awarded to SBs grew by almost 68% between 2015 and 2021, the total number of SBs in the defense market shrank nearly 23% concurrently. The decline in SBs can be attributed to the fact that SB program policies fail to address the underlying issues that keep small and nontraditional companies from navigating the defense market successfully. Furthermore, SB policies enable the largest SBs—which include companies that generate hundreds of millions or billions of dollars in DoD revenue annually—to expand their market share, irrespective of price, quality, or innovativeness. To contextualize these findings, we provide an overview of the history and stated objectives of DoD SB initiatives and utilize qualitative research to understand the experiences of individual SBs in the defense market. We offer a series of concrete recommendations to improve how the DoD SB program is structured and measured, to enable it to better meet its objectives.

Introduction

For nearly 70 years, the U.S. government (USG) has afforded small businesses (SBs) preferential treatment in the federal procurement process by limiting competition for certain contracts to SBs. Congress justifies SB set-aside contracts (“SB set-asides”) on the basis that “the Government should aid, counsel, assist, and protect ... the interests of small-business concerns in order to preserve free competitive enterprise ... and to maintain and strengthen the overall economy of the Nation” (Small Business Act and Small Business Investment Act, 1). Likewise, the Small Business Administration (SBA) website states that SB set-aside contracts exist to “help small businesses compete for and win federal contracts” and to “help provide a level playing field for small businesses” (U.S. SBA, n.d.-b). In its “Small Business Program Guide for Government and Industry,” the Army Corps of Engineers (n.d.) summarizes that the congressional philosophy for the SB program is to

- Utilize the annual federal budget to promote Small Business Programs
- Promote economic stability through the use of Small Businesses to enhance the nation's defense
- Preserve and promote free enterprise
- Maintain a viable industrial base
- Ensure competitive economic climate
- Provide opportunities for entrepreneurship and inventiveness



A 2007 House committee report stated that the basis for SB contracting programs "is the positive economic benefits they provide, as well as assisting small businesses to overcome the complexities of the system" (Dilger & Blackford, 2022). The report emphasizes that SB programs "are designed to increase and diversify small contractors with the intent of expanding the federal supplier base" so as to increase competition and product diversity, improve product quality, and reduce prices. The report also notes that "these contracting initiatives lower barriers to entry in a wide range of markets for small businesses ... [which] provides greater market access for small firms' [products] and services. ... Such access is critical to generating positive macroeconomic benefits, including higher job creation, wage growth, and greater income distribution."

In spite of these stated objectives, the success of the SB set-aside program has been measured primarily by whether the government meets Congressionally established set-aside procurement goals. Specifically, Congress directs the USG to allocate 23% of eligible procurement spend for SBs annually, with procurement goals from within this spend for subsets of the SB program including woman-owned SBs, small disadvantaged businesses, HUBZone SBs, and service-disabled veteran-owned SBs.

Assessing the amount of money awarded to SBs as a share of overall government spending does little to evaluate the impact of the SB program on the industrial base, the economy, or the competitive environment for products and services in the USG. Our research aimed to provide a more comprehensive assessment of the DoD SB program vis a vis its stated objectives. Specifically, we conducted a quantitative analysis of SB suppliers to DoD annually from Fiscal Year (FY) 2015 through FY2021 and analyzed trends in the data related to SBs' DoD procurement obligations and subcontracting practices. For additional context, we interviewed DoD SBs and reviewed USG contracting policies that impact all suppliers. We conclude that rather than achieving its stated objectives, the DoD SB program reduces opportunities for SBs, creates a less competitive economic climate, and weakens the defense industrial base (DIB); and throughout the paper, we offer a series of recommendations for reforming the program—both how it is structured and how it is measured—to improve its outcome.

Sizing the Small Business Defense Industrial Base

Considering that one objective of the SB set-aside program is to expand and diversify the industrial base, the number of SB contractors supporting the DoD should be increasing over time. We sought to evaluate this metric by calculating the number of SB contractors to DoD (DoD SBs) each year from FY2015–FY2021.

Research Note: Timeframe

We selected FY2015–FY2021 as our analysis period because it allowed us to assess year over year trends as well as a wide range of features associated with DoD SBs. Unless otherwise noted, quantitative analyses referenced in the paper are associated with FY2015–FY2021.

Sizing the Overall DIB

To assess trends in the SB DIB, we needed to identify and isolate SBs from the DoD vendor pool. First we created a mirror of the Federal Procurement Data System (FPDS), the clearinghouse for all USG procurement data. Next, we isolated the data to all DoD-funded procurements from FY2015 through FY2021. To calculate the annual number of DoD-funded vendors, we grouped the data by FY and calculated the number of distinct DUNS numbers across all active procurements from that FY. Table 1 shows the total number of DoD vendors by year.



Table 1. Total DoD Supplier Base, Annually

Fiscal Year	Count of Distinct DoD Funded DUNS Numbers
2015	68,257
2016	66,290
2017	64,184
2018	61,242
2019	57,746
2020	54,418
2021	52,597

Classifying the Small Businesses

Next, we categorized each distinct vendor as either an SB or an entity other than an SB (“large business” or “LB”). Size standards vary based on industry; government reporting on size standards is inconsistent; and company size can change from one year to the next. To classify each DoD vendor, we developed a classification system that weights multiple features associated with a DUNS number using data from FPDS and the System for Award Management (SAM) Entity Registration Database to designate it as an SB or LB accordingly.¹ For instance, some FPDS contract actions indicate the use of an SB in a field labeled “business size determination,” and there are other references to set-asides in the FPDS data. So, for each DUNS number, the system considers all historic contract actions from FPDS—not just the contract actions associated with it from FY2015–FY2021. SAM data can also reference features such as “Business Type” and “Set-Aside Type,” which often correlate to SBs, so the system considers data from these fields when classifying each DUNS as well. Table 2 outlines the features used to classify each entity by data source.

Table 2. Small Business Classification Features

Data Source	Feature			
	Business Size Determination	Set-Aside Contract Feature	Business Type	Set-Aside Type
FPDS	X	X		
SAM			X	X

Recommendation: “Single Source of Truth” for Defining SBs

The fact that the USG does not adhere to a consistent classification system for defining SBs severely limits any effort to comprehensively evaluate the SB program, including efforts to assess the share of overall DoD spend awarded to SBs.

In a subsequent section, we discuss the need to modify revenue and employee thresholds for what qualifies as “small” by USG standards. However, irrespective of qualification criteria, it is essential that a company’s status as small or large is reported consistently across government data sources. We recommend the USG establish and maintain a “small business registry” for all active DUNS numbers containing detailed information about their SB contract

¹ For the purposes of our technical approach, each DUNS number corresponds to either an SB or an LB. FPDS contains a higher volume of features that, while less accurate than SAM features, in some cases allowed us to categorize a business as an SB even if it is not currently active in SAM; or even if is not currently registered as an SB in SAM, but was considered an SB for the majority of our analysis period.



awards and, if necessary, distinguishing between revenue they generated as an SB versus revenue they generated as a large business (since the same company can qualify as “small” for certain contracts but not others). This registry would eliminate the need to cross-reference FDPS and SAM to determine which contract awards were SB set-asides.

Sizing the SB DIB

Using the previously outlined classification system, we calculated the number of distinct SBs contracting with the DoD annually. **As shown in Table 3, over the last 6 years the number of SBs that were awarded defense-funded contracts declined nearly 23%, from 48,322 to 37,294. Contrary to the stated objectives of the SB set-aside program, the number of small contractors within the defense market is shrinking.**

Table 3. SB Suppliers to DoD

Fiscal Year	Count of Distinct DoD Funded SB DUNS Numbers
2015	48,322
2016	46,952
2017	45,609
2018	43,505
2019	40,940
2020	38,703
2021	37,294

Funding to the SB DIB

Next, we calculated the amount of DoD funding awarded to small versus large businesses. **As shown in Table 4 and Figure 1, while overall defense spending increased by 46%, the amount of money DoD awarded to SBs grew by almost 68%, from ~\$54 billion in 2015 to ~\$91 billion in 2021. In other words, as the pool of SB vendors contracted, the DoD awarded substantially more in contracts to SBs—both in total dollars and as a share of overall spending.**

Table 4. Breakdown of DoD Spend by Business Size

Fiscal Year	Total DoD Funded Procurement	Total DoD Funded Procurement to SBs	Total DoD Funded Procurement to LBs	% DoD Funded Procurement Awarded to SBs
2015	\$294,357,455,264	\$54,500,060,463	\$239,857,394,801	18.51%
2016	\$318,628,870,367	\$58,858,890,994	\$259,769,979,374	18.47%
2017	\$344,813,865,145	\$62,493,984,962	\$282,319,880,183	18.12%
2018	\$386,911,953,179	\$74,865,344,991	\$312,046,608,188	19.35%
2019	\$427,876,600,900	\$81,259,290,822	\$346,617,310,078	18.99%
2020	\$465,451,566,836	\$87,928,706,954	\$377,522,859,882	18.89%
2021	\$428,635,700,550	\$91,584,868,966	\$337,050,831,584	21.37%
Total	\$2,666,676,012,242	\$511,491,148,151	\$2,155,184,864,091	19.18%



INDEX OF RELATIVE SHARE OF 2015 DEPARTMENT OF DEFENSE FUNDED OBLIGATIONS BY BUSINESS SIZE

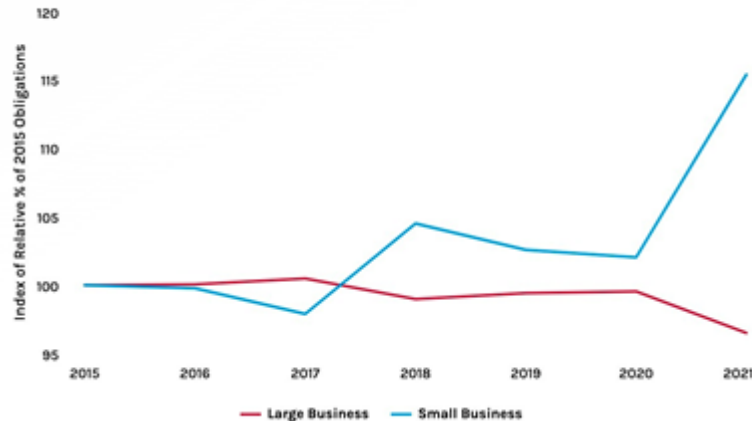


Figure 1. Index of Growth in DoD Procurement to Small vs. Large Businesses

Total Spend to SBs: A Myopic Measure of Success

If you consider the proportion of DoD spend allocated to SBs as the primary performance metric, the DoD SB program appears successful, with nearly 20% of procurement awarded to SBs annually. However, the fact that the pool of SB vendors simultaneously shrank not only runs counter to the intended purpose of the program, but also suggests anti-competitive forces at play. **The more the DoD procured from SBs, the fewer SBs benefited. In a free, competitive market, increasing the amount of money spent on SBs should attract a growing number of SBs into the DIB.**

Rather than providing “greater market access for small firms’ goods and services,” as the House report asserts, **DoD SB policies have made the DoD increasingly reliant on fewer suppliers, thereby reducing the variety of available products and services and posing risks to the health and resilience of the industrial base.**

The DoD and USG should not measure the success of the SB program exclusively by the share of overall procurement awarded to SBs. **To assess the program relative to its stated objectives, they must consider a subset of key metrics, such as the total number of SB suppliers each year and the number of new SBs working with DoD annually.**

Composition of the SB DIB

For a shrinking number of SBs to receive a substantially greater share of overall DoD procurement suggests that these SBs, or a subset of them, dramatically increased their DoD revenue during our analysis period. To better understand these trends, we explored the distribution of DoD funding to the individual SBs.

SB DoD Revenue

We calculated the total defense funded procurement for each of the 93,306 distinct SB DUNS in our dataset. Table 5 presents the top 20 SBs that received the most DoD funding during the analysis period. It is apparent that **businesses can receive hundreds of millions, or even billions of dollars, in DoD contracts annually and still qualify as small.** Furthermore, **the top 20 SBs alone received more than \$53.6 billion in DoD funded procurement—over 10% of all DoD funding to SBs.**



Table 5. DoD Procurement to the Top 20 Small Businesses

Company Name	Total DoD Funding, FY2015–FY2021	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021
ATLANTIC DIVING SUPPLY INC.	\$15,720,363,970	\$1,114,565,311	\$1,250,613,527	\$1,609,645,315	\$2,509,511,257	\$3,233,362,687	\$3,138,616,046	\$2,864,049,826
MODERNATX INC.	\$8,167,157,644	\$0	\$0	\$0	\$0	\$0	\$1,255,697,789	\$6,911,459,855
FEDERAL RESOURCES SUPPLY COMPANY	\$3,639,062,189	\$191,105,314	\$190,329,295	\$233,348,924	\$288,268,243	\$339,501,133	\$2,017,338,638	\$379,170,642
TORCH TECHNOLOGIES INC.	\$2,793,079,298	\$230,809,413	\$297,477,436	\$343,020,172	\$407,159,701	\$506,888,808	\$534,814,811	\$472,908,957
AMERICAN ROLL-ON ROLL-OFF CARRIER LLC	\$2,127,079,115	\$162,123,014	\$121,500,994	\$299,618,926	\$402,194,232	\$409,332,723	\$401,249,517	\$331,059,709
W. S. DARLEY & CO.	\$2,116,004,701	\$88,187,907	\$104,757,067	\$137,284,656	\$290,071,939	\$447,459,381	\$619,533,680	\$428,710,071
SUPPLYCORE INC.	\$2,063,094,270	\$216,465,938	\$270,658,624	\$287,081,017	\$483,843,845	\$314,088,442	\$238,994,116	\$251,962,287
NOBLE SALES CO. INC.	\$1,596,066,944	\$82,503,610	\$146,790,206	\$214,925,343	\$419,501,578	\$343,312,708	\$163,182,149	\$225,851,349
PATRIOT CONTRACT SERVICES LLC	\$1,527,239,912	\$211,826,458	\$208,532,530	\$202,886,173	\$201,692,062	\$229,600,183	\$249,576,431	\$223,126,075
SCIENCE AND ENGINEERING SERVICES INC.	\$1,504,421,418	\$161,310,210	\$198,748,354	\$203,236,582	\$230,739,555	\$399,540,265	\$201,691,936	\$109,154,516
INTUITIVE RESEARCH AND TECHNOLOGY CORPORATION	\$1,356,791,448	\$243,750,490	\$271,883,798	\$141,934,429	\$132,888,518	\$161,577,735	\$150,588,243	\$254,168,235
REDSTONE DEFENSE SYSTEMS	\$1,348,465,209	\$409,931,908	\$290,605,504	\$268,598,914	\$364,629,509	\$20,055,527	-\$4,559,932	-\$796,221
PETROMAX REFINING COMPANY LLC	\$1,318,910,681	\$0	\$50,639,235	\$168,748,000	\$289,379,308	\$175,004,910	\$210,103,376	\$425,035,852
AASKI TECHNOLOGY INC	\$1,297,017,594	\$268,424,777	\$185,202,403	\$138,632,480	\$73,974,621	\$185,177,343	\$281,011,125	\$164,594,844
LINQUEST CORPORATION	\$1,242,341,667	\$93,040,472	\$116,169,557	\$145,481,202	\$191,800,933	\$246,554,703	\$226,637,383	\$222,657,417
STERLING COMPUTERS CORPORATION	\$1,201,065,386	\$113,739,696	\$139,257,654	\$194,142,865	\$207,344,777	\$206,333,948	\$177,827,869	\$162,418,578
OASIS SYSTEMS LLC	\$1,185,405,811	\$46,900,883	\$90,364,813	\$115,206,223	\$137,248,228	\$282,548,753	\$238,203,287	\$274,933,625
RADIANCE TECHNOLOGIES INC.	\$1,174,024,159	\$74,488,287	\$106,085,426	\$146,400,995	\$160,501,398	\$262,801,414	\$186,364,266	\$237,382,374
PROGENY SYSTEMS CORPORATION	\$1,140,344,606	\$90,349,414	\$187,885,609	\$89,783,297	\$182,629,973	\$172,766,058	\$213,144,546	\$203,785,709
PLACID REFINING COMPANY LLC	\$1,138,393,266	\$261,394,162	\$137,389,081	\$142,381,210	\$228,259,639	\$53,777,964	\$125,369,386	\$189,821,824
Total	\$53,656,329,288							



As shown in Table 6 and Figure 2, the number of SBs that received more than \$100 million in DoD funded procurement in 2021 was 3.23x that of 2015. By comparison, the number of DoD SBs awarded \$1 million or less in DoD procurement *shrank* by 32%. An increase in SB spend has disproportionately benefited the “largest” SBs, enabling them to dramatically expand their DoD market share while the DoD market became less opportune for the smallest businesses.

Table 6. Count of SBs with \$100M+ in DoD Procurement, Annually

Fiscal Year	Count of SBs with \$100M+ DoD Procurement	Count of SBs with <\$1M in DoD Procurement
2015	26	34,205
2016	38	32,727
2017	48	31,100
2018	66	29,070
2019	79	26,538
2020	84	24,352
2021	84	23,337

INDEX OF DISTINCT SMALL BUSINESS DUNS: UNDER \$1M VS OVER \$100M IN TOTAL FISCAL YEAR OBLIGATIONS

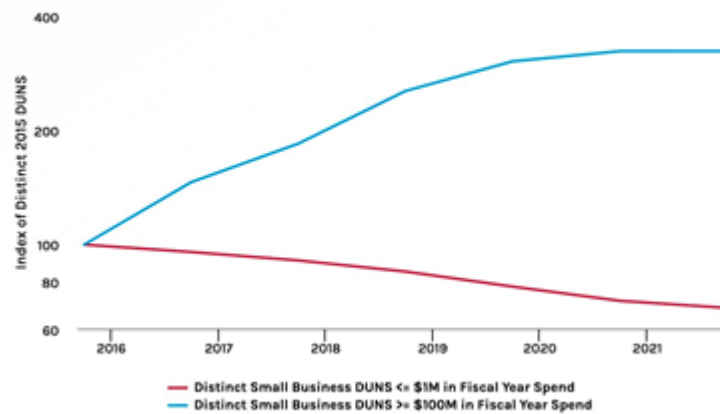


Figure 2. Index of SBs with <\$1M DoD Revenue vs. SBs with \$100M+ DoD Revenue

Small by What Standards?

The SBA defines an SB based on its average number of employees over the past 12 months or average annual receipts (U.S. Department of State, 2020). In the case of Atlantic Diving Supply, for instance, although it generates billions in DoD revenue annually, it has fewer than 500 employees. Based on its NAICS code, it qualifies it as an SB by SBA standards.²

² ADS has faced controversy regarding its SB set-aside status, but ultimately had its SB set-aside status reaffirmed.



The fact that a company with billions in DoD procurement can qualify as an SB offers one explanation for a relatively few number of SBs consuming a disproportionate share of overall DoD SB spend. Because the sole measure of success for the DoD SB program is whether the DoD awards 23% of prime contract spend to SBs, **enabling certain types of companies to compete as SBs regardless of their revenue incentivizes the DoD to work with—and award large contracts to—these larger SBs. Since the DoD is not incentivized to exceed the 23% set-aside goal, smaller SBs are in turn crowded out of the defense market.** It also creates an easily gameable system whereby a company can outsource aspects of work to teaming partners and subcontractors in order to keep employee headcount artificially low to maintain its SB status despite significant revenue.

Recommendation: Redefine SBs

Current policies, which enable—even encourage—firms with hundreds of millions or billions of dollars in DoD revenue to compete for SB contracts, have created an inhospitable environment for smaller companies. Based on our analysis, it is evident that the system favors the largest SBs at the expense of smaller ones, which runs counter to the stated purpose of the SB Program. Furthermore, the size standards the SBA and DoD apply to government contractors are unreasonable. Most Americans do not consider a company that generates hundreds of millions or billions of dollars in revenue, or a company with a multibillion dollar market capitalization, to be “small.” To the extent Congress and the USG permit procurement policies that afford special treatment to SBs, qualifying companies should, at the very least, *be* small. We therefore recommend that the SBA change the criteria for qualifying as an SB.

Further research is required to determine revenue/employee caps for qualifying as an SB, but as a frame of reference, the average revenue for the largest SBs in the private sector (companies with 100–499 employees) was approximately \$41 million in 2007 (Godlewski, 2020). Regardless of NAICS code, revenue, rather than number of employees, should be the primary consideration to qualify as an SB. Employee count is more difficult to track and can be obfuscated through subcontracting/teaming arrangements and/or independent contractors. Additionally, in the age of automation, businesses across sectors can achieve substantial growth without expanding their workforce.

Furthermore, there is a tremendous amount of opacity around size standards in general. The SBA Table of Size Standards is 49 pages long and contains confusing and arbitrary criteria. For instance, NAICS 339112, “Surgical and Medical Instrument Manufacturing,” has an SB size standard of 1,000 employees while NAICS 339113, “Surgical Appliance and Supplies Manufacturing” has a size standard of 750 employees (U.S. SBA, 2017). NAICS 448110, “Men’s Clothing Stores,” has a size standard of \$12 million in revenue; NAICS 448120, “Women’s Clothing Stores,” has a size standard of \$30 million in revenue; and NAICS 448130, “Children’s and Infants’ Clothing Stores,” has a size standard of \$35 million in revenue. Firms can and do register for multiple NAICS codes, and the government can also issue waivers to enable companies that exceed these standards to qualify as small. Collectively, these inconsistent, complex, and subjective standards are difficult to enforce, favor entrenched businesses that understand the system and how to maximize it to their advantage, and discourage new entrants. We recommend the SBA engage an independent panel of U.S. demographic experts, data scientists, and industry experts to overhaul and streamline SBA size standards.

Subcontracting in the SB Ecosystem

Because a DoD SB, like a large business, can win a contract as the prime and allocate work to teaming partners and/or subcontractors, we sought to evaluate the effects of subcontracting practices on the SB DIB. Depending on the contract type, there are certain



restrictions on how much of the work an SB is permitted to outsource to subcontractors/partners, as shown in Figure 7. **If these requirements are met, SBs can outsource work to subcontractors regardless of size, including large businesses.**

Contract Type	Rule
Services	SB Prime must provide 50%+ of the contract cost for personnel
Supply	SB Prime must perform work for 50%+ of the cost of manufacturing the supplies, not including the cost of materials, unless the business qualifies as a non-manufacturer
General Construction	SB Prime must perform 15%+ of the cost of the contract with its own employees, not including the cost of materials
Specialty Construction	SB Prime must perform 25%+ of the cost of the contract with its own employees, not including the cost of materials
<i>The SB Prime can utilize “similarly situated subcontractors,” or subcontractors with the same required size and SB program status as the SB Prime, to meet these performance requirements.</i>	

Figure 7³. SB Subcontracting Limitations

Sizing the SB Subcontractor Industrial Base

To analyze the subcontracting data, we leveraged data from USASpending, which contains information about subcontract awards, including instances in which an entity served as the prime contractor, and how much and to whom it awarded subcontracts. We isolated subcontracting data from USASpending for FY2015–FY2021, where the prime contract award was funded by the DoD and where the prime contractor was a vendor from our DoD SB dataset.

For this analysis, we isolated all prime contractor SBs with at least \$10,000 in defense-funded procurement between FY2015–FY2021. Doing so streamlined the data and reduced the potential impact of government reporting errors on the results. Of the 76,286 SBs with at least \$10,000 in defense-funded procurement, we identified 863 SBs that awarded DoD-funded subcontracts during our analysis period (“SB Primes”).

It is important to note that while we were able to associate a subcontract award to its prime contractor and we were able to verify that both prime and subcontract funding came from the DoD, due to computational limitations, we could not link the subcontract action to its specific prime contract award action. To proxy the prime/subcontractor relationships, we linked DoD-funded subcontract awards from FY2015–FY2021 that were affiliated with the 863 SB Primes into our data set.

As shown in Figure 8, these 863 SB Primes received approximately \$242 billion in defense funded procurement from FY2015–FY2021. During that same timeframe, they collectively subcontracted ~\$91 billion in defense-funded subcontract awards.

³ These limitations apply to SB set-aside contracts \$150K+.



Total SB Prime DoD Procurement, FY 2015–FY2021	Total DoD-Funded Outlays to Subcontractors by SB Primes, FY2015-FY2021
\$242,013,278,183	\$91,171,095,487

Figure 8. DoD-Funded Subcontract Awards Associated with SB Primes

Who Are the Subcontractors?

Next we sought to analyze the universe of companies that performed as subcontractors to DoD SB Primes (“subcontractors”). Filtering the USASpending subcontracting data associated with our SB Primes to isolate unique DUNS, we determined that the 863 DoD SB Primes collectively worked with 13,924 unique subcontractors. At first glance, we recognized many of the world’s largest government contractors among the names. Figure 9 provides a snapshot of 10 large government contractors that perform as subcontractors to DoD SB Primes and the DoD subcontracting dollars awarded to them during our analysis period.

Subcontractor Name	Total DoD-Funded Subcontract Awards, FY2015–FY2021
ACCENTURE	\$7,427,637
BOEING	\$183,412,223
BOOZ ALLEN HAMILTON	\$1,326,752,662
DELOITTE	\$120,403,176
GENERAL DYNAMICS	\$542,271,351
HARRIS CORPORATION	\$572,658,238
L3	\$861,609,111
LOCKHEED MARTIN	\$284,056,045
NORTHROP GRUMMAN	\$541,770,770
RAYTHEON	\$341,913,820

Figure 9. Snapshot of Large Subcontractors

As evidenced by the revenue generated by these 10 companies through DoD SB set-asides, DoD SB policies benefit the most entrenched government contractors. We were interested in understanding the extent to which other LBs also performed as subcontractors to DoD SB primes. We classified the 13,924 subcontractors in the data as “small” or other than small (“large”) using the same approach we employed when classifying SBs from the overall pool of DoD vendors. However, the process requires the subcontractor DUNS to be associated with a procurement action directly funded by DoD from FY2015 through FY2021—in other words, for us to determine whether a subcontractor was an SB, that subcontractor also needed to have been a prime contractor to DoD from FY2015–2021. Of the 13,924 subcontractors in the data, 6,537 had no associated DoD prime contract awards during the analysis period. Because we were unable to determine the size of these businesses, we labeled them “unknown.”

As shown in Figure 10, 2,177 subcontractors—approximately **16% of all subcontractors to DoD SB Primes during our analysis period—were large businesses. Collectively these LBs were awarded more than \$24 billion in DoD-funded subcontract awards, which represents nearly 27% of all DoD-funded subcontract procurement from**



FY2015–FY2021. Taken as a percentage of the total ~\$511.4 billion DoD SB procurement during the same period, **\$24 billion represents 4% of DoD SB spend.**⁴

Subcontractor Type	Count	Total DoD Funded Subcontracts from DoD SB Primes, FY2015–FY2021
SMALL BUSINESS	5210	\$43,194,628,990
OTHER THAN SMALL BUSINESS	2177	\$24,207,193,451
UNKNOWN	6537	\$23,769,273,045

Figure 10. Breakdown of Subcontractors to DoD SB Primes, by Business Size

Recommendations: Subcontracting Reforms

There are merits to permitting LBs to subcontract to SBs. The policy allows certain SBs to compete for and win work they would be unable to perform without the assistance of a large, experienced contractor. The streamlined procurement process for set-asides also incentivizes LBs to engage with the SB community, which helps SBs’ innovative capabilities reach the warfighter. However, the policy has resulted in LBs receiving a substantial amount of money earmarked for SBs. We therefore recommend that contract dollars that flow through SBs to LBs be excluded from SB procurement goals.

Furthermore, there is no evidence to suggest that current subcontracting policies enable more SBs to participate in the defense market—on the contrary, the SB DIB continues to contract in spite of them. Liberal teaming and subcontracting policies also create opportunities for the largest SBs to partner with one another as similarly situated contractors, making the defense market even harder for smaller SBs to penetrate. Just as the USG and DoD must reconsider how they define SBs to be more reasonable and aligned with the views of taxpayers, so too must they reassess subcontracting policies.

Subcontracting Data: Limitations & Further Research

Pursuant to FAR 4.1403(a), all contracts that report to FPDS with subcontracts over \$30,000 must report first-tier subcontract data. However, from working with the data, we believe that public records pertaining to government subcontract awards are to some extent incomplete and are less reliable than prime contract award data. There can also be significant lags between when the DoD awards a prime contract and when subcontract dollars are outlaid. Further research is required to ascertain gaps in public records for subcontracting data. While we cannot determine how this limitation may affect the efficacy of our results, the broader trends we identified in the subcontracting data provide valuable insights.

Additionally, as shown in Figure 11, when we analyzed the amount of DoD procurement SB Primes awarded to subcontractors from FY2015–FY2021, we found that 37 SB Primes appeared to have outlaid more in DoD-funded subcontract awards than they received in DoD-funded prime contract awards during the same period. In other words, according to the data, from FY2015–FY2021 Torch Technologies had ~\$5.5 billion in DoD-funded procurement, yet there were ~\$27.2 billion worth of DoD-funded subcontract awards associated with Torch during that same period. Likewise, A&D Fire Sprinklers received ~\$8.8 million in DoD procurement but had ~\$71 million in affiliated DoD-funded subcontract awards.

⁴ Because we cannot resolve subcontract awards to specific prime contract actions, it is possible that some portion of subcontract awards are associated with prime contract awards that predate our analysis period. It is also possible that some subcontract awards are associated with classified prime contracts wherein the prime contract value is not made public, but certain subcontract procurement data is unclassified. As a result, this calculation is a proxy.



SB Prime	Total DoD Procurement, FY2015–FY2021	Total Associated DoD Subcontract Award Outlays, FY2015–FY2021	%Total DoD Procurement Subcontracted
IE-PACIFIC INC	\$414,933,772	\$3,951,765,106	952.38%
A&D FIRE SPRINKLERS INC	\$8,810,415	\$71,040,705	806.33%
TECOLOTE RESEARCH INC	\$1,423,163,688	\$8,269,466,123	581.06%
RA BURCH CONSTRUCTION CO INC	\$627,474,597	\$3,371,236,769	537.27%
TORCH TECHNOLOGIES INC	\$5,583,425,252	\$27,207,753,458	487.30%
ADGC BONITA PIPELINE JV	\$9,629,749	\$42,865,581	445.14%
A&D-DORADO JOINT VENTURE LLP	\$14,576,277	\$64,534,551	442.74%
NOREAS ENVIRONMENTAL SERVICES LLC	\$81,476,858	\$335,706,927	412.03%
ASSURANCE TECHNOLOGY CORPORATION	\$812,546,967	\$3,256,627,173	400.79%
ALUTIIQ GENERAL CONTRACTORS LLC	\$103,568,080	\$387,876,239	374.51%
ANALYSIS COMPUTING & ENGINEERING SOLUTIONS INC	\$32,076,047	\$114,361,141	356.53%
STORMWATER PLANS LLC	\$50,045,437	\$141,033,739	281.81%
WALGA ROSS GROUP 2 JV	\$52,833,910	\$148,203,722	280.51%
BLACK RIVER SYSTEMS COMPANY INC	\$432,776,550	\$1,200,501,496	277.40%
1CYBERFORCE LLC	\$13,539,676	\$36,611,639	270.40%
ALUTIIQ GENERAL CONTRACTORS LLC	\$110,308,752	\$294,784,776	267.24%
SOLVUS GLOBAL LLC	\$227,036	\$600,000	264.28%
APTIMA INC	\$395,504,344	\$972,253,276	245.83%
MUNRO CONSTRUCTION COMPANY INC	\$2,478,218	\$5,492,610	221.64%
ALUTIIQ CONSTRUCTION SERVICES LLC	\$72,611,308	\$150,799,451	207.68%
ROSS GROUP CONSTRUCTION CORPORATION	\$328,251,640	\$665,465,786	202.73%
WALGA ROSS GROUP JV	\$175,234,420	\$355,115,556	202.65%
A&D GC INC	\$74,203,984	\$149,927,006	202.05%
ITSTARS2 LLC	\$10,163,613	\$19,640,936	193.25%
LUKOS-VATC JV LLC	\$199,797,768	\$347,746,602	174.05%
H F WEBSTER ENGINEERING SERVICES INC	\$7,521,910	\$12,840,503	170.71%
WALGA MTE LLC	\$17,151,826	\$26,804,564	156.28%
SHEFFIELD KORTE TEAM LLC	\$56,054,522	\$85,963,900	153.36%
MILSUP LLC	\$12,326,498	\$16,891,230	137.03%
ASRC BUILDERS LLC	\$360,278,865	\$482,793,017	134.01%
ALUTIIQ COMMERCIAL ENTERPRISES LLC	\$845,764,485	\$1,112,413,698	131.53%
TECH-MARINE BUSINESS INC	\$555,375,489	\$696,846,588	125.47%
BRISTOL-CANNON JV LLC	\$8,550,879	\$10,728,642	125.47%
GRACON LLC	\$47,128,505	\$55,839,532	118.48%
ALUTIIQ MANUFACTURING CONTRACTORS LLC	\$36,366,794	\$39,115,654	107.56%
ASSURED INFORMATION SECURITY INC	\$1,687,968,801	\$1,810,475,399	107.26%
AKIMA GLOBAL LOGISTICS LLC	\$2,071,751	\$2,129,336	102.78%

Figure 11. DoD SB Primes With More in Subcontracting Outlays Than Prime Contract Awards



We contacted 15 of these companies via email indicating that they appeared to have outlaid more in DoD-funded subcontracts than they received in direct procurements and invited them to provide us with feedback and context. Two companies responded, one via email and one by phone. Both simply stated that the figures we cited were inaccurate but offered no further explanation. Despite their feedback, our data is accurate according to USASpending. We also emailed USG points of contact associated with a subset of Torch Technologies' largest subcontract actions in hopes of gathering more information, but we did not hear back. Additionally, we spoke with several DoD contracting experts about these findings. They were surprised by the data and had no clear explanation as to how or why a contractor would outlay substantially more in subcontracts than it received in direct procurements.

Possible theories included administrative errors (government personnel inputting data incorrectly); instances where monies were awarded to a company in an earlier year and used in later years; and/or instances where classified prime contract award data was not in the public realm, but subcontracting data associated with that contract was publicly available. Further research is required to better understand this finding; if, when and why this activity is permitted in prime/subcontractor relationships; reporting practices inside of the government that obfuscate how companies partner and subcontract; and how these practices affect the composition of the DoD SB industrial base. In future research, we would also strive to link subcontract actions with their prime contract.

Consolidation of the SB DIB

As the largest SBs expanded their DoD market share, thousands of other SBs ceased working in the defense market. As previously referenced in Table 3, the number of DoD SBs shrank nearly 23% from FY2015 to FY2021, from 48,322 to 37,294. While we have concluded that SBA size standards and subcontracting policies favor larger SBs and measuring the success of the DoD SB program based on the share of DoD spend awarded to SBs incentivizes DoD stakeholders to award larger contracts to fewer suppliers, we were interested in understanding other factors contributing to SB attrition from the defense market.

Technical Approach & Research Limitations

For the purposes of our research, we define a company as “leaving” the defense market if it had associated DoD contract actions at one point during our analysis period, but not in the subsequent year(s). For instance, an SB with DoD contract actions in FY2016 and FY2017, but no DoD contract actions from FY2018–FY2021, was treated as “leaving” the DoD market in FY2018.

There are generally four explanations for why a company would no longer appear in the dataset during the analysis period:

- It went out of business entirely.
- It ceased working in the defense market but continued to work commercially.
- It ceased working in the defense market but began working, or continued to work, with other USG customers.
- It was acquired or it merged with another company (and it may or may not continue to support the DoD through this new entity).

We cannot discern which of these explanations applies to an individual SB in our data. We recommend further research to explore the possibility of joining additional data sources for analysis, including non-DoD-funded USG procurement data, to help determine the status of an SB. Irrespective of this limitation, the results of a shrinking SB DIB are the same: a less robust



industrial base, with less supplier diversity. The consolidation also undermines the purported economic benefits of the SB program.

Why SBs Leave the DoD: The Cost of Doing Business

One significant factor that has resulted in SBs leaving the DoD market is the rising costs associated with working with defense customers.

In 2020, the DoD implemented the Cybersecurity Maturity Model Certification (CMMC), a mandatory security requirement for contractors and subcontractors. Compliance burdens companies with numerous hard and soft costs. Companies must now devote internal resources for planning, documentation, training, and assessments. Outsourcing an assessment comes with an estimated cost of \$15,000–\$45,000, and investments to reach requisite certification levels range from \$3,000–\$100,000 (Dawson, 2021).

New security requirements have also resulted in additional insurance requirements, including new and/or increased professional liability and cyber insurance policies. According to Insureon, an online insurance marketplace for SBs, the median cost for cyber liability insurance for SBs is \$1,675 annually (“How Much Does Cyber Liability Insurance Cost?”). Coverage requirements for DoD SBs, however, often far exceed the average. For example, PW Communications is a certified woman-owned SB that has performed on contracts for the Defense Information Systems Agency (DISA) since 2012. In 2020, PW Communications was required to obtain additional professional liability/cyber insurance policies to continue supporting DISA. PW Communications paid \$13,576 for these new policies in 2021, and \$18,333 in 2022. Robert Chamberlain, the Founder and President of Monterey Technologies, Inc., an engineering firm that has supported DoD customers since the 1980s, estimates that his firm had to invest more than \$100,000 over the last 2 years to satisfy new security requirements.

As these costs rise, larger SBs have the ability to absorb them more easily. They further benefit because these costs, which are untenable for smaller SBs, drive competitors out of the market.

Balancing the Risks

While increased security requirements are necessary to respond to evolving threats, the DoD must be cognizant of the impact current and future requirements have on SBs. At a certain point, SBs will not be able to justify the costs, particularly relative to the ease with which they can work in the commercial market. The DoD should consider offset strategies to reduce the cost burdens on SBs.

Shifting Procurement Strategies

Shifts in DoD and Defense Logistics Agency (DLA) procurement strategies over the last decade have also severely impacted the ability for specialized SBs to support DoD customers. In 2012, the DoD and DLA began implementing a contract bundling practice called “Captains of Industry” (COI) that involves awarding multi-year, multi-billion dollar sole-source contracts to large Original Equipment Manufacturers (OEMs) and large aerospace integrators. These contracts bundle a large number of National Stock Numbers (NSNs) that were historically purchased individually into one single contract. The intention of the COI program was to deliver cost savings, value, and other benefits to the DoD (DoD IG, 2021). According to a February 2021 DoD Office of Inspector General (IG) report along with a study conducted by the Small Business Aerospace Industrial Coalition (SBAIC), there is no indication that COI bundling policies have yielded cost savings or on-time deliveries (Small Business Aerospace Industry Coalition, 2021).



COI has, however, rerouted millions in DoD contract dollars from components manufacturers and other SBs to large integrators and OEMs. **The IG report estimates that SB participation has declined by 61% in the COI program.** SBAIC has reported that many of its 200 member companies—which have gross revenue under \$20 million and specialize in manufacturing and supplying military aerospace spare parts, components, and assemblies—have been financially devastated as a result of these bundling policies. Several have gone out of business entirely, with others on the brink of bankruptcy.

Other factors that inhibit small and nontraditional companies' ability to succeed in the defense market, which we identify and explore in earlier research, include but are not limited to:

- Complex, anticompetitive solicitation processes: It is extremely difficult for companies to identify relevant requirements due to the design of SAM.gov. If and when companies find relevant opportunities, the majority of DoD solicitations require responses within 21 days of when they are published, and the vast majority of these solicitations/requirements are not written clearly (Bresler & Bresler, 2021).
- Redundant requirements: USG/DoD stakeholders do not coordinate outreach efforts. As a result, dozens and sometimes hundreds of distinct stakeholders solicit the same capabilities concurrently. SBs cannot participate in all of them and have limited ability to prioritize them.
- Lack of awareness across the DoD about what capabilities SB suppliers possess: DoD stakeholders rely on certain suppliers because they do not know that other qualified vendors exist—even if these alternative vendors already support other defense customers.

Simply limiting competition for certain contracts to SBs does not address these underlying issues. **Until the SBA, DoD, and USG address them, the defense market will continue to prove inhospitable for non-entrenched suppliers.** The fact that the procurement process, even for set-aside contracts, disproportionately benefits companies with institutional knowledge of the system also means that the DoD ends up awarding contracts to SBs that understand the system, rather than companies with the “best” or most competitive offering—particularly considering the DoD is *obligated* to award a certain percentage of annual procurement to SBs. **Thus, just as SB policies contribute to the failure of some SBs, they also prop-up certain companies that would and/or should naturally go out of business.** Permitting SBs to evade full and open competition for certain opportunities, in general, is also the opposite of “preserving free competitive enterprise.” With a portion of the market excluded from the competitive process, SBs are not incentivized to innovate and/or reduce costs in ways they would be if free market forces were at work.

Conclusions

Rather than “leveling the playing field,” government set-aside policies enrich the largest SB vendors and fail to benefit the groups they were designed to serve. They afford preferential treatment to entities that understand the system and how to maximize it to their advantage. As these entities consolidate power, they can withstand the costs and procedural challenges that keep smaller, would-be competitors from succeeding. Compounding these issues is the fact that arbitrariness, opacity, and lack of standardization around USG and DoD size-standards make it difficult to evaluate the results of the set-aside program in general.

While this paper focuses on the SB program broadly, the issues we identified become more acute in the context of set-aside policies for companies that qualify for preferential treatment in the procurement process based on other USG-defined criteria, such as where the



business is located and the socioeconomic and/or demographic features of a company's owners. **These initiatives do not make it easier for members of set-aside communities to navigate the defense market on a practical level. Instead, they create new, increasingly insulated/anticompetitive avenues for entities well-versed in government contracting to exploit the system.**

In conclusion, **until the real challenges keeping small and nontraditional companies from succeeding in the public sector are addressed, the DoD and USG must award contracts based on technical merit, innovativeness, price, and ability to perform**—not based on the size of a company or the demographic features of its owners. They must rigorously analyze the composition of the industrial base on an ongoing basis using consistent, verifiable data; and commit to addressing the underlying causes if and when certain types of businesses are underrepresented.

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

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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 III 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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