SBTC Comments on AFWERX Working Paper and AF Ventures Year in Review

Across FY19, FY20, and FY21, the Air Force invested a billion dollars in the AFWERX open topics experiment.

The Small Business Technology Council (SBTC) was asked by Air Force to offer its feedback to two papers: the NBER Working Paper titled "Opening up Military Innovation: Causal Effects of Bottom-up reforms to US Defense Research", and the AF Venture FY18-FY20 Impact Report. Neither of these papers compare AFWERX with the successful traditional SBIR program. We also comment relative to how the open topics have compared with the traditional Air Force SBIR program.

Before we offer thoughts on the papers, SBTC would like to present some general comments and recommendations that we have about the AF SBIR program before the AFWERX changes.

Points We May Agree On

1. The US is seriously threatened by technological advances of our adversaries
2. There is an urgent need to transition new advanced and innovative technologies that are better than those of our adversaries to the Air Force and other DoD Warfighters
3. These technologies need to be rapidly transitioned into platforms, systems, and components so that they can be used by our war fighters. As the primes develop and build platforms and systems, buy in/participation by them is critical to transition to the field
4. Fast tracking contract awards and reducing contract complexity is needed and welcomed if done properly
5. The ultimate goal is technology transition to the Warfighter.
6. The Air Force has not done enough to transition new technology into their programs of record.

What SBTC Believes

1. The strongest and most reliable indicator of whether an SBIR technology is successful is whether a program manager or PEO voluntarily puts money into it via a Phase III contract. A Phase III contract proves the Phase II generated a technology that the DOD wants to buy or put into a program of record.
2. Prior to changes made by AFWERX, the Air Force SBIR program was beginning to show significant improvement in Phase III generation, increasing the amount of Phase III funding from fy15 to fy20 (*see table A & D*).
3. Technologies funded by AFWERX SBIRs have been less successful than traditional SBIR at generating Phase III follow-ons. AF SBIR Phase III funding appears to be down 33% through the first 3 Quarters of fy21 compared to fy20.
4. VC investment and patents granted to the small business are not demonstrative of successful technology transition, whereas follow-on Phase III contracts and relevant Prime contractor engagement have been long-standing, proven transition pre-requisites. This funding would be more likely to produce commercial products that would provide technology to our adversaries.

SBTC Recommendations for improving Phase III and Tech Transition Outcomes

These recommendations should be applied to both specific and open topics.

- More closely match the program offices with the new topics: Make sure new topics have program office transition interest and serve the long term R&D needs of the Air Force. Improve SBIR topics and award selections to better match program office interest.
- Extend contract standardization to Phase IIIs: Complete Air Force Phase I and Phase II SBIR model contract standardization to also create a standardized Phase III contract. A standard Phase III contract would substantially speed Phase III contracting actions. Standardizing contracts could save a year or more of development time.
- Publish a memorandum encouraging Air Force direct Phase III awards, to procurement and contracting officers as well as program officers and contracting representatives. These can follow Phase I/IIs and do not require matching funding. This would explain how directed SBIR Phase III awards may be made without further competition, an empowerment tool provided by NDAA and the SBIR Policy Directive. Combined with the standardized Phase III contract, this would encourage more rapid transition of desired SBIR technologies. A memo by Assistant Secretary of the Navy Sean Stackley in January 2015 highlighted that SBIR Phase III sole source awards were an authorized and encouraged exemption under J&A to further competition, and set the Navy on a faster transition path directed to program office interests.
- Encourage Primes to implement SBIR technologies into their deliverables by encouraging and incentivizing them to subcontract to SBIR firms, perhaps to 1) include added value in procurement decisions, 2) perhaps through setting percentage targets under major awards, or 3) perhaps by awarding bonuses to Primes who meet certain goals. Writing a guideline to Primes on rights and obligations relating to SBIR Phase III subcontracts would clear the way for many more Prime Phase III awards. The law allows incentives for primes.
- Matchmake the backlog: Air Force may have many SBIR technologies that offer solutions for Air Force programs, but are not being transitioned for lack of PEO knowledge or incentive. Create a process to match SBIR companies and their prior Air Force and other DOD SBIRs with the program offices and the Prime Contractors. Use of an ombudsman and internally published list would expedite this process. This could take lessons learned from the recent AFWERX open topic on how to best empower companies to link with program offices and Primes. The CRP allows matching funds.
- Improve communications with the small business industrial base: Take effective action to increase and improve communications between the Air Force SBIR office, program offices and the Air Force's SBIR proposing companies and awardees. This includes improving access to AFWERX SBIR personnel, information and policies. Most recently, the Air Force SBIR website appears to be saying that debriefs will no longer be offered on Phase I proposals, a step away from enhanced communication. Not having post-award debriefings is inconsistent with FAR 15.506(A) 1 and 2.
- Profitability is insufficient to encourage many innovative firms to participate or remain in the SBIR/STTR program. This reduces the number of new entrants to the program and makes it harder for existing firms to survive. Encourage COs to accept a fee of 15 % for all Ph I, II, and III SBIR/STTR contracts.

BACKGROUND

Traditional SBIR program Success

- The AF SBIR program had been working well and was improving, with AF Phase III growing from $391M in fy2018 to $528M in fy2019, to $855M in fy20. Part of this growth was fueled by increased SBIR funding, but it was also by getting PMs increasingly involved in topic and award selection. Through the first 3 Quarters of FY21, AF Phase III contracts totaled $359M, 33% lower than the amount through the First 3 quarters of FY20 ($541M). Total Phase III awards exceeded the SBIR expenditures for these three years. (*see Table A*)
- It is interesting to note that the Navy SBIR program appears twice as successful in getting follow on Phase III contrast as the Air Force, $2.00 for every dollar invested in the SBIR program. According to the Air Force year in review, The Air Force SBIR program had $2.7B in in public and government Phase III for traditional SBIRs in 2018 alone.
- The Phase III figures are hard data that are taken from sam.gov. We searched for all contracts labeled Phase III at the DOD and sorted by Agency name and date.
- A lot of the focus of the AFWERX approach has been on VC. We want to reiterate that the SBIR law is clear that VC investment cannot be an evaluation criteria for SBIR (15 USC 638(dd)(7)), but the results from AFWERX seem to indicate that it has been. 100% of the AFWERX jumbo "STRATFI" awards went to firms that had received venture capital prior to the jumbo award and that 66% of the awards went to one state: California.
- Initially, AFWERX eliminated traditional topics completely, and has now moved to 20% funding of traditional topics, with 80% for open topics and Stratfi. We believe this ratio should be reversed. AF SBIR was succeeding at technology transition before the change to open topics was made. Emphasis should be given to topics that have support from program managers.

SBIR Multiple Award Winners

The NBER working paper claims that multiple SBIR award winners:

- Are not innovative
- Are not transitioning technology
- Have taken an outsized share of SBIR funding

However:

- By definition and by the evaluation criteria, traditional topics require an innovative solution that has potential to transition to the Air Force
- The best proposed solutions are the ones that should be funded, based on merit, regardless of where they come from.

- Multiple award winners have transitioned many technologies. These solutions are out in the field helping the Warfighters right now, and traditional topics will continue to do that in the future if sufficiently funded
- The AFVentures 2020 report states that companies with an extensive history of participation in the SBIR/STTR program and who have received 20 or more federal prime contracts only comprises 16% of SBIR/STTR traditional topic award winners.
- More than two thirds of SBIR awards (68%) from traditional topics go to companies with 0-5 SBIR or other Federal Contracts.

Security Concerns with the AFWERX Approach

- DCSA regularly releases bulletins about the severity of technology theft in the US, particularly by China.
- Many small commercially focused companies that have never worked for the DoD before have employees that are not of US origin; some are from adversarial countries such as China and Russia, many have foreign funding support, or may have investments from foreign owned VCs.
- How is DCSA working with AFWERX to investigate companies that apply for AFWERX funding?
- How is this concern being addressed for open topic Phase I, Phase II, and Phase III applicants?
- How is AFWERX addressing potential IP theft and counterintelligence of companies that have not been vetted for handling of ITAR, CUI, and do not have CMMC compliant IT systems?

Comments on NBER Working Paper

We appreciate your sharing this paper with us, and your looking for our feedback, as we provide below. We do have concerns. Among our concerns:

- Correlations are often reported as causal, when they may be related to other separate factors that could be causal, such as prior VC investment.
- The paper appears to have some pro-Open topic themes that are driving it that do not appear derived from the data.
- There is an underlying assumption that a primary purpose of SBIR awards is to drive VC investment, and less focus on actual transition success against Air Force's requirements.

Below is some more substantive discussion:

VC Funding

Stated conclusions:

- P 4: "We find that winning an Open topic competition increases the probability of subsequent VC investment by 5.4 percentage points, which is 68% of the mean among Open applicants."
- P 22: "Panel A of Table 2 shows that winning the Open program has a strong positive causal effect on subsequent VC investment."

Commentary

- Correlation is assumed to imply causation: There does not appear to be a basis for the assumption that winning an Open topic increases the probability of VC investment. The paper concluded that open topic SBIR awards led to VC funding, but the majority of the open topic winners may have had previous VC funding, and so would already be more likely to win subsequent VC money than companies that had not yet won any VC rounds. There seemed to be no effort to separate this effect, despite it appearing an obvious factor driving subsequent VC investment. By ignoring this factor and also by ignoring other causal factors, there can be no conclusion that it was the SBIR wins that led to any subsequent VC funding.
- What fraction of open topic winners already had VC backing? Figure 2 (p 41) indicates that having had previous VC investment correlated to a 5X greater likelihood of winning the open topic compared to the conventional topic. Prior VC funding would appear to be a factor which is strongly correlated with subsequent VC investment, and which has a stronger claim on causation. Most VC-funded companies already have plans for subsequent rounds of VC investment, so this predisposition may be the true primary causal basis of subsequent VC rounds, not a SBIR Phase I or II award. We did not find the paper describing the proportion of open topic winners that had had prior VC investment, a surprising omission given its potential importance and the many analyses relating to VC funding, but the apparent 5X greater likelihood of winning among prior VC-funded firms implies that the proportion could be large.
- The prior VC funding factor could be easy to control for: We suspect the prior VC effect would be easy to remove statistically. One way would be to simply remove all pre-VC backed

companies from the analysis of both open and traditional and rerun the numbers. Or the writers could add prior VC funding as a control variable such as adding it to Table 5, but the paper conspicuously did neither of these.

- Was there an implicit selection criteria towards favoring companies with prior VC investment? A selection predisposition towards VC funding could go a long way in explaining why the selected open topic companies showed more VC funding following winning the SBIR (Table 1).
- VC funding is not a Congressional objective nor is it an Air Force objective. Presumably the actual objective should be actual transitions. We question using VC funding as a source of success when it seems to be one of the main selecting factors for winning the award.
- Venture Capital firms invested in 3,385 SBIR firms - 8% of all venture capital investments are to SBIR involved firms.

Non-SBIR DOD Contracts

Stated conclusion:

- P 4: "Second, we find that winning an Open award increases the chances of a subsequent non-SBIR DoD contract by 7.5 percentage points (51% of the mean)."

Comments:

- The paper's tables appear to contradict the conclusion: Table 2, Panel B's overall data seems to say the opposite - that specific topic winners win over twice as many subsequent non-SBIR DoD contracts than open topic winners. 0.324 outcome mean for specific topics vs 0.148 outcome mean for open topics.
- Did the "control for prior SBIR awards" that is mentioned counteract the apparent doubled non-SBIR Phase III productivity of the specific topics? There is the comment that the writers have "controlled for previous Air Force SBIR awards", but while the formula is described how the data was implemented was not. Introducing such a factor provides a mechanism to offset the Phase III advantage of specific topic winners.
- There does not seem to be any specific linkage of the Phase III awards to the open or specific topics that are being examined.
- We agree that the "shopping" style of the Open competitions may lead to Air Force discovering needs it did not know it had. It is not clear that other approaches for Air Force programs to staying at the forefront of technology opportunity would not work also, and we suggest that any specific source program is presumably (or should be) directed to Air Force program needs. There is still ultimately the need for the program offices to decide which technologies they want to support – typically a Phase III evaluation made among all technologies that may show promise.
- We are curious why all the Traditional rank 4 proposals in Figures 4-7 drop rather than rise. We can't explain this, but it seems to drag down the "success" numbers of Traditional SBIRs, especially when looking at the plots with the same y-axis, which the paper does not use.

Patents

Stated conclusion:

- P 5: "Winning an Open award increases the chances of a patent by about twice the mean."

Comments:

- As with non-SBIR Phase IIIs, the Tables also appear to contradict the conclusion: See Table 3, Panel A, p 46. To the contrary of what was concluded, specific topic winners seem to win 5.4X as many patents as do the Open topic winners. 0.146 specific topic outcome mean vs 0.027 outcome mean for the open topics.
- Again, the "control for prior SBIR awards" that was applied may be counteracting the patent advantage of the specific topic winners apparent doubled non-SBIR Phase III productivity of the specific topics? There is the comment that the writers have "controlled for previous Air Force SBIR awards", but we didn't see this described as to how this was done. A simple division of outcomes by total number of SBIR awards would substantially overdilute the patenting success of multiple award/multiple year winners as it does not include the Phase III awards from the other years in the studied period.
- We question the relevance of any short term reporting of patents on any transition potential, as patents tend to issue much later than the innovations to which they relate.
- We also note that patenting puts the technology into the public domain, allowing competitive nations to also use the technology, so it may not be a good measure for DoD R&D success.
- Traditional SBIR winners across all agencies have received 137,443 patents.

Future/Projected Outcomes

- As for future SBIR contracts we are uncertain as to the relevance. In this case, the paper the outcome mean is 0.312 vs 0.105 for the open topic, but the commentary implies this must be a negative. The paper shows an attitude including a clear assumption that the SBIR program should be metered so that no firm wins more than a few to make room for newcomers. Yet the Air Force doesn't have this attitude relative to its primes (who win the lion's share of external Air Force R&D, and doesn't apply to overall Federal policy, which sets up national labs for multiple awards as well as purposefully making many awards to the best private contractors, e.g. Johns Hopkins University).
- We believe the question should be whether Air Force programs are supported with new transition opportunities that they select based on their merit and that are then carried forward to the warfighter. This statistically-focused paper does not really touch into this issue, yet we would suggest it should be the objective

US Defense Industrial Base

- The NBER working paper states that there is a significant decline in the Defense Industrial Base, and that the remaining primes are not innovative.
- There seems to be an assumption by the writers that purchasing more SBIR awards from a single company is contrary to AF objectives. This is editorializing not borne by their data. It would presumably be to AF objectives to select the best technologies for the warfighter, from whatever source, and to find the best way to transition these forward. We assume that Air Force makes repeat R&D purchases from its all its larger competing R&D vendors in the process of selection based on merit, choosing the best.
- Traditional topic SBIR award winners must be CUI (and for many topics ITAR) and CMMC compliant and have a DCAA approved accounting system
- These small businesses are a vital part of the Defense Industrial Base, and that includes companies that have won multiple SBIR/STTR awards
- Per the evaluation criteria, traditional topics are awarded to the most innovative firms that can present a viable path for commercial transition.

VC Support of DoD technologies

- We believe VCs firms welcome selected SBIR technologies for the potential for high value investments, but this is true for the entire SBIR program, not just AFWERX. It is not clear that DoD's competitive advantage requirements across both hardware and software necessarily map up with the scalability preferences of VC investors.
- VC-funded firms may look at SBIR opportunities as opportunities to boost their R&D programs, and at DoD applications of their commercially-focused technologies, just as they will look at non-SBIR DoD awards for defense applications.

Final Thoughts

- It's hard to see how analysis of the awards emerging from SBIRs in 2017 through 2019 would have had time to mature, unless the technology was already commercial and ready to race through transition, and the SBIR award was just confirmatory J&A lubricant and armor to facilitate speedy transition.
- The Air Force is fully capable of writing J&As to support any non-SBIR award they want to do, if they can mobilize their program offices to recognize and support new technology. If the Air Force wants to make awards from already-commercial technologies, including to small businesses, it could and should be doing so using regular program funding also. The SBIR program is not the sole avenue to contract with small businesses.
- Open topics stretch the basis for SBIR J&A justification precisely because they do not invite competition directed to a specific topic. In inviting 1300 companies into a cagefight, there is no rational basis for assuming the ones that emerged actually had any competition from any other companies seeking to solve the same Air Force requirements. This will lead to protests later

that will have justification, because in fact there was not a competition relating to the specific topic of the follow-on Phase III award.

- Overall, if the Air Force's only goal is to attract a new and different talent pool to the SBIR program, then this paper may reinforce that Open topics help accomplish this. SBTC believes the goal of SBIR ought to be to make sure that the needs of the Air Force are met, and that the warfighter has the best technologies for their needs - this paper doesn't address that broader objective.

Comments on AF Ventures Annual Report

- The report makes the case that the biggest technological innovations come from commercial technology markets, not government funded sources, and uses that as justification for reallocating SBIR resources to fund dual-use commercial technology. But if the technology is available on the global market, then all our adversaries already have it. The only tech AF can maintain a monopoly on is tech that AF funds and develops itself
- ITAR/EAR/CUI/Classified technologies cannot be dual use, and technologies that will bring us past our adversaries will almost certainly fall under these restrictions.
- That isn't to say that technology available on global commercial markets isn't useful or necessary to AF (ie 5G), but there is a lot of other technology that can only be funded by AF. Allocating only 20% of AF R&D small business funds to develop military-only technology seems insufficient.
- If AF wants more dual-use technology developed by small business, a solution could be to simply increase the size of SBIR, rather than treating military-only technology as an afterthought. Imagine telling Raytheon or Lockheed that 80% of the tech they develop using AF funds must be dual-use
- The paper makes the point that VC investment in companies that won AF Venture portfolio SBIRs is greater than in traditional SBIR winners. This only underscores - not solves - the underlying problem: VC doesn't want anything to do with the DOD. Instead of bringing Silicon Valley to the Pentagon, the approach simply pours DOD money into technology Silicon Valley is already investing in.
- Stating that "AFVentures portfolio companies have received $2.22 billion in private sector investment following an Open Topic award" or that "AFVentures portfolio companies earned $1.42 billion in government funding following participation in the Open Topic" is fairly meaningless, and misleading. As the paper admits, it cannot be established how much of this investment is related to the open topic awards.
- The AF Ventures report does not show any information on the AF SBIR prior to AFWERX. Data shows that the AFWERX data is no better than the prior program.
    - For example follow on Phase III 2018 had a return of 2.726 Billion on a $663 SBIR/STTR investment or a ROI of 4:1 close to the 5.8:1 the report mentions. . A review of the three Economic Impact Studies of 96% of all SBIRs awards had for the Air Force a 12:1 ROI and for all DOD a return of 22:1
    - Additionally, the traditional SBIR program at the DOD has had 829 firms go public and 2120 firms acquired many by major DOD prime contractors who wanted to incorporate the SBIR technology into program of records. L3 Com, GE, SAIC,BAE,Lockheed Martin, Raytheon, Gen Dynamics, Philips, Teledyne have each acquired 10 or more SBIR Firms One firm, L3 Com, has acquired 43 SBIR Firms

Appendix

Table A: Non-SBIR Phase III Funding by Service

Phase III by Service	2018	2019	2020	First 3 Qs 2021	Total Per Agency
Navy	$743,134,063	$674,313,088	$893,977,509	$535,807,710	$2,847,232,369
Air Force	$391,936,154	$528,850,815	$855,060,886	$359,015,078	$2,134,862,933
Army	$151,651,706	$113,341,936	$170,912,517	$135,925,090	$571,831,249

AF 1st 3 Qs 2020: $541,662,803

Table B: Five STRATFI Winners Have non-SBIR Phase III Contracts

STRATFI/Big Bet Winner	FY 20 & FY 21 AF Phase III Funding
ANDURIL INDUSTRIES INC.	$72,646,513.00
ENVIEW INC.	$487,500.00
ORBITAL INSIGHT	$3,062,614.36
SHIFT.ORG INC.	$2,129,184.00
WICKR INC.	$8,805,023.70
Total	$87,130,835.06

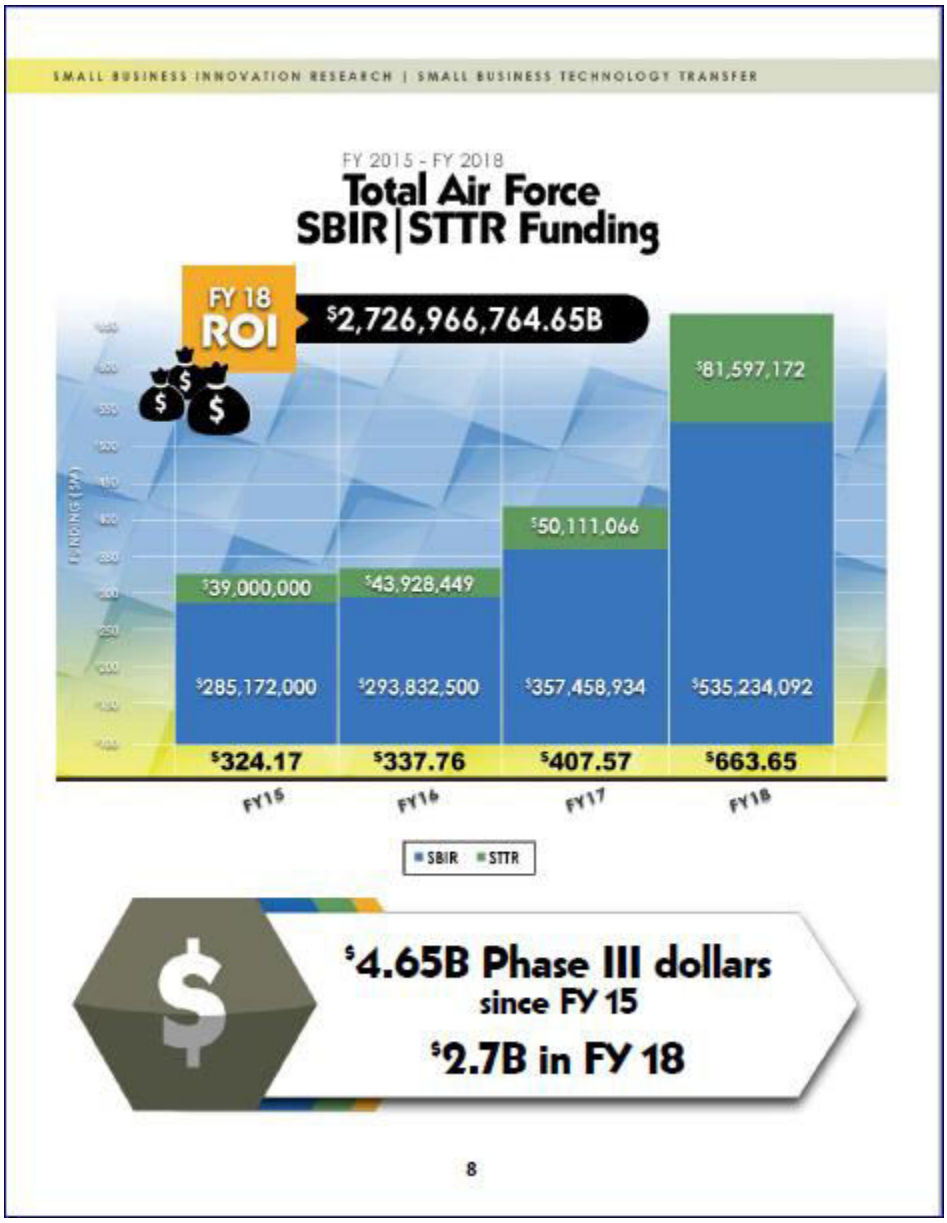
Table C: 12 of 144 Direct 2 Phase II awards have non-SBIR Phase III Contracts

	1st 3Q FY21 AF Phase III Funding
All AF Phase III	$359,015,078.27
Companies that won FY19 D2PHII	$6,329,824.55
Companies that won FY20 D2PHII	$8,086,525.35

- Of 70 FY19 Direct to Phase II winners, 7 have received Phase III contracts in FY21 totaling $6.3 million
- Of 74 FY20 Direct to Phase II Winners, 5 have received Phase III contracts in FY 21 totaling $8 million

Source: Sam.gov AF Phase III Actions, FY20 & FY21

<u>Table D</u>: AF Phase III had shown Steady Improvement fy15-fy18



Source: AF SBIR/STTR Year in Review 2018