



# U.S. Army Applied SBIR Program *Innovation Framework*

**Leveraging Small Business Innovation Research Capital to  
Overcome Army Technology Challenges**

*Published by the*

*Office of Army Prize Competitions and Army Applied SBIR Program  
Assistant Secretary of the Army for Acquisition, Logistics and Technology*

Version 1.0

JULY 2023

## Table of Contents

---

|   |           |
|---|-----------|
| <b>How to Read the <i>Innovation Framework</i></b> .....  | <b>5</b>  |
| <b>Executive Summary</b> .....  | <b>6</b>  |
| <b>Section I: The Core Tenets of Army Applied SBIR</b> .....  | <b>13</b> |
| Introduction .....  | 13        |
| <i>Innovation Framework</i> .....   | 15        |
| Innovation and Actionable Information Sharing.....  | 16        |
| Program Focus and Limits.....   | 19        |
| Modeling Risk .....   | 21        |
| Important Terminology.....  | 22        |
| Identifying Our Customers .....   | 22        |
| Internal Customers: Army Modernization Enterprise .....   | 23        |
| External Customers: Innovation Economy.....   | 23        |
| Prior to Starting .....   | 24        |
| <b>Section II: Innovation Profiles</b> .....  | <b>25</b> |
| Innovation Profile 1: Open the Door to Innovation .....   | 26        |
| Applied SBIR Enabling Activities .....  | 28        |
| Using SBIR Capital to Buy Down Enterprise Risk .....  | 29        |
| Non-Traditional Technology Providers Grow the Defense Industrial Base.....  | 30        |
| SBIR Contracting Center of Excellence .....   | 30        |
| Intellectual Property Rights.....   | 30        |
| Innovation Profile 2: Balancing Flexibility with Efficiency in Both Problem Discovery and Solution<br>Discovery ..... | 32        |
| Innovation Classification Types .....   | 33        |
| Science + Engineering, Not Science vs. Engineering.....   | 35        |
| Problem Framing .....   | 37        |
| Example of a Defined Problem Statement (For Routine Innovation) .....   | 38        |
| Example of an Open Problem Statement (For Non-Routine Innovations) .....  | 39        |
| Effective Problem Statements: Three Core Elements.....  | 40        |
| Innovation Profile 3: Adopt an Investor Mindset.....  | 42        |
| Elements of Portfolio Investing .....   | 43        |

|  |    |
|--|----|
| Metrics for Effectiveness and Performance .....  | 44 |
| Innovation Profile 4: Engage External Customer (Innovation Economy Firms) .....                  | 46 |
| The External Customer is Essential.....  | 46 |
| Army Joins the Innovation Economy .....  | 46 |
| Build Trust Through Communication .....  | 48 |
| Establish a Scalable Process .....   | 49 |
| Reasons to Invest in Brand-Building as an Innovation Economy Member .....                        | 51 |
| How to Find Partners.....  | 52 |
| Measuring an Innovation Network .....  | 53 |
| Innovation Profile 5: Transition Broker Teams.....   | 54 |
| Mission.....   | 54 |
| Team Composition and Structure.....  | 54 |
| TBT Role.....  | 56 |
| TBT Function.....  | 56 |
| Innovation Profile 6: Investment Thesis: What Applied SBIR Funds, What It Doesn't, and Why ..... | 59 |
| The Importance of an Investment Thesis.....  | 59 |
| Applied SBIR's Investment Thesis.....  | 60 |
| Policy.....  | 60 |
| Funding Characteristics .....  | 61 |
| The Kernel of a Good Strategy .....  | 61 |
| Diagnosis.....   | 62 |
| Guiding policy.....  | 64 |
| Set of Coherent Actions.....   | 66 |
| Applied SBIR's Investment Thesis.....  | 67 |
| Innovation Profile 7: Active Management .....  | 68 |
| Definition of Active Management .....  | 69 |
| Active Management Matrix.....  | 69 |
| Outline of the Active Management Methodology .....   | 69 |
| Innovation Profile 8: Applied SBIR Funding Characteristics .....                                 | 72 |
| Phase I: Small Bets .....  | 72 |
| Phase II: Larger Bets.....   | 72 |

|   |           |
|---|-----------|
| Award Evaluation Criteria.....            | 73        |
| Innovation Profile g: Acceleration .....  | 75        |
| Acceleration is a Process .....           | 75        |
| Overcoming Communications Challenges..... | 76        |
| <b>References and Readings.....</b>       | <b>77</b> |

## How to Read the *Innovation Framework*

---

The **U.S. Army Applied SBIR Program *Innovation Framework*** is a reference document that codifies the program's approach to bring small business talent and technologies into the Army enterprise (e.g., research, acquisition, and sustainment) to help overcome military technology challenges. As a practice-informed model, the *Innovation Framework* brings clarity to Applied SBIR operations and objectives and adds urgency to the broader debate over reform of the Army modernization business model. The purpose of the framework is to shape the SBIR Program's innovation leadership and inform its role as an important Army interface with the emerging technology sector, also referred to as the **innovation economy**.

In **Section I**, the *Innovation Framework* presents the theory and key elements underpinning the Applied SBIR approach to innovation leadership. It introduces the approach to key stakeholders, staff, and partners. It includes the program's mission, roles, functions and objectives, and provides the justification for the thinking that underpins the Program's interpretation of both its purpose and operating environment — the "Why" of Applied SBIR.

Succinctly, Applied SBIR is a Congressionally mandated pool of R&D capital provided from the Army's budget to fund small businesses to develop solutions to overcome Army technology challenges. As a Federal Department participating in the U.S. Small Business Administration administered "America's Seed Fund," the program's mission is to make high-risk R&D bets that smartly leverage small amounts of capital to buy-down risk for the Army's larger, more scalable acquisitions and research efforts.<sup>1</sup> Understanding the "Why" fuels decisiveness at all levels within the program to support the smartest capital allocations across the multi-year trajectory of the SBIR investment lifecycle.

**Section II** of the *Innovation Framework* defines the "What" of Applied SBIR. Through implementable illustrations called **Innovation Profiles**, the section demonstrates different aspects of Applied SBIR's approach. Providing more than an outline of activities, **Innovation Profiles** are an expression of the program's principles to maximize the impact of every dollar of SBIR R&D capital. Each profile is intended to be read on its own as a separate module and is not required to be read in a specific order.

The *U.S. Army Applied SBIR Process and Measures Manual* is a companion to this document containing the detailed processes supporting the **Innovation Profiles** and the measures by which the successes and failures of the model and its execution are evaluated.

### **Acknowledgement**

*In the spirit of the Joint Force, the Office of Army Prize Competitions and Army Applied SBIR Program gladly acknowledges the conceptual debt owed to the U.S. Air Force and its AFWERX Playbook.*

---

<sup>1</sup> U.S. Small Business Administration website, What is Small Business Innovation Research (SBIR/STTR), <https://www.sbir.gov/>, accessed on 15 January 2022.

# Executive Summary

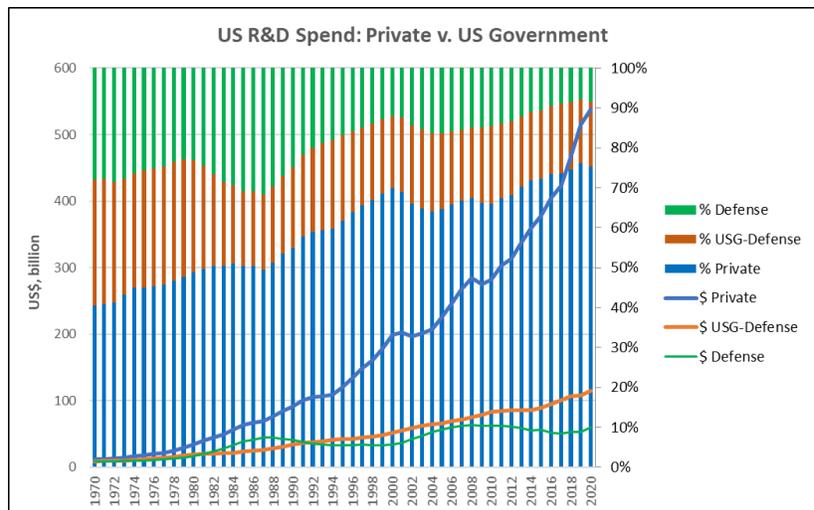
The purpose of the *Innovation Framework* is to shape the Army SBIR Program’s innovation leadership framework and showcase its role as an important Army interface with emerging technology firms. The framework helps staff and partners of the U.S. Army Applied SBIR Program to optimize designing and managing SBIR funded R&D efforts to best overcome Army technology challenges. This document is not about process, as the program has a companion document, *Army Applied SBIR Processes and Measures Manual*, detailing its process and metrics. Under the tenet that an organization’s culture is the culmination of the behaviors of its people (*talent*) plus the organizational channels through which those behaviors flow (*process*), the combination of the ***Innovation Framework*** and *Applied SBIR Processes and Measures Manual* represents the codification of the Applied SBIR culture: the “secret sauce” of the program’s success in dealing with the emerging technology industry — hereafter referred to as the **innovation economy**.

## Innovation Economy as Competition Zone

The innovation economy is the portion of the overall economy — mostly private but also includes academia and government — in which technologies new and existing are emerging into novel applications to close the gap between current capabilities and a desired future state. This is the program’s working definition of “innovation.” Technology providers — those firms developing discrete technologies — are the most obvious innovation economy participants, but other essential participants are capital providers (e.g., venture capital), technology and business accelerators (e.g., Y Combinator, TechStars, etc.), and the consulting, legal, and accounting firms that support these participants.

Since the innovation economy is both the primary source of military technological advantage and global in nature, it is currently the primary field of great power competition where battles between many participants are fought daily to secure technologies essential to national security. The Army should be an active participant in the innovation economy, understanding that its standing and reputation within this economy is directly proportional to the *real* and *perceived* value it brings to the innovation economy.

Historically, the Army boasted a strong brand and contributed value in the form of funding, research, and testing opportunities; however, since the 1990s, Army acquisition and R&D funding practices have not kept pace with the perpetually evolving and increasingly consumer-oriented, private sector-oriented innovation economy. The failure to adapt to a



changing environment has led to a growing gap between the Army's potential versus actual value contribution.

### **Shifting Center of Gravity of R&D**

In 1988, U.S. government R&D spending dipped below that of similar domestic private sector investment and has been diving ever since as a percentage of total U.S. domestic R&D. This change represents a ground-shift away from the Army in who decides the direction of innovation as well as the considerations shaping end-use priorities. Successful Army funding models and practices employed to integrate emerging technologies in the mid-20th century are proving their obsolescence within the contemporary innovation economy. The Applied SBIR Program is part of the Army's answer to develop new approaches and processes that not only recognize the shift in influence over the innovation agenda, but also seize the opportunities presented to the Army by the enormous growth in private R&D spending.

### **Two Elements of Applied SBIR**

As part of a larger reform effort to close the gap between what the Army can and does offer the innovation economy, the Applied SBIR Program recognizes two core elements of the nature of the program. The **first element** is the recognition that financial capital is the Program's primary resource to achieve its mission because that is the only asset it directly controls, as it does not itself conduct R&D nor acquires anything on behalf of the Army. The logical consequence is the program's **core competency is deciding how to best allocate its assigned capital**.

In a mission-focused sense, Applied SBIR's role is to provide financial intermediation between the Army and small, technology businesses; in essence, acting as a bank. The program functions to make many small bets to identify a few firms with the technical and business capacity to meet Army needs, and then participate in the planning to viably integrate these companies into an acquisition program. This description of function is the **second element** of the program and is the same function as a financial investment team. Recognizing this second and final element of the nature of the program should permit both the program and its stakeholders to understand where it fits within the larger Army enterprise as well as to appreciate what the program can and cannot do.

## Applied SBIR Value Proposition

|  <b>Challenge</b>  |  <b>Approach</b>   |  <b>Desired Outcome</b>  |
|---|---|---|
| <ul style="list-style-type: none"> <li>As the private sector outpaces the public sector in innovation, <b>the Army becomes increasingly isolated due to incompatibilities between legacy Army practices and rapidly evolving innovation economy channels and practices.</b></li> <li>This gap between the public and private sectors' innovations is an under-penetrated market that can be leveraged to foster innovation across the DoD.</li> </ul> | <ul style="list-style-type: none"> <li>Army Applied SBIR facilitates information, ideas, and resources to flow freely between members of its social system from the earliest stages of strategy formation.</li> <li>The program leverages teams incorporating experts in <b>acquisition, technology and market knowledge</b> to gain awareness of changes in the innovation operating environment.</li> </ul> | <ul style="list-style-type: none"> <li>The program's potential network is massive and represents a social system connecting hundreds of thousands of Soldiers, acquisition and laboratory professionals, contracting officers, emerging tech companies, research institutions, private sector investors and fellow government agencies to its mission and the opportunities it offers network members.</li> <li>The Applied SBIR innovation leadership model creates a <b>strong network to rapidly communicate needs across the maximum accessible social system</b> (i.e., total innovation economy) to <b>generate competitive solutions</b> from a wide field of creative endeavors.</li> </ul> |

**Applied SBIR's central value proposition to the Army is how it buys down risk** to the Army's much larger acquisitions and non-SBIR R&D activities. This **risk buy-down** leverages small amounts of Army money to test technologies and prove the business case around their practicality and feasibility to address Army challenges. As small bets that succeed or fail in a technical sense, all SBIR investments add to the Army's R&D and broader innovation economy knowledge base. But feasibility of said technology's integration into Army acquisitions is just as important and encompasses testing and evaluating criteria from the small business' ability to scale production to uniquely Army considerations like willingness of acquisitions to integrate the tech into an existing platform or the availability of acquisition dollars from appropriated funds.

### Investor Mindset Components:

With respect to Applied SBIR's direct value proposition to the innovation economy, the program leverages its financial strengths by making apparent the following three key advantages:

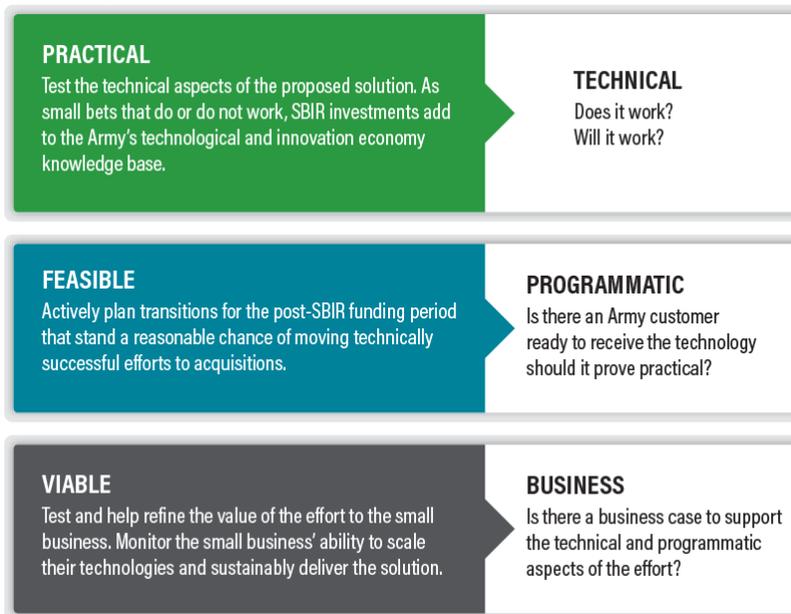
- 

\$250,000 - \$4,000,000 in capital with twice these amounts possible.
- 

SBIR R&D capital is non-dilutive with neither loan or bond repayment nor covenants.
- 

Successful technologies qualify for consideration for Department of Defense non-compete acquisition contracts which are significantly larger than a SBIR award.

Modeling Risk:



The program employs three “fitness parameters” to shape which R&D efforts to fund and then monitors each effort’s risk profile across the SBIR investment lifecycle. These parameters directly support the use of “risk and opportunity tests” to ensure the program models its portfolio to assess both risks and opportunities, both planned and emergent. A structured approach to assessing fitness, risks and opportunities supports cost effectiveness. Through continuous monitoring and dynamic planning, these tools

help the program achieve results at the speed of relevancy to the innovation economy and manifest the program’s core value proposition of buying down risk for Army acquisitions.

Two Customer Types: Applied SBIR intermediates between two sets of customers:

- **Internal customers:** Acquisition professionals, technologists, and supporting organizations (contracting, legal, etc.).
- **External customers:** Innovation economy firms who deliver or support the delivery of technological solutions to Army problems.

To effectively deploy its capital and safeguard its investments, the Applied SBIR Program must serve both types of customers appropriately and mindfully. To do this, the program strives to build and maintain an understanding of its market, its customers, and their relative market positioning. Given the unique considerations in working with the government, structuring R&D investments to be attractive to innovation economy participants is essential to overcoming resistance to doing business with the government — especially among capital providers.

**Solution and Problem Discovery**

How the Army communicates its technology challenges is important to the productivity of its engagement with the innovation economy. The Army’s tendency is to solicit proposals for a solution per an identified Army requirement. However, with the increasing pace of private sector innovation and the emergence of peer, great power competitors, the Army’s technological environment demands processes aware of the opportunities and threats of non-routine, disruptive innovations.

The growing cadre of technological challenges that do not fit a proscriptive approach opens the Army to the danger of a rush to solutions of incremental effectiveness by limiting the process to only “solution discovery,” e.g., seeking new technologies that solve for known problems. Preventing technological surprise and leveraging disruptive innovations requires a model built to also recognize “problem discovery,” or the process by which a solution discovered that doesn’t work for the problem as originally sought is nonetheless a valuable solution to another problem. In communicating problem statements to the innovation economy that recognize the non-linearity of disruptive innovation, Applied SBIR funded R&D efforts go beyond incrementalism by opening ourselves to solutions looking for the right problem.

Intertwining Science and Engineering: Building on the openness to discovery of both solutions and problems is the Army SBIR Program’s recognition of the value of intertwining the reasoning of the *scientific method* with that of the *engineering process*. Engineering is excellent at solving practical, discrete problems, and SBIR funded R&D efforts must always tie back to supporting technologies that solve discrete Army problems. However, engineering alone can fall into the narrowness trap of excessive focus on lower-risk processes and repeated testing that lacks connection with the original purpose of the R&D.

In contrast, the scientific method starts with a question, observations and experiments, and leads to a theory that is generalized to other similar phenomena. The benefit to this openness is the flexibility to discover solutions and new problems. However, the limitation of the scientific method is its theories may be easily disproven, and, most importantly for the Army, it is a method toward improved understanding of “why” things work and not necessarily intended to understand “how” things work necessary to achieve specific outcomes.

Drawing on developments in the understanding of technological change, Applied SBIR’s innovation leadership employs a blend of both science and engineering to make the best decisions on how to allocate its R&D funds and manage the investments over their lifecycle to improve the chances of transition. Applied SBIR intertwines the openness of science with the focus of engineering to move quickly and nimbly to support the intake to the Army of information on the talent and technology within the innovation economy and assist our internal customers to develop discoveries into focused, practical solutions.

### **Transition Broker Team (TBT)**

Modeled on a financial investment team and Section 809 Panel recommendations, Applied SBIR’s Transition Broker Teams (TBTs) are the principal mechanism by which the program blends investing with Army priorities and then science with engineering to incubate effective problem and solution discovery.

TBTs are a cross-organizational team (e.g., acquisitions, technologists, business analysts) for information share among team members improve mutual understanding with the aim of enhancing SBIR fund allocation decisions. TBTs maximize the effectiveness and impact of Army SBIR funds to reduce technical and execution risk in Army acquisitions and R&D programs. The outcomes of the SBIR investment

portfolio must both enhance and expedite Army programs and enable commercialization opportunities for small businesses.

TBT Functions:

- **Action Shared Information:** Operating in the information space between its members, TBTs are knowledge managers who ensure that as developments occur in the technological, programmatic, and private sector business case, TBT members are aware of these changes and quickly take actions to mitigate risks and exploit opportunities.
- **Allocate Funds:** Institutionalized knowledge-sharing among internal customers improves risk-weighted decision-making in the allocation of SBIR capital to specific R&D efforts. Called Active Management, TBT processes employ the team's collective talent to achieve optimal decision-making over the SBIR lifecycle.
- **Transition SBIR Funded Technologies:** Synchronize the planning and actions of TBT members to lower the risk to transition of the SBIR funded technology to an acquisition program or further R&D.

### **Applied SBIR Investment Thesis**

To succeed in its mission of applying its core competency of allocating capital to effectively support R&D activities, Applied SBIR needs a strategy to identify objectives, priorities, appropriate actions for capital allocations, and an approach to recognize which R&D opportunities fit with its mission. **Applied SBIR's investment thesis is to fund R&D to identify and then develop commercially available technologies into solutions for Army technology challenges.**

The following four policies constitute the program's execution of this thesis:

- A. Establish itself as a government-styled investment firm by recognizing both the program's core competency of allocating scarce funding to specific R&D purposes as well as its fiduciary responsibilities to the Army to safeguard and manage those funds after allocation.
- B. Employ a portfolio management model to actively manage risk and exploit opportunities.
- C. Structure its activities within multi-disciplinary, cross-organizational entities (e.g., transition broker teams) to share information to improve mutual understanding of the risks and opportunities with the purpose of supporting the best capital allocation decisions.
- D. Set as its objective the transition of technologies from the R&D to Army acquisition and then focus its planning and activities to achieve that transition in cooperation with internal and external customers.

Applied SBIR takes the following actions intended to overcome the obstacles it encounters:

- A. Address a tech problem that can be solved by a U.S. small business with a rough total of \$4M and in no more than four years.
- B. The SBIR funded R&D technology solutions must have a commercial, consumer-oriented market application and revenue prospect.

- C. While SBIR funding is RDTE and therefore the small business must perform some type of “research and development,” there is no prerequisite minimum of either research or development in a SBIR funded R&D effort.
- D. Firstline management of the SBIR funded R&D effort shall come from an Army expert with both the relevant technical competency and the time to manage the work of the small business.
- E. An appropriate and willing transition partner shall be directly involved from the beginning of the R&D effort to furnish a transition plan to integrate the technology into a larger Army system using identified funds to make the transition feasible.
- F. Through a TBT, all three parties to the effort (e.g., technologist, acquisitions, Applied SBIR) shall remain engaged across the entire SBIR lifecycle, and employ a team-based approach to lead through the inevitable changes and problems to transition.

### **Summation**

The *Innovation Framework* creates a synchronization of effort for the Applied SBIR Program and its partners to improve mutual understanding of Army technology problems and the innovation context within which solutions may be found. Treating SBIR awards as investments managed by a stabilized team means there is a unified effort around consistent objectives over the entire SBIR investment lifecycle. Fine tuning the approach over time, with valuable contributions from partners’ diverse, iconoclastic thinking, will foster an Army that is in sync with the innovation economy and is essential to furthering national security.

# Section I: The Core Tenets of Army Applied SBIR

---

## Introduction

Created in 2020 by the Assistant Secretary of the Army for Acquisitions, Logistics and Technology (ASAALT), the intent of Army Applied SBIR Program is to improve the quality and speed of the transition of innovative technologies into the Army's acquisition and R&D programs.<sup>2</sup> What you are about to read is a thought guide and reference document to shape your actions to support that intent. Though taken as the perspective of the Army Applied SBIR Program, the principles and approaches of the framework are relevant to any Army organization seeking to tap into private sector talent and technologies.

Section I of the *Innovation Framework*, the Core Tenets of Army Applied SBIR, provides the "Why" of the Applied SBIR Program in the form of a formal mission statement and definitions of the Applied SBIR role and function. Subsequently, Section II, Innovation Profiles explains the "What" of the program through several illustrations of foundational Applied SBIR practices.<sup>3</sup> Innovation Profiles exemplify the Applied SBIR innovation leadership model, the understanding of which is necessary to continue mission within an ambiguous, fragmented, and very inter-dependent innovation environment. The *Innovation Framework* should not curtail your thinking about problems and problem solving by setting limits, but rather enable it by providing a structure and common approach to carry the team forward beyond where written rules and procedures on their own enable organizational success.

The intent of the framework is to help program staff and internal Army partners more effectively contribute their human capital to the Applied SBIR efforts to best allocate SBIR financial capital to R&D efforts aimed at overcoming Army technology challenges. The *Innovation Framework* will assist our decision-making in the allocation of SBIR capital and is a guide to navigate shifting internal Army culture and Army modernization enterprise processes, while also incorporating as much as feasible the whole Army and Joint Force in common problem-solving. This document is not about process, as the program has a companion document, *Applied SBIR Processes and Measures Manual*, detailing standard operating procedures. Under the tenet that an organization's culture is the culmination of the behaviors of its people (*talent*) plus the organizational channels through which those behaviors flow (*process*), the combination of the *Innovation Framework* and *Applied SBIR Processes and Measures Manual* represents the codification of the Applied SBIR culture: the "secret sauce" of our success in dealing with the emerging technology industry – hereafter referred to as the **innovation economy**.<sup>4</sup>

Explained later in (Innovation Profile 4: Engage the External Customer (Innovation Economy Firms)), the innovation economy is currently the primary field of great power competition where battles are fought

---

<sup>2</sup> Applied SBIR definition of *transition* is the process by which a technically successful innovation proves feasible for integration into an acquisitions program or further R&D. See *Important Terminology* section for more detail.

<sup>3</sup> For more on thinking terms of the organizational Why and What, Simon Sinek, "Start with Why," <https://youtu.be/zSs78LfY3nE>, accessed September 23, 2022.

<sup>4</sup> Adapted from John Kotter, "Leading Change," Harvard Business Review Press, 2012, p. 33.

with other nations to secure technologies essential to our national security. It is the portion of the overall economy — mostly private but also includes academic and government — in which technologies new and existing are emerging into novel applications to close the gap between current capabilities and a desired future state of capabilities. These new technologies are either hardware or software, and either a product or process methodology.<sup>5</sup> Combined, the preceding two sentences are the *innovation framework's* definition of “innovation.”

In terms of an innovation economy participant taxonomy, technology providers — those firms developing discrete technologies — are the most obvious innovation economy participants, but other essential actors are capital providers (e.g., venture capital), technology and small business accelerators (e.g., Y Combinator, TechStars, etc.), and legal, accounting, and consulting businesses that support the other participants. The government, and the Army in particular, can and should be a member of the innovation economy, but only if they materially contribute to value creation and are *perceived* to be doing so in a manner that encourages partnerships with other innovation economy actors.

In allocating capital, the Applied SBIR Program relies on a team-based model with members drawn from Army acquisitions and research centers to identify technical fields for its R&D efforts, generate SBIR topics for small businesses to submit proposals against, and manage the SBIR awards until success or exit from the effort (see [Innovation Profile 5: Transition Broker Teams](#)). In terms of transaction partners in capital allocation execution, Applied SBIR identifies two types of customers: one, internal Army customers (e.g., acquisition and research centers) and two, external customers as participants in the innovation economy (e.g., technical and capital providers along with technology accelerators and supporting business service firms). The ***Innovation Framework*** will help you to work with innovators regardless of organization and to leverage on behalf of the Army the talent and technologies within their organizations and the innovation economy at large.

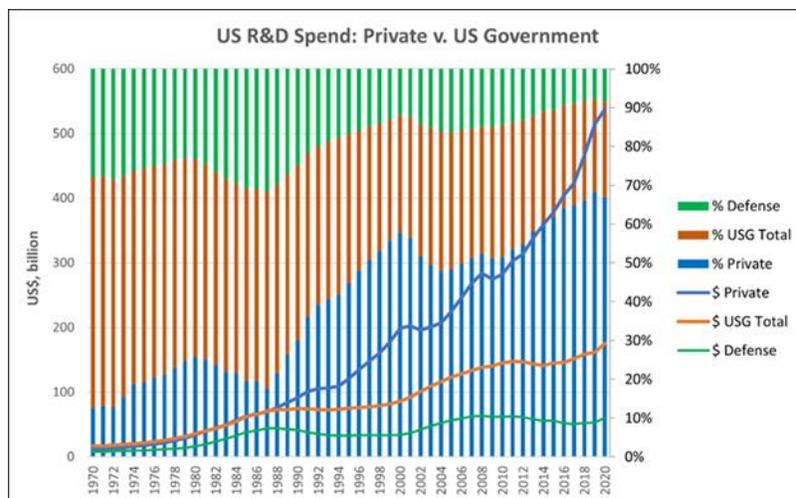
Drawn from innovation diffusion research and leading change literature, lessons from the Joint SBIR experience, as well as the finance industry, the ***Innovation Framework*** will prepare you to move at the rapid pace innovation requires, enabling the access to talent found in every innovation organization for cutting-edge technologies. You will not only face challenges requiring technical knowledge, but also confront some of the same business and use-case issues facing small businesses. In confronting those issues, you will gain fluency in both government needs and the parameters of small business decision-making. You will use this fluency to smartly allocate SBIR capital to incentivize small business technology firms to tackle military problems, while simultaneously preparing the Army acquisition and research systems to accept the ensuing technical solutions. What follows are principles and guidelines; modify them to fit the problems you encounter in executing Applied SBIR programs; and share them far and wide with partner organizations both internal and external to the Army.

---

<sup>5</sup> Pisano, Gary, “Creative Construction,” Harvard Business School Press, 2018, p. 45.

## Innovation Framework

Starting in 1988, U.S. Government R&D spending dipped below that of domestic private expenditures and has shrunk from 51% in 1987 to 25% in 2020. Defense R&D spending has halved to reach a 2020 low of 8%.<sup>6</sup> Both U.S. government types of R&D spending are yet again much smaller when compared to the aggregate of global R&D spending. The decline in government and particularly defense R&D spending



represents a ground-shift away from government and defense in terms of whose interests set innovation priorities and determines end-use applications.<sup>7</sup> A disturbing outcome of this ground-shift is the progressive divorce of the Army from large swathes of the innovation economy for whom the Army's needs are irrelevant.

For the past 30 years, most fields of R&D have followed the demands of the consumer and not that of national security concerns. Army funding models and practices to integrate emerging technologies successful in the mid-20th century are proving their obsolescence within the contemporary innovation economy. The incentives, network effects, and driving factors within the innovation economy have changed; likewise, the Army's approach should recognize these changes and adapt to the operating environment. The Applied SBIR Program is part of the Army's answer to develop new approaches and processes that not only recognize the shift in influence over the national and global innovation agenda, but also seize the opportunities presented to the Army by the enormous growth in private R&D spending.<sup>8</sup>

A disturbing outcome of the changes in R&D funding trends is the progressive divorce of the Army from large swathes of the innovation economy for whom national security in general, and the Army's particular needs in individual lethality, are seemingly irrelevant if not outright counter to some contemporary

<sup>6</sup> U.S. Bureau of Economic Analysis, "Government Gross Investment: Intellectual Property Products: Research and Development," and "Gross Private Domestic Investment: Fixed Investment: Nonresidential: Intellectual Property Products: Research and Development," and "Investment in Government Fixed Assets: Federal: National defense: Intellectual property products: Research and development," Federal Reserve Bank of St. Louis, accessed 18 December 2021, <https://fred.stlouisfed.org/series/Y057RC1Q027SBEA> and <https://fred.stlouisfed.org/series/Y006RC1Q027SBEA> and <https://fred.stlouisfed.org/series/I3GDEFN1RD000>

<sup>7</sup> O'Mara, Margaret, "The Code: Silicon Valley and the Remaking of America," Penguin Press, 2019, p. 316.

<sup>8</sup> Grewal, David S., "Network Power: The Social Dynamics of Globalization," Yale University Press, New Haven, CT, 2008, p. 4.

values. One perspective on the Applied SBIR Program mission is to overcome the consequences of this cultural divide. The program employs the talents of its people along with financial capital to catalyze the innovation, integration and implementation of creative, routine, and disruptive technology options derived from mutually beneficial relationships with industry, academia, and non-traditional acquisition sources. Connecting diverse, innovative members from traditional and non-traditional communities is at the heart of the Applied SBIR mission, and the program is at the leading edge of the crucial Army–innovation economy interface.

## Innovation and Actionable Information Sharing

To inform its model, the Applied SBIR Program uses *innovation diffusion research* to conceptualize innovation and the environment within which it occurs.<sup>9</sup> The first and most important step is to define an innovation. There is no single definition that incorporates all the potentially useful ways to look at innovation, but in the words of Everett Rogers:

*An innovation is an idea, practice or object perceived as new by an individual or other unit of adoption. It matters little, so far as human behavior is concerned, whether or not an idea is objectively new...If an idea seems new to the individual, it is an innovation.*<sup>10</sup>

Applied SBIR builds on this definition to create a version appropriate to the Army:

*New and existing technologies emerging into novel applications within the Army that close the gap between current capabilities and a desired future state of capabilities that may be hardware or software and a product or process methodology.*

The power of this innovation definition is in its inclusion of both the more often thought of technical aspect along with the less apparent communication and community aspects of innovation. It explicitly covers technology as something being “new” relative to a specific group. It recognizes that innovation is both a body of knowledge (i.e., the accepted facts and forms of science and engineering) as well as a cultural issue since innovation is subject to the abilities and style of communication across groups and the groups’ respective members’ receptiveness to messages from outside their own group.<sup>11</sup> In light of the changes in the economic environment over the past 30+ years illustrated above, the relevance of this type of inclusive definition is to help the Army recognize that its attempts to overcome technical challenges is not just a technical issue but a cultural and communication issue. An inclusive approach to technical problem solving may help the Army address the negative consequences of it being seen as a limited or even non-participant in the innovation economy. To the extent its mandate and resources

---

<sup>9</sup> Space limits the detail presented here to explain the state of innovation research but please see the Recommended Reading section at the end for a listing of the resources employed in writing the *Innovation Framework*.

<sup>10</sup> Rodgers, Everett M. “Diffusion of Innovations,” Free Press, Fifth Edition, 2003, p.12.

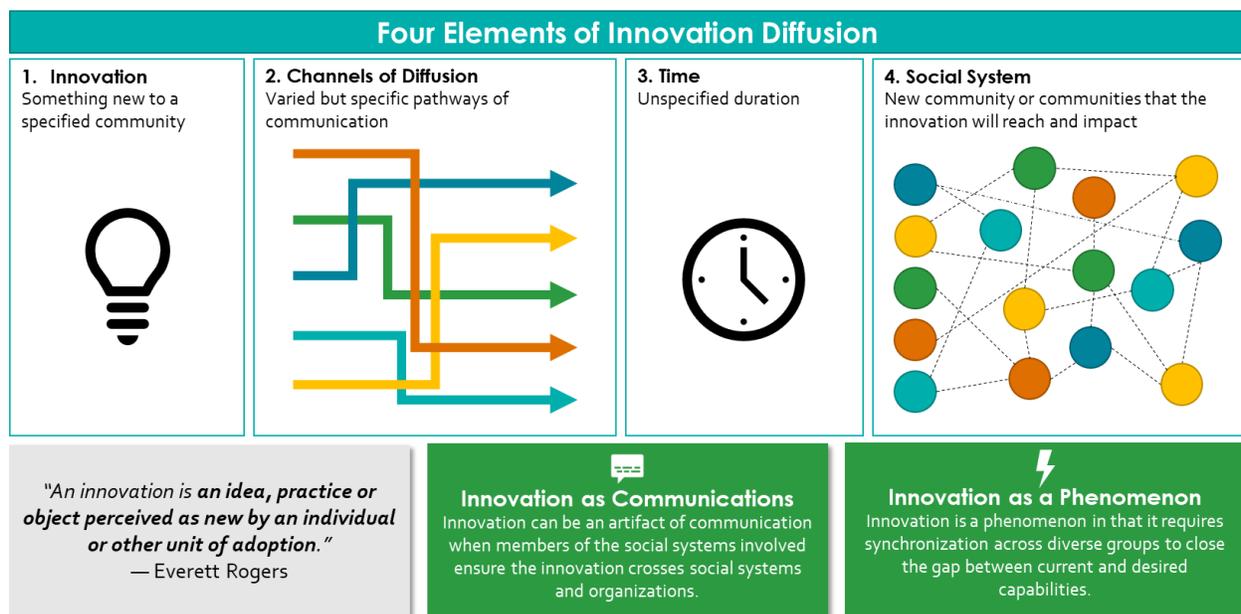
<sup>11</sup> Narayanamurti and Tsao, “The Genesis of Technoscientific Revolutions.” Cambridge, Harvard University Press, 2021, p. 29.

permit, the Applied SBIR Program works to return the Army presence within the broader American innovation economy that current Army acquisitions and research pathways do not enable on their own.

Rogers’ four elements of how innovations diffuse are an effective way to conceptualize the program’s operating environment and provides clues on how to navigate that environment.<sup>12</sup>

Under this concept of innovation, something new to the community (1) flows through varied but specific pathways of communication (2) over a time of unspecified duration (3) to reach and then impact members of a social system (4) — or the information doesn’t flow through the entire ecosystem, in which case some or all members of the social system remain ignorant of the innovation and its potential. The Applied SBIR Program explicitly looks at this process flow and identifies key aspects of it (highlighted in [Section II: Innovation Profiles](#)) to first, identify opportunities for exploitation, and second, drive operational planning to capture the potential return to the Army from these opportunities. The resulting programmatic posture is essentially the “campaign plan” Applied SBIR uses to address key tasks within the execution of its mission.

Since innovation is both a phenomenon<sup>13</sup> and an artifact of communication, these two aspects of



innovation must be synchronized and maximized for effect, without which “innovation” is either anemic in delivery on its promise to close the gap between current and desired capabilities or is simply non-existent regardless of the money or effort invested. **Innovation as a phenomenon** means the Applied SBIR Program works to synchronize for practical effect R&D efforts across the Army’s many component organizations with those of the much larger, more diverse innovation economy. **Innovation as communication** is ensuring the discovery of something new crosses social systems and organizational boundaries. As a financial intermediary and interlocutor between the Army and the innovation economy,

<sup>12</sup> Rogers, p. 11.

<sup>13</sup> Merriam-Webster definition of phenomenon, “something that can be observed and studied and that typically is unusual or difficult to understand or explain fully.”

the program invests in constructing both the content and form of its messaging campaign. In using Rogers' innovation diffusion elements, which recognize innovation as both something done and something communicated, the Applied SRIB Program pushes the envelope of its practice to allocate capital to the highest best use R&D efforts to achieve success for its partners and, through them, the Army.

The Applied SBIR Program works with partners to address an **innovation deficit** the Army has accumulated over the past few decades as the innovation economy has surged ahead with new technologies not widely incorporated into the Army. This deficit exists due to incompatibilities between legacy Army practices and rapidly evolving innovation economy practices and agendas. Compounding diverging structures and practices, the Army's inability to communicate as an innovation economy participant interferes with its access to the innovation economy's growing pool of potential technological solutions. The deficit is driven in part by the language and mindset the Army uses to both conceive of and express its practice of managing its interactions with the innovation economy.<sup>14</sup>



The burden of adjustment falls on the Army to recognize changes in the innovation economy because many private sector firms do not find the Army's "funding tune" sufficiently attractive. A manifestation of the innovation deficit is the Army has formed a largely isolated innovation community (i.e., defense industrial base) composed of a small slice of the total innovation economy that is less innovative because its rate and focus of innovation is driven by a relatively small buyer (i.e., the Army) with limited needs compared to the much larger, more dynamic consumer-driven marketplace. The consequence for the Army of this deficit is access to a small subset of the total potential innovations of value to the Army to fulfill its national security mission. From the innovation economy's perspective, the deficit is an under-penetrated market and opportunity to grow. To address the deficit, the Applied SBIR Program synchronizes technical needs across Army research and acquisitions and communicates with the innovation economy in its own language respecting the decision-making parameters common to participants in that economy. It does this to benefit the Army and to fulfill unrealized potential for both sides.

An inclusive innovation model relies on creating new and diverse **connections** to source the best ideas and solutions. Porous organizational boundaries and dense networks enable the process by allowing information, ideas, and resources to flow between members of the innovation social system. The Applied SBIR model directly incorporates acquisition managers and technologists (collectively, the program's internal customers) from the earliest stages of the innovation effort and maintains this team-based approach to ensure awareness of changes in the innovation operating environment to support the best decision-making across the Applied SBIR investment lifecycle. The program's potential network power is massive and represents a social system connecting hundreds of thousands of Soldiers, acquisition managers laboratory professionals,



---

<sup>14</sup> Azhar, Azeem, "The Exponential Age," Diversion Books, New York, 2021, p. 80.

contracting officers, emerging tech companies, research institutions, private sector investors and fellow government agencies to its mission and the opportunities it offers network members. The Applied SBIR innovation leadership model creates a strong network to rapidly communicate needs across the maximum accessible social system (i.e., total innovation economy) to generate competitive solutions from a wide field of creative endeavors and then have a plan of how to integrate those solutions into the Army's programmatic structure (i.e., internal Army customers).<sup>15</sup>

## Program Focus and Limits

Recognizing that good strategy is as much about choosing what not to do as it is about what to do, it is important to be clear about both the focus and limits of the Applied SBIR Program's roles and functions.<sup>16</sup> The program marshals capital for maximum effect by focusing on its capital deployment role (i.e., choosing how to best allocate assigned capital) to support the R&D activities of small businesses to most effectively address Army technology challenges. The Applied SBIR Program prioritizes its traditional mission of supporting technical innovation through its funding of discreet R&D efforts. However, the Program goes beyond a purely technical approach to innovation by also emphasizing continuous innovation within its internal organizational approach and processes to optimize allocation of capital to its highest, best use within those SBIR funded R&D efforts. Combining vertical innovations (e.g., discrete R&D efforts) with horizontal innovations (e.g., program improvements) is how Applied SBIR remains relevant and effective in a highly dynamic and difficult operating environment.

Included in the bounding its strategic role, **Applied SBIR is** a conduit for the bi-directional flow of technologies and related business-case information between the innovation economy and the Army. In a mission-focused sense, the program's role is like a bank or venture capital entity (or as marketed by the Small Business Administration "America's Seed Fund") providing capital to emerging tech small businesses and, in so doing, providing financial intermediation between the Army and those businesses<sup>17</sup> (see [Innovation Profile 3: Adopt an Investor Mindset](#) for more detail on how Applied SBIR executes its financial intermediary function). The program has a fiduciary responsibility on behalf of the Army to allocate its assigned capital to achieve its highest best use on behalf of the Army and to fulfill its Congressional authorization.<sup>18</sup> As a fiduciary, the results of Applied SBIR intermediation should be assessed against clear measures and held accountable for the outcomes of its activities.

The program's practice of using capital through a team-based model to develop an innovative prototype means its **core competency is making decisions on how to best allocate assigned capital** (see [Innovation Profile 5: Transition Broker Teams](#)). The program does this under the premise that the much larger private sector R&D industry has enormous untapped potential to offer in overcoming Army

---

<sup>15</sup> David Grewal, 2008, p. 20.

<sup>16</sup> Rumelt, Richard, "Good Strategy, Bad Strategy," Crown Business, 2011, p. 62.

<sup>17</sup> U.S. Small Business Administration website, What is Small Business Innovation Research (SBIR/STTR), <https://www.sbir.gov/>, accessed on 15 January 2022.

<sup>18</sup> Definition of fiduciary, "A person or organization that acts on behalf of another person, putting their clients' interests ahead of their own, with a duty to preserve good faith and trust. Tasks often involve managing the assets of others," Investopedia.com, accessed 25 September 2022.

technology challenges. The program diffuses innovation by using its capital to facilitate the small business providers of technology to convert ideas into prototypes.<sup>19</sup> It executes these fund manager activities explicitly to transition external innovations into the Army and, in so doing, buy down risk to larger, more complex Army acquisitions system.<sup>20</sup>

Excluded from the bounding of its strategic role, **Applied SBIR does not** stray from its capital allocation mission focus. As a pool of capital of a few hundred million dollars annually, the program is relatively small compared to both leading venture capital funds as well as many Army acquisition programs. It deploys objectively small amounts of capital to catalyze change in much larger acquisition and R&D programs (see [Innovation Profile 6: Applied SBIR Funding Characteristics](#)). The program right-sizes its operations to quickly discover routine and especially disruptive innovations to catalyze change and then acts nimbly to help its partners to exploit the value proposition created.<sup>21</sup> As part of “right-sizing” functions, the program eschews extensive vertical integration of its activities as well as the otherwise admirable Army *can-do* (“can do it all”) ethos by not directly participating in some aspects of the Army innovation.

Applied SBIR core competencies lie in the **allocation of capital to high-risk technology bets** and in **marshalling the information and partnerships** necessary to achieve the most positive outcomes feasible for the R&D effort.

Applied SBIR’s internal customers have the core competency of directly interfacing with Army end-users, and it is through such partnerships that **TBTs maintain visibility on end-user environments and outcomes representing the ultimate impact of allocation decisions.**

The program does not engage in technical development because it lacks that competency and associated infrastructures that are rightly held by other Army organizations. Nor does it prioritize direct engagement with technology end-users within the Army because it lacks the outreach and knowledge management capabilities necessary to truly understand end-user needs and assess relative risk / reward between and among those needs. It would be ill-advised for the program to acquire those capabilities because of the dilutive effect on the program’s capital allocation competencies. As analogy for why directly dealing with the Army end-user is ill-advised, banks do not run management consulting practices to advise loan recipients on how to use their funds nor do most venture capital firms run their own business accelerator.<sup>22</sup> Applied SBIR purposefully does not perform these functions and relies on partners to effectively fill gaps in technical and end-user knowledge. Relying on Army and Joint partners (e.g., Army Applications Lab, AFWERX, Catalyst-Pathfinder) who possess these competencies both preserves Applied SBIR’s core competency and institutionalizes the cooperation and collaboration essential to maximize any single organization’s innovation effort.

<sup>19</sup> Small Business Administration, *SBIR/STTR Policy*, October 2020, p. 11, prototype definition: A product, material, object, system or process, or a model thereof, that is in development, regardless of whether it is in tangible, electronic, graphic or other form, at any stage of development prior to its intended ultimate commercial production and sale, includes computer programs embedded in hardware or devices.

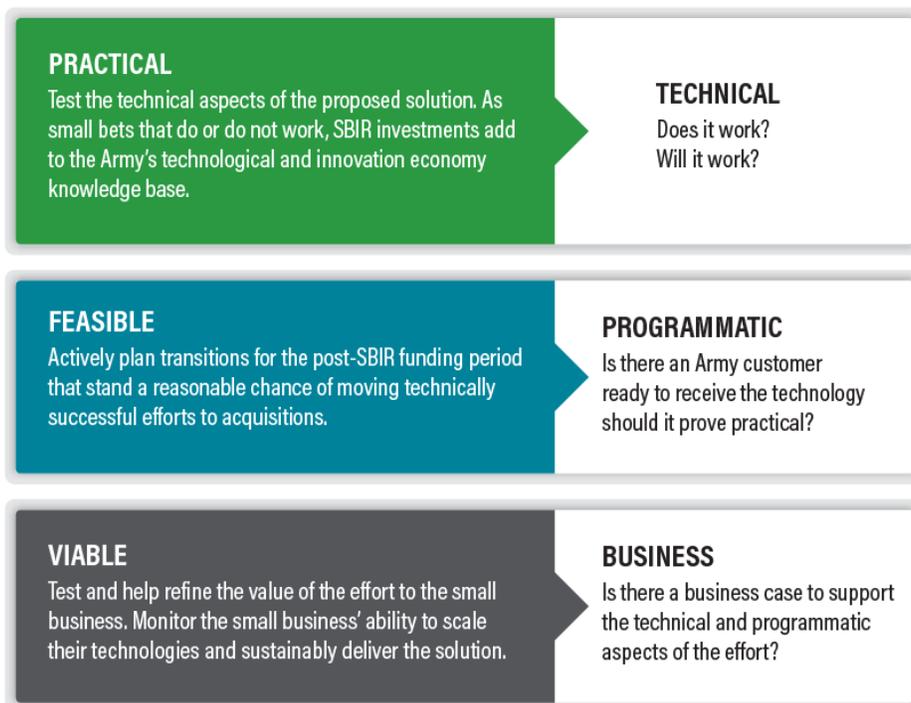
<sup>20</sup> See Important Terminology for a definition of “risk” and “buy-down risk.”

<sup>21</sup> Christensen, Clayton M., “The Innovator’s Dilemma,” Harvard Business Review Press, 2000, p. 134.

<sup>22</sup> While many venture capital firms provide management advice and board participation, this is well beyond what Applied SBIR is either permitted to do per its authorization or resourced to execute.

## Modeling Risk

Because the challenges of moving from research to prototype development are complex, the Applied SBIR Program does not concentrate its work on immature technologies and is categorically prohibited from funding low-rate or other manufacturing or acquisition programs. Therefore, the program seeks to fund R&D work with a reasonable chance of producing a prototype within four to five years, the generally accepted maximum duration of a SBIR R&D effort. The intent of the program is to have the SBIR funded small business deliver to the program's internal customer a prototype that is sufficiently mature for integration or further research. In its capital allocation modeling, the program uses three analytical perspectives on risk to assess the fitness of an R&D effort for SBIR funding:



Within its team-based model, the program employs an active management process to perform this analysis at initial capital allocation and across the SBIR investment lifecycle (~one to four years). Acquisition professionals, research center technologists, and Applied SBIR portfolio managers collaborate to generate SBIR topics and then manage the R&D effort to account for inevitable and sometimes un-forecastable changes in each of the three risk parameters.

Maintaining focus on the program's core competency — capital allocation decisions — is important to ensure Army leaders can appropriately hold the program accountable for outcomes specific to its mission. The Applied SBIR Program maximizes its operational potential by focusing on what it is designed to do and doing that well. Because there is no single solution to the Army's extremely wide innovation problem set, the program explicitly designs its operations to rely on partnerships with both its internal and external customers.

## Important Terminology

At the end of the Innovation Framework, there is a Glossary of terms but what follows is an expanded explication of three of the most operative terms used by the program.

**Transition** is defined as the effective and meaningful adoption of an externally sourced innovation to an Army acquisition program or further non-SBIR, Army R&D funding. A secondary definition of transition includes successful small business revenue generation as measured by sales to the private sector of technologies for which SBIR funding was crucial.<sup>23</sup> An extended definition includes the term **transition partner** as the organization identified at the inception of the SBIR investment cycle and the organization ultimately responsible to integrate into other programs the technology when and if delivered.

**Risk** in its broadest sense is the chance for any reason an innovation will fail to progress from the lab to the field and from the innovation economy into Army acquisitions or non-SBIR R&D funding. Applied SBIR disaggregates overall risk into three degrees of risk as covered above in the discussion of its capital allocation parameters: Practical (technical), Feasible (programmatic), Viable (business).

**Buy-down risk** is what the Applied SBIR Program does when it invests relatively small amounts of capital (normal range of \$250,000-\$4 million) over short investment periods (six months to five years) to quickly explore a potential technical solution's fitness for the Army. The successful technologies developed, and the lessons learned from unsuccessful R&D efforts accelerates Army evaluation of a technology and reduces the risk — and associated costs — for acquisition programs interested in exploring innovative options. In the case where technologies do not fit Army needs, the program can exit from the R&D effort with minimal financial loss and lessens the natural but inappropriate inclination of decision-makers to fall into the "sunk cost fallacy" by continuing to invest in an otherwise low-return effort.<sup>24</sup> Since the Applied SBIR Program's Transition Broker Team model institutionalizes a bridge across the organizational seams of acquisition and research, information from its R&D efforts on what does and does not work efficiently flows back into the broader Army knowledge base (see [Innovation Profile 5: Transition Broker Teams](#)). This is an important aspect of how the program leverages itself as a channel of diffusion to access the deep and complex social system (i.e., networks) that is the innovation economy.

## Identifying Our Customers

The Applied SBIR Program has a range of customers spanning Army and by extension government (i.e., internal customers) and the innovation economy (i.e., external customers) all representing diverse participants who possess complementary and sometimes unique resources and capabilities vital for the successful use of innovations.

---

<sup>23</sup> Small Business Administration, SBIR/STTR Policy, October 2020, p. 23.

<sup>24</sup> Ronayne, D. et al., "How Susceptible Are You to the Sunk Cost Fallacy?" Harvard Business Review, July 15, 2021.

## Internal Customers: Army Enterprise

Internal customers include Army acquisition offices, research centers and supporting service organizations (e.g., Army Contracting Command) that represent the “internal customer” for Applied SBIR funds. Although “stakeholder” is also a relevant term, from the perspective of the program’s core competency as a capital allocator with fiduciary responsibilities, “internal customer” is the preferred reference because it denotes a service relationship between Applied SBIR and those on whose behalf the program conducts its work. Included in this category are DOD, Joint, and Federally Funded Research and Development Centers (FFRDC) organizations.

## External Customers: Innovation Economy

The innovation economy refers to all the organizations found within the private sector that originate, develop, and sustain changing technologies (capital as well as technology providers, accelerators, universities, and essential supporting organizations like accounting and legal firms). While these organizations may or may not sympathize with the Army’s strategic mission of national security, these private sector businesses are the essential source of talent, technology, capital, scalable manufacturing, and sustainable solutions to Army problems. Fully engaging our external customers and making SBIR funds both accessible and attractive to the best and brightest within the innovation economy is an Applied SBIR essential task.

To effectively deploy and safeguard its capital, the Applied SBIR Program must constantly strive to build and maintain its understanding of its market, its customers, and its relative market positioning. Robust market intelligence contributes to this market mapping essential for program success and requiring close teamwork within the Army and strong network connections with a broad range of innovation economy participants. In principle, innovation economy members can come from any part of society or the economy, so to clarify the wide range of innovation economy participants, the program uses the following taxonomy to structure its interactions:

| Army Enterprise   | Technology Providers   | Capital Providers  | Academic Institutions   | Technology Accelerators and Consultancies   | Legal and Accounting  |
|---|--|--|---|---|---|
| <ul style="list-style-type: none"> <li>• Army acquisition offices</li> <li>• Research centers</li> <li>• Supporting service organizations (e.g., Army Contracting Command)</li> <li>• Representing the internal customer for Applied SBIR funds.</li> </ul> | <ul style="list-style-type: none"> <li>• Those directly building the technology through science and engineering; traditionally what the Army considers its primary touchpoint or delivery mechanism for innovation.</li> </ul> | <ul style="list-style-type: none"> <li>• Those who provide the financial capital necessary to enable the innovation process over time; often overlooked and not traditionally considered directly relevant to satisfying Army technology needs.</li> </ul> | <ul style="list-style-type: none"> <li>• Those who provide science and engineering support directly to technology providers and process technologies to the entire innovation economy.</li> </ul> | <ul style="list-style-type: none"> <li>• Those working to improve efficiency and effectiveness of technology providers; often overlooked as not directly relevant to solving Army technology problems.</li> </ul> | <ul style="list-style-type: none"> <li>• Those firms providing essential business services to the innovation economy with connections across the innovation economy; again, oftentimes overlooked and not considered relevant.</li> </ul> |

Government organizations, and the Army in particular, can and should be a member of the innovation economy, but only if it both materially contributes to value creation and is perceived to be doing so in a manner that encourages partnerships with other innovation economy participants.

## Prior to Starting

Prior to funding an R&D effort, the Applied SBIR Program orients its activities around five principles. It starts with where good/great ideas may originate (anywhere inside or outside the Army), progresses to the prudent way to execute experimentation and manage the associated risk, balances the priorities of both its internal and external customers by explicitly recognizing the motivations of the private sector small businesses it is dependent on for talent and technology, and consistently communicates internally and externally around both opportunities and obstacles to build the Army's brand across the innovation economy spectrum.

1

### THE RIGHT PEOPLE

Innovation can come from anywhere. Internally, Applied SBIR serves to develop the innovation culture and engage people across multiple organizations in the innovation process. Externally, we clearly communicate Army challenges to the innovation economy to identify the best organizations and individual participants with whom to invest in building mutually productive relationships. These relationships are based on current and forecasted value creation and must not be limited to known or easy to work with collaborators.

2

### A CULTURE OF EXPERIMENTATION

The only constant is change. Leveraging the Army culture of experimentation is the foundation for an innovation-driven technology procurement process. Applied SBIR continuously explores and tests new approaches to transform the relationship with the innovation economy while ensuring clarity of purpose and unity of effort across the enterprise to increase the chances of a successful technology transition. While Applied SBIR takes on high-risk R&D bets to reduce risk among acquisitions and larger R&D programs, risk is assessed, not ignored. When high risk is assumed, it is taken only after careful senior leader deliberation and calculation.

3

### NETWORK ORIENTED

External networks and the relationships they bring will improve the Army enterprise, demanding change in some areas and a sharper focus on leveraging the Army's inherent strengths in others. Capital for R&D performed by the innovation economy, clear and transparent communications, empowered Applied SBIR personnel, and adaptable Applied SBIR investment structures signal to the world the Army's attractiveness as a business partner. The more the Army becomes an attractive business partner, the more effectively will it foster a 21st-century defense industrial base that is both responsive to and sustainable under the pressures of commercial as well as great power competition.

4

### INVESTMENT MINDSET

The government is no longer the R&D titan it once was as private actors and their capital dominate activity in most technology fields. This is especially true as our great power competitors are actively and extensively leveraging private sector means to achieve their strategic aims. They seek access to the same talent and technology within the U.S. innovation economy we seek. Aligning innovation programs with commercial markets and helping to catalyze additional investment is necessary to develop competitive forces in a broader, more robust and resilient defense industrial base.

5

### BUILD THE ARMY BRAND

Applied SBIR is one way the Army is building its brand among innovation economy firms. Unfortunately, the "innovation deficit" mentioned earlier in "Innovation Sharing," stems from the historical complexity and especially slowness associated with doing business with the Army. To correct this negative perception of the Army as a business partner, Applied SBIR designs its processes to emphasize clarity, speed, and actively aligns its internal customers' requirements prior to going to the innovation economy with R&D funding opportunities. Integrating Army acquisitions and research center technologists from the inception of Applied SBIR investments (i.e., topics) internally aligns the Army demand signal to create a more understandable and predictable business offer to innovation economy firms.

## Section II: Innovation Profiles

---

1. **Open the Door to Innovation**
2. **Problem Statements to Recognize Both Problem and Solution Discovery**
3. **Adopt an Investor Mindset**
4. **Engage the External Customer**
5. **Transition Broker Teams**
6. **Investment Thesis: What Applied SBIR Funds, What Doesn't It, and Why**
7. **Active Management**
8. **Funding Characteristics**
9. **Acceleration**

Section II, **Innovation Profiles**, sketches the rationales for the “What” of the program’s unique approach to allocating SBIR dollars. Short expositions of the Applied SBIR portfolio management model, the profiles highlight the practice of Section I’s framework principles. Providing more than a vision, these profiles are practical expressions of the program’s principles and approaches to maximize the impact of each dollar of capital allocated on behalf of the Army. Understanding the “What” fuels decisiveness and supports prudent capital allocation decisions across the multi-year trajectory of the SBIR investment lifecycle. Common across the profiles is the emphasis on empowerment of those engaged in the Applied SBIR Program and the intent to add urgency to debate over reform of the Army’s broader modernization business model.

## Innovation Profile 1: Open the Door to Innovation

Traditional acquisition and R&D programs with long time-horizons and onerous processes repel technology and capital providers who have numerous, lucrative other options within the consumer-driven private sector. The opportunity cost of their time is high, so they naturally choose the business partner that represents the greatest value-creation potential. Many innovation economy participants — technology providers, but especially capital providers — purposefully avoid doing business with the government due to the difficulties they experience from information gathering to contracting delays to programmatic surprises around funding and product delivery timelines. In turn, technology providers hold a common belief that working with the government is a massive time-sink compared to the nimbler and more remunerative private sector.<sup>25</sup> Since the innovation economy is a community, members of that community talk to each other creating a negative word-of-mouth impact on the attractiveness of the Army as a customer.<sup>26</sup>

One aspect of the money sensitivities of small businesses is that in the emerging technology world there is a term called “funding runway.” This is the time the company has before it runs out of money; in most cases, it’s less than 18 months. Even the biggest and most successful emerging tech firms have high burn rates (how fast the company spends money to support their business) and short runways. To work with technology providers, it is essential to understand this constraint, especially since this is a reality that government agencies never worry about. If it takes six to eight months simply to sign a contract, plus several months more for award selection and check disbursement, few emerging tech firms will bring their cutting-edge technology to the government. They simply cannot wait that long.

**Traditional acquisition and R&D programs** with long time horizons and onerous processes repel technology and capital providers who have numerous, lucrative options within the private sector.

The opportunity cost of their time is high, so **they naturally choose the business partner that represents the greatest value-creation potential.**

Many innovation economy participants — technology providers, but especially capital providers — **purposefully avoid doing business with the government due to the difficulties they experience** from information gathering to contracting delays to programmatic surprises around funding and product delivery timelines.

Potentially, these firms may even find America’s great power competitors more attractive business partners with whom to share their innovations. Competitors’ purposely exploiting their advantage in availability and speed of funding results in unnecessary risk to U.S. interests, both domestically and around the world. The clear and present danger to the Army of less effective processes for transitioning innovation economy technologies is our Soldiers may enter a conflict with lower quality, less effective equipment, and technologies than what could have been provided by the American innovation economy.

---

<sup>25</sup> See United States Army Acquisition Support Center, <https://asc.army.mil/web/news-business-breakthrough/>, accessed 21 January 2022.

<sup>26</sup> MIT Innovation Initiative, “Breaking Defense: Silicon Valley warns the Pentagon: ‘Time is running out,’” <https://innovation.mit.edu/news-article/breaking-defense-silicon-valley-warns-the-pentagon-time-is-running-out/>, accessed 21 January 2022.

As mentioned in Section I, the innovation economy is changing at an increasing rate and largely without reference to national security considerations. Adapting our processes to match the changes in the economy is necessary to access the critical technologies necessary to overcome Army technology challenges. The clarity of the information provided, and the speed of funding execution are important ways in which the Applied SBIR Program signals to the innovation economy its attractiveness as a business partner. Clear information helps small businesses assess the potential risk and reward of participating in Applied SBIR investment projects. Speed of award selection, contracting, selection for follow-on funding, and potential transition to an acquisition program directly affects a small business's assessment of the potential value of working with the Army versus spending the same management time and company resources within the private sector.<sup>27</sup>

| Examples of Barriers to Small Business Engagement |   |
|---|---|
| ➤   | Unclear or hard to find entry points to the SBIR process  |
| ➤   | Highly restrictive technical calls for proposals  |
| ➤   | Burdensome and unnecessary SBIR application requirements  |
| ➤   | Investment topic release, evaluation and funding timelines that do not suit small business cash needs |
| ➤   | Burdensome and extremely time-consuming contracting process   |
| ➤   | Opaque SBIR award management practices that raise investment cycle management costs                   |

The Army launched the Applied SBIR Program in 2020 to amplify innovation investment capabilities and ensure funding for high-potential solutions potentially available within the small businesses of the innovation economy. The program brings the private sector into partnership with the Army and connects program offices, test centers, and research and development teams with pivotal innovation resources. When an emerging tech firm is ready to bring its innovative products to either private enterprises or the government, why would they choose to work with the Army when the consumer market is so much larger? Applied SBIR needs to have a positive and attractive offer ready to raise the odds the best companies choose the Army as a business partner.

|  |   |
|--|---|
|  | Change processes and language and improve responsiveness to create a positive user experience   |
|  | Partner with companies who can succeed in commercial industry as well as with the government  |
|  | Improve access to Army people, problems, and data, while reducing restrictive requirements  |
|  | Release topics on a rolling basis to better reflect how technology challenges manifest within the Army and create multiple entry points for companies |
|  | Create a SBIR Contracting CoE dedicated to ever improving and expediting the contracting experience for small businesses                              |
|  | Ensure partnerships are a stepping-stone to transition to Army programs of record and/or further non-SBIR R&D funding                                 |

The reality that **companies have a choice** to avoid the

<sup>27</sup> BCG, "Why Startups Don't Bid on Government Contracts," <https://www.bcg.com/publications/2017/public-sector-agency-transformation-why-startups-dont-bid-government-contracts>, accessed on 21 January 2022.

government as a business partner demands the Applied SBIR Program rethink how it supports Army acquisition and R&D activities. Recall the five Applied SBIR Principles, and especially the fourth: Investment Mindset. While there will always be obstacles to challenge small businesses in doing business with the Army compared to the private sector, the Applied SBIR Program also offers unique advantages to those small businesses. First, the program frames its budget as an investment tool to attract and fund innovative solutions. Second, by publicizing that SBIR dollars are non-dilutive meaning emerging tech firms do not have to surrender equity (i.e., ownership shares) of their company to the Army as is usually necessary when they accept venture capital funding. There is no repayment required of the invested funds beyond delivering on the contracted deliverable (i.e., feasibility study or prototype). Third, once the company wins its first SBIR award, it is eligible to seek government contracts on a non-compete basis, representing a significant advantage in time and business complexity over all other private firms seeking the same contracts.

Applied SBIR Program's three key selling advantages apparent to the innovation economy:

1. Awards from \$250,000 to \$4 million in capital, with up to two times these amounts possible.
2. SBIR R&D capital is non-dilutive with neither loan or bond repayment nor covenants.
3. Successful technologies qualify for consideration for DOD non-compete acquisition contracts which are significantly larger than a SBIR award.

To position the Army to work with more high-potential technology providers, the Applied SBIR Program seeks to leverage small dollar amounts deployed in a fashion and speed to diminish if not remove the barriers to working with the Army. Delivering quickly on these strengths can make the program a very attractive business partner for the innovation economy because Army acquisition contracts represent a significant amount of revenue and access to sometimes unique talent and resources to spur companies' growth and development. Emerging tech firms could benefit greatly from the strengths that government agencies can provide, but they won't explore the option if the on-ramp is too steep.

## Applied SBIR Enabling Activities

Mentioned earlier, the five principles upon which the Applied SBIR Program orients its activities manifest in the program's four activities. If knowledge is power, then market research is the road to that power. Likewise, understanding the business case of why an innovation economy firm may be interested or conversely turned-off to pursuing a SBIR funded R&D effort is essential to reaching the widest set of potential problem solvers. Then, maintain a relentless focus on reducing the barriers our program may create to effectively fund small businesses and transition those efforts that prove technically practical. Related, look at the financial and timing decisions of our program's execution to understand their impact from the perspective of the small business. We will not succeed in growing the defense industrial base beyond a narrow sub-set of the innovation economy if we do not map the financial viability of what the Army's Applied SBIR Program provides to the eager-to-grow small businesses.



### **MARKET RESEARCH**

To the maximum extent feasible, understand the technology space within the private sector, where it is, and how it's changing.



### **BUILD THE BUSINESS CASE**

Through market research, develop a strong understanding of the technical case to improve assessments of technical risks to execution. In parallel, develop an understanding of the business case that technology providers must account for as private sector actors seeking to remain viable enterprises; benchmark leading firms through competitive market analysis to better understand the potential value of new approaches and individual company offerings.



### **IMPROVE PROGRAMMATIC EFFICIENCIES**

Based on the technical and business case research, the program works to make the Applied SBIR process easier for emerging tech firms to enter. It lowers the risk to successful R&D execution by reducing unnecessary requirements and enabling more informed decisions by both the Applied SBIR Program as well as the small business regarding continued investment or exit.



### **CASH MANAGEMENT AWARENESS AND PLANNING**

The program assesses the funding timeline — from proposal to application, to pitch, to cutting the first check to ensure it does not effectively exclude the most promising small businesses. Through its on-going oversight of all SBIR funded R&D efforts, the program plans for when the effort will potentially hit the “valley of death” and identifies a plan to lower risk to the effort and assigned responsibilities for plan execution.

## **Using SBIR Capital to Buy Down Enterprise Risk**

Leveraging the Applied SBIR Program allows the Army to fund R&D work for technology feasibility studies and prototype delivery performed by qualified, U.S. domiciled, small businesses using Congressionally mandated set-aside funds. An essential investment stratagem is to fine-tune offers to small businesses in terms of funding levels and periods of performance to reflect the needs of the problem. Whenever possible, the program avoids homogenized processes that sacrifice the attractiveness of the SBIR program to small businesses by failing to recognize the unique aspects of each Applied SBIR R&D investment and the needs of each technology provider.

The Applied SBIR Program's key value proposition to the Army is how it buys-down risk to the acquisition portfolio by permitting nimble execution on the part of the wider Army enterprise. The program makes many small bets to identify a few winners with the technical and business capacity to scale and meet the needs of an acquisition program. The program absorbs some of the risk inherent in emerging tech funding by employing relatively small amounts of funding of a few hundred thousand to several million dollars to explore new technology pathways and develop initial prototypes. This approach allows for "failed ideas" to be acceptable without risking a "failed business" (i.e., existential risk to the Army). The approach contributes to the Army's store of knowledge as it navigates the "unknowables" of emerging technology development.<sup>28</sup> Larger bets would necessitate more due diligence, government process, and time — all likely to stifle exploration.

## **Non-Traditional Technology Providers Grow the Defense Industrial Base**

The Army SBIR Program seeks to work with the best and brightest innovation economy talent and organizations. Some of these firms are already suppliers to the Army; however, a far greater number are uninterested or unaware of the value creation opportunities in working with the Army. This latter category of non-traditional suppliers has historically been absent from defense contracting. Opening the procurement pipeline to a new category of partners and suppliers with commercially viable technology draws new partners into our network who may not otherwise have opted into government work. Applied SBIR funding then not only enables access to the best and brightest emerging technology firms, but in turn provides R&D capital to stimulate high-tech innovation and entrepreneurship among emerging tech firms powering additional expansion within the innovation economy.

## **SBIR Contracting Center of Excellence**

The creation of the Army's SBIR Contracting Center of Excellence streamlines contracting processes, improves process clarity from topic initiation to award, and provides the opportunity to reinforce the imperative of both technical effort as well as organizational process innovation at every stage of the SBIR lifecycle. Reconfiguring the system and unifying the processes of evaluating, contracting, and financing solutions avoids the time-consuming, serial characteristic of legacy processes to minimize re-work of process steps as the SBIR effort moves in the seams between different and sometimes disconnected Army organizations. With an already realized target of 60 days or less for the contracting stage within the total SBIR lifecycle, the Applied SBIR Program is creating a new norm for speed to money for innovation economy firms. This more focused and faster approach allows the Army to access a greater portion of the total potential pool of small business talent and innovative capacity.

## **Intellectual Property Rights**

Patents, copyrights, trademarks, and trade secrets are part of the valuation of a technology provider and this intellectual property is often the technology providers' most valuable asset. It is important to understand how Applied SBIR policies, practices and agreements may affect an emerging tech firm's IP

---

<sup>28</sup> Clayton Christensen, "The Innovator's Dilemma," p. 155.

rights and perceived risk to the IP’s value. To curtail concerns about IP, the SBA’s SBIR policy directive includes provisions for its participants to retain title to the IP they develop during a SBIR period of performance. The provision, known as the University and Small Business Patent Procedures (Bayh-Dole) Act, states that “a small business may retain the entire right, title and interest throughout the world to each subject invention” developed through government-funded research.<sup>29</sup>

| SBIR Capital Buys Down Enterprise Risk   | Non-Traditional Tech Providers Grow the Defense Industrial Base   | SBIR Contracting CoE Streamlines Processes  | SBIR Stimulates the Creation of Domestic Intellectual Property  |
|--|---|---|---|
| <ul style="list-style-type: none"> <li>➤ The Applied SBIR Program’s key value proposition to the Army is how it <b>buys down risk</b> to the acquisition portfolio by <b>permitting nimble execution</b> on the part of the wider Army enterprise</li> <li>➤ <b>The program makes many small bets</b> to identify a few winners with the technical and business capacity to scale and meet the needs of an acquisition program</li> <li>➤ <b>This approach allows for “failed ideas” to be acceptable</b>; larger bets would necessitate more due diligence, government process and time — all likely to stifle exploration</li> </ul> | <ul style="list-style-type: none"> <li>➤ The Army SBIR Program seeks to work with the best and brightest innovation economy talent and organizations, many of which are <b>uninterested or unaware of the value creation opportunities in working with the Army</b></li> <li>➤ Opening the procurement pipeline to a new category of partners and suppliers with commercially viable technology <b>draws new partners into our network</b> who may not otherwise have opted into government work</li> </ul> | <ul style="list-style-type: none"> <li>➤ The creation of the Army’s SBIR Contracting Center of Excellence <b>streamlines contracting processes, improves process clarity</b> from topic initiation to award, and <b>provides the opportunity to reinforce the imperative of innovation</b> at every stage of the SBIR lifecycle</li> <li>➤ This more specific, focused and faster approach <b>allows the Army to access a greater portion of the total potential pool</b> of small business talent and innovative capacity</li> </ul> | <ul style="list-style-type: none"> <li>➤ <b>Intellectual property (IP) is often technology providers’ most valuable assets</b>; patents, copyrights, trademarks and trade secrets are part of the valuation of a technology provider</li> <li>➤ The SBA’s SBIR policy directive includes provisions for its <b>participants to retain title to the IP</b> they develop during a SBIR period of performance</li> </ul> |

<sup>29</sup> [Bayh-Dole Act \(University and Small Business Patent Procedures Act\) | RAND](#), accessed 12 July 2022.

## Innovation Profile 2: Balancing Flexibility with Efficiency in Both Problem Discovery and Solution Discovery

In its broadest form, a problem statement is a description of an issue an internal Army customer is experiencing and identifies the gap between the current state and the desired state for the customer. The “art of the problem statement” is essential to the Applied SBIR Program’s effectiveness as a facilitator of innovation because it sets the questions, and therefore molds the exploration paths through which solution discovery is made — or may stop prematurely.

Like many large, established enterprises conducting R&D at scale, the Army tends to solicit proposals from the innovation economy for a solution per a given identified Army requirement or semi-fixed technology challenge parameter. This is done in large part because individual pieces of technology must usually be integrated into larger platforms whether they be a chip in a radio or software in a rotary-wing power management system. The historical success of this method is under-appreciated by some innovation advocates who believe the solution to current acquisition problems is to go in the opposite direction by eliminating requirements from topic solicitations. Yet, for routine improvements of existing technologies using existing production, application, or business methods, the approach of a well-defined problem statement makes sense since it improves the efficiency in matching knowable, if not yet proven, solutions with known problems.

Unlike a company who can declare bankruptcy and whose founders can likely just get another job, the Army – and, more personally, it’s Soldiers – is subject to existential risk from inadequately thought-out or poorly executed innovation efforts. The scale, complexity, and expense of Army acquisition programs and associated technological platforms (e.g., global communications systems, main battle tanks, attack helicopters, etc.) combine to limit risk and therefore openness to disruptive innovation. The result is most (by number) Army R&D problems are routine in nature. However, the Army’s environment is changing. With the increasing pace of private sector innovation and the emergence of peer, great power competitors, pressure is growing for the Army to move beyond incrementalism and towards a need for greater awareness of the opportunities and threats of non-routine innovations. The growing cadre of technological challenges that do not fit the routine pattern demands a different problem-solving approach. The consequence of denying or misunderstanding the type of technological problem the Army seeks to solve with any particular R&D project is to short-circuit creativity by limiting the range of potential solutions, and thereby missing out on unanticipated innovations.<sup>30</sup>

*"In both structure and communication, Applied SBIR topics must reflect the innovation type of the challenge we seek to overcome."*

**>**  
**If Routine Innovation is Desired:**  
Problem statements should be well-defined with clear parameters to ensure best fit with existing technologies and business models.

**⚡**  
**If Disruptive Innovation is Desired:**  
Problem statements should open the aperture for un-thought of potential solutions by listing few requirements in the topic solicitation.

While there is insufficient space in the **Innovation Framework** to go into detail about applied innovation theory, Applied SBIR needs a competency in those theories and practices to have credibility with other members of the innovation economy. Team members should have basic knowledge of private sector

<sup>30</sup> Clayton Christensen, “The Innovator’s Dilemma,” p. 31.

innovation approaches and practices sufficient to shape their work to contextualize the type of innovation a particular Applied SBIR funding effort is pursuing. If we don't learn the language and thinking of the social system we seek to be a part of, we will be perceived as amateurs conducting "innovation tourism" instead of as professionals seeking to build common, attractive value propositions with our innovation economy partners.

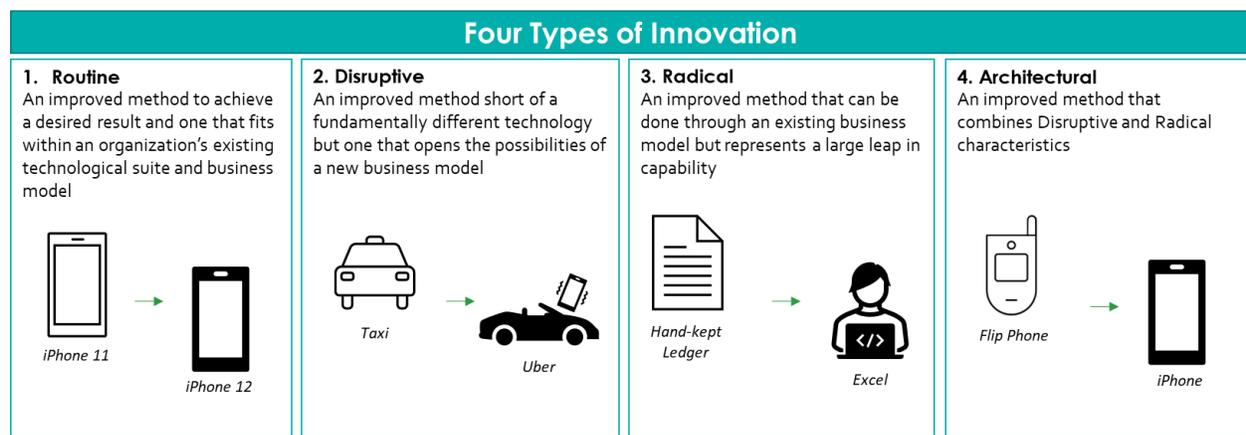
There is no single way to characterize innovation, but below is a generally accepted classification by type.<sup>31</sup> Further reading on the sources for this taxonomy as well as on a wide range of innovation theory and practice are listed at the end of the *Innovation Framework* under Recommended Readings.

## Innovation Classification Types

Gary Pisano describes four types of innovation:

- **Routine:** An improved method to achieve a desired result and one that fits within an organization's existing technological suite and business model (civilian: next version of the iPhone; military: M-16 rifle replaced by M-4 rifle).
- **Disruptive:** An improved method short of a fundamentally different technology, but one that opens the possibilities of a new business model (civilian: traditional taxi and the advent of Uber; military: a World War I tank tied to infantry because of slow speed replaced by a WWII tank with a much-improved engine, enabling greater speed over a greater area of operations).
- **Radical:** An improved method that can be done through an existing business model but represents a large leap in capability (civilian: transition from paper notes or abacus for accounting to a mainframe computer; military: a WWII propeller fighter replaced by a jet fighter).
- **Architectural:** An improved method that combines Disruptive and Radical characteristics (civilian: 'dumb' flip-phone and the advent of the iPhone; military: the first aircraft carriers and their associated planes affecting war at sea).

As a general rule, Applied SBIR Program seeks to fund the first three types and avoids architectural for reasons due to its risk profile and the complexity of such innovations usually causing the effort to exceed



<sup>31</sup> Gary Pisano, p. 31-33.

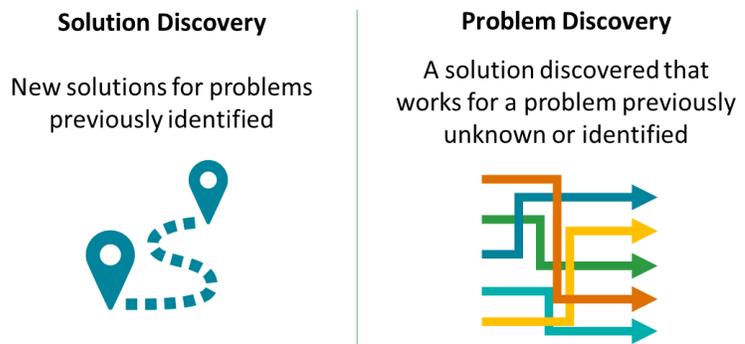
the normal SBIR funding lifecycle.<sup>32</sup> Applied SBIR Program seeks innovation types based on the breadth of Army need, competitor threats, and technological capabilities, Applied SBIR R&D problem statements must each conform to the character of the technology challenge we seek to overcome with our allocation of SBIR capital. For example, if routine, problem statements should be well-defined with clear parameters to ensure best fit with existing technology platforms and how they are employed (i.e., an existing business model). If disruptive, problem statements should open the aperture for “un-thought” of potential solutions by listing few specifics in the topic solicitation likely to limit innovation economy creativity.

While having innovation types like routine and disruptive that recognize the differing character of technical problems is necessary to guide us in crafting optimal problem statements, there is a danger of assuming a linearity between the problem statement and the search for a solution that may not be true or is unnecessarily self-limiting of potential outcomes. Linearity between problem and solution is appropriate for routine problems, but not for other types. The danger for the Applied SBIR Program is a rush to solutions under the assumption that “innovating” is only about “solution discovery,” or ending-up with a new technology that solves the problem as identified.<sup>33</sup>

There is also “problem discovery,” which is the process by which a solution discovered doesn’t work for the problem as originally conceived. It is a process of learning about the new technology in relation to both the perceived and potentially unappreciated needs of the business model into which the innovation needs to fit. Problem discovery is incorporated as an element of

problem statements that recognizes innovation’s non-linearity. Put in other terms, sometimes we are not only seeking a solution but also looking for the right problem for the innovations we encounter along our discovery pathway. This is less likely to happen with incremental innovation cases than disruptive, because with disruptive innovations we often do not know what we don’t know and therefore the chances of stumbling into an unforecasted/unforecastable discovery are much greater. If our approach and systems are not open to perceiving that we have stumbled (positively), then the value of this type of discovery may go unrealized.<sup>34</sup>

Like any form of experimentation or exploration, innovation is messy and unpredictable. Sometimes, while pursuing our pathway to solution discovery, we encounter innovations outside the original box of inquiry that represents a rich opportunity but one not applicable to our conception of the problem. When this happens, the Applied SBIR Program as a “discovery” organization needs to be capable of (1) recognizing the inherent value of the unexpected discovery, and (2) demonstrate the flexibility rooted in



<sup>32</sup> For more detail on Applied SBIR Program’s investment thesis [Innovation Profile 6: Investment Thesis: What Applied SBIR Funds, What It Doesn’t, and Why, Possible, Next Possible, Next Adjacent Possible](#).

<sup>33</sup> Narayanamurti et al., p. 66.

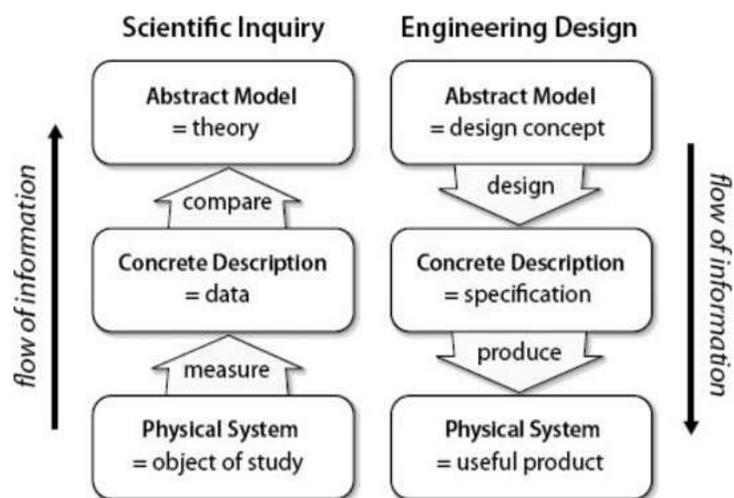
<sup>34</sup> Clayton Christensen, p. 40-41.

our cross-organizational design to effectively communicate between customers to bring to light ways to lever the solution to solve problems we did not set out to solve. When the program pursues solution and problem discovery in parallel, we can focus on solutions while remaining open to the new applications for our solutions we may not have thought of during our initial problem framing at the start of the SBIR investment effort.

The Applied SBIR Program’s twin discovery approach increases the information processing load on our knowledge management systems and coordination efforts between people and across organizations. However, this extra effort is essential to seizing opportunities as they attempt to catapult our understanding of the possible beyond current beliefs and definitions. While this can be true regardless of how narrow or open the original conceptualization and writing of the problem statement, for all other than routine innovations, the more open statement leads to wider sampling of possibilities and potentially greater learning. To help strike the balance of defined versus open, the heart of a good problem statement is a description of the capability gap a given technical end-user is experiencing. This description contains two nodules of information — capability gaps and identity/needs of technical end-users — that should provide all the empowering information necessary to get innovative brainpower to work on Army challenges.

## Science + Engineering, Not Science vs. Engineering

Building on the openness to discover both solutions and problems, the Applied SBIR Program recognizes the value of intertwining the reasoning of the *scientific method* with that of the *engineering method*. Engineering is excellent at solving practical, discreet problems, and SBIR funded R&D efforts must always connect to supporting technologies that solve discreet Army problems with the added goal of expeditiously ending up in the hands of Soldiers. However, as fundamentally a practice in design, engineering alone can be captured by its set processes starting with a design concept followed by delineated specifications (i.e., requirements), then repeated testing with the intent to produce a useful product.<sup>35</sup> This very problem-oriented process benefits from its focus on set questions and the pursuit of answers as determined by the stated requirements, all at the tempo of the particular structure of



<sup>35</sup> Drexler, Eric, “Radical Abundance: How a Revolution in Nanotechnology Will Change Civilization,” <https://fs.blog/the-difference-between-science-and-engineering/>, accessed September 19, 2022.

prototype experimentation.<sup>36</sup> However, the method may also suffer from a lack of openness to problem discovery. Because engineers are humans existing in a social network, the engineering group culture focused on set processes may manifest the method's focus weakness by placing a high social value on being seen within the group to conform to proven approaches and methods.

In contrast, the scientific method starts with a question derived from a set of observations. From comparisons made from further observations and experiments, the scientific method leads to a theory often generalized to other similar phenomena.<sup>37</sup> While the question (i.e., hypothesis) is the focus, it can be an open mental model compared to engineering's design concept, as the former is a question that does not state a proscription nor do the succeeding steps of observation and experimentation further and purposely narrow the focus through their practical application. In other words, scientific thinking — as a model of thinking — does not need to work the same way the practical development of technology does in engineering. The benefit to this openness is its flexibility to discover solutions and new, yet unconceived problems and perspectives on those problems, related ones, or unthought-of ones at least at the initiation of the method. However, the limitation of the scientific method is that its theories may be disproven at the very next experiment even if they have survived many such prior experiments. Second, the intent of science is to explain the workings of things, not necessarily to make things work, which contrasts with the Army's imperative to achieve specific applications that transition into the hands of the Soldier and can be relied upon on the battlefield.

Drawing on developments in the understanding of technological change, innovation requires a blending of both science and engineering as neither one has the single, successful mental model and methods to achieve the Army's goals.<sup>38</sup> Like a rope, the robustness of the intertwining of each logical method — science and engineering — goes a long way to determine the effectiveness of the discreet R&D effort Applied SBIR supports. In the words of Fred Brooks, the computer scientist, and A.M. Turing Award winner:

*A scientist builds in order to learn; an engineer learns in order to build.*<sup>39</sup>

Too much science in Applied SBIR's approach to innovation will most likely result in theories that within an indeterminate timeframe may or may not inform practice. Too much engineering, and we doom ourselves to more of the same incrementalism based on currently knowable.<sup>40</sup> Worse, on their own they take too much time to deliver even those limited returns on investment. The Applied SBIR Program needs to grasp its science and engineering operating environment for the same reason it needs to adopt an

---

<sup>36</sup> Hammek, William and John L. Anderson, "Working in the Penumbra of Understanding," A Discussion on the Next 75 Years of Science and Technology Policy, Issues in Science and Technology, National Academy of Sciences, Engineering, and Medicine, February 16, 2022.

<sup>37</sup> "Comparing the Engineering Design Process and the Scientific Method," <https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-compare-scientific-method> Accessed 19 Sep 22.

<sup>38</sup> Narayanamurti et al., p. 167.

<sup>39</sup> Vieth, R., & Kazerounian, K. (2003, June), *Teaching Engineering, Teaching Science: A Two Sided Coin* Paper presented at 2003 Annual Conference, Nashville, Tennessee. 10.18260/1-2--11451

<sup>40</sup> Narayanamurti et al., p. 111-112.

investor mindset: to improve funding allocation decisions informed by an improved understanding of its operating environment (see [Innovation Profile 3: Adopt an Investor Mindset](#)). The program combines its buy-down of risk (see [Section I, Using SBIR Capital to Buy Down Enterprise Risk](#)) with its dual discovery approach to problems from its blend of the scientific and engineering methods to implement its version of “planning to learn.” The intent behind planning to learn is the SBIR Program not only funds innovative R&D efforts but also innovates its own approach and processes on a consistent basis.

Even though Applied SBIR does not itself conduct research and development, the program uses its awareness of the intertwining of science and engineering to make the best decisions on how to allocate its R&D funds and then manage the investments over their lifecycle to improve the chances of transition. Like Applied SBIR’s need for an investor mindset to articulate its core competency of allocating capital to R&D efforts, the program employs its awareness of the nature of the intertwining of the two methods of science and engineering to be open to discovery from the enormously potent innovation economy. Once defined and matched, the program uses this knowledge of its operating environment in which its financial support is employed to assist internal Army customers to develop those discoveries into focused, practical solutions.

## Problem Framing

The Program conducts its operations recognizing that at the start of — and many times throughout — an emerging technology effort, we know very little about what we will find along our discovery pathway. In contrast, rushing to execution with a particular plan using forecasts of dubious quality leads to a false surety underlying decision-making that may prove patently wrong with the passage of time.<sup>41</sup> In retrospect, we then ask ourselves how we could have missed such effective technology as time proved to be the case. The answer is often because we went too big, too soon, with too much surety and not enough exploration in our thinking and processes. The program affords the Army small, fast and forward-leaning discovery opportunities that it does not have to commit to until enough has been learned to underpin decision-making that better reflects reality when it is still in its “unknowable” stage of development. That is the power of SBIR funding as an innovation tool.

First in fulfillment of its innovation leadership approach acting as a financial intermediary, Applied SBIR assists its Army customers to frame their capability gaps and problems. Through its structure and methods, the program strives to preserve focus and efficiency while recognizing that effectiveness demands the execution of high-risk R&D projects – and by extension their funding – must be flexible, open, and iconoclastic. When launching a SBIR funded R&D effort, it is not necessarily – or maybe even desirable to have all or even most of the questions answered to advance the project or select individual technology providers to fund. At this stage in Applied SBIR’s model, answers come later. First, the program needs facts. Facts based on the information gathered by the Applied SBIR model from the innovation economy to get beyond the comfort zone of the existing defense industrial base. Applied SBIR’s funding model explicitly addresses the imperative for facts derived from exploration of

---

<sup>41</sup> Clayton Christensen, p. 156.

innovation-focused social systems. Using a practice, language, and message appropriate to its target market, the program taps into every feasible corner of ingenuity to find good, unpleasant, unthought of facts.

Second, once the program has helped to bring those facts into the Army from the innovation economy, it must then pivot to assisting its Army customers to convert information (i.e., facts) into knowledge not just to know or “explain” things but with the intent of integrating the relevant pieces into the customers’ systems and practice. While lacking both technical experts and acquisition competencies, Applied SBIR facilitates knowledge integration through the structures by which it brings all the relevant internal Army customers together and maintains a team-based approach to risk mitigation (see [Section I, Modeling Risk](#)) and problem solving. This process technology called “Transition Broker Teams” is how the program exercises innovation leadership within its limited but powerful role as a financial intermediary on behalf of the Army. The *Innovation Framework* is intended to ground the practice of Applied SBIR to achieve a culture of innovation driven not only through the funding provided to specific R&D efforts but also by innovating within the SBIR program itself and maybe across the Army as a whole. Articulating the approach of the blended scientific and engineering methods is an important shaping effort within the overall Applied SBIR approach to innovation.

### Example of a Defined Problem Statement (For Routine Innovation)

*The Army Corps of Engineers seeks a software program that plans the safest, fastest routes through a defensive layer of mines and obstacles. The program must be able to account for a series of known types of mines and obstacles over a given geographic area and produce a recommended route within X seconds. The resulting software must conform to the Army’s existing ABC programming language to be interoperable with related systems and run on a hardware system that conforms to Army standard LMN.*

This is an example of a problem statement that has discrete information pertaining to technology solution parameters that shape and delimit the efforts of emerging technology firms. Phrases like “must account for a series of known types” and “interoperable with related systems” are essential pieces of information to convey to prospective technology providers when the solution sought is constrained, either by the existing technical suite it must fit into, or by the existing business model (i.e., tactics, techniques, procedures of the end-user) that will employ the integrated technology. For the right technical challenge, this type of problem statement makes sense.

The issue with defined problem statements that limits them to routine innovation efforts is their reach beyond outlining the technical end-user’s identity and/or needs and into specifications that automatically exclude potential areas for discovery. It limits the type of threat by its statement of “known types of mines and obstacles,” while also disregarding potential problem discovery by explicitly excluding any potential solutions outside the Army’s current “ABC programming language.”

While providing parameters (e.g., capability gap and end-user identity and/or needs) for R&D investments is necessary to focus the R&D work and recognize the efficiencies that may result when adopted into a procurement program, the Applied SBIR Program will not fulfill its mission to buy down risk to Army acquisitions if it starts its investments as if we already know the solution. Acquisition

programs buying in large quantities for large programs of non-disruptive technologies need to know exactly what they are buying. In contrast, when the program's mission is "discovery," meaning our R&D investments are bets on technologies yet to be prototyped, we are required to have a different type of problem statement.

### Example of an Open Problem Statement (For Non-Routine Innovations)

*Army dismounted infantry effectiveness and safety are degraded by lack of visibility in hilly or urban terrain. A Soldier on foot needs to see over or through hills and concrete walls, day or night, in all atmospheric conditions. Maximum final system weight is x kilos and must have a self-contained energy supply enabling no less than six hours of continuous operations.*

The first thing that should stand out about this problem statement is its relative brevity. While there is no pre-defined length, the statement must only convey enough information to be meaningful to the innovation economy and not prematurely limit the audience's thinking. In presenting a vision of the technical end-user's (i.e., Army dismounted infantry) reality post-technical solution delivery, a good problem statement describes both the nature of the end-user as well as the essential characteristics of the challenge. It conveys the end-user's need in a way that's easy to understand, so our communication of the problem is not self-limiting to only technology providers already familiar with the problem.

Less prescribed problem statements are highly important to non-routine innovation because they can enlist a much wider audience potentially unfamiliar with the specific technical challenge but with value to add. Since we don't know what the final technical solution will look like and we can only make educated guesses about who is best placed to potentially deliver that solution, one value of expanding the portfolio of potential solution providers is to expand the sampling of alternative value-creating perspectives. For example, using the term "innovation economy" instead of "provider" for the intended audience for our problem statements is important because the Applied SBIR audience is more than just the clearly essential technology providers. In highly complex innovation networks, it takes a village of technical and business partners to sustainably and at-scale deliver cutting edge technology. To increase access to the best talent and the most promising technologies, our understanding of the innovation economy must include other participants (e.g., capital providers and accelerators, etc.) who are less obvious from a government perspective but who are nonetheless critical contributors to any SBIR R&D effort to improve the chances of the outcome being sustainable and scalable within a follow-on Army acquisitions program.<sup>42</sup>

Another aspect of open problem statements is they permit the Applied SBIR Program to practice "problem discovery" while pursuing "solution discovery." Without this approach, it is most improbable we will see the best, alternate applications of the technical discoveries we make. Explained through analogy, if all we are looking for is a certain type of nail, we're unlikely to find the screw that works better or just as well and costs less. In finance, not leveraging your investment in whatever way that fulfils the organization's mission is called "leaving money on the table" — money and/or technologies our competitors are only too likely to exploit to our disadvantage.

---

<sup>42</sup> Mallaby, Sebastian, "The Power Law, Venture Capital and the Making of the New Future," Penguin Press, 2022, p. 85.

## Effective Problem Statements: Three Core Elements

There are three core elements to an effective problem statement:

1. **Technology End-User and Related Customers:** The person(s) who experiences a challenge. In the example of an open problem statement, the technology end-user is identified as an infantryman. This is important because the nature of an infantryman's role, risks and constraints is different from that of a tank or helicopter crewman. The technology provider needs this information to appreciate the end-user who will employ their solution. In the open statement example, we have one end-user in mind to limit the challenge set. More often, there are several types of technology end-user (e.g., infantry versus motorized, battlefield intelligence versus satellite intelligence analyst or all four mutually connected). There are also usually many others directly impacted by the infantry's use of the technical solution (e.g., organizational maintenance and supply of required support technologies, secondary consumers of the technologies output like the intelligence analysts). For these reasons, there is an essential hierarchy of needs across potential users. In crafting problem statements, we do not only look at the binary connection of technical solution with end-user but add the more expansive term "customer" to accommodate the complexity of users more often found in fielded Army systems.
2. **Capability Gap (or Problem):** In describing the characteristics of the challenge, use a lot of adjectives and nouns and few verbs. Verbs declare action and action is more likely to prescribe approaches to solutions than tell the customer's story. Use descriptive language to prioritize the relative importance of the challenge's different characteristics. This empowers innovation economy participants to explore aspects of the challenge those who live the challenge may be unaware of and go beyond the limited lens of any one type of potential solution provider. This approach to writing helps to instill flexibility of thinking to enable "problem discovery," or when our innovations are powerful but don't work for the problem for which we originally set out to solve.
3. **Desired Outcome:** A clear description of what the desired future state looks like with the capability gap closed. Describes the customer's anticipated environment post-technological solution delivery, while limiting references to definite and immutable characteristics that the anticipated solution must have. This is where fewer words are almost always better. Avoid doing the thinking best performed by the innovation economy. Write a problem statement with a future state that permits innovation economy participants to use their talent and imagination on the Army's behalf. Worry about facts like some operators always have gloves on that means buttons need to widely spaced for the human centered design activities of prototype development.

None of this open problem statement guidance means the Applied SBIR Program should not produce disciplined, focused problem statements. The program’s high-risk investments need to have a transition plan in place from their inception and start with a problem statement that recognizes acquisition

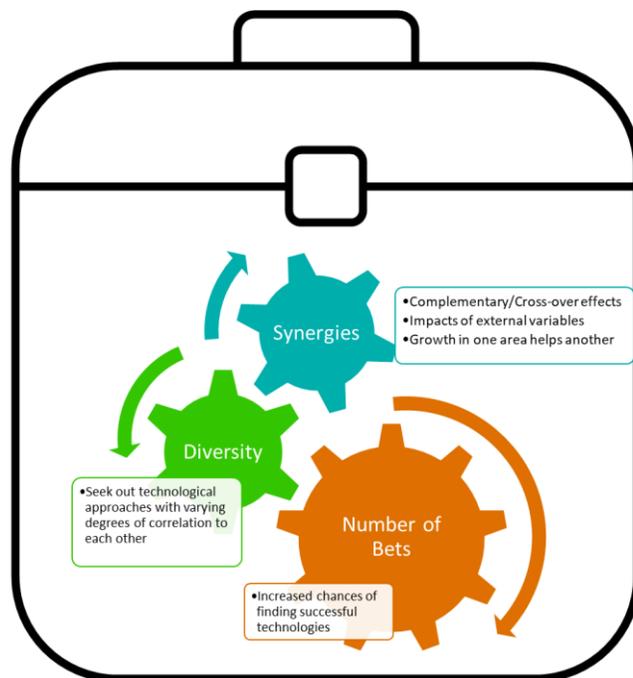
| Tech End User & Related Customers   | Challenge/Capability Gap   | Desired Outcome   |
|---|--|---|
| <ul style="list-style-type: none"> <li>• The person(s) who experiences a challenge.</li> <li>• Important because the technology provider needs this information to appreciate the nature of the customer’s role, risks, and constraints.</li> <li>• Including “related customers” is necessary to accommodate the complexity of users often found in fielded Army systems.</li> </ul> | <ul style="list-style-type: none"> <li>• Use descriptive language to prioritize the relative importance of the challenge’s different characteristics.</li> <li>• This empowers the innovation economy to explore aspects of the challenge those who live the challenge may be unaware of and go beyond the limited lens of any one type of potential solution provider.</li> </ul> | <ul style="list-style-type: none"> <li>• A clear description of the what the desired future state looks with the capability gap closed.</li> <li>• Describes the customer’s anticipated environment post-technological solution delivery while limiting references to definite and immutable characteristics that the anticipated solution must have.</li> <li>• Less words is almost always better.</li> </ul> |

program constraints; however, limiting thinking and potential innovation economy solutions is counter-productive in sourcing disruptive innovations. The better way to guide robust pathway discovery to increase chances of transition to Army acquisitions is through early, regular, and effective communication, coordination and synchronization between the program and our transition partners. It is this over-riding imperative to employ team-based problem solving that the Applied SBIR Program model is premised on building cross-organizational teams sharing information to improve mutual understanding (see [Innovation Profile 5: Transition Broker Teams](#)).

### Innovation Profile 3: Adopt an Investor Mindset

Like with routine innovation problem statements, traditional procurement strategies that emphasize process efficiency and highly proscribed characteristics for the delivered innovation product are appropriate for routine innovation (i.e., stable or commoditized technologies with a clear end-use). When the technology is immature or of unexplored potential application (i.e., “problem discovery”), a portfolio investment approach is more appropriate with its emphasis on successive, rapid iteration, the disciplined exploration of “known unknowns,” and openness to emergent discovery of “unknown unknowns.” The net results of a portfolio approach are improved returns and lower risk on a total portfolio basis. The portfolio investment approach has these features due to (1) the number of “bets” that increase the chances of finding successful technologies and (2) investing in diversified technological approaches with varying degrees of correlation to each other; however, portfolio investing is not simply buying a lot of different assets or what is pejoratively known as “spray and pray.” It is understanding how diversified investments do or do not relate or support each other in terms of complementarities or cross-over effects (i.e., synergies); how exogenous variables impact them in their market or economic environment; and how learning from one technology area impacts another.

The potential for synergies across a portfolio epitomizes the principle that financial professionals court being fired if their portfolios produce returns of “1 + 1 = 2.” To stay employed let alone be successful, the manager must oversee portfolio synergies with outcomes best typified as “1 + 1 = 5, or 6, or 20.” While picking individual, superlative investments in funding R&D efforts that prove to be outstanding is necessary to making breakthrough type gains, diversified portfolio actions are essential because they increase the odds of finding a winner and they present the opportunity of creating synergies between investments of all stripes. To achieve that happy state of capturing breakthroughs when available but also manage the more incremental activities, the program must be designed to enable portfolio management and then contribute in their exploitation as and when they manifest.



Applied SBIR employs portfolio investment principles that align with a venture landscape of immature technologies and imprecisely defined use cases. The intent is to discover value in new technologies, assess the requirements of the Army program to integrate technically practical innovations, and then validate the chances the technology provider has a sustainable business case (see [Section I, Modeling Risk](#)). All three criteria are necessary to realize the technical solution’s potential in the form of a

procurement or R&D contract. An investor mindset opens the door to innovation essential to overcome the Army's increasingly complex and complicated technology challenges.

## Elements of Portfolio Investing

While not non-exhaustive, the following list illustrates the elements most important to the Applied SBIR Program's approach to portfolio investing.

1. **Well-Designed and Relevant SBIR R&D Investments:** Planning to receive proposals at a certain rate and level of quality, Applied SBIR topics announced to the innovation economy must derive from authentic Army technology challenges — not just be experiments in discovering the art of the possible. The best chances of maturing an idea from conception through transition to an acquisition program is to start the effort with a strong connection to an existing mission requirement. This connection primarily manifests itself in the form of a transition plan identified at the very inception of the SBIR investment effort and dynamically adjusted across the SBIR award lifecycle to reflect changes in both the technology and the programmatic needs of the effort the technology will transition to. The transition plan requires a team effort on the part of the program, our partners, and especially the pre-identified transition partner who will accept the technical solution when it materializes over the 1-4 year lifecycle of the typical SBIR award.

2. **Buy-Down Risk:** Steps to increase the likelihood of a successful outcome or reduce exposure to loss. By providing small amounts of funding to explore the feasibility of fledgling technology, the Applied SBIR Program accelerates evaluation of a technology and reduces the risk for a customer interested in testing an innovative option that's outside their comfort zone. This is useful when a customer understands the benefit of a new technology but requires more time, information, and options prior to moving to procurement.



**Well-Designed and Relevant**

- Connected to mission requirements
- Transition plan from the outset



**Buy-down Risk**

- Iterative process
- Enables exploration of fledgling technologies



**Co-Investors**

- Access to research labs
- TPOCs

3. **Other People's Money:** Enable third-party investment that would not otherwise materialize. The Applied SBIR Program has redefined its public role in innovation with the goal to stimulate additional investment from the wider innovation economy. Guaranteed revenue, non-dilutive capital, and access to research labs and other resources available to program awardees are powerful signals to other private investors and government agencies. In this way, an Applied SBIR investment serves as a force multiplier for emerging tech firms seeking capital to develop their technology and business potential.

## Metrics for Effectiveness and Performance

Measuring investment effectiveness is essential to (1) determine what is working and what is not within the program's approach and processes, and (2) to demonstrate Applied SBIR's value contribution to the Army to senior leaders. The Applied SBIR Program is too new to calculate its contribution to the Army, but tracking data and outcomes from inception against time, resources expended, and innovation economy participation is critical.

For all the metrics tracked by the program, please see the companion to this document titled *Army Applied SBIR Program Process and Measures Manual*. The following are the parameters that underpin the metrics found in that manual.

- **Speed of Relevance:** Acting on a decision during the sometimes very narrow window of time for an R&D effort to fit within technical and business case requirements. As outlined in [Innovation Profile 1: Open the Door to Innovation](#), technology providers need investment partners who move fast. The Applied SBIR Program model facilitates information flow in support of better understanding and endows decision-making at the lowest appropriate level to increase emerging tech firm participation and improve transition rates. Reducing friction at each step in the process allows our investments to move faster. Evaluating proposals, cutting contract bureaucracy and decision-making overhead, and building internal and external customer interest in the program are all part of the program's speed to support the efficacy behind its investments.
- **Benefits of the Investor Mindset for the Army:** An efficient, well-crafted SBIR award supports broader reform and relevancy across the procurement process and delivers relevant solutions faster. Centralizing within the Applied SBIR Program the duties of topic sourcing, due diligence and contracting frees hundreds of other Army professionals from the SBIR administrative burden. It also indirectly builds the Army brand among innovation economy firms by clarifying the technical and business case pathways for them to deliver meaningful solutions to the Army. The clarity of that offer, plus the speed at which we deliver on it, needs to be comparable to what innovation economy firms are familiar with in the private sector. Timely contracts, simple funding models and fluid feedback loops make the Army a more attractive business partner.
- **Creating Value for Emerging Tech Firms:** While most innovation economy firms have a mission that goes beyond money and their founders may be highly eclectic in their company vision, they all must prioritize earning money to make theirs a sustainable enterprise. In the "x, y" graph of business success, y is money and x is time. Every business decision contains aspects of this time value of money equation that adjusts the value of a given dollar by the time it takes to earn that money. An effort that takes a lot of time must have a proportionally large payout without which the effort will be avoided as an unsustainable business case. For the Applied SBIR Program, we recognize this business reality in how we address the question in the mind of the businessperson, "How much money over what period of time does this opportunity represent?" When the program speaks like this, we make our potential business partners' lives easier by assisting their decision-making. The Applied SBIR Program gains through clear language by eliminating those for whom our investments are not attractive and focuses our investments on partners more likely to sustain their efforts to the benefit of the Army. Likewise, a partnership with the Army centered on investments in developing technology helps emerging tech firms to meet their biggest goals and challenges.

- Expanding the Defense Industrial Base:** Investing in technology that is relevant to both defense and commercial markets supports the growth of a 21<sup>st</sup> century innovation economy in which most emerging tech firms must thrive. Government funding and resources can catalyze additional investment to accelerate innovation and competitive solutions across multiple industries with large, positive second order effects for the U.S. economy at large. Finally, an Army that is a more attractive business partner and is more present in the innovation economy also raises the risks and costs for our great power competitors as they increasingly operate in and benefit from our national talents and resources.

|   |  |
|---|--|
| <p><b>Speed of Relevance</b></p>  | <p><b>Benefits of an Investor Mindset for the Army</b></p>   |
| <ul style="list-style-type: none"> <li>➤ The Applied SBIR model facilitates <b>information flows</b> in support of better understanding and <b>endows decision-making</b> at the lowest appropriate level to <b>increase</b> emerging tech firm participation and <b>improve</b> transition rates.</li> <li>➤ Evaluating proposals, cutting contract bureaucracy and decision-making overhead, and building internal and external customer interest in the program are all part of Applied SBIR's speed to <b>support the efficacy</b> behind its investments.</li> </ul> | <ul style="list-style-type: none"> <li>➤ Centralizing within the Applied SBIR program the duties of topic sourcing, due diligence, and contracting <b>frees hundreds of other Army professionals from the SBIR administrative burden.</b></li> <li>➤ Timely contracts, simple funding models, and fluid feedback loops make the Army a more <b>attractive business partner.</b></li> </ul>   |
| <p><b>Creating Value for Emerging Tech Firms</b></p>  | <p><b>Expanding the Defense Industrial Base</b></p>  |
| <ul style="list-style-type: none"> <li>➤ The Applied SBIR program focuses our investments on partners more likely to <b>sustain their efforts</b> to the benefit of the Army.</li> <li>➤ A partnership with the Army centered on investments in developing technology helps emerging tech firms to <b>meet their biggest goals and challenges.</b></li> </ul>   | <ul style="list-style-type: none"> <li>➤ Government funding and resources can <b>catalyze additional investment</b> to accelerate innovation and competitive solutions across multiple industries with large, <b>positive second order effects for the U.S. economy at-large.</b></li> <li>➤ An Army that is a more attractive business partner and is more present in the innovation economy also <b>raises the risks and costs</b> for our great power competitors.</li> </ul> |

## Innovation Profile 4: Engage External Customer (Innovation Economy Firms)

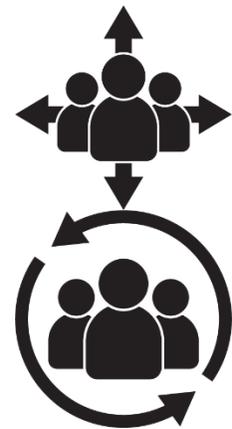
The Applied SBIR Program's ability to engage the innovation economy meters the quantity and quality of the new technologies the program brings into the Army.

### The External Customer is Essential

Few things outweigh the importance to the Applied SBIR Program's R&D investment success than the quantity and quality of emerging tech firms within our innovation network. Our mission is to find and transition external-to-the-Army technologies necessary to overcome the scope of Army challenges as wide as the Army's own mission is broad. The practical implication of this imperative is that however successful we are in managing our internal resources, we fall short of the potential value creation possibilities within the innovation economy by the percentage of firms within that economy relevant to Army technology challenges that we leave untapped.

As a financial intermediary, the Applied SBIR Program is an Army interface between two sets of customers (see [Section I, Identifying Our Customers](#)):<sup>43</sup>

1. **Internal Customers:** Program Executive Offices, technologists (labs & research centers) and supporting organizations (contracting, legal, etc.).
2. **External Customers:** Innovation economy firms that may potentially deliver or support the delivery of technology solutions to overcome Army capability gaps.



The degree to which we succeed in tapping the innovation economy's potential will set the limits on the depth of access to America's talent and resources, the number of technologies we discover, and how fast the Army deploys them to overcome its capability gaps. As captured by the Everett Rogers quote in the [Section I, Introduction](#), a technology does not need to be objectively new to humanity for it to be an innovation to the Army. It only needs to be new to a particular social group. The Applied SBIR Program is in large part about ensuring minimal gap between what the Army knows and the enormous knowledge and capabilities of the innovation economy. This fact should underline our appreciation of the bi-directional nature of the Applied SBIR customer base (see [Section I, Innovation and Actionable Information Sharing](#)).

### Army Joins the Innovation Economy

To leverage the inherent value of our external customers, the Applied SBIR Program must be two things at once: (1) It must be an Army organization marshalling SBIR R&D capital on behalf of the Army; (2) it must also be a full-fledged member of the innovation economy. The program must avoid "innovation tourism" that only window-dresses its potential connections with the innovation economy and limits itself to superficial relations. The program needs to roll-up its sleeves and get to innovating as a member of the innovation economy.

The Applied SBIR Program's most powerful approach to being an innovation economy member is through the allocation of its R&D capital. The quality of an entrepreneur's ideas is like the quality of a car that's designer aspires it to be a performance automobile. While the fit and synchronization of its parts, as well as the aesthetic of the whole, is essential for the car to stand out, the car needs gas to realize its potential as a vehicle. The fuel in the tank of any innovation enterprise is the money enabling the processes by which good ideas turn into practical engineering forms. The program's ability to put fuel in the entrepreneur's tank is the expectation that by working with us, the entrepreneur may access a certain amount of SBIR capital to help fund their prototyping, and then be advantaged for competing for the much larger pool of Army acquisitions funding.

| <b>Army Joins the Innovation Economy</b>  |  |   |
|---|--|---|
| <b>As a member of the innovation economy, there are vital assets we must share with the external customer to ensure the greatest success.</b>                                     |  |   |
| <b>Utilizing R&amp;D capital to fuel entrepreneurial ideas</b><br>comes with the expectation that the entrepreneur gains access to certain <b>competitive, advantaged funding</b> | <b>Provide innovation economy firms with expansive resources, knowledge, and a new network that will improve their work output</b> in many ways<br> | <b>Ensuring scalability</b> through the <b>consistent innovation of the programs process technologies</b> necessary to optimize its practice of <b>allocating capital to the best use</b> |

While hugely important, money isn't our only asset. Applied SBIR also brings to its customers knowledge and networks. Engaging with PEOs permits innovation economy firms to learn about the Army as a business partner, improve their ability to forecast and benefit from future Army needs, and position themselves to learn from the technical depth of Army labs who excel their civilian counterparts in some technology for which there is no private sector business case. The fourth asset we offer the innovation economy is our understanding of how large, diversified enterprises use R&D capital to power their larger, more scalable production systems.<sup>44</sup> Because Applied SBIR regularly and consistently innovates its process technologies or information-sharing systems necessary to optimize its practice of allocating capital to its highest, best use, the program should make this learning and evolving practice an element of its contribution to the innovation economy. If the program is to maximize the value it seeks to absorb from entrepreneurs, we must in different ways, and beyond only money, demonstrate our own value proposition to the innovation economy.

<sup>44</sup> See "Applied SBIR's Focus and Limits."

## Build Trust Through Communication

Communication can make or break any relationship. Effective communication is imperative to building the Applied SBIR Program’s reputation as a “partner of choice” for emerging tech firms — and overcoming negative perceptions about the challenges of working with the government. While the dollars it uses to support the R&D efforts of small emerging technology firms is the core of Applied SBIR’s offer to the innovation economy, communication is a strategic tool to express the program’s message as a member of the innovation economy and to have that message heard in a way that earns the trust of that economy’s other participants. The Applied SBIR Program infuses its communications with a customer-service orientation throughout the entire engagement process, from the first moment a firm learns about an Applied SBIR opportunity, to when their technology either successfully transitions to an acquisition program or exits any further funding. Yes, “exits” (i.e., a technology failing to meet Army needs and no longer receiving SBIR dollars) do happen and are a simple fact that all businesses know how to accept if regrettably, but the messaging appropriate to communicate that an R&D effort is trending poorly is an important aspect of securing residual relationship value from an otherwise negative outcome.



A trust-building communication strategy has six criteria, each requiring tailoring to the needs of the program’s different customers and their circumstances:<sup>45</sup>



### CLARITY AND CONSISTENCY

Clear, accurate, timely and readily available information attracts and sets innovation partner expectations. Consistency creates a sense of predictability, trust and security that will encourage engagement and influence opinions across the network. Direct communication about what’s important to both sides of the potential investment transaction is important to gain attention in a very competitive marketplace for innovation and avoid causing confusion.



### RESPONSIVENESS

Receiving a timely response conveys respect and commitment, and opens a line of communication for feedback, ideas and partnership.

<sup>45</sup> This section and the remainder of this Innovation Profile is adapted from “The Air Force Innovation Ecosystem Development Playbook”, [https://downloads.regulations.gov/PTO-P-2020-0057-0033/attachment\\_1.pdf](https://downloads.regulations.gov/PTO-P-2020-0057-0033/attachment_1.pdf), originally accessed May 21, 2022.



### **TRANSPARENCY**

Giving stakeholders a sense that they are “in the know” can overcome potential skepticism about working with the government. Delivering candid information promptly implies openness and conveys accountability. Also, the Applied SBIR Program respects innovation economy firms by facilitating their assessment of opportunity costs of working with the Army by clearly communicating both the advantages and requirements of SBIR funding. The second-best answer an emerging tech firm receives is “no” because it informs their all-important decision-making around their allocation of scarce time and resources.



### **ACCESSIBLE INFORMATION**

An accessible website with program information makes consistent, responsive transparent communication possible at scale. Group messaging and community management platforms help organize and encourage information-sharing across the network. This scales direct customer service and creates the benefit of exposing firms to the questions and ideas introduced by others in the network.



### **WELL-CRAFTED MATERIALS**

Documentation that provides clear guidance, templates and examples is powerful. Excellence is the delivery of just the right amount of information, at the right time, to the right customer. External customers have different interests that reflect their different business models. Technology providers are usually very interested in technical aspects of the program's efforts. Capital providers are interested in the technology challenges but are particularly keen on factoring expected financial payouts. All innovation economy firms need as clear as possible information on the “dollars over what period of time” issue raised in Innovation Profile 3: Adopt an Investor Mindset.



### **INTERNAL COMMUNICATION**

It is difficult, if not impossible, for an organization to speak clearly and effectively with external audiences if it isn't first clearly communicating among its constituent parts. Implementing internal communication tools and protocols ensures the program's communications agents can find and externally convey information quickly and accurately (see Innovation Profile 5: Transition Broker Teams).

## **Establish a Scalable Process**

As one of the necessary aspects of improving the Applied SBIR Program's brand as a value-creation partner for our external customers, we must continuously improve efficiencies in our interactions with an expanding set of emerging tech firms. The program manages its topics, external customer engagements, responsiveness to companies' information needs and other team activities to improve the timeliness,

quality, and number of potential investments we can feasibly make with limited personnel. Transparent processes around our activities help to match our ability to be a good business partner with our intent of accessing and increasing portion of the total American innovation economy.

To support the scale of our external customer base, Applied SBIR processes include:

- **Direct Engagement:** Applied SBIR events, website and external customer engagements with emerging tech firms provide a clear and centralized entry point for the full spectrum of innovation economy firms.
- **Responsiveness:** An engaged program team and directly participating internal Army partners employ a contact management system with defined protocols to respond quickly and effectively to a large and growing volume of inquiries from external customers.
- **Smart Communications:** The program sends general updates to its external customers on a regular basis, as well as targeted communications to portions of our external customers providing information customized to the role those firms play in the innovation economy (e.g., technology providers, capital providers, tech and business accelerators, tech-oriented law firms, etc.).

### Establishing Scalable Processes

As a value-creation partner for our external customers, we must continuously improve efficiencies in our interactions with an expanding set of emerging tech firms.

**Direct Engagement:** provides a clear, centralized entry point for all different types of firms

**Responsiveness:** quick and effective communication to a large and growing volume of inquiries

**Smart Communications:** targeted communication providing customized information based on the firm's role



## Reasons to Invest in Brand-Building as an Innovation Economy Member

While reality of the Army's delivered value in exchange for accessing small business talent and technologies is essential to the Army's reputation, the perceptions of what we deliver can be as important as the facts of how and what is delivered.

- **Co-Branding:** Emerging tech firms are more likely to trust the Applied SBIR Program if they hear about it from other innovation economy sources. This is particularly important since the Army as a business partner is challenged in how it is perceived especially around the time it takes to receive Army funding and the transparency of how that money flows to innovation economy participants. Affiliating the program with trusted leaders in the innovation economy can garner validation for our innovation-economy friendly program and form positive first impressions.
- **Diversity:** When it comes to innovation, diversity goes a long way to determine potential outcomes. In both government and venture capital realms, most deal activity happens within a handful of innovation hubs. While to a degree this simply reflects the concentration in innovation activities and venture financing, building a network inclusive of different kinds of partners in non-traditional communities and regions will help the program reach pockets of talent and resources often overlooked or ignored. A widely distributed network, diverse in stakeholders and geographies, will improve the quality and quantity of innovation partners and their respective talents.
- **Facilitating Partners:** Innovation economy facilitators, like accelerators and for-profit and not-for-profit business development organizations, are often highly adept at identifying emerging tech firms within their specific networks representing the highest potential fit to work with the Applied SBIR Program. These facilitators share a mission to connect emerging tech firms to promising opportunities and are attractive to emerging tech firms because they are a source of information, resources, and technical assistance. Ensuring the program — and by extension, the Army — is seen as one of those promising opportunities is important to building Army brand equity.

### Investing in Brand-Building

The perceptions of what we deliver can be just as important as the actuality of how and what we deliver to the external customer.

**Co-Branding:** affiliate the program with trusted leaders in the innovation economy

**Diversity:** build a network of non-traditional communities and regions

**Facilitating Partners:** Utilize facilitators to connect with emerging tech firms

## How to Find Partners

The Applied SBIR Program must have a set of tactics it consistently employs to build bridges first of information and then, hopefully, collaboration with the best and brightest among the innovation economy.

- **Create a “Friendly Front Door”:** Making the Applied SBIR website dedicated to partner engagement helps capture inbound interest and serve as the place to discover the program, get information, and join the network. Sustaining responsiveness to inquiries and up-to-date information on the site is essential to maintaining relevancy of the page to the innovation economy and to build their engagement with the program.

- **Proactive and Meaningful Engagement:** The Applied SBIR Program maintains a database of potential, current, and historical partners and reaches out to them on a regular but not inappropriately frequent basis to enlist or maintain their activity within the program’s network. Reflecting the program’s monthly release of new SBIR funded R&D opportunities, the program communicates concise details of those

### How to Find Partners

- Create a “Friendly Front Door”: Dedicate the Applied SBIR website to **partner engagement**, including responding to inquiries and maintenance of up-to-date information
- Proactive and Meaningful Engagement: **Raise awareness** amongst external customers through **regular communications**, such as monthly topic summaries
- Attendance at Conferences and Events: Being present allows for a great way **to connect to new and existing partners**



opportunities to our innovation network as an important way to raise awareness among our external customers of where the program is putting its money. They can then use these short R&D investment summaries to quickly determine if the specific topic is of interest to them or not.

- **Attending Conferences and Events:** Having a presence at events where innovation economy participants gather is a great way to connect with new and existing partners. Target audiences based on where they fit within the innovation economy and customize materials to heighten the appeal of the Applied SBIR Program’s offer to what’s important to the audience of any specific event. For the event organizers, be a value-adding attendee by offering to contribute content, speakers, or sponsorship as appropriate. Host events specifically designed to inform, educate, and engage external customers about Applied SBIR R&D investments, both current and future. Even if awards are not made at every event, all program events should focus less on explaining processes and more on the dollar values and timelines of its current and forecasted investing activities. Go beyond talking about business to talk actual, discreet business opportunities surrounding the technology challenges for which the Army seeks innovation economy help. Root this talk in the time needed to earn that money and include a concise estimation of the opportunities and risks of earning that money. Anything less specific runs the risk of being confused with “innovation tourism.”

## Measuring an Innovation Network

The Applied SBIR Program must measure its impact on and the resonance of its messaging with the innovation economy. Network engagement can open many hereto closed or undiscovered doors to deliver returns to the program, but this is more likely to occur when goals are defined, measured, and evaluated. Here are a few ways the program measures its external customer engagement:

- Increase in number of partners, subscribers, attendees, or applicants toward specific goals for overall composition and reach.
- Number and variety of new small businesses engaged, ideas submitted, solutions funded, and networks engaged.
- Changes in level of participation by geography and socio-economic measures relevant to federal programs (e.g., disadvantaged groups and women-owned businesses).
- Increase in number of partners, subscribers, attendees, or applicants toward specific goals for overall composition and reach.
- Social media engagement on Facebook, LinkedIn, and Twitter (followers, likes, shares, etc.).

### Measure Engagement Impact

- Increase in **number of partners**, subscribers, attendees or applicants
- Number and **variety of new small businesses engaged** (ideas submitted, solutions funded, networks engaged)
- Changes in level of participation by **geography and socio-economic measures**
- **Social media** engagement on Facebook, LinkedIn, and Twitter



## Innovation Profile 5: Transition Broker Teams

The Transition Broker Team (TBT) model is the principal mechanism by which the Applied SBIR Program enables itself to become a better business partner for the innovation economy and thereby achieve the Army's objective of the best access feasible to the talent and technology within those firms. The TBT model is based on a cross-organizational structure employing a portfolio management approach to manage Applied SBIR R&D investments. One consequence of a portfolio management approach is the risk diversification associated with making investments with varying correlation and doing so in a manner that synchronizes both knowledge and effects of those investments for the benefit of the entire portfolio, not just single investments in isolation. While drawn from the financial industry, the TBT model portfolio approach is consistent with the findings and recommendations of the Section 809 Panel.<sup>46</sup>

The following TBT corporate statements guide the execution of the TBT model and ensure those teams remain synchronized with both the larger Army enterprise as well as with each other.

### Mission

The Applied SBIR Program Transition Broker Teams (TBT) maximize the effectiveness and impact of Army SBIR funds to reduce technical and execution risk in Army acquisitions programs. TBTs use a cross-organizational team structure (Acquisition, Technology, Business Analyst) for **rapid and effective information sharing among team members to support mutual learning with the intent of enhancing SBIR fund allocation decisions**. TBTs support the provision of solutions to Army technology challenges through a balanced-risk SBIR funded R&D portfolio linking the needs of the Army with the agility and innovation of American small businesses. The outcomes of the portfolio **enhance and expedite Army programs and enable commercialization opportunities for small businesses**.<sup>47</sup>

### Team Composition and Structure

Using the analogy of a stool, TBTs have three "legs:"

1. **Acquisition (Program Executive Offices)**
2. **Technology (Research Centers)**

These two team members represent the preponderance of technology challenge owners, are the usual source of post-SBIR research and acquisition contracting dollars for small businesses and constitute most of the program's transition partners (i.e., those organizations agreeing to incorporate the SBIR-supported technology into their programs post-SBIR funding).

3. **Business (analyst)**

This team member represents the voice of the private sector to inform Army members about private sector circumstances, perspectives, language, and decision-making constraints. They also connect the TBT with the program's related technology scouting capabilities.

---

<sup>46</sup> Section 809 Panel, Report of the Advisory Panel on Streamlining and Codifying Acquisition Regulations Volume 3 of 3 (Arlington, VA: January 2019).

<sup>47</sup> From SBIR FY22 Investment Guidance dated 23 Sep 21.



A key aspect of the TBT structure is its stabilized membership that distinguishes it as a “team” versus a “committee,” “group” or “council.” Stabilized TBT membership is defined as members attending and contributing to TBT meetings and processes on a sufficiently regular basis to undertake effective group work overtime. “Teams” solve collective problems and are empowered to make decisions appropriate to their level of execution. TBTs are true “teams” because their members regularly make real and sometimes unique contributions to the collective undertakings of the team, its capital allocation decisions, and the effective transition of technologies into the Army. **The power of the TBT structure is it helps ensure the Applied SBIR Program collectively knows what its constituent members know individually.**

While the Director, Applied SBIR is the only one within the Applied SBIR program with source selection authority (i.e., authority to legally commit SBIR funds), the TBT Portfolio Manager is nominally at the top of each TBT organizational diagram because he or she has ultimate responsibility for the success or failure of the individual and portfolio outcomes of the funding decisions made by the TBT. However, unlike a military commander, almost no one within the TBT works for the Portfolio Manager as the TBT is largely a “coalition of the willing” of different Army organizations coming together to secure the benefits of well deployed SIBR dollars. Even though TBT members work for other Army organizations, the Applied SBIR program has chosen to place the responsibility for team outcomes on the Portfolio Manager because committees are a bad way to run organizations needing to allocate scarce resources for defined objectives. Simply put, someone must have a “first among equal” voice in making those allocations because a person, not an amorphous group, must be held accountable for the outcomes of those decisions. In the TBT structure, it is the Portfolio Manager who is held accountable.

Acquisition professionals and technologists become members of a TBT because their respective professional competencies and experiences make them capable of solving complex problems and because they and their home organizations value SBIR funding to support their R&D efforts. The value creation relationship between members and TBTs must be bi-directional. In one direction, members derive value from the TBT in the form of SBIR funding and information sharing. In exchange, they not only participate on SBIR investments that directly relate to their home organizations but contribute their

time and talent to tackle the full range of challenges tasked to the TBT to overcome on behalf of all the TBT's members and the Army organizations which they represent.

## TBT Role

Subject to Army priorities and Deputy Assistant Secretary of the Army for Research and Technology guidance, TBTs allocate Applied SBIR capital and then manage the resulting investments along the entire SBIR investment lifecycle to achieve the mission of expediting Army R&D programs and transitioning technologies developed through those investments. TBTs are Applied SBIR's primary entity for collaboration with all elements of the Army enterprise.

As a financial intermediary, TBTs act like a "bank," enabling the work of its internal customers to fulfill their missions and develop their "lines of business" (e.g., an acquisition program to fill a technology gap in a POR). In this business-to-business role, TBTs do not have a "retail" function equivalent to providing funding and services to the Army end-users themselves. TBT core competencies lie in the allocation of capital to high-risk technology bets and in marshalling the information and partnerships necessary to achieve the most positive outcomes feasible for the R&D effort. Rather, it is the core competencies of TBTs' internal customers to interface directly with end-users, and it is through such partnerships that TBTs maintain visibility on technology environments and outcomes that are indeed the ultimate impact of TBT allocation decisions (see [Section I, Focus and Limits](#)).

Tasks representing TBT financial intermediation core competencies:

- Identify and select R&D pathways (*industry and sub-industry focus*) for the focus of each TBT.
- Interface with innovation economy firms (*targeted market intelligence*).
- Identify and select SBIR funded R&D efforts and characteristics (*structure specific investments*).
- Monitor the SBIR award process with essential support from Applied SBIR Program Operations and the Army SBIR Contracting Center of Excellence (*contract execution*).
- Manage SBIR awards across their complete lifecycle from award to either exit or transition (*portfolio management, exit valuation and program assessment*).
- Support pre-identified transition partners to incorporate sufficiently developed technologies into acquisition or non-SBIR funded R&D activities (*post-exit value capture*).

## TBT Function

TBTs function to allocate their assigned capital to R&D efforts with the best practical and feasible prospects of transitioning into the Army to fill Army capability gaps (see [Section I, Modeling Risk](#)). This is essentially the same function as an investment management team in the financial industry. Members are drawn from those organizations capable of developing technology and positioned to transition the resulting capabilities to the Soldier. As investment managers employing SBIR funding subject to statutory limits, TBTs make bets on high-risk endeavors to buy-down risk to the Army's acquisitions and research centers technology efforts. TBTs also function to institutionalize information exchange among members and between their respective organizations. The intent is to build common understanding to

optimize team risk/reward decision-making around fund allocation to maximize R&D outcomes for the benefit of the Army.<sup>48</sup>

The TBTs have three primary functions:

1. **Share information** across TBT-member Army organizations to improve common understanding of technologies and the business cases necessary to attain solutions to Army technology challenges.
2. **Allocate SBIR funds** to specific R&D efforts (i.e., SBIR topics) and do so to optimize outcomes across the SBIR R&D portfolio and along the total SBIR investment lifecycle.
3. **Transition SBIR-facilitated technologies** to an acquisition program or further R&D effort.

| Share Information  | Allocate SBIR Funds   | Transition SBIR-facilitated Tech   |
|--|---|--|
| <ul style="list-style-type: none"> <li>• Facilitate cross-organizational understanding of technologies and the business cases necessary to attain solutions to Army technology challenges</li> <li>• Act as knowledge managers building communication architectures and practices across internal networks to ensure a team-based approach to risk mitigation and opportunity exploitation</li> <li>• Be a conduit for external customers by providing information on SBIR funding and paths to long-term contracts</li> </ul> | <ul style="list-style-type: none"> <li>• Improve risk-weighted decision-making in the allocation of SBIR capital to R&amp;D efforts conducted by specific technology providers</li> <li>• Use its organizational structure and personnel to synthesize resources, efforts and potentially related outcomes across their portfolios to first learn and then act</li> <li>• TBT buys down risk to the larger, more scalable Army procurement programs by employing relatively small amounts of capital to try new approaches, quickly learn from failures, and exploit successes</li> </ul> | <ul style="list-style-type: none"> <li>• Synchronize the planning and actions of acquisition and technology stakeholders to transition the SBIR-developed technology to a Program of Record or further R&amp;D</li> <li>• Facilitate the success of technology integration by having the internal customers directly involved from start to finish for every TBT investment</li> <li>• Systemic collaboration among internal and external customers bolsters innovation through the value gained from synchronization</li> </ul> |

The TBT's **first function** is to share information across its internal customers to build mutual understanding. Operating in the information space between and among its three "legs" (acquisition, research centers, business analysis), TBTs are knowledge centers building communication architectures and practices across internal Army networks to ensure a team-based approach to risk mitigation and opportunity exploitation. This ensures the collective knows what the collective's individuals know permitting true team-based knowledge management to support improved decision-making. In relation to the external customers of the innovation economy, TBTs are the single, responsible voice for SBIR topics/awards processing and lifecycle management. TBTs interface with the innovation economy to provide information on SBIR funding and paths to long-term contracts. The intent is to provide external customers a clarity of message and a transparency on individual SBIR award risk that makes the Army an attractive and valued business partner.

Institutionalized knowledge sharing among internal customers supports the TBT's **second function** to improve risk-weighted decision-making in the allocation of SBIR capital to specific R&D efforts conducted by technology providers. In making these high-risk bets on individual small businesses, the Applied SBIR Program employs the knowledge of the cross-organizational TBT to achieve optimal decision-making by incorporating the appropriate organizational perspectives to manage the R&D effort across the one to five-year average total SBIR investment lifecycle. Recognizing that most innovations

<sup>48</sup> Dalio, Ray, "Principles," Simon & Schuster, 1230 Avenue of the Americas, New York, NY 10020, p. 358.

are not eureka moments in the lab, but rather manifest along an evolutionary pathway<sup>49</sup>, TBTs have the organizational structure and personnel to synthesize resources, efforts and disparate but potentially related outcomes across their portfolios to first learn and then act. In so doing, the TBT buys down risk to the larger, more scalable Army procurement programs by employing relatively small amounts of capital to try new approaches, quickly learn from failures, and exploit successes.

The TBT's **third function** is to synchronize the planning and actions of acquisition and technology TBT members to transition the SBIR-developed technology to acquisitions or further R&D. This is the TBTs' toughest function to fulfill. Over the total SBIR lifecycle, TBTs synthesize resources, efforts and disparate but potentially related outcomes across their portfolios to first learn, and then act. TBTs consistently apply the Active Management Methodology in regularly repeating this assessment cycle to push the envelope of the possible (see [Innovation Profile 7, Active Management](#)). With their collection of cross-disciplinary processes, talent and organizational interests, TBTs foster new thinking among members to first see innovation as it happens and, second, best position the eventual success of any technology by having the internal customer directly involved from start to finish of every TBT investment.<sup>50</sup> The Applied SBIR-sponsored systemic collaboration among internal and external customers underpins innovation through the value unlocked through synchronization. This improves Army enterprise success as measured by technology transitions to Army acquisitions and non-SBIR funded research.

---

<sup>49</sup> Think vehicle batteries first becoming an innovation with Thomas Edison more than a hundred years ago followed by GM's efforts in the 1970s. While practical in the lab, the aspiration of the electric vehicle didn't become market feasible until the early 2000s.

<sup>50</sup> Gary Pisano, p. 130.

## Innovation Profile 6: Investment Thesis: What Applied SBIR Funds, What It Doesn't, and Why

The Applied SBIR's mission is to use its assigned capital to support the R&D efforts of its internal Army customers and in the quickest, most appropriate manner to assist the efforts of other Army organizations to put the best kit into the hands of the Soldier. To succeed, the program needs to have a strategy to identify objectives, priorities, appropriate actions for capital allocations, and an approach to recognize whether and which R&D opportunities fit with its mission. Section I and prior modules addressed the first three criteria (objectives, priorities, and appropriate actions). That was "thinking big." This module and those subsequent will go into specifics on funding and acceleration services, which is "thinking small."<sup>51</sup>

This module will connect the two echelons of thinking by presenting Applied SBIR's strategic approach to recognize R&D funding opportunities that do or do not fit with its mission. Succinctly, how does the program know where to put its money, and, on the flip side of that decision, what should the program avoid? In finance, this approach to an investment strategy is called an "investment thesis." The fact that Applied SBIR must have a credible investment thesis is proof through practice that Applied SBIR is by nature an investment manager with fiduciary responsibilities to those who provide its capital (see [Section I, Program Focus and Limits](#)).

### The Importance of an Investment Thesis

An investment thesis is the logic that underpins why a particular allocation of capital (i.e., an investment) is made.<sup>52</sup> It is an industry term, with the most basic definition to "have a plan and stick to it until something causes you to revisit the plan." In practice, this means if an investment leverages or supports the investment thesis, then it is a generally validated move. It may not be the right move to make at that specific time and instance, but the due diligence on an investment that supports the investment thesis confirms its general fit with the direction management wants to go. However, an investment thesis is more than just a plan that outlines steps to allocate capital. If developed properly, it is more akin to an implementable investment strategy of how the mission can be achieved.<sup>53</sup> An investment thesis confers two primary benefits to investment execution: Discipline and Foreknowledge.

**Discipline** is the number one reason to have an investment thesis. In a world of unlimited possibilities but limited resources, the first need is to eliminate potential investments in those things that might seem attractive or important but are likely to distract management and lower the value of expected outcomes. An investment thesis guards against pet projects, fads of the moment, or the peccadilloes of key individuals. Mis-allocated capital may not only waste the money directly involved but also the even scarcer management time consumed in those inappropriate investments.

---

<sup>51</sup> Ray Dalio, p. 512.

<sup>52</sup> A definition of an investment thesis within the financial industry "An investment thesis is a reasoned argument for a particular investment strategy, backed up by research and analysis." Investopedia, <https://www.investopedia.com/terms/i/investment-thesis.asp>. Accessed on June 22, 2022.

<sup>53</sup> John Kotter, p. 73.

Like any strategy to be executed over several years, an investment thesis at its simplest is a guide to make individual decisions as well as ensure collectively those decisions are consistent with management's vision. An investment thesis' second benefit is the **foreknowledge** conferred by up-front research and analysis. Foreknowledge creates useful templates with which to analyze future investments. The research and analysis to craft an investment thesis conducted prior to ever making an investment, and then periodically revised, supports faster, less risky, and more effective individual decisions.

Investments that do not fit the thesis should be avoided because they will lack either a planning and analytical structure or are unlikely to fit with other investments within the portfolio. When made following an investment thesis, individual decisions are more likely to synchronize with each other in support of creating and managing a risk-weighted portfolio of investments with the benefits of diversification and risk management. Validating individual investments through an investment thesis is essential when investing over several years, during which time political priorities may change, hot new trends may develop, personnel may change, and simple organizational drift may lower the sum of the portfolio outputs.

## Applied SBIR's Investment Thesis

**Applied SBIR's investment thesis is to fund R&D to identify and then develop commercially available technologies into solutions for Army technology challenges.** The rest of this Profile outlines the steps to arrive at this thesis statement and underpins the rationale of its implementation. While a capital allocator likely has an intuitive feel for their thesis, it is dangerously self-deceptive to start with the thesis. While an investment thesis and its execution are certainly informed by intuition, it is a strategy derived from research and analysis. It represents the summation of the strategy and an investment organization's jumping-off point to execute its mission.

The research and analysis to develop an investment strategy starts with the "givens" that animate the organization. Like all funding programs within government or the financial industry, a program's ability to execute its mission is affected by its leadership's direction (e.g., policy). When embedded in the operational environment in which the program deploys its funding (i.e., the "reality" of government direction and process interfacing with innovation economy circumstances and expectations), policy and the direction it provides characterizes the dollars deployed. Understanding these funding characteristics is essential to developing an organization's investment strategy because they shape how innovation economy participants can access the value of those dollars.

## Policy

For the Applied SBIR Program, this direction starts with Congressional authorizing language then flows through the Small Business Administration (SBA) as the administrator of the SBIR program for all qualifying federal departments. Congress has given SBA the authority to establish SBIR policy for award sizes, proposal and program evaluation criteria, etc.<sup>54</sup> Then comes DOD policy and procedures with its control of the official channels for small business R&D proposals. Finally, there is official Army policies

---

<sup>54</sup> See SBA SBIR/STTR website for details on policy: <https://www.sbir.gov/>.

and directives both for the Army SBIR Program as well as those relating to Army modernization, procurement, and sustainment.

These are examples of Army strategic guidance relevant to shaping the Applied SBIR Program's activities:

- Army Modernization Strategy
- Army Climate Strategy
- Army EXORDs and Memoranda

## Funding Characteristics

Though policies should and do change to reflect changing reality and leadership priorities, the following six are the seemingly enduring aspects that shape the Applied SBIR Program. They will be used in the next section to diagnose the Applied SBIR environment as part of the analysis to substantiate the program's investment thesis.

1. May only be disbursed to a U.S. domiciled business (i.e., no government agency, prime, etc.).
2. The recipient business must have less than 500 employees.
3. May only be used to fund R&D, but, within that category, they are "colorless" in that they can be used for any appropriate Research, Development, Test, and Evaluation activities.
4. SBIR funds are disbursed via a contract with specific deliverables.
5. Currently, the norm for SBIR funding is about \$4M over one to four years, but dollar size may be about doubled with an SBA waiver to its policy on award sizes.
6. Once awarded, a SBIR makes the small business eligible for non-compete government contracting for the technology developed which potentially remunerative for the small business itself as well as makes the company a valuable acquisition target by larger firms.

## The Kernel of a Good Strategy

As part of the due diligence to substantiate Applied SBIR's investment strategy, this section places the Applied SBIR Program within its operating environment. Then, it outlines the program's governing policy and essential funding characteristics to "diagnose" the strategic challenge the program faces in best employing its assigned capital. The strategy model employed in this section is taken from Richard Rumelt's book "Good Strategy/Bad Strategy," which posits that good strategy has a structure termed a "kernel" with the following three components:<sup>55</sup>

1. **Diagnosis:** Defines or explains the nature of the challenge. A good diagnosis simplifies the often-overwhelming complexity of reality by identifying certain aspects of the situation as critical. Other aspects are not discarded only set-aside for future use to allow for focus on what is currently assessed to be critical.

---

<sup>55</sup> Rumelt, p. 77.

2. **Guiding Policy:** The overall approach chosen to cope with or overcome the obstacles identified in the diagnosis.
3. **Coherent Actions:** A set of coherent (i.e., coordinated and mutually supporting) actions designed to carry out the guiding policy.

## Diagnosis

Section I, **Innovation Framework** explains a large portion of Applied SBIR's and the entire defense industry's operating environment, which includes the significant shift of U.S. R&D activities towards commercial, consumer-oriented markets and the growth in great power competition to gain and control access to emerging technologies for military advantage. Herein will be added the Department of Defense's challenges in contracting with small businesses. As background, in 2016 there were 375,000 technology firms in the United States. By 2020, that number had grown to 556,000 firms for a compounded annual growth rate of 8.6 percent.<sup>56</sup> In that same period, the number of firms classified as the "defense industrial base" shrank from 69,000 to 55,000 firms for a compound annual growth rate of negative 4.4 percent.<sup>57</sup> The fact that not every defense industrial base firm is an emerging technology company exacerbates the implications of the simple math that makes the **military's access to less than 1 in 10 technology firms** even more sobering and problematic for Army modernization.

While the number of factors within the Army's operating environment are legion, the Applied SBIR Program makes sense of it through a distillation into three factors:

- A. The bulk of U.S. R&D expenditures goes to consumer-oriented purposes with little regard to the national security agenda.
- B. There is growing and increasingly sophisticated attempts by U.S. competitors and adversaries to control the flow of emerging technologies to gain military advantage.
- C. The Army's access to the emerging tech industry is shrinking.

To round-out its diagnosis of the challenge, Applied SBIR interprets its six funding characteristics listed above to generalize the effect of each on the value of SBIR funding to innovation economy firms.

**1. May only be disbursed to a U.S. domiciled business (i.e., no government agency, prime, etc.).**

This clearly limits not only the range of companies that can receive SBIR funding for their R&D activities but likewise affects the type of technical challenge that can be directly addressed with SBIR funding. Some technical problems require capabilities that exceed what is possible for a U.S. domiciled firm. The role of international subcontractors or suppliers within the U.S. firm's R&D activities must be limited; the Primary Investigator on the effort must at least be a U.S. resident alien; and there is growing emphasis placed on ferreting-out malign foreign influence in SBIR-awarded firms, which affects whom the firm can employ and where they can do their work.

**2. The recipient business must have less than 500 employees.**

Even more than the U.S. domicile requirement, some technical challenges exceed what a firm with less than 500 employees can adequately address. Second, this requirement has implications for larger firms

---

<sup>56</sup> State of the Tech Workforce, Cyberstates 2016 and 2020, The Computing Technology Industry Association (CompTIA), 2016 and 2020.

<sup>57</sup> Government Accountability Office, Small Business Contracting: Actions Needed to Implement and Monitor DOD's Small Business Strategy, (Arlington, VA: October 2021).

interested in acquiring or investing in a small business. If the larger firm's ownership share exceeds 50%, SBA's Affiliation rule applies disqualifying the small business from eligibility for "small business" programs. The rule eliminates small businesses that have significant investments from the most successful venture financing firms as most of the largest (by assets) and best-known venture firms in Silicon Valley and New York City have themselves more than 499 employees.

- 3. May only be used to fund R&D, but, within that category, Applied SBIR dollars are "colorless" in that they can be used for any appropriate Research, Development, Test, and Evaluation activities.**

Within the R&D activity set, Applied SBIR can fund anything from basic research when scientific knowledge starts to translate into applied research (*technology readiness level 1*) to the test and evaluation of the technology in the actual system within which it is intended to work (*technology readiness level 8*). That is a very wide funding scope, but it does not include buying or acquiring the technology itself. Neither does Applied SBIR fund production or manufacturing capital expenditures.

- 4. SBIR funds are disbursed via a contract with specific deliverables.**

SBIR funding is a discreet amount of money associated with a set of deliverables enumerated in a relatively simple government contract. It is not an equity investment taken in exchange for an ownership share, nor is it a grant given in hopes the results are generally productive, nor a debt with any specific outcome other than needing to be repaid. The specificity of the enumerated deliverables is at the discretion of the two parties to the contract (see [Innovation Profile 2: Balancing Flexibility with Efficiency in Both Problem Discovery and Solution Discovery](#) for the problem statements that inform contract scopes of work).

- 5. Currently, the norm for SBIR funding is about \$4 M over one to four years, but dollar size may be roughly doubled with an SBA award size waiver or through the SBIR Catalyst Program that requires government and private matching funds.**

A somewhat over-simplified but powerfully succinct way of analyzing a business case is with "\$/time." This expression – money divided by time to receive that money – is the "time value of money equation" and a cornerstone principle of finance and business operations.<sup>58</sup>

When Applied SBIR or any capital provider solicits to pay a company to conduct R&D work, the first thing the company asks is the logical question, "to do what?" because the answer will determine if the particular R&D work solicited fits their capabilities. Possibly less apparent to government, the very next question is, "how much will I be paid, and over what time will I receive that payment?" Companies of any size ask this question to determine if the time value of the dollar amount on offer is of interest given how it fits into their other business lines and the opportunity cost of focusing on the government solicitation instead of those other lines (see [Section I, Innovation Framework](#) for more on the binary choice many emerging tech firms face when considering defense work versus commercial market work).

To further show the importance of "\$/time", the Small Business Administration uses the slogan "SBIR is America's seed fund." While true 10 years ago and still true in spirit, in the contemporary venture industry

---

<sup>58</sup> The time value of money (TVM) is the concept that a sum of money is worth more now than the same sum will be at a future date due to its earnings potential in the interim. The time value of money is a core principle of finance. Investopedia, <https://www.investopedia.com/terms/t/timevalueofmoney.asp>. Accessed on 23 December 2022.

seed funding ranges from \$2M to \$5M annualized.<sup>59</sup> SBIR's normal \$1 million per year offering (\$/time: \$4M divided over four years) is squarely in the smaller "angel" and "friends and family" category. The import of this relative sizing means many leading emerging technology firms are deterred from pursuing SBIR awards because for similar effort they can earn much more in commercial, consumer-oriented markets.

The Applied SBIR Program recognizes time as a critical element of the total value proposition the program offers to small businesses. While every business transaction takes time, the amount of time it takes for company proposals to progress from initial submission to evaluation and decision to signed contract are either minor or major deterrents to innovation economy participants bringing their technology to the Applied SBIR Program. The issue of time value is also why when the technology challenge justifies and the market demands, the Applied SBIR Program request waivers to flexibly adjust upwards SBIR award sizes.

#### **6. Once awarded, a SBIR makes the small business eligible for non-compete government contracting for the technology developed.**

A powerful characteristic of a SBIR award is that it makes the receiving company eligible for a federal government procurement contract on a non-compete basis. The attractiveness of this non-compete status is it, obviously, lowers the competitive threat to winning another contract, and it greatly simplifies government contracting rules, making the award much faster to procure.

While eligibility for non-compete contracting process and the time-value of the money on offer from a SBIR contract are both important criteria, the third and ultimate direction-orientating question asked by innovation economy participants is, "where will this (small) SBIR contract lead?" Very few innovation economy firms are interested in making \$1 million a year in revenue. Nor is their main concern finding ways to pay for their R&D activity. **Their main concern is finding large and profitable markets to sell into.** They are seeking market entry opportunities, pathways, and support to big, fat markets because this is what success in consumer-oriented markets looks. Innovation economy participants ask the medium- to long-term question of whether the SBIR contract will lead to a much larger, longer term, lucrative acquisitions contract. This is the opportunity for them to get beyond research and development and to produce their technology at scale and at an attractive profit. That is the "pot of gold at the end of the rainbow." **The associated risks and expected returns of this larger acquisition income stream to which a SBIR may be a steppingstone is the crux of the business case.** In terms of making the most attractive business offer to emerging technology firms that have a choice between private and military customers, Applied SBIR focuses enormous effort in working with its Army partners to build and oversee a credible and feasible transition to post-SBIR contracts and funding.

### **Guiding policy**

In the prior Diagnosis section, three operating environment factors were identified:

1. Bulk of U.S. R&D expenditures goes to consumer-oriented purposes and markets;

---

<sup>59</sup> "How Seed Funding Has Exploded In The Past 10 Years," <https://news.crunchbase.com/venture/seed-funding-startups-top-vc-firms-a16z-nea-khosla/>. Accessed 20 October 2022.

2. Growing attempts by U.S. competitors and adversaries to control the flow of emerging technologies to gain military advantage;
3. The Army's access to the emerging tech industry is shrinking.

Recognizing the saliency of those factors, the Applied SBIR Program follows four policies that constitute the program's approach to addressing them:

- A. Act like the government-styled investment firm it is by recognizing both the program's core competency of allocating scarce funding to specific R&D purposes as well as its fiduciary responsibilities to the Army. (See [Section I, Program Focus and Limits](#).)
- B. Employ a portfolio management model to manage risk and exploit opportunities. (See [Section I, Modeling Risk](#) and [Innovation Profile 3: Adopt an Investor Mindset](#).)
- C. Structure its activities within multi-disciplinary, cross-organizational entities to share information to improve mutual understanding of the risks and opportunities with the purpose of supporting the best capital allocation decisions feasible. (See [Innovation Profile 5: Transition Broker Teams](#).)
- D. Set as its objective the transition of technologies from the R&D to Army acquisition phases, and then focus its planning and activities to achieve that transition in cooperation with internal and external customers. (See [Section I, Program Focus and Limits](#) and [Innovation Profile 5: Transition Broker Teams](#).)

### **Possible, Adjacent Possible, and Next Adjacent Possible R&D Echelons**

A manifestation of these policies is Applied SBIR supports R&D work that takes place in either the "possible" or the "adjacent possible."<sup>60</sup> R&D work in the "possible" is where problems and solutions are already known but require a refinement or improvement to overcome a specific technological challenge. While often difficult, recombining the known (i.e., already "possible") is rarely disruptive and shows a low risk profile. This is usually called routine innovation in Applied SBIR's innovation taxonomy.<sup>61</sup>

R&D work in the "adjacent possible" is where problems and solutions may not be known but likely exist as the next layer of knowledge removed from the "possible." Even though the basis of knowledge usually exists within the "possible," when executing within the "adjacent possible," the "possible" must be recombined through experimentation and development (i.e., educated guessing through practice). This is the echelon Applied SBIR prioritizes for funding since while the risk profile is much higher than routine innovation, the expected returns are exponential while the complexity of knowledge discovery means it is likely not to exceed the time horizon constraint of the one-to-four-year SBIR investment lifecycle. This is usually called disruptive or radical innovation in Applied SBIR's innovation taxonomy.

The third and most abstract echelon of R&D work is "next adjacent possible." This is the most abstract echelon of R&D work, is always extremely difficult; and inherently carries with it high risk to concept,

---

<sup>60</sup> Narayanamurti et al., pp. 82-90.

<sup>61</sup> See [Innovation Profile 2: Balancing Flexibility with Efficiency in Both Problem Discovery and Solution Discovery, Innovation Classification Types](#).

execution, and fit in its applicability to the Army. This is usually called architectural innovation in Applied SBIR's innovation taxonomy.

Applied SBIR does not generally fund the "next-adjacent possible," which as the name implies is at least two knowledge layers beyond what is currently known. "Next-adjacent possible" efforts are either basic research or are architectural in that they combine both disruptive and radical innovation. Google's Moonshot Projects is an example of R&D efforts designed for architectural innovation.<sup>62</sup> Applied SBIR generally avoids this type of R&D work due to their resource demand and risk profile. First and foremost, the resources and time required for success in "next-adjacent possible" efforts exceeds the program's capabilities. Second, because such efforts require the forging of largely new knowledge, their risk of failure exceeds Applied SBIR's tolerance for risk.

### Set of Coherent Actions

The set of actions intended to articulate the Applied SBIR's approach to overcoming the obstacles it encounters in its path to fulfill its mission are addressed throughout the *Innovation Framework* in both Sections I and II, with the bulk of the detailed approach enumerated in the ten [Innovation Profiles](#):

1. [Open the Door to Innovation](#)
2. [Problem Statements to Recognize Both Problem and Solution Discovery](#)
3. [Adopt an Investor Mindset](#)
4. [Engage the External Customer](#)
5. [Transition Broker Teams](#)
6. [Investment Thesis: What Applied SBIR Funds, What Doesn't It, and Why](#)
7. [Active Management](#)
8. [Funding Characteristics](#)
9. [Acceleration](#)

For the purposes of supporting the investment thesis, these actions complement those already contained in the [Innovation Profiles](#):

- A. Should be a tech problem that can be solved by a U.S. small business with a rough total of \$4M and in less than five years.
- B. The proposed technical solution **must have a commercial, consumer-oriented market application and revenue prospect**. This position is supported by the first of the three operating environment factors listed under Diagnosis: most R&D work happens outside the defense industrial base because defense spending is no longer large enough to attract the best talent and technologies. Prioritizing commercialization revenues for the R&D work SBIR funds not only addresses a priority in SBIR Congressional authorizing language to foster economic development but also fits the reality of where technical solutions are most likely to be found.
- C. While SBIR funding is RDTE and therefore the small business must perform some type of "research and development," there is no prerequisite minimum of either research or development in a SBIR funded R&D effort.

---

<sup>62</sup> See <https://x.company/>. Accessed on 24 October 2022.

- D. Firstline management of the SBIR funded R&D effort shall come from an Army expert with both the relevant technical competency and the time to manage the work of the small business.
- E. An appropriate and willing Transition Partner shall be directly involved from the beginning of the R&D effort to furnish a transition plan to integrate the technology into a larger Army system, using identified funds to make the transition feasible.
- F. Through a Transition Broker Team (TBT), all three parties to the effort (e.g., Technologist, Acquisitions, Applied SBIR) shall remain engaged across the SBIR lifecycle, employing a team-based approach to lead through the inevitable changes and problems to transition.

## Applied SBIR's Investment Thesis

From the research and analysis outlined in this Innovation Profile, the Applied SBIR's investment thesis is to **fund R&D to identify and then develop commercially available technologies into solutions for Army technology challenges.**

## Innovation Profile 7: Active Management

Because the Applied SBIR Program relies on money as the primary resource to execute its mission, the **program's core competency must be the decision-making process of how best to allocate its assigned money and then execute over time its fiduciary responsibilities** associated with those allocations. The element of time, one to five years for the average SBIR series of awards to a single R&D effort, means multiple decisions need to be made by the SBIR program; the internal Army customers directly managing the R&D work as well as those preparing to transition the practically successful technology into their programs; and of course, the small business conducting the R&D. These decision points must be prepared for through careful planning and adequate due diligence by each partner to minimize risk and exploit opportunities as and when they manifest. The Applied SBIR's process of fulfilling its fiduciary responsibilities through these decision points is called Active Management.<sup>63</sup>

Active Management relies on a team-based problem-solving methodology by which Applied SBIR Portfolio Managers (PM), Business Analysts (BA), SBIR Coordinators, Contracting Officer Representatives (COR), and Technical Points of Contact (TPOC) regularly exchange information concerning SBIR funded R&D efforts to overcome emerging issues with a consistent eye towards best preparing the effort for transition. However, recalling [Section I, Focus and Limits](#), the program only works in a collaborative manner not command-relationship with its partner organizations to support **their** R&D efforts. It takes the efforts of the entire team to ensure the money allocated to SBIR funded R&D efforts deliver maximal value to the Army. Active Management is the process by which Applied SBIR structures that teamwork.

While Applied SBIR's fiduciary responsibilities span all three stages of the SBIR lifecycle and therefore Active Management must likewise be comprehensive, its activities are centered within the second stage.

1. **Topic Ideation and Selection:** R&D pathway identification and development of specific SBIR funded R&D efforts; ends with an initial SBIR award to a small business.
2. **Active Management:** Monitoring and management of each SBIR funded R&D effort to mitigate risks, exploit opportunities, and prepare for either transition or exit<sup>64</sup> from the R&D effort; begins with the first signed SBIR contract and ends with the last deliverable of the last SBIR contract.
3. **Transition:** Transfer of a SBIR funded R&D effort to an acquisition program or continued R&D funded by non-SBIR dollars. Though beyond its direct responsibilities, the program remains engaged with transition partners, contributing its knowledge and network to increase the chances of a successful transition.

---

<sup>63</sup> For the definition of active management within the financial industry see "The term active management means that an investor, a professional money manager, or a team of professionals is tracking the performance of an investment portfolio and making buy, hold, and sell decisions about the assets in it." Investopedia, <https://www.investopedia.com/terms/a/activemanagement.asp>, accessed June 22, 2022.

<sup>64</sup> Applied SBIR defines "exit" as the termination for any reason prior to transition of a SBIR funded R&D effort.

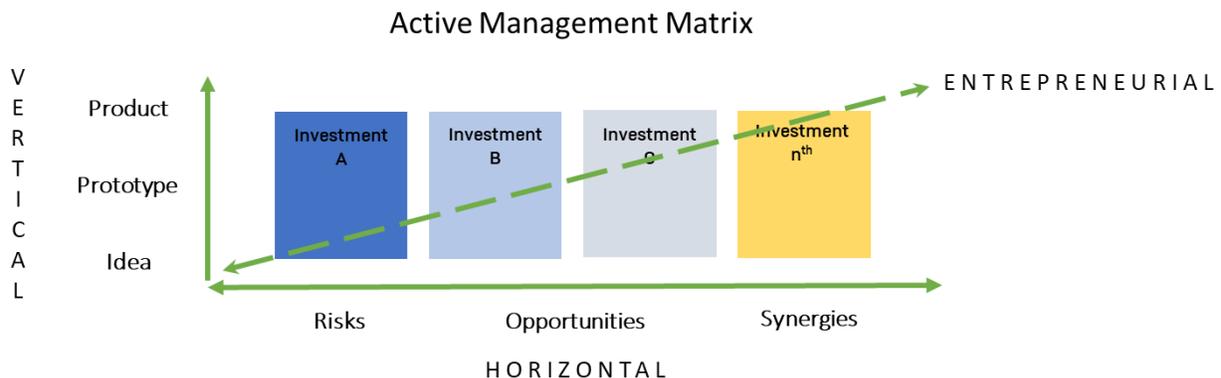
## Definition of Active Management

Active Management is the methodology by which the Applied SBIR Program executes its fiduciary function to reduce risk and improve the chances of a successful technology transition. It is conducted across the three-to-five-year lifecycle of the average SBIR funded effort, from SBIR award to transition or exit. Consistent with the program’s team-based Transition Broker Team (TBT) model, Active Management is a structured process to bring together the collective talents of the team to solve problems, mitigate risks, and exploit opportunities. While Active Management relies on essential inputs from TPOCs and multiple TBT members, Applied SBIR Portfolio Managers are primarily responsible for the process and the health of their SBIR funded R&D portfolios.

## Active Management Matrix

Each TBT Portfolio Committee (consisting of a Portfolio Manager and Business Analyst) uses the Active Management Matrix to manage along three performance lines:

1. **Vertical:** Monitor every R&D effort for issues, risks and mitigations, and opportunities; time spent on any SBIR funded R&D effort is determined by its priority relative to other efforts (see [Section I, Modeling Risk](#)).



2. **Horizontal:** Synchronize individual SBIR funded R&D efforts to mitigate risks and optimize outcomes across the portfolio.
3. **Entrepreneurial:** Shape the context within which the program funds R&D to include collaboration with non-Army organizations, policy advisors and industry partnerships.

## Outline of the Active Management Methodology

Using the Active Management methodology, a Transition Broker Team’s Portfolio Committee (Portfolio Manager and Business Analyst) evaluates each SBIR funded R&D effort, both individually and in relation to the TBT’s whole portfolio. The methodology informs the cadence and depth of Applied SBIR management engagement. The following are the principal steps in the process and how both the process and its outcomes are evaluated.

1. Applied SBIR Award Lifecycle Prioritization:

- Assessment of relative importance of SBIR funded R&D effort as guide for allocation of scarce management time for depth of execution of Active Management.
  - Initially assessed during Stage 1: Topic Ideation and Selection of SBIR Lifecycle.
  - Periodically reassessed during Stage 2: Active Management.
2. Active Management Engagement:
- A central component of how the program executes its fiduciary responsibility and applied to every SBIR funded R&D effort.
  - Employing a team-based approach, discussions among the TPOC, COR, SBIR Coordinator, PM, and BA are intended to assess R&D effort progress and provide varying perspectives to optimize problem-solving and exploit opportunities.
  - Portfolio Committee collects on eight standard data points for current assessment and future trend analysis. Other questions may be added to recognize the unique characteristics of each R&D effort.
  - Active Management Matrix alignment: *Vertical*.
3. Portfolio Committee Review:
- The TBT Portfolio Committee (Portfolio Manager and Business Analyst) review output of each active management engagement.
  - Portfolio analysis and balancing exercise.
  - Active Management Matrix alignment: *Vertical and Horizontal* (may include *Entrepreneurial*).
4. TBT Health of the Portfolio Report:
- Quarterly status and forecasting report prepared by Portfolio Committee (Portfolio Manager and Business Analyst).
  - Active Management Matrix alignment:
    - **Vertical:** SWOT analysis of each SBIR investment to highlight the status and anticipated development; supported by Applied SBIR measures of effectiveness and performance.
    - **Horizontal:** Qualitative assessment of synergies across the portfolio; includes portfolio financial review and budget forecasting; (*Applied SBIR is developing a quantitative analytical tool to complement qualitative factors for portfolio management*).
    - **Entrepreneurial:** Identification of obstacles and untapped potential within both the Army (internal) and innovation economy (external) SBIR operating environment.
5. TBT Portfolio Review:
- TBT members meet quarterly to review the TBT Health of the Portfolio.
  - Portfolio Manager updates TBT members on problems, risks and opportunities of each investment and the portfolio as a whole; intended to solicit ideas and support to best position the SBIR funded R&D efforts going forward.
6. SBIR Director-Level Portfolio Review:

- Quarterly presentation by Portfolio Manager of TBT Health of the Portfolio report to the Program Director.
  - Program Director provides guidance on portfolio changes; final output of the meeting is Director's certification of the portfolio until the next quarterly meeting. The certified report forms a part of the permanent TBT record for later trend analysis and decision accountability.
7. SBIR Total Portfolio Health:
- Six-monthly review of all Applied SBIR-supported R&D efforts.
  - Informs Applied SBIR annual guidance and planning.
  - Intended for Army Senior Leaders.

## Innovation Profile 8: Applied SBIR Funding Characteristics

Applied SBIR's TBT model "cuts the program to fit reality," not the other way around, meaning SBIR awards are flexible in terms of periods of performance and dollar size varying based on the specific characteristics of the tech problem they are designed to address. Flexible funding mechanisms are one of the ways by which TBTs buy-down risk to larger Army acquisition and R&D programs. They allocate relatively small amounts of R&D capital to explore technologies to learn what emerging tech firms are capable of, both technically and commercially.

### Phase I: Small Bets

TBTs employ Phase I awards to test technical concepts not yet ready for prototyping or to explore what emerging tech firms may have already developed for the private sector. Phase I awards should primarily be thought of as investments in the Army Modernization Enterprise's knowledge base. They are "small," with the norm being \$250,000; however, because the definition of "small" varies by technology field, \$250,000 is only a funding "norm," not a fixed limit.

#### Phase I Characteristics:

- Proof of concept, technical feasibility intended to either develop a new technology or improve the Army's understanding of applying a technical solution already available in the commercial sector.
- Normally \$250,000 but can go up to several hundred thousand dollars for technical challenges requiring greater funding amounts.
- Normally, 6-12-months periods of performance.

### Phase II: Larger Bets

TBTs employ Phase II awards to move beyond technical feasibility assessment and into prototype development. Phase II awards are investments of relatively larger amounts of capital to create a prototype for further development under an acquisitions contract (non-SBIR funding). Skipping Phase I altogether, **Direct to Phase II awards are available** in cases that TBT research substantiates an already high level of technical readiness among emerging tech firms to meet a particular Army technical challenge. Both a normal Phase II and Direct to Phase II are larger awards, with the norm being \$1.9 million per award; however, for the toughest challenges, awards may go up to the high single digit millions of dollars. A second Phase II award, called a Sequential Phase II, is possible upon completion of the Phase II or Direct to Phase II contract. Sequential Phase II awards are like Phase II awards in every way, except the Sequential awards are limited to \$1.4 million in SBIR funds, above which there is a requirement that incremental SBIR investment dollars above \$1.4 million must be matched at a two-to-one ratio by non-SBIR dollars (\$2 SBIR to \$1 non-SBIR).

#### Phase 2 Characteristics:

- Prototype development.
- Delivering a product or service intended for integration into an Army acquisitions contract or for further research and development.

- Normally \$1.9 million but can go up to high single digit millions for technical challenges requiring greater funding.
- Normally, 12-24 months periods of performance.
- Sequential Phase II is possible as a follow-on award to further develop the prototype.

As recognized by the existence of Direct to Phase II awards, TBT investments do not need to follow the logical sequence of a Phase II needing to be preceded by a Phase I. If an internal customer wants to acquire the technology immediately, the company may transition out of any award phase and into an acquisition contract. As one of the program's key value offers to innovation economy firms, a SBIR awardee is eligible for consideration for sole source contracting.

### Award Evaluation Criteria

TBTs use the three standard Small Business Administration criteria to evaluate proposals from technology providers seeking SBIR R&D investments; however, the TBTs adjust the weight of each criterion to best reflect individual topic characteristics.

1. **Technical Merit:** What are the odds the technology will work? This criterion is usually defined by what is currently accepted as generally sound science, but Phase I awards may include "moonshots" to substantiate a revision of currently accepted sound science. Accepting outsized risk is appropriate if in the TBT's collective judgement there is a reasonable chance the R&D effort elicits the statement, "this could be possible." Technical risk tolerance is usually significantly higher for Phase I awards.
2. **Technology Provider's Qualifications:** What are the investigative team's capabilities to deliver on the proposed R&D effort? Because innovation usually stems from network effects, it is just as important for the technology provider to demonstrate their connectivity with other quality members of the innovation economy as it is to show its team's internal talents.
3. **Commercial Potential:** Has the technology made any money and/or is anyone else putting money into the R&D effort? This substantiates the technology's potential to transition to private sector applications, government applications or government contractor applications. This criterion is measured by the technology provider's historical success in transitioning technologies, funding commitments from non-SBIR funding sources and existence of future commitments for the technology.

Because the risk level is usually elevated when moving from research to prototype development, the Applied SBIR Program uses its three tests of fitness for SBIR funded R&D efforts (see [Section I, Modeling Risk](#)) to inform and integrate with these three evaluation criteria.

Though the average SBIR funded R&D has a high-risk profile, each effort must be evaluated as a separate undertaking with its own unique risk profile. The three fitness tests or risk assessment categories help the program to raise awareness of the risk profile within an effort, and their standard implementation facilitates risk-balancing across the entire portfolio.

Three fitness tests:

- **Practical:** Technically capable; “will it work?”
- **Feasible:** Appropriate and credible for integration into an Army system; “can and will it be bought?”
- **Viable:** Sustainable business case for the small business; “can the business deliver on its promise?”

The program employs a team-based model to perform this analysis at the initial capital allocation as well as across the full SBIR investment lifecycle. Acquisition professionals and research center technologists along with Applied SBIR Portfolio Managers collaborate to generate SBIR topics, and then manage the R&D effort to account for inevitable and sometimes un-forecastable changes in each of the three capital allocation model parameters. The three analytical perspectives are employed to assess corresponding risks to execution and search for planned or emergent opportunities.

## Innovation Profile 9: Acceleration

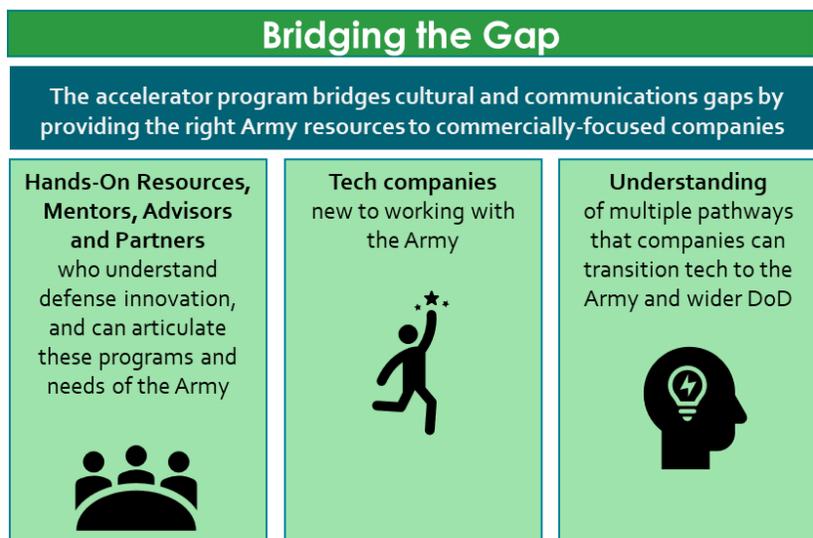
The Applied SBIR Program offers innovation economy technology providers access to an Accelerator program designed to speed-up a company's growth, development, and ability to address key gaps in either its technological offer to the market or assess the best market for its offer. Accelerator programs focus on early-stage, growth-driven companies and deliver value to company participants through education, mentorship, and financing. Companies typically enter accelerators for a fixed time and as part of a cohort (group) of companies.

The Applied SBIR Accelerator provides a select group of awardees with tailored resources to support them in advancing their technology, while also helping them better understand how to do business with the Army. The goal of the Applied SBIR Accelerator is to guide these companies in the business-case aspects of delivering their technologies through the R&D and acquisitions process to increase the chances of that technology successfully transitioning to the Soldier.

### Acceleration is a Process

Each Applied SBIR Accelerator is uniquely crafted to provide education, mentorship, exposure and consulting to strategically grouped technology providers that have overlapping resource requirements or needs. The Accelerator is usually 8-10 weeks in duration, and the programs are designed to support technology-focused companies in advancing their SBIR funded solutions toward major Army programs, while also helping them to grow and thrive as a small business. These services can include (but are not limited to): educational modules, exercises, data analysis, strategy sessions, mentorship sessions, talent searches, pitch days, networking opportunities, conference support, expert office hours and introductions to potential partner organizations.

Among the most important elements for any company to deliver new products to market are relationships, partnerships, and collaborations. The Accelerator helps to facilitate strategic meetings with external organizations, such as manufacturing, supply chain support, training organizations, operations teams, maintenance services, and external funding sources that these companies might not have had access to or had even considered as being vital to their ability to launch, grow and scale.



## Overcoming Communications Challenges

The Accelerator also helps bridge the cultural and communications gaps that often exist between commercially focused companies and the Army as a customer. Some of the most prevalent pain-points companies experience when working with the Army for the first time are the complexities of government contracting, military technological requirements, and understanding of how their technology fits with the existing Army systems and associated needs. The Accelerator helps address these issues by providing hands-on resources, mentors, technical advisors, and partners who understand the defense innovation and contracting ecosystem and can help articulate these programs and the needs of the Army. With the Accelerator's comprehensive week-by-week focus and the associated supporting educational modules, the cohort gains an understanding of the multiple pathways they may be able to transition their technologies to the Army and potentially the wider DOD.

### Accelerator results for companies include:



### Accelerator results for the Army include:



Dozens of Army acquisition offices have made these Accelerators available to hundreds of businesses, and many Accelerator participants have succeeded either by transitioning from a Phase I to a Phase II award; signing Cooperative Research and Development Agreements; partnering with defense prime contractors; or successfully transitioning their technology to the Soldier. Accelerator programs have proven to be a valuable tool in meeting both the goals of the companies and the Army.

The collaborative effort with both the Applied SBIR Program and between companies comprising each cohort also produces insight reports, quantitative and qualitative data, and further recommendations for how Applied SBIR can continually evolve its programs to be better positioned to facilitate rapid and transformative innovation. This program allows the Army an opportunity to better communicate their needs and requirements, to have a greater understanding of the challenges of small businesses, and the opportunity to grow their collaborative resources and relationships.

Innovation is not a destination; it is an iterative and continuous process that the Applied SBIR Program understands and fosters on behalf of the Army and for the benefit of its innovation economy partners.

## References and Readings

---

- Azhar, A. (2021). *The Exponential Age*. Diversion Books.
- Christensen, C. M. (2000). *The Innovator's Dilemma*. Harvard Business Review Press.
- Dalio, R. (2017.) *Principles*. Simon & Schuster.
- Drexler, E. (n.d.). *Radical Abundance: How a Revolution in Nanotechnology Will Change Civilization*. Farnam Street Blog. <https://fs.blog/the-difference-between-science-and-engineering>
- Government Accountability Office. (2021, October 14). *Small Business Contracting: Actions Needed to Implement and Monitor DOD's Small Business Strategy*. <https://www.gao.gov/products/gao-22-104621>
- Hammek, W., & Anderson, J. L. (2022, February 16). *Working in the Penumbra of Understanding*. Issues in Science and Technology. <https://issues.org/penumbra-engineering-perspective-hammack-anderson/>
- Janeway, W. (2018). *Doing Capitalism in the Innovation Economy*. Cambridge University Press.
- Kissinger, H., Schmidt, E. and Huttenlocher, D. (2021). *The Age of AI and Our Human Future*. Little, Brown and Company.
- Kotter, J. (2012). *Leading Change*. Harvard Business Review Press.
- Mallaby, S. (2022). *The Power Law, Venture Capital and the Making of the New Future*. Penguin Press.
- Narayanamurti, V., & Tsao, J. Y. (2021). *The Genesis of Technoscientific Revolutions: Rethinking the Nature and Nurture of Research*. Harvard University Press.
- O'Mara, M. (2019). *The Code: Silicon Valley and the Remaking of America*. Penguin Press.
- Pisano, G. (2018). *Creative Construction*. Harvard Business School Press.
- Rodgers, E. M. (2003). *Diffusion of Innovations* (5th ed.). Free Press.
- Rumelt, R. (2011). *Good Strategy/Bad Strategy*. Crown Business.
- Ronayne, D., Sgroi, D., & Tuckwell, A. (2021, July 15). *How Susceptible Are You to the Sunk Cost Fallacy?* Harvard Business Review. <https://hbr.org/2021/07/how-susceptible-are-you-to-the-sunk-cost-fallacy>
- Schumpeter, J. (2008). *Capitalism, Socialism and Democracy*. Harper Perennial Modern Classics.

Section 809 Panel. (2019, January). *Report of the Advisory Panel on Streamlining and Codifying Acquisition Regulations, Volume 3 of 3*. [https://discover.dtic.mil/wp-content/uploads/809-Panel-2019/Volume3/Sec809Panel\\_Vol3-Report\\_Jan2019\\_part-1\\_0509.pdf](https://discover.dtic.mil/wp-content/uploads/809-Panel-2019/Volume3/Sec809Panel_Vol3-Report_Jan2019_part-1_0509.pdf)

Sinek, S. (2011). *Start with Why*. Portfolio.

Taylor, M. (2016). *The Politics of Innovation*. Oxford University Press.

U.S. Small Business Administration. (n.d.). *What is Small Business Innovation Research?*  
<https://www.sbir.gov>

Vieth, R., & Kazerounian, K. (2003, June 22). *Teaching Engineering, Teaching Science: A Two Sided Coin*. ASEE 2003 Annual Conference, Nashville, TN. <https://peer.asee.org/11451>