ARMY APPLICATIONS LABORATORY

ON THE RECORD

PERFORMANCE REPORT

CONTENTS

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MESSAGE FROM THE DIRECTOR

Army Applications Laboratory's (AAL) annual performance report isn't a year in review. To begin with, it doesn't cover one year. This first report covers the three years that AAL has had a budget. Most importantly, it's a clear-eyed quantitative and qualitative report on the outcomes of AAL's innovation activities — including the commercial innovation by our portfolio companies and our own process innovations — in an effort to determine return on the Army's investment. It is intended to open a conversation with commercial and government stakeholders about how we think of return on investment for innovation activities in the Army.

Sixty years ago, two-thirds of research and development was federally funded. That has dropped to only one-fifth today, and many technologies the Army needs are developing faster in commercial industry. As the Army becomes increasingly reliant on technologies being developed by companies that do not traditionally do business with the government — companies with business models that are not built around DoD processes — we need novel approaches to access the technology. We cannot wait the two years extant processes take for a novel technology to get added into the budget. By then, the technology will be out of date, and the Army will continue to lag behind.

Increased investment in defense innovation indicates significant stakeholders' belief in the endeavor. At a minimum, it is a belief in the potential of innovation activities based on outcomes since the Defense Innovation Unit was founded in 2015. Venture capital in defense has increased from $1.8 billion in 2018 to more than $8 billion in 2022, according to PitchBook. This is a strong signal from a sector known for due diligence. There is a belief, in some corners, that defense innovation works.

But how do we know it works in the absence of a standard set of metrics by which we measure innovation activities? And how do we see through the complexity that inhibits such standardization? There is no one metric that can be applied to every project, at every innovation organization, to serve as a measure of success.

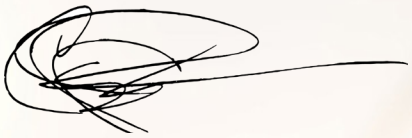
That each of the DoDX organizations has a different approach to innovation and uses different tools, or the same tools differently, adds to this complexity. This is a feature of DoDX, however, not a bug. These varied approaches are mutually-beneficial experiments that provide runways, off ramps, and landing pads for technologies in ways that the services couldn't before "innovation" became the trend.

I think defense innovation does work, and that this report gives Army leaders, entrepreneurs, and investors reason to be optimistic about the way multi-service innovation efforts combine to be more than the sum of their parts. Despite indications that various AAL initiatives and projects were succeeding, I was admittedly apprehensive about what our metrics would reveal. Nevertheless, as a scientist I was fully prepared to disclose the numbers regardless of what they reveal under the belief that the utility of experiments also comes from the discovery of what doesn't work. And AAL certainly has done that.

That AAL has transitioned nearly half its projects to DoD stakeholders is one indicator that the inclusion of commercial innovation is returning value to the Army and its sister services, but it's just an indicator. It is, with our current tools and a lack of baselines, incredibly hard to quantify success vis-à-vis cost, performance, and schedule. The metrics are very clear, however, that working with the Army has been a boon to companies and investors including, and perhaps especially, those that don't often do business with the Department of Defense. The value of a robust, diverse, and reliable defense innovation base would be hard to overestimate.

I am privileged to lead a team of dedicated professionals who are committed to delivering the best technology in the world to the best Army in the world. I am further privileged to be part of a command that works tirelessly for the continuous improvement of the Army it serves. Additionally, the unprecedented cooperation across services has led to significant parts of our success, and I hope we have returned the favor.

Sincerely,



Dr. Casey Perley
Executive Director
Army Applications Laboratory (AAL)

EXECUTIVE SUMMARY

This report identifies and explains the metrics Army Applications Laboratory uses in an attempt to quantify the value of its activities to the Army, the DoD, companies, and investors. It attempts to describe AAL's achievements, challenges, and lessons learned since its inception in 2019 with a focus on the last three years since AAL received its first budget. This report gives insight into how the work was accomplished, how nontraditional businesses and the Army benefited, lessons learned, and recommendations for how the entire innovation ecosystem can examine relevant approaches and work together to gain efficiencies.

Among the notable metrics indicating ROI for the Army include:

- Forty-five percent of AAL's completed projects transitioned to programs of record, Soldiers, sister services, or to other science and technology (S&T) organizations for further development and integration.
- Since AAL received its first budget, it has awarded more than $105 million to companies. This funding has been matched by $78 million from other government and industry partners.
- Sixty percent of AAL portfolio companies had little to no DoD experience before working with AAL.
- There are 13,000+ companies in AAL's solver network.

Companies and investors also have experienced significant success working with AAL and its models:

- AAL portfolio companies have raised more than $933 million since being on contract with AAL.
- AAL portfolio companies see, on average, a 45 percent increase in private capital funding following an AAL contract.
- Companies with limited to no DoD experience averaged nine follow-on US government contracts after working with AAL.

The Lab also consistently innovates internally, in addition to the work AAL does to incentivize commercial innovation in the Army's solution development. It pilots new programs and ways of doing business to help the Army effectively ingest innovation, to make the Army a preferred business partner to the commercial technology ecosystem, and to demonstrate constructive ways to evolve Army business culture. These include:

- **VERTEX** – an event series that reimagines how companies participate in problem framing and solution development for specific Army tech problems (more on page 13),
- **Cohorts** – a new program that encourages companies to cooperate to build true best-in-class solutions rather than compete to make different versions of a solution specified in a requirement (more on page 15),
- **SPARTN** – a method of using Small Business Innovation Research (SBIR) grants as a powerful, flexible innovation tool (more on page 16), and
- **A fresh approach to communications** that enables AAL to be a familiar, approachable entry point for nontraditional corporate DoD partners.

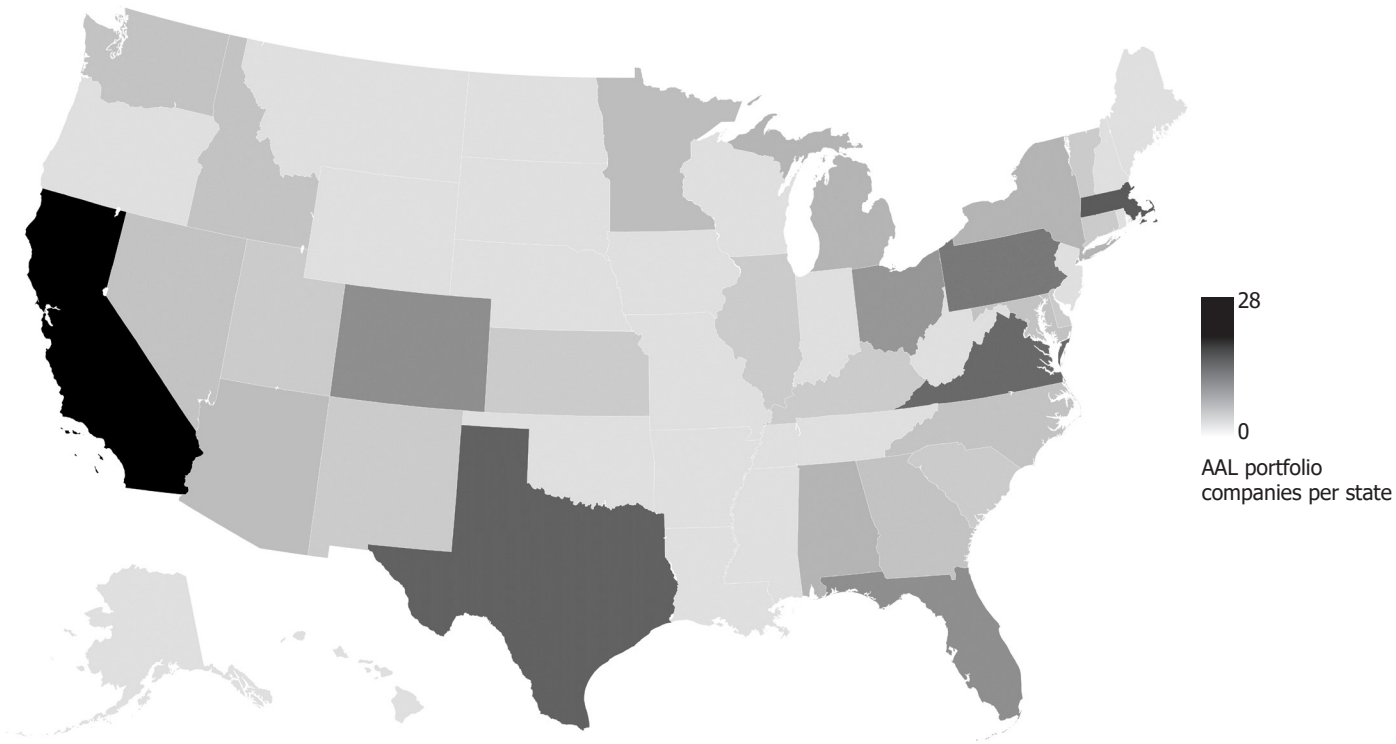
This report also functions as part of AAL's remit to capture and share innovation best practices and lessons learned, such as:

- How starting with a broad problem statement — not a rigid solution request — leads to better outcomes in the long run,
- Why it is important to align stakeholders from project inception (to save time and money),
- What best practices and funding types help to mitigate technology risk and transition uncertainty, and
- Why proactively reaching commercial sector partners where they are — and educating them about the intricacies of working with the government sector — will benefit the innovation ecosystem.


VERTEX
DAY 1 BACK BRIEF
COL Clay McVay
Deputy Director
Army Applications Laboratory
CAPITAL FACTORY

ARMY APPLICATIONS LABORATORY

AAL BY THE NUMBERS



TOTAL NUMBER OF AAL PORTFOLIO COMPANIES: 158

AAL'S PORTFOLIO COMPANIES SPAN 31 STATES

MINORITY- AND WOMAN-OWNED AAL PORTFOLIO COMPANIES: 22

AAL PORTFOLIO COMPANY SIZE BREAKDOWN

1–10 Employees: 48
11–100 Employees: 83
101–1,000 Employees: 23
1,001–10,000 Employees: 4

AAL PORTFOLIO COMPANY PRIOR DOD WORK BREAKDOWN

0 DoD Contracts: 26
1–20 DoD Contracts: 75
21–100 DoD Contracts: 31
>100 DoD Contracts: 26

TOTAL INVESTED

$183 MILLION

$105 MILLION
AAL invested

$78 MILLION
Co-invested

9
Average number of follow-on US Government contracts nontraditional* companies receive after working with AAL

$933 MILLION
Total funds companies raised after being on AAL contracts

15
Companies in AAL's portfolio have a >$100-million valuation

7
Companies reached a $100-million valuation after working with AAL

12 Sucessful Exits

Companies working with AAL remain attractive to other businesses/investors as acquisition targets

*A nontraditional is any company with fewer than 20 DoD contracts over the life of the company

COMPLETED PROJECTS

20

$60 MILLION
Total invested

$45 MILLION
AAL invested

$15 MILLION
DoD and private co-invested

$44 MILLION
Total value of follow-on contracts

45%

9 of AAL's 20 completed projects transitioned, some with multiple technologies from a single project

13

Technologies transitioned

22

Desired characteristics added to requirements documents

ACTIVE PROJECTS

28

$123 MILLION

Total invested

$60 MILLION

AAL invested

$63 MILLION

Co-invested

ARMY APPLICATIONS LABORATORY

HELPING THE ARMY EVOLVE BUSINESS PRACTICES

AAL supports US Army Futures Command's (AFC) mission to get the best technology in the hands of Soldiers as quickly as possible by expanding the Army's access to the commercial innovation base. A critical part of AAL's mission is to experiment with process and share the lessons to help the Army ingest innovation more effectively, from problem framing to sustainment. By questioning and adapting the conventional approach to capability development, the Lab provides new ways for industry and the Army to work together, to expand the number of companies willing and prepared to work with the Army, and to ensure Soldiers have faster access to cutting-edge technology.

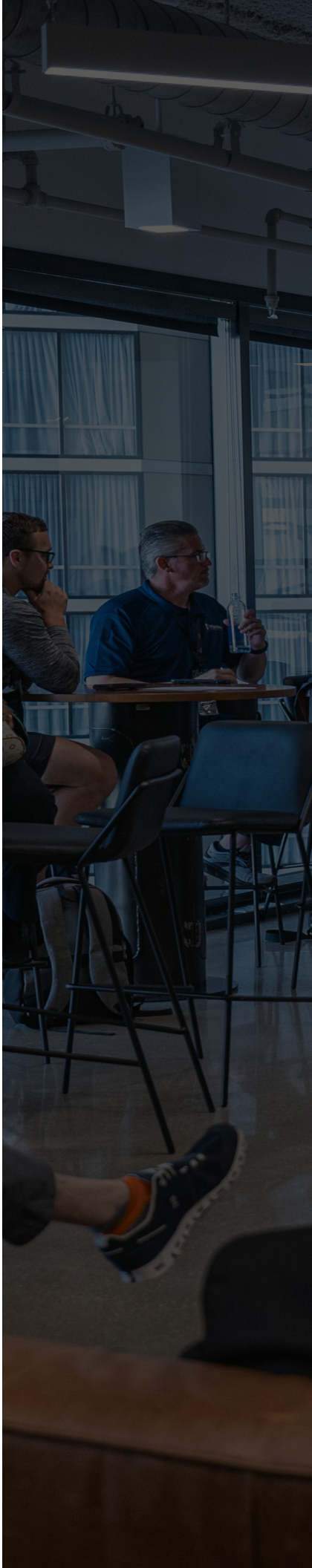
The VERTEX market intelligence series, the Cohort Program, SPARTN SBIR, and a commercial approach to communications are four ways AAL is driving process innovation throughout the Army.

PROCESS INNOVATION

VERTEX COMPLETED: 5

FOCUS AREAS:

- ENERGY
- HUMAN PERFORMANCE
- ROBOTICS
- ARMORED FORMATIONS
- CONTESTED LOGISTICS



VERTEX

VERTEX is a first-of-its-kind event series that invites industry to help the Army frame problems and develop solutions for priority Army tactical and operational challenges. Started in April 2022, VERTEX captures market intelligence used to inform everything from future warfighting concepts to requirements (that determine what the Army will buy) for some of the Army's highest priority mission areas. VERTEX prioritizes working with innovators with few or no DoD contracts to ensure the Army taps broad swaths of technology and fresh solver perspectives.

More than 150 engineers, Army problem owners and technical experts, and end users participate in each VERTEX. The companies represent a range of growth stages, sizes, and experience, from startups with exciting new technologies to established industry giants. Industry applies to attend VERTEX, and AAL selects the companies and job titles most likely to align with the use cases for which the Army needs solutions. Typically, these include founders/CEOs and scientists or engineers, and not business development people.

Before each VERTEX, AAL conducts VERTEX | Forge — a government-only preparation event — to re-verify and adjust the Army use cases to be addressed at VERTEX. The group collaborates before engaging industry to better identify, describe, and verify the nuances of the Army use cases so industry has the right information to inform possible solutions, and ensures that the important capability gaps facing Soldiers are addressed.

VERTEX is not a pitch competition, and no contracts or funding are awarded at the event. Instead, VERTEX provides a stage for exploration, discussion, and collaboration. There have been five focus areas explored at VERTEX: energy, human performance, robotics, armored formations, and contested logistics.

Each day of VERTEX begins with keynotes and panel discussions from leading private-sector innovators and Army/DoD experts. In the afternoons, participants break into small groups to talk about how their technologies address critical Army use cases. These breakout sessions give industry unprecedented and invaluable access to Army stakeholders, including Soldiers, Cross-Functional Teams representing modernization priorities, and Centers responsible for requirements and development.

Insights gleaned from each VERTEX will inspire future solicitations that yield tech solutions for the Army's toughest challenges.


RICCHIO
U.S. ARMY

COHORT PROGRAM

AAL's Cohort Program is a twist on commercial accelerator cohort programs that brings novel perspectives to solving the most complex Army problems. With cohorts, the Army does not presuppose the solution. Rather, AAL invites companies to work side by side with Soldiers, Army stakeholders, and mission partners to dive deep into the end-user experience and to help the Army frame, dissect, and solve complex problems through the lens of what their company does best.

AAL cohorts incentivize companies to create superior solutions by combining their expertise, rather than competing against one another to build different versions of the same solution, as results from the typical solicitation. With AAL portfolio managers guiding companies through the process, and unparalleled access to Soldiers and Army stakeholders, the relevant Army experts are easily accessible to the cohort companies to inform solution requirements, deliver feedback, and validate their concepts. This allows for efficient capability development and ensures Army investments are put toward relevant solutions Soldiers will actually use.

The cohorts often result in unexpected solutions to additional Army problems. Read about the Field Artillery Autonomous Resupply (FAAR) cohort on page 29 to learn about the various outcomes AAL cohorts enable.

Cohort participants have shared the impact the program had on their technologies:

"Seeing how we could adapt our technology in a pretty straightforward way for a use case as different as munitions inventory opened our eyes to other, similar adaptations that we can do in the commercial sector."
–Ben Ziomek, Co-founder & CTO, Actuate
FAAR Cohort Member

"Even in the private sector we rarely get this much exposure at every level of end-user management. System architects, buyers — the whole chain of decision makers."
–Ryan Cousins, CEO, KRTKL Inc.
Robotic Combat Vehicle Sustainment (RCVS) Cohort Member

"In the other SBIR efforts we've done, decision makers typically get involved much later in the process but in this cohort, the decision makers and solvers connected for a touchpoint at the beginning to uncover end users' insights. We found this extraordinarily helpful, and if we designed a SBIR approach, it would look exactly like this."
–Aron Kain, CTO, BH Sensors
Robotic Combat Vehicle Sustainment (RCVS) Cohort Member

SPARTN

Reimagining SBIR

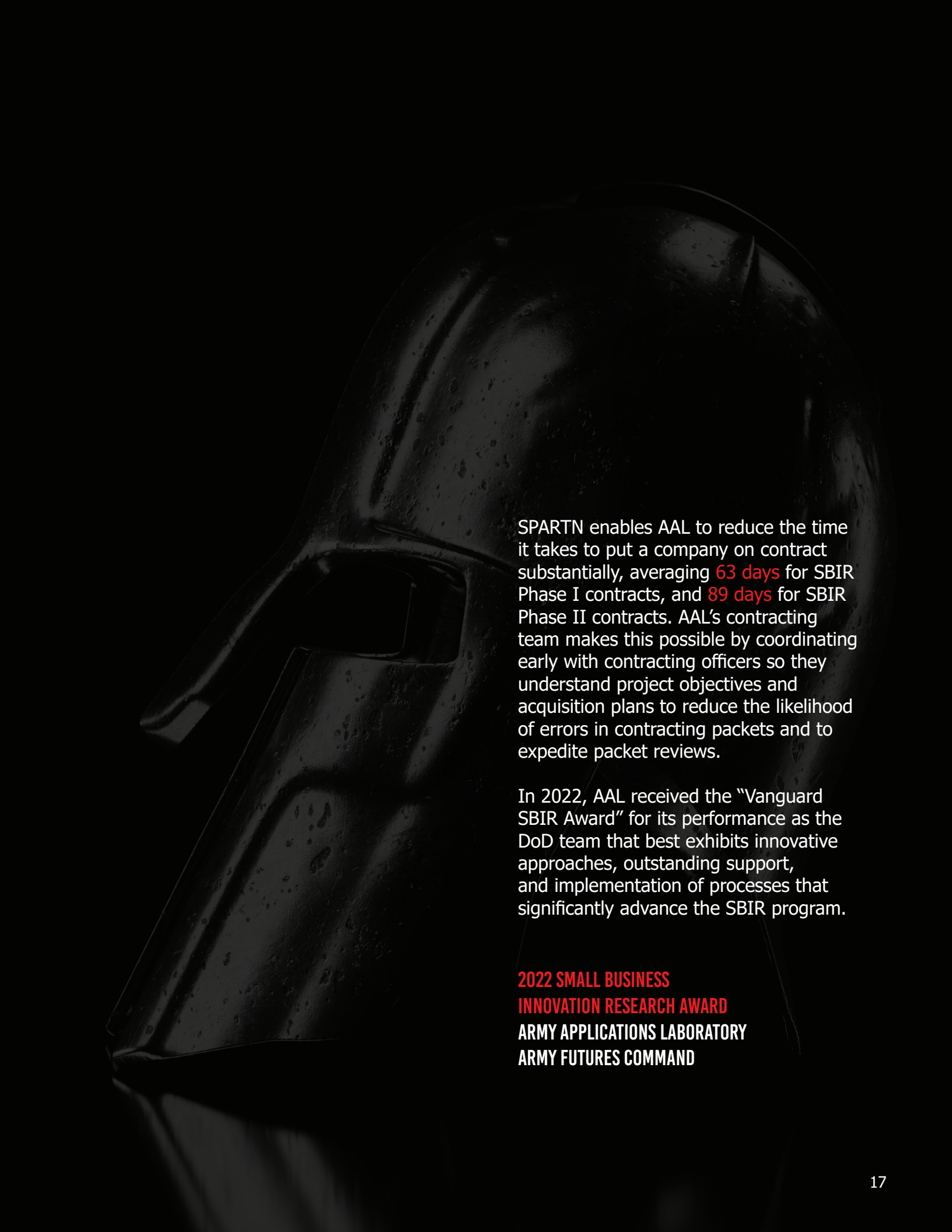
The Special Program Awards for Required Technology Needs (SPARTN) is AAL's way of using the Small Business Innovation Research (SBIR) Program as a powerful innovation tool that operates at the speed of business. SPARTN is organized to give the Army access to best-in-class commercial technologies by increasing access to Army stakeholders and end users, being transparent about timelines and scale of potential transitions, and increasing the speed of payments.

SPARTN is a key part of AAL's blended funding model in which flexible Research Development Test and Experiment (RDT&E) funds, SBIR, and private capital are combined to help bridge both tech and transition uncertainties to get the best technologies in the hands of Soldiers.

The SPARTN SBIR Model

Each SPARTN topic focuses on closing specific Army capability gaps with innovative commercial technologies. Here's how AAL does it:

1. AAL ingests an Army stakeholder problem and develops a solicitation that explains the problem in commercially-relevant, easy to understand language and provides examples of successful solution features.
2. The solicitation is posted to the AAL website and the Defense SBIR Innovation Portal (DSIP). AAL promotes the project through social media and direct emails to a broad network of relevant companies to ensure the opportunity reaches nontraditional solvers.
3. AAL hosts webinars and technical point of contact (TPOC) calls so potential solvers can engage subject matter experts (SMEs) to learn more about the topic.
4. Businesses submit their proposals and, if selected and put on contract, receive capital when they need it. Payments are based on deliverables rather than timelines, which enables AAL to front-load payments to small businesses that need the capital to be able to compete.
5. During solution development, vendors have unparalleled access to Army stakeholders to inform their concepts. Upfront feedback on solutions from acquisition stakeholders allows businesses to see the routes by which they can scale their business via the Army.



SPARTN enables AAL to reduce the time it takes to put a company on contract substantially, averaging 63 days for SBIR Phase I contracts, and 89 days for SBIR Phase II contracts. AAL's contracting team makes this possible by coordinating early with contracting officers so they understand project objectives and acquisition plans to reduce the likelihood of errors in contracting packets and to expedite packet reviews.

In 2022, AAL received the "Vanguard SBIR Award" for its performance as the DoD team that best exhibits innovative approaches, outstanding support, and implementation of processes that significantly advance the SBIR program.

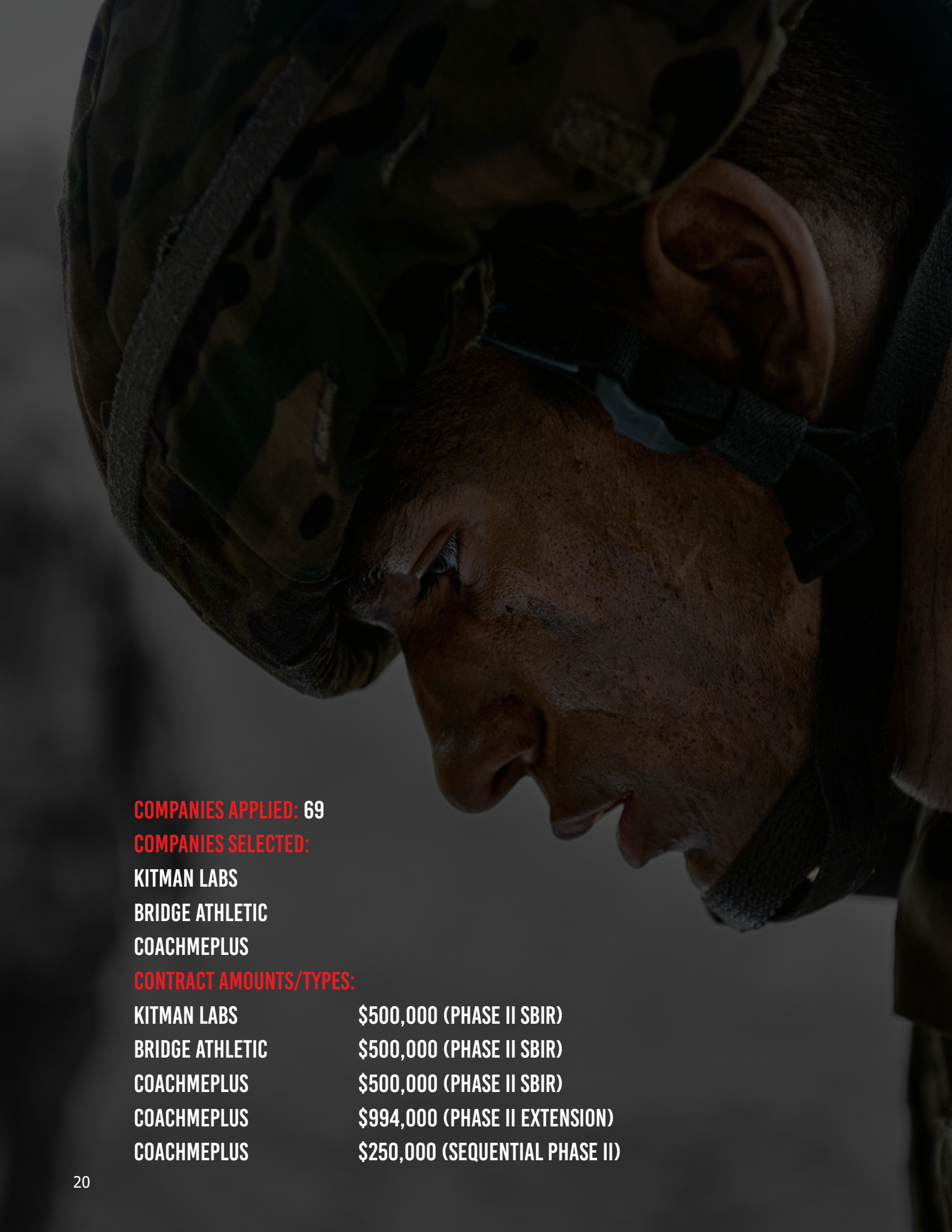
2022 SMALL BUSINESS INNOVATION RESEARCH AWARD
ARMY APPLICATIONS LABORATORY
ARMY FUTURES COMMAND

CASE STUDIES

THE FOLLOWING CASE STUDIES REPRESENT SOME OF THE SIGNIFICANT AAL PROJECTS THAT ADDRESS CRITICAL CAPABILITY GAPS, SAFEGUARD SOLDIERS, AND EVEN ALTER THE CHARACTER OF WAR. THE CASE STUDIES AIM TO PROVIDE AN UNDERSTANDING OF AAL'S APPROACH TO DISRUPTIVE* OR RADICAL INNOVATION AND SHED LIGHT ON THE PROJECTS' IMPACT AND LESSONS LEARNED.**

*Disruptive innovation occurs when a company uses a new technology to enter an existing market.

**Radical innovation occurs when a company develops and applies a new technology to a new market.



COMPANIES APPLIED: 69

COMPANIES SELECTED:

KITMAN LABS

BRIDGE ATHLETIC

COACHMEPLUS

CONTRACT AMOUNTS/TYPES:

KITMAN LABS	$500,000 (PHASE II SBIR)
BRIDGE ATHLETIC	$500,000 (PHASE II SBIR)
COACHMEPLUS	$500,000 (PHASE II SBIR)
COACHMEPLUS	$994,000 (PHASE II EXTENSION)
COACHMEPLUS	$250,000 (SEQUENTIAL PHASE II)

H2FMS

Holistic Health and Fitness Management System

Data-Driven Soldier Health Decisions

In 2021, the 82nd Airborne Division's commanding general asked AAL for a solution to track and aggregate Soldiers' holistic health and fitness (H2F) data so that leaders could use it to make informed decisions about Soldier readiness. H2F is the Army's framework to encompass all aspects of human performance — physical, sleep, nutritional, spiritual, and mental health/fitness — to optimize Soldiers' readiness, reduce injury rates, improve post-injury rehabilitation, and produce physically and mentally tough Soldiers.

At the time, the Army was using a database called Army Vantage that tracked Soldiers' physical fitness data at each duty station but didn't transfer the data across stations as Soldiers moved throughout their careers. Also, the narrow focus on physical fitness overlooked the other confounding variables that affect Soldier readiness — an oversight that resulted in incomplete information and challenged effective decision-making.

A software/cloud solution was needed to track Soldier/unit readiness across the five domains of H2F and transfer the data across Army units so that it moved with the Soldier. The idea was that this level of streamlined, long-term tracking of H2F data, amalgamated into a user-friendly system for data collection and display, would allow leaders to understand the readiness level of their force and identify Soldiers who may be struggling before the Soldier failed a physical fitness test, suffered an injury, or required practitioner intervention.

The solution the Army sought was much like athlete management systems commonly used by teams in the NFL, MLB, MLS, Premier League, and NHL — systems that track athletes' (Soldiers') health over time and provide coaches (Army leaders) with insights about each athlete to determine who should be on the field, benched, or is at risk of injury.

AAL released the H2F Management System (H2FMS) Direct to Phase II (DP2) SBIR solicitation — it was a DP2 since the technology (athlete management systems) already existed in industry — to which 69 companies submitted solution proposals. The three companies that were selected (CoachMePlus, BridgeAthletic, and Kitman Labs) had athlete management-like software solutions through which users could log health and fitness data and display it for analysis.

(Continues on page 22)

Finding the Best Solution

Each company received $500,000 to adapt its fitness app-like solutions to fit Army needs, test them, and ingest the feedback for the potential to receive further funding in a Phase II Extension. The companies' solutions were piloted across four units (82nd Airborne Division, 513th Military Intelligence Brigade, 232nd Medical Battalion, and a US Army Reserve detachment) with each solution tested at every participating unit for feedback on user experience, vendor-provided training, the time it takes users to input data on the five fitness dimensions, platform features, dashboards and reports to leaders/trainers/health providers, and ability to measure Soldiers' overall fitness across the H2F domains. After each rotation, AAL surveyed the units, gathering more than 150 responses from Soldiers and leaders, and sent the results to the companies so they could update/modify their solutions. Each month of the six-month pilot, unit representatives provided verbal and written feedback on the platforms they were testing. AAL captured Soldier feedback and took it into consideration when the companies were evaluated for selection at the end of the DP2 period of performance.

Based on pilot testing feedback, CoachMePlus received $994,000 for a SBIR Phase II Extension to further develop its Warrior Performance Platform (WP2) because of its user-friendly interface and ability to address all five health and fitness domains. The scope of the Phase II Extension included enhancing platform security measures to protect Soldiers' health data, and optimizing platform interface to improve user experience depending on role (e.g., Soldiers, leaders, doctors, dietitians, etc.).

Transition Plan

H2FMS is intended to transition to the US Army's Training and Doctrine Command (TRADOC), the home of the H2F program. TRADOC isn't a traditional transition partner for AAL's projects because its scope doesn't often require technology solutions as would a Program Executive Office, Program Manager, or another four-star Army Command like US Army Materiel Command.

Joint Collaboration

When the Naval Health Research Center (NHRC) expressed interest in using the H2FMS solution for a Navy use case, AAL's H2FMS Portfolio Manager MAJ Nick Rinaldi worked with their director to explore funding vehicles that could get NHRC on the WP2 platform. This resulted in a Sequential Phase II contract funded by the Office of the Secretary of Defense (OSD) Transitions SBIR Technologies (OTST) program with $250,000 contributed by AAL.

Benefits of Co-investment:

- With the Navy as a funding partner on H2FMS, the Army will benefit from additional features or capabilities developed in the R&D effort, while the Navy is able to invest in a solution with a higher technology readiness level.
- Additional funding from the Navy is not only a direct benefit to CoachMePlus and its development effort, but the company's work with the Army has resulted in an additional, unanticipated DoD customer for H2FMS.

The Bottom Line

The Warrior Performance Platform will help Soldiers achieve their holistic fitness goals and enable Army leaders to have access to the information they need to address Soldier readiness and well-being across the force better. WP2 will allow the Army to:

- Plan and distribute workouts to Soldiers across the Army via mobile app,
- Coordinate across the entire organization with custom roles and permissions for Soldiers, coaches, leaders, health providers, etc.,
- Pull in testing and monitoring data from Soldiers' devices,
- Collect performance data, centralize data, customize dashboards, and use advanced analytic capabilities so leaders can address specific unit needs,
- Deliver help where it's needed, increase performance across the force, and enable leaders to methodically improve readiness over time, and
- Educate the force and change its culture of prioritizing only physical fitness, to prioritizing holistic health and fitness practices.

This project provided the Army with a user-friendly platform that tracks individual, team, and unit health and fitness, and makes data management digitally accessible from the palm of a hand, alleviating the inefficiencies that came with paper logs/journals or whiteboard scorecards. This platform also securely connects to government-owned data warehouses, centralizing the data so that it can follow Soldiers throughout their careers. This platform is currently used by more than 40 brigades and there are plans to expand that number to 110 brigades by FY2030.

Lessons Learned

Future Army projects aiming to adopt data-centric software or technologies can use lessons from the H2FMS initiative to avoid similar hurdles. These include:

- Vendors' solutions must have data-export capabilities so Soldier data can be delivered and stored in government-owned data warehouses to ensure its proper management and security.
- Develop adaptable solutions that are flexible enough to pivot/integrate into newer systems as they emerge.
- Multiple software and hardware solutions exist; consolidate information about them in a single location that vendors can access, and create a playbook that provides vendors transparency on how to participate.
- Prepare the Authority to Operate (ATO) and accreditation pipeline or involve the transition partner in the process immediately. Interim Authorization to Test (IATT) is good to test products. Start both processes immediately.
- When dealing with data, privacy impact assessments must come before the project kicks off.

ARMORS

Augmented Reality Maintainer-Operator Relay System

Sustainment Solution

During a 2019 feedback session at Fort Cavazos, a Soldier from the 1st Cavalry Division raised the many pain points of motor pool maintenance operations. It was an almost entirely manual process, he said, that required too much paperwork to identify, document, and manage maintenance issues. And the relaying of this often-erroneous paperwork between expert mechanics and the Soldiers performing maintenance was incredibly inefficient, negatively impacting operational readiness. The Soldier proposed a digitized maintenance solution that implements augmented reality-based guidance since he knew this capability was used by the commercial automotive industry. At the same time, a battalion commander from the 1st Cavalry Division expressed a desire for paperless maintenance to improve his situational awareness.

Combining those problems, AAL turned to industry experts for a maintenance system that would allow Soldiers to identify, document, and manage motor pool maintenance, and receive maintenance guidance easily and in a user-friendly format; have telemaintenance capabilities; and use augmented reality (AR) to help Soldiers better leverage the telemaintenance system or operate offline in austere areas that lack network connectivity.

COMPANIES APPLIED: 55

COMPANIES SELECTED:

DESIGN INTERACTIVE, INC.

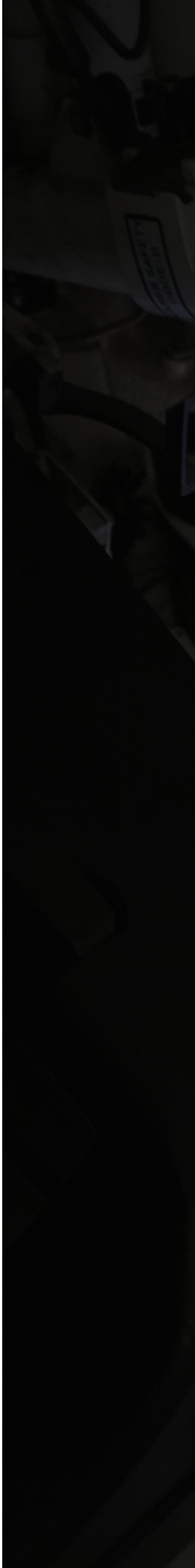
TIPPING POINT MEDIA

TAQTILE

CONTRACT AMOUNTS/TYPES:

DESIGN INTERACTIVE, INC.	$111,447 (PHASE I SBIR)
TIPPING POINT MEDIA	$105,745 (PHASE I SBIR)
TAQTILE	$110,450 (PHASE I SBIR)
TAQTILE	$1.6 MILLION (PHASE II SBIR)
TAQTILE	$1.9 MILLION (SEQUENTIAL PHASE II SBIR)

COMMERCIAL INNOVATION



The Process

Fifty-five companies submitted proposals to AAL's Augmented Reality Maintainer-Operator Relay System (ARMORS) Phase I SBIR solicitation. Of the 55, Taqtile, Tipping Point Media, and Design Interactive Inc. were awarded contracts with a six-month period of performance. In Phase I, the vendors were to develop proof-of-concept solutions that integrated Army preventative maintenance checks and services (PMCS) procedures, fault capture using real-time data, and improved maintenance training — such as digital annotations and videos — to their original solution proposals. Phase I concluded with a presentation of each company's proof-of-concept. Beyond the proof-of-concept presentation, Taqtile demonstrated an existing AR maintenance solution — called Manifest — on an M1 Abrams.

Taqtile advanced to a SBIR Phase II and received $1.6 million for a 24-month period of performance. Taqtile also took advantage of the program where the Small Business Administration matches funding from private industry to enhance research and development. Taqtile brought $250,000 to the effort, which was matched by an additional $500,000 in SBIR funding to the program in SBIR funds. During the Phase II, Taqtile:

- Digitized fault mitigation workflow to enhance maintenance logistics,
- Reduced the dependence of a fiducial marker for the tracking of vehicles in 3D space,
- Enabled integration with Global Combat Support System (GCSS)-Army — the Army's logistics and financial management information enterprise resource planning solution,
- Implemented permissions-based viewing of work instructions to ensure maintenance would be conducted by the proper maintenance personnel, and
- Developed cybersecurity strategy to ensure deployability.

The Results

Taqtile developed a telemaintenance tool that employs augmented reality-based guidance systems, allowing Soldiers to easily identify, document, and manage vehicle maintenance issues. This solution reaches all levels of sustainment, from operators and mechanics to logistics units responsible for the distribution of parts and materials.

What's Next

Taqtile's solution was recently awarded a Sequential Phase II contract that will allow the company to conduct an assessment for brigade-level maintenance/operational readiness requirements, develop a solution design and implementation plan, and develop training materials that include a change management strategy. As part of this effort, the technology will deploy with 1-2 Stryker Brigade Combat Team, 7th ID for a nine-month rotation to Korea. While there, and at other Army exercises like Sustainment Exercise (SMEX), the tool will be evaluated on its improvement of the Army's ability to conduct maintenance on widely dispersed units, its support of expeditionary/operations, and on its support of less-trained Soldiers to complete maintenance tasks without the physical presence of a technical expert.

Taqtile's Manifest software is also the backbone for telemaintenance/AR maintenance systems under development by the Air Force and the Navy, and has even been trialed by the Australian Navy. The lessons learned from other services and upcoming exercises and rotations will help demonstrate the return on investment in this technology for the DoD.

Lessons Learned

- AAL PMs will continue to explore different types of funding that can be added to increase the effectiveness of the project. Here, the ability to match private capital with SBIR brought an additional $750,000 to the program, which allowed for the development of additional features.
- When technology is used by multiple services and partner nations, the Army is able to capitalize on their development work and lessons learned.

ANTI-JAM

Anti-Jam Antenna for Soldiers' Navigation

In 2020, the Command Power and Integration Directorate (CP&ID) — Position Navigation and Timing (PNT) Division at the US Army Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance, and Reconnaissance (C5ISR) Center asked AAL to help find technologies related to making PNT more resilient against jamming attempts.

The focus was on finding PNT anti-jamming solutions that were small and had low enough power consumption to be used by Soldiers on foot and that could be integrated into future dismounted PNT devices.

AAL used RDT&E funding for the project, which allows companies of any size or nationality to compete for awards. The solicitation was announced as a special topic on AAL's Broad Agency Announcement, a standard way that government RDT&E opportunities are publicized and put on contract. AAL received 69 submissions from industry; 10 were selected and pitched their solution to stakeholders. Three companies were then selected to provide formal proposals to identify and develop anti-jamming solutions. Two of those were selected to receive RDT&E 6.3 funding: Ball Aerospace received $1.4 million and Hexagon US Federal received $1 million.

COMMERCIAL INNOVATION

COMPANIES APPLIED: 69

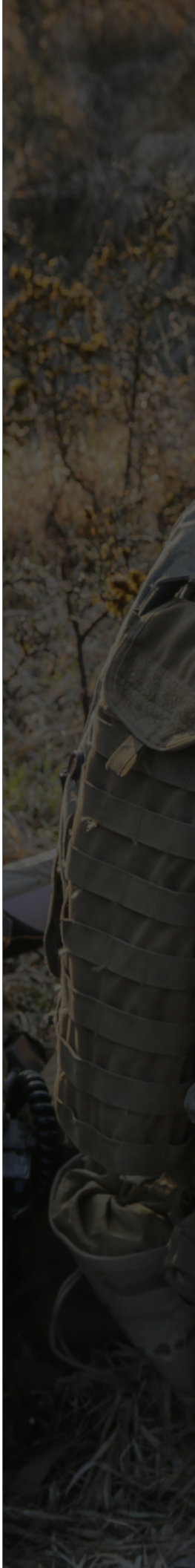
COMPANIES SELECTED:

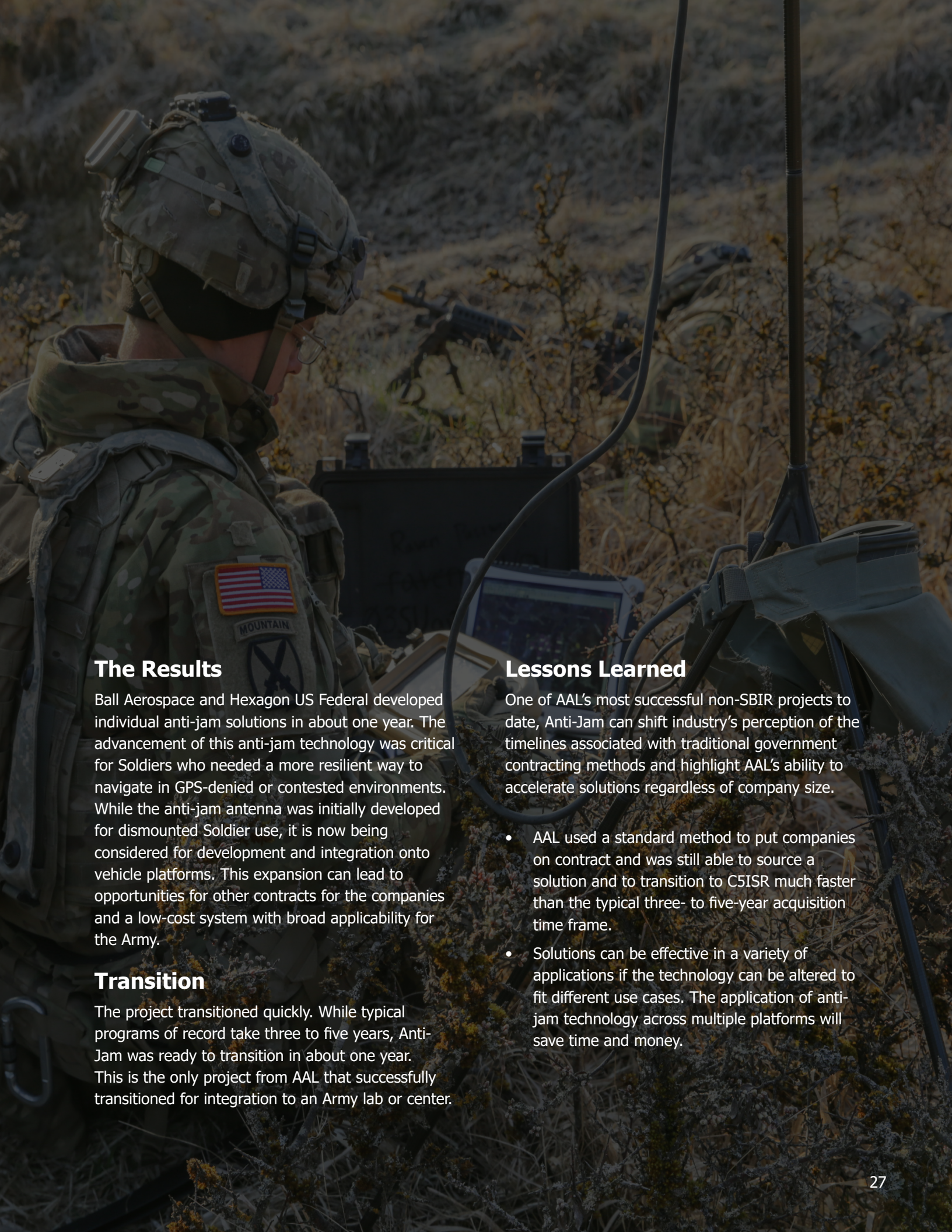
BALL AEROSPACE

HEXAGON US FEDERAL

CONTRACT AMOUNTS/TYPES:

BALL AEROSPACE	$1.4 MILLION (RDT&E)
HEXAGON US FEDERAL	$1 MILLION (RDT&E)





The Results

Ball Aerospace and Hexagon US Federal developed individual anti-jam solutions in about one year. The advancement of this anti-jam technology was critical for Soldiers who needed a more resilient way to navigate in GPS-denied or contested environments. While the anti-jam antenna was initially developed for dismounted Soldier use, it is now being considered for development and integration onto vehicle platforms. This expansion can lead to opportunities for other contracts for the companies and a low-cost system with broad applicability for the Army.

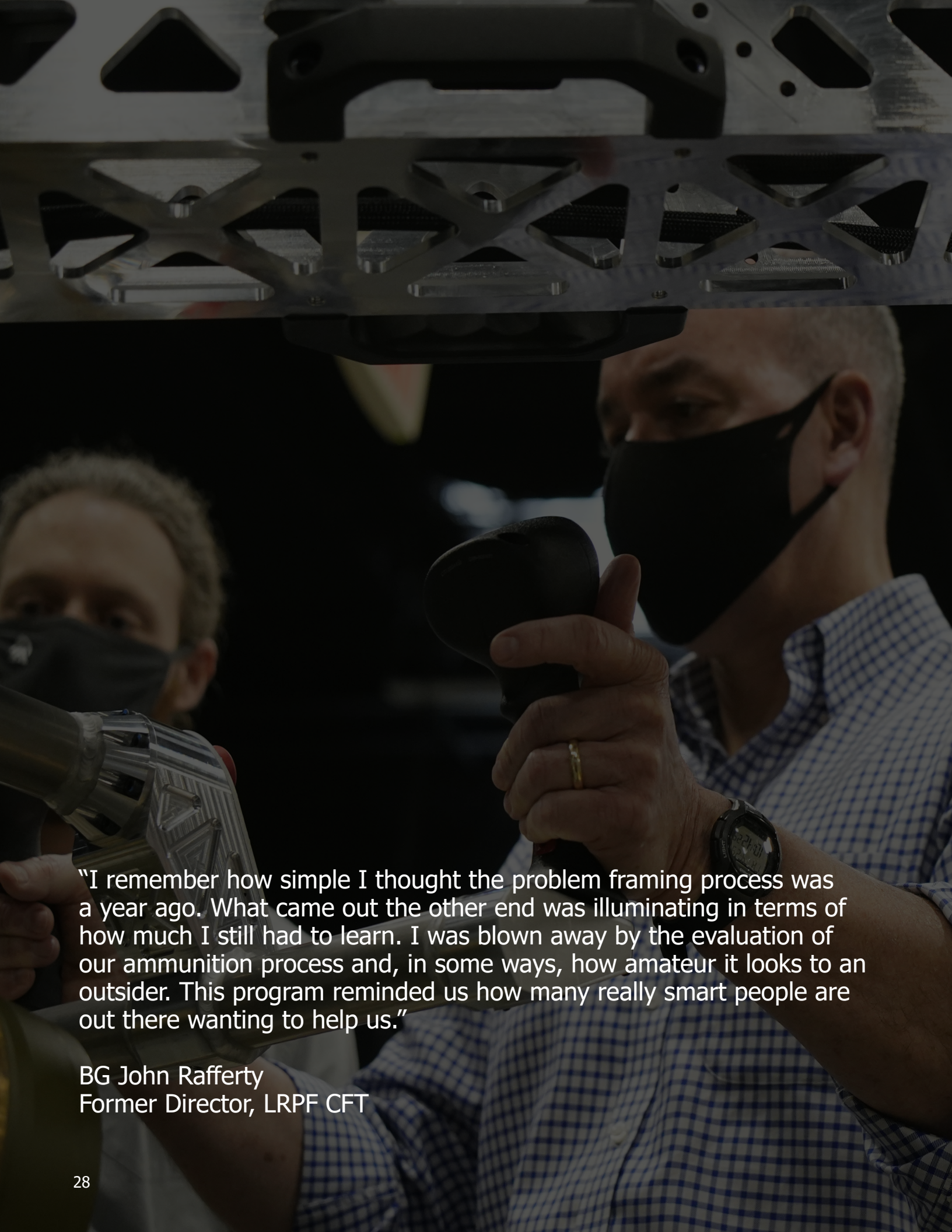
Transition

The project transitioned quickly. While typical programs of record take three to five years, Anti-Jam was ready to transition in about one year. This is the only project from AAL that successfully transitioned for integration to an Army lab or center.

Lessons Learned

One of AAL's most successful non-SBIR projects to date, Anti-Jam can shift industry's perception of the timelines associated with traditional government contracting methods and highlight AAL's ability to accelerate solutions regardless of company size.

- AAL used a standard method to put companies on contract and was still able to source a solution and to transition to C5ISR much faster than the typical three- to five-year acquisition time frame.
- Solutions can be effective in a variety of applications if the technology can be altered to fit different use cases. The application of anti-jam technology across multiple platforms will save time and money.



"I remember how simple I thought the problem framing process was a year ago. What came out the other end was illuminating in terms of how much I still had to learn. I was blown away by the evaluation of our ammunition process and, in some ways, how amateur it looks to an outsider. This program reminded us how many really smart people are out there wanting to help us."

BG John Rafferty
Former Director, LRPF CFT

FAAR

Field Artillery Autonomous Resupply

FAAR Cohort

During the Extended Range Cannon Artillery (ERCA) program, the Army identified a need for faster resupply operations. With the ERCA's mission to deliver rapid, sustained firepower, artillery units would expend all available ammunition quickly, and would need a faster resupply to match this increased tempo of operations. The Long Range Precision Fires (LRPF) Cross-Functional Team was responsible for finding resupply solutions that would support the rapid stocking, restocking, and transfer of boxed and individual unit inventory assets, including the automated loading of material from logistics vehicles to field artillery weapon systems.

LRPF CFT and AAL worked together to better understand the problem by going over field artillery resupply operations and identifying specific pain points and requirements. After a series of events, briefings, and webinars to showcase the problem to the industry solvers, 87 submissions were received. Six companies, each with different technologies, were awarded $150,000 to participate in a 12-week cohort. Three solutions (RAAR, CAMS, VBIM) and their respective companies (Apptronik, Carnegie Robotics Tactical, Actuate) were selected for prototype development, discussed on the following pages.

COMPANIES APPLIED: 87

COMPANIES SELECTED: 6

CONTRACT AMOUNTS/TYPES: $150,000 (RDT&E) PER COMPANY

RAAR

Robotic Arm Artillery Resupply

Rapid Firing Requires Rapid Resupply

During the FAAR cohort, Apptronik and other cohort participants identified several problem areas that restricted faster resupply, including the physical strain on Soldiers during manual ammunition resupply operations. Some artillery munitions weigh as much as 110 pounds each and manual handling of these munitions becomes difficult during extended resupply operations. The size of artillery teams relative to the size of the artillery vehicle hull is another challenge. Only two Soldiers fit in the hull to resupply the artillery ammunition racks, but a standard resupply team is about 10 Soldiers.

Apptronik proposed an external, vehicle-mounted robotic arm and a receiver table system to assist Soldiers in resupply operations. Their goal was to reduce the physical strain on Soldiers, reduce the number of Soldiers needed to conduct ammunition resupply operations, and reduce the time it takes to resupply ammunition. The Robotic Arm Artillery Resupply (RAAR) project was awarded $1.9 million in RDT&E funding to deliver a prototype that would demonstrate how the robotic arm could reduce the time to resupply. This effort culminated with a demonstration to stakeholders from AFC, LRPF CFT, and Program Manager Self-Propelled Howitzer Systems (PM SPHS) in April of 2021. Artillery Soldiers and other stakeholders had the opportunity to operate the prototype robotic arm and evaluate its capabilities.

COMMERCIAL INNOVATION

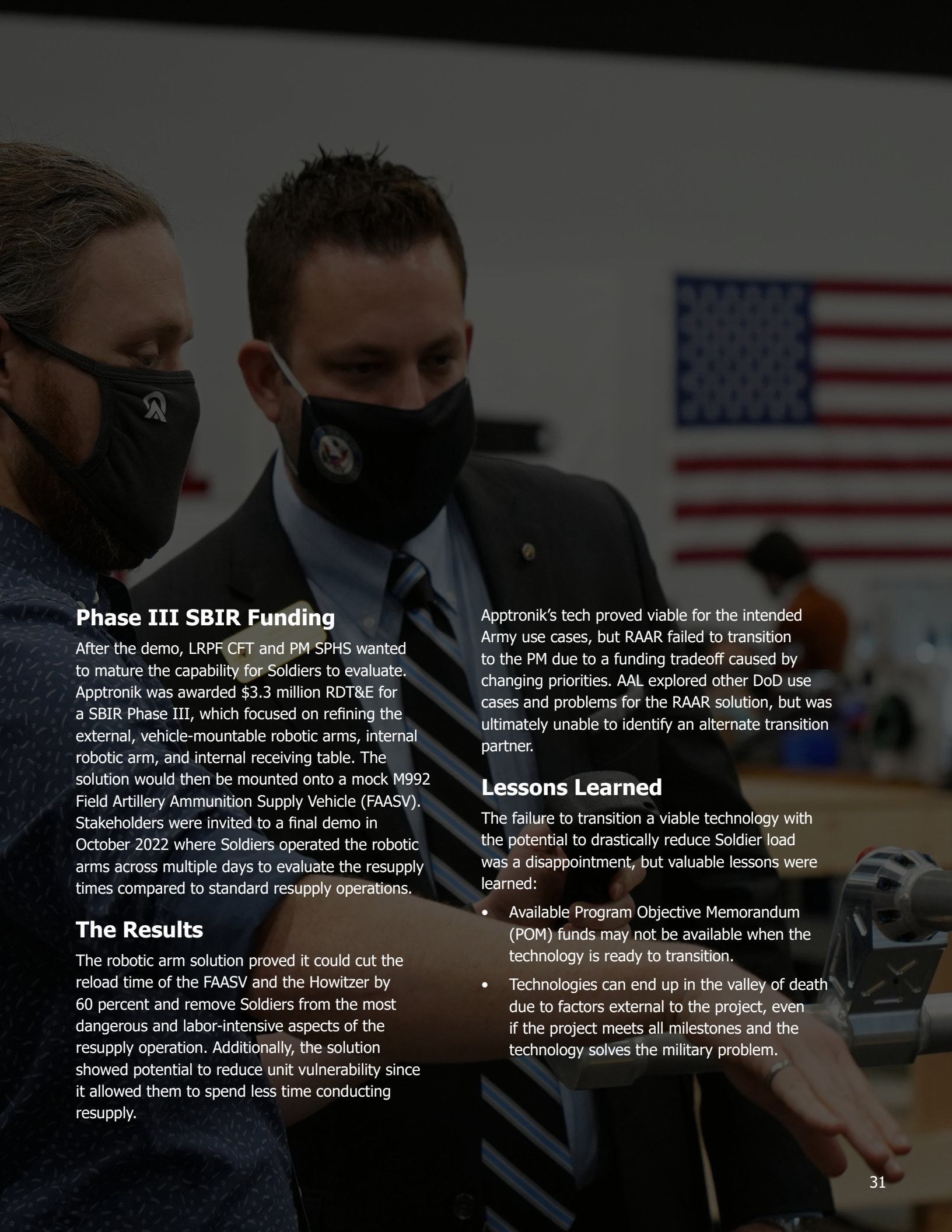
COMPANY SELECTED: APPTRONIK

CONTRACT AMOUNTS/TYPES:

$150,000 (RDT&E)

$1.9 MILLION (RDT&E)

$3.3 MILLION (RDT&E)



Phase III SBIR Funding

After the demo, LRPF CFT and PM SPHS wanted to mature the capability for Soldiers to evaluate. Apptronik was awarded $3.3 million RDT&E for a SBIR Phase III, which focused on refining the external, vehicle-mountable robotic arms, internal robotic arm, and internal receiving table. The solution would then be mounted onto a mock M992 Field Artillery Ammunition Supply Vehicle (FAASV). Stakeholders were invited to a final demo in October 2022 where Soldiers operated the robotic arms across multiple days to evaluate the resupply times compared to standard resupply operations.

The Results

The robotic arm solution proved it could cut the reload time of the FAASV and the Howitzer by 60 percent and remove Soldiers from the most dangerous and labor-intensive aspects of the resupply operation. Additionally, the solution showed potential to reduce unit vulnerability since it allowed them to spend less time conducting resupply.

Apptronik's tech proved viable for the intended Army use cases, but RAAR failed to transition to the PM due to a funding tradeoff caused by changing priorities. AAL explored other DoD use cases and problems for the RAAR solution, but was ultimately unable to identify an alternate transition partner.

Lessons Learned

The failure to transition a viable technology with the potential to drastically reduce Soldier load was a disappointment, but valuable lessons were learned:

- Available Program Objective Memorandum (POM) funds may not be available when the technology is ready to transition.
- Technologies can end up in the valley of death due to factors external to the project, even if the project meets all milestones and the technology solves the military problem.

CAMS/VBIM

Cannon Ammunition Management System/
Vision-Based Inventory Management

Ammunition Management Game-Changers

The FAAR cohort illuminated the time consuming and highly manual nature of the inventory management process for artillery. Two companies proposed solutions to automate parts of the process, saving time and increasing accuracy while providing real-time visibility for commanders into ammunition availability status. CR Tactical's Cannon Ammunition Management System (CAMS) received $1.7 million and Actuate's Vision-Based Inventory Management (VBIM) received $1.6 million to build minimum viable products to this end.

CAMS began with a data modeling study of the existing ammunition management systems of record. Findings indicated the need to integrate disparate, large, and complex multi-source data sets into a consolidated but efficient data structure that could provide better ammunition tracking by leveraging data visualizations and artificial intelligence and machine learning.

VBIM was meant to speed up the ammunition transfer process by digitally populating Class V accountability forms by scanning ammunition using computer vision with AI engine algorithms, enabling greater inventory accuracy. The system then assists CAMS to track ammunition across the battlefield. CAMS and VBIM integrate seamlessly, ensuring battlefield-wide ammunition tracking.

COMMERCIAL INNOVATION

COMPANIES SELECTED:

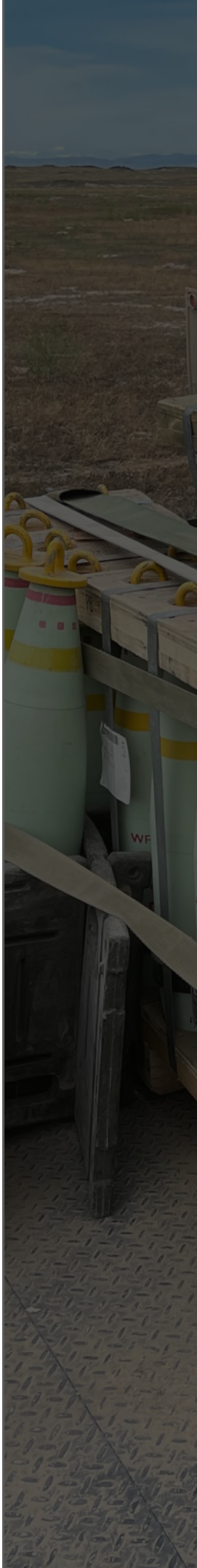
CR TACTICAL

ACTUATE

UBIHERE

CONTRACT AMOUNTS/TYPES:

CR TACTICAL	$1.7 MILLION (RDT&E)
ACTUATE	$3.3 MILLION ($1.7M RDT&E AND $1.6M SBIR)
UBIHERE	$1.6 MILLION (SBIR)



Based on the variety of technical approaches to solving the VBIM problem, AAL re-competed the effort through SBIR. AAL targeted businesses that develop inventory management software in hopes of finding a solution to expedite the ammunition transfer process by digitally populating accountability forms through ammunition scanning, greatly enhancing inventory accuracy. Thirty seven companies submitted proposals and the two companies selected to advance were Actuate and Ubihere; both received $1.6 million in funding.

Transition

In December 2023, CAMS and VBIM transitioned to the Joint Program Executive Office for Armaments and Ammunition, with CR Tactical integrating the two solutions. Their continued development under the Total Ammunition Management Information System project marks a significant step forward in modernizing ammunition management within the Army. By addressing the challenge of real-time inventory visibility, these projects will bring a new level of accuracy and effectiveness to ammunition operations within field artillery units, ultimately enhancing the readiness and effectiveness of the Army.

Lessons Learned

The cohort model brought fresh eyes to an Army process that had barely been improved for decades, and helped the Army identify pain points it didn't know it had. Lessons include:

- Thorough and successful problem framing occurred as a result of inviting multiple companies with different expertise to examine the problem.
- The traditional approach of picking one company to deliver a solution does not necessarily result in the best solution. Companies with unique expertise can combine to design a solution that is truly best-in-class.
- Companies are more likely to work together if they are able to combine their expertise to produce a solution with a better chance of transitioning to a program of record. The ability for small businesses to serve as the integrator also decreases costs, as prime vendors are not needed.
- Combining different types of funding, such as RDT&E and SBIR, can reduce technical risk and advance solution development.

LESSONS LEARNED

As AAL has refined its business practices over the last five years, it has learned valuable lessons on what works — and what doesn't — when working with commercial companies to apply their technologies to Army use cases.

1. Start with a broad problem statement — not a solution

It is far more effective to identify a problem and apply commercial expertise and creativity to solve it than it is to identify promising technology and shop it around the Army to find a buyer. The two-year wait to get technology into the budget and the long timelines associated with creating or updating requirements documents can leave companies waiting years for funding.

Writing solicitations too specifically can define a solution before innovators have the opportunity to contribute ideas based on their expertise. If the Army wants artillery to fire faster, for example, a solicitation for an autoloader eliminates broad swaths of technology that could help, like inventory management or Soldier safety solutions. Especially for complex problems, there is a lot of value in letting commercial companies bring new perspectives and technologies that the Army would not have thought to ask for.

AAL uses cohorts to create conditions that encourage collaboration between companies to solve complex problems. Under a traditional model, where only one vendor is contracted to solve a problem, solutions proposed are often superior in some areas but only "good enough" in others. By creating cohorts of five to 15 companies, each with partial solutions or critical enabling technologies, and encouraging collaboration by selecting multiple awardees per down-select, companies are incentivized to work together. This has led not only to better holistic solutions, but also to small businesses stepping up to serve as integrators — growing a new line of business, and creating a new type of integrator for the Army. (See page 15 for more on AAL's Cohort Program.)

2. Align stakeholders early to save time and money

Aligning end users, requirements writers, and acquisition professionals at the start of a project gives solutions the best chance of meeting the Army's needs, and helps companies avoid having (and generally failing) to find the correct partners within the Army. Nontraditional companies don't know whom to engage inside the Army, resulting in solutions that veer from a desired capability due to a lack of context and critical insights that engagements with end users and acquisition professionals can provide, and time and money wasted when companies deliver uninformed solutions to misaligned problems.

Waiting until a technology is fully developed to write a requirements document delays transition by a minimum of one year, and potentially more given timelines associated with getting technology into the budget. By involving requirements writers from the start, an acquisition strategy can be built (i.e., is this technology part of multiple requirements documents/programs, or is it a stand-alone requirement/program?), requirement entry gates can be met year(s) in advance of the POM, and funding has the potential to flow at project completion. Even if a project fails, this understanding can inform requirement documents so that failures are not repeated.

(Continues on page 36)

3. Involving contracting officers early in project development expedites the process and leads to more tailored contracts

Early alignment with contracting officers can speed up the contracting process and tailor contracts' timelines and funding to the problem being solved. The Army shouldn't wait six months or more to get companies on contract after a solicitation closes — and industry doesn't want this either. Working with dedicated contracting officer teams in advance of solicitation close will:

- Provide fidelity on needed documents,
- Focus the team on rapidly submitting packages,
- Streamline the contract submission process, and
- Speed up contracting times.

Structuring contracts based on deliverables where applicable, rather than time, and placing a deliverable worth up to $100,000 at the end of the first week can help companies get paid faster, and reduce the amount of money they need to pay out of pocket to work with the DoD. This increases the number of early-stage companies that are able to work with the Army because they don't have to worry about running out of money before the government contract is signed.

4. Communication approaches should proactively reach commercial sector partners

SAM.gov works for companies that are actively looking for solicitations because they've already decided to work with the government. To reach companies that aren't considering it, the DoDX community needs to put information in spaces they frequently visit. For example:

- Social media is a great way to reach new audiences if you use the right channels. So are articles in publications that don't cater to DoD-specific audiences.
- Use economic development organizations to inform companies of opportunities. Chambers of commerce, regional technology councils, aggregators, venture capital firms, mission acceleration centers, consortia, and other organizations are always looking for opportunities for their members. AAL engages its network of these types of organizations to pass opportunities onto their members — especially if their technology focus area or geographic location has a high number of potential solvers.
- General education about working with the government can pay off — especially to investors. Companies may want to work with the government, but if their investors are opposed, it can prevent the Army from accessing the technology. Educating companies and investors on the types of questions to ask when considering whether or not to apply for a solicitation and how to think about potential ROI for a pivot into the defense market can pay dividends for both active and future solicitations. General education about adversarial capital can also help venture capitalists build cleaner funds, and help companies think about from whom they should take funding.

5. Integrated Soldier feedback supports solution design better than episodic feedback

By integrating Soldiers and other Army stakeholders into the design process, companies get direct, iterative feedback. When going to market in the commercial sector, companies relentlessly test product/market fit. This is much harder to do for DoD products where access to end users is severely limited. Identification of a unit with which to conduct iterative Soldier touchpoints at the start of the project is critical. It enables the company to get consistent feedback from the same team over the life of the project, eliminating contradictory information. It also allows units to get continuous access to technology and its improvements, even if it's at an early technology readiness level.

6. Use multiple funding types to mitigate technology risk and bridge the valley of death

Combining SBIR, RDT&E, and private funding can help mitigate transition uncertainty. Funds for a technology may be in the POM, but continuing resolutions, Congressional cuts, or challenges elsewhere in the portfolio can jeopardize the transition of a technology. If Army- or OSD-level innovation programs are involved in transitioning a technology, uncertainty about consistency of funding can add additional risk. By combining SBIR, flexible RDT&E (for which the precise project doesn't need to be defined until the year of execution), and private investment, AAL can mitigate or respond to this uncertainty, helping to bridge the valley of death. For example, flexible RDT&E can be deployed to transition a SBIR project for which POM funding was delayed a year due to challenges elsewhere in the PM's portfolio, or connections to private capital can be made when private investment could add additional, commercially-relevant capabilities to a technology that would also benefit the Army.

7. Account for lack of reciprocity for certifications and processes between services

Navigating working with the Army can be challenging. Navigating working with the Army and other services, each of which has its own processes, can make it exponentially harder. There is a lack of consistency among the Services in what the private sector can expect from working with them. Risk tolerance for each branch varies, and the required government certifications can be difficult for companies to manage. And even when a company has a certification with one service, like an ATO, it does not transfer to others. These differences and the lack of reciprocity can cost companies a lot of time and money. DoD innovation organizations, under the auspices of the Defense Innovation Unit (DIU), are taking on the task of driving policy change in these areas but that takes time. Collaborations between innovation organizations are also sharing best practices on Foreign Owned and Controlled Influence (FOCI) practices, and lessons learned during ATO processes, to help make the processes more uniform for industry.