



AFWERX

2.0 PROGRAM OVERVIEW



COVER PHOTOS



SpaceWERX: Shortly after the launch of SpaceWERX, the U.S. Space Force's newest innovation organization initiated the Orbital Prime Program. As congestion and debris threaten the long-term sustainability of the space domain, Orbital Prime will transition agile, affordable, and accelerated On-Orbit Servicing, Assembly, and Manufacturing (OSAM) space capabilities to build the foundation for space logistics while preserving the global commons. On-orbit capability will be demonstrated on an accelerated timeline in two to four years, beginning with Active Debris Removal (ADR).

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AFVentures: With its open door to some of the world's greatest technology developers, the AFWERX program attracts small companies with big ideas and helps them become big companies delivering big returns on taxpayer investment. Since the inception of AFWentures, 26 small businesses have grown into unicorns as they achieved a one billion dollar valuation. Some, like Joby Aviation, started with \$50,000 in small business contracts and quickly graduated from small business funding to become a publicly traded company on the New York Stock Exchange.

Photo by Joby Aviation



Spark: The key success for AFWERX is empowering the Department of the Air Force Airmen and Guardians. Each year the Spark Tank competition highlights some of the top innovators in the force. The 2022 Spark Tank trophy was awarded to Senior Master Sgt. Brent Kenney, for "Project Arcwater," a simple, green, expedited way to provide drinking water. Other projects have included autonomous logistics for battlefield blood delivery and the Low Cost Threat Emitter, which was an Airman electronic warfare project that was **recently deployed to combat operations in Ukraine.**

Photo by Staff Sgt. James A. Richardson Jr.



Prime: In an effort to rapidly accelerate emerging dual-use technology sectors, AFWERX Prime partners with companies to reduce technical, regulatory, and financial risk. The purpose is to capture strategic markets, transform acquisition processes, and deliver game-changing capability. On March 9, 2022, United States Air Force pilots Hank "Hog" Griffiths and Maj. Jonathan Appleby flew BETA Technologies' electric vertical takeoff and landing (eVTOL) aircraft, ALIA, as the first-ever Airmen to fly an electric aircraft with a military airworthiness.

Photo by BETA Technologies / Historic First Airman Flight



THE AFWERX **MISSION**

AFWERX accelerates agile and affordable capability transitions by teaming innovative technology developers with **Airman and Guardian talent.**

Springfield-Beckley Municipal Airport's proximity to Wright-Patterson AFB makes it an ideal location to pursue the AFWERX mission, serving as the site of several key testing activities related to eVTOLs.



LETTER FROM THE **DIRECTOR**



The events of 2022 continue to highlight the growing risks to international security. Adversaries are accelerating the pace of technology development, and they are demonstrating their willingness to use it in conflict. To preserve a competitive advantage in this evolving environment, it is essential for the Department of the Air Force to accelerate change.

Harnessing the full power of the American and allied innovation ecosystem for competitive advantage demands a cultural transformation, particularly given the rapid pace of technology development and the growing percentage of dual-use technologies created without government-driven requirements. The catalyst for this transformation is a deliberately-developed innovation corps, creating unprecedented collaboration beyond traditional networks, while reinvigorating those existing networks. To preserve an enduring advantage, AFWERX uses this cultural transformation to shape future military systems as well as the structures necessary to field those systems.

Building on a foundation of AFWERX 1.0, the team identified several opportunities to amplify the early successes. 2021 represented the first year in which the restructured AFWERX included the following five Department of the Air Force innovation organizations: 1) SpaceWERX; 2) Air Force SBIR/STTR; 3) AFVentures; 4) AFWERX 1.0 (now Spark); and 5) Agility Prime (now Prime). AFWERX operates as part of the Air Force Research Laboratory, but reports to the Service Acquisition Executive with additional guidance from a board of directors. While mergers are not easy, the integration of these different capabilities into one AFWERX creates phenomenal synergies for the mission of accelerating agile and affordable capability transitions to the field, by teaming innovative technology developers with Airman and Guardian talent. With this restructuring, AFWERX is now postured to build the team with a deliberately-developed innovation corps to meet the mission demand.

If properly designed, AFWERX can leverage emergent technologies for Department of the Air Force priorities even though commercial markets are often driving the creation of these technology solutions. The benefit of dual-use is that industry has often begun to align new technologies to emerging markets—innovators are already developing the solutions and often have substantial private funding. As such, dual-use technologies can frequently be procured faster and more affordably than defense-driven technologies.

To leverage these emerging technology solutions, AFWERX does not dictate requirements in a traditional manner. Instead, AFWERX helps align and shape emerging technologies to Department of the Air Force problems in a way that can accelerate commercial markets and military adoption. Collaboration that propels the American and allied innovation ecosystems could yield vast savings for the taxpayer while creating great leaps in advanced capabilities for the security and prosperity of the nation. This report shows the ongoing steps in that collaboration.



COL NATHAN P. DILLER | USAF
DIRECTOR, AFWERX | AFRL/RG

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Photo by Joshua Conti

A Falcon 9 rocket launches from SLC-40 at Cape Canaveral Space Force Station, Fla., Jan. 13, 2022. The Transporter-3 mission delivered 105 microsattellites and nanosatellites into orbit for commercial and government customers.

EXECUTIVE SUMMARY

“UNLESS THE VOID THAT EXISTS BETWEEN THE SCIENTIST OR ENGINEER AND THE WARFIGHTER IS RECOGNIZED, A HIATUS WILL EXIST BETWEEN THE INVENTOR WHO KNOWS WHAT THEY COULD INVENT, IF THEY ONLY KNEW WHAT WAS WANTED, AND THE SOLDIERS WHO KNOW, OR OUGHT TO KNOW, WHAT THEY WANT AND WOULD ASK FOR IT IF THEY ONLY KNEW HOW MUCH SCIENCE COULD DO FOR THEM.”

- WINSTON CHURCHILL

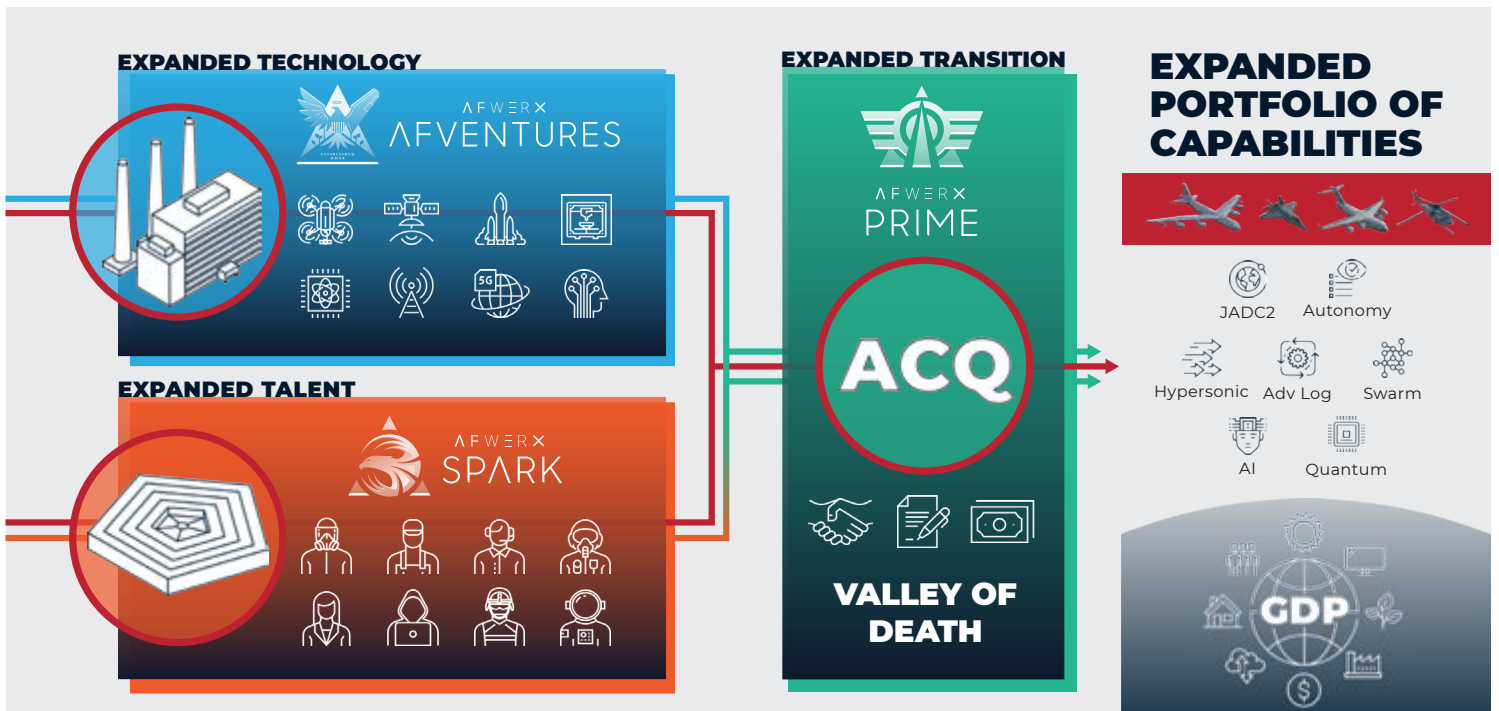
Recent events have demonstrated the willingness of adversaries to rapidly escalate conflict, demonstrate increasingly lethal technologies, and continue aggressive actions against American allies. With the acceleration of technology and the increasing complexity of both the battlefield and the process for delivering capability to the battlefield, it is imperative to build a team of technologists, users, and acquirers from the beginning. This imperative drives organizational design and mission execution in AFWERX. It is also key to rapidly transition capabilities to the field. Success demands not just technological innovation but innovation in warfighting concepts and acquisition processes.

The Department of the Air Force has a phenomenal record of creating some of the most amazing warfighting capabilities on earth (see **red rectangle below**). These capabilities have emerged from an acquisition process highly dependent on major defense contractors creating military-specific

capabilities based on a complex requirements process and fielded through traditional acquisition approaches (see **red circles**).

With an expanding share of technologies being created through the commercial sector, AFWERX strives to expand access to technology through **AFVentures**, then leverage expanded Airman and Guardian talent through **Spark** for innovative concepts, and finally field capability through expanded transition processes in **Prime**. If successful, the result is an expanded portfolio of capabilities for the Department of the Air Force in a way that also expands the nation's access to advanced technology for both security and prosperity.

In 2021, following the call to “**Accelerate Change or Lose**,” AFWERX advanced across multiple measures to both reshape the cost, schedule, and performance of this expanded portfolio of capabilities, as well as the **structures, stakeholders, and workforce** that develop those capabilities.



"WE MUST MOVE WITH A PURPOSE – WE MUST ACCELERATE CHANGE OR LOSE."

- GEN C.Q. BROWN, JR. (All quotes from [Accelerate Change or Lose](#))

<p>1. Capability</p> <p>“Unlike the past, much of the emerging technologies that will determine our future are no longer created or funded by the Department of Defense. The processes with which we build capabilities have not adapted to these changes.”</p>	<p>2. Budget</p> <p>“Likely future budget pressures will require the most difficult force structure decisions in generations.”</p>	<p>3. Speed</p> <p>“Capabilities must be conceived, developed, and fielded inside competitors’ fielding timelines—knowing we need to adapt over time.”</p>
<p>\$2.9B Non-SBIR Government Contracts for Portfolio Companies Since AFWERX 2.0 Launched</p>	<p>> \$325M Major Defense Contractors Co-Investment</p>	<p>Reduced Time to Award (171 > 64 days)²</p>
<p>AI/ML: \$296M/307 Companies¹</p>	<p>\$27B+ Follow-On Private Investment in AFWERX Portfolio Companies Since AFWERX 2.0 Launch</p>	<p>In Less Than Two Years, Airworthiness On 5 Full-Scale Flying Electric Passenger Aircraft</p>
<p>Space: \$281M/272 Companies¹</p>	<p>12:1 Private/Gov't Follow-On Funding to SBIR</p>	
<p>Sustainment & Advanced Manufacturing: \$235M/253 Companies¹</p>		

¹Since AFWERX 2.0 launched in May 2020

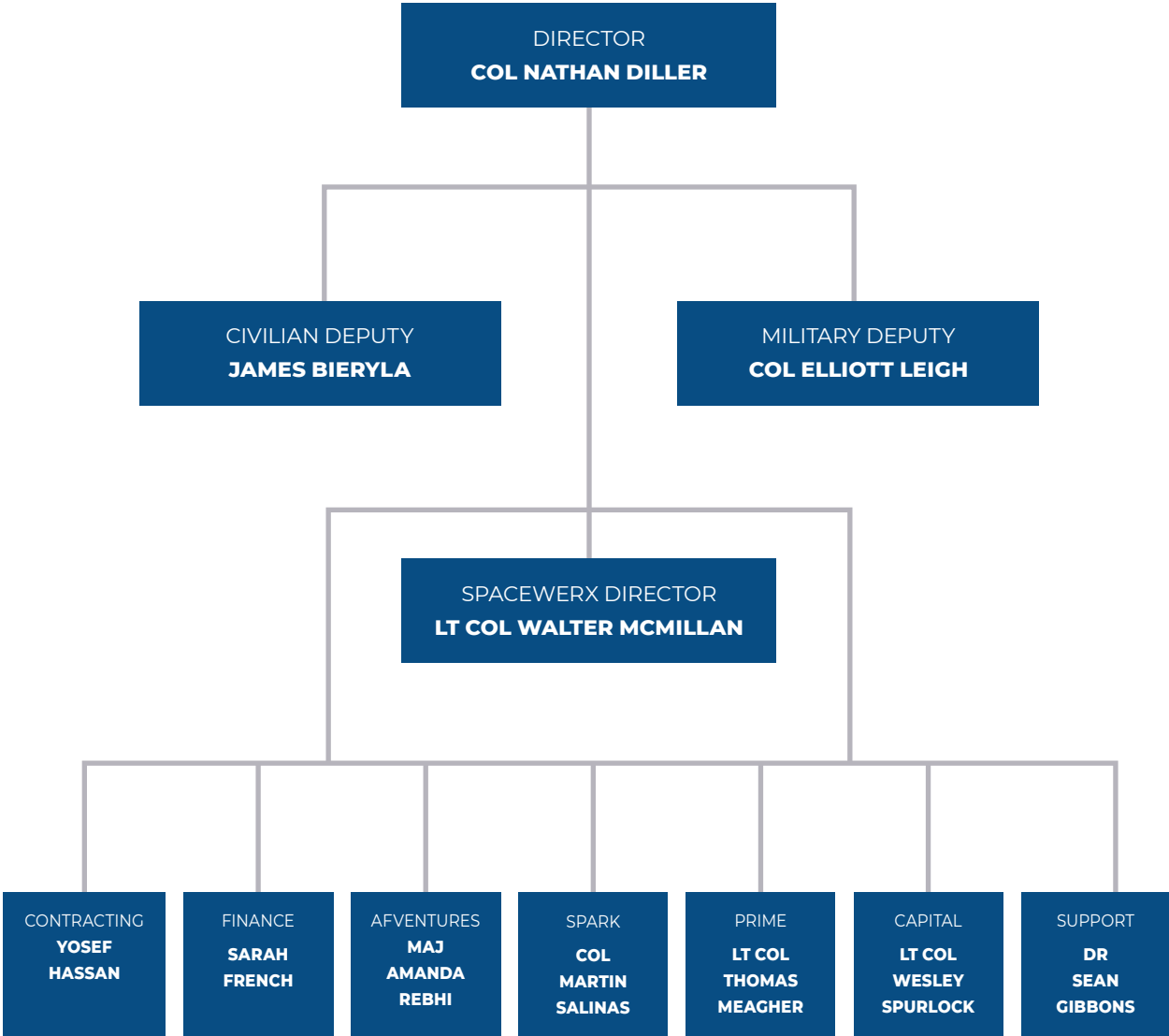
²Phase I time to award, FY15-18 vs Open Topic FY19-22. Phase II saw a decrease from 228 days to 125 days for the same comparison group.

"COST, SCHEDULE, AND PERFORMANCE METRICS ALONE ARE NO LONGER SUFFICIENT METRICS OF ACQUISITION SUCCESS."

<p>4. Stakeholders</p> <p>“The Air Force must work differently with other Department of Defense stakeholders, Congress, and both traditional and emerging industry... If we are to beat our competitors in conflict, we must also beat them in development and fielding of capability.”</p>	<p>5. Workforce</p> <p>“Successful operations and combat support in a contested environment demand maximum delegation, trust, and empowerment of Airmen before conflict starts.”</p>			
<p>2,287 New Companies to DAF</p>	<p>36 Hybrid and Electric Aircraft Proposals</p>	<p>MOAs w/NASA, DOE, Jt Svcs</p>	<p>108 Spark Cells at the base level</p>	<p>2,960 augmentees</p>
<p>Increased HBCU Engagement by 300%</p>			<p>157 Fellows (w/Sage) / 226 Interns</p>	
			<p>27K small business employees</p>	

AFWERX ORGANIZATION

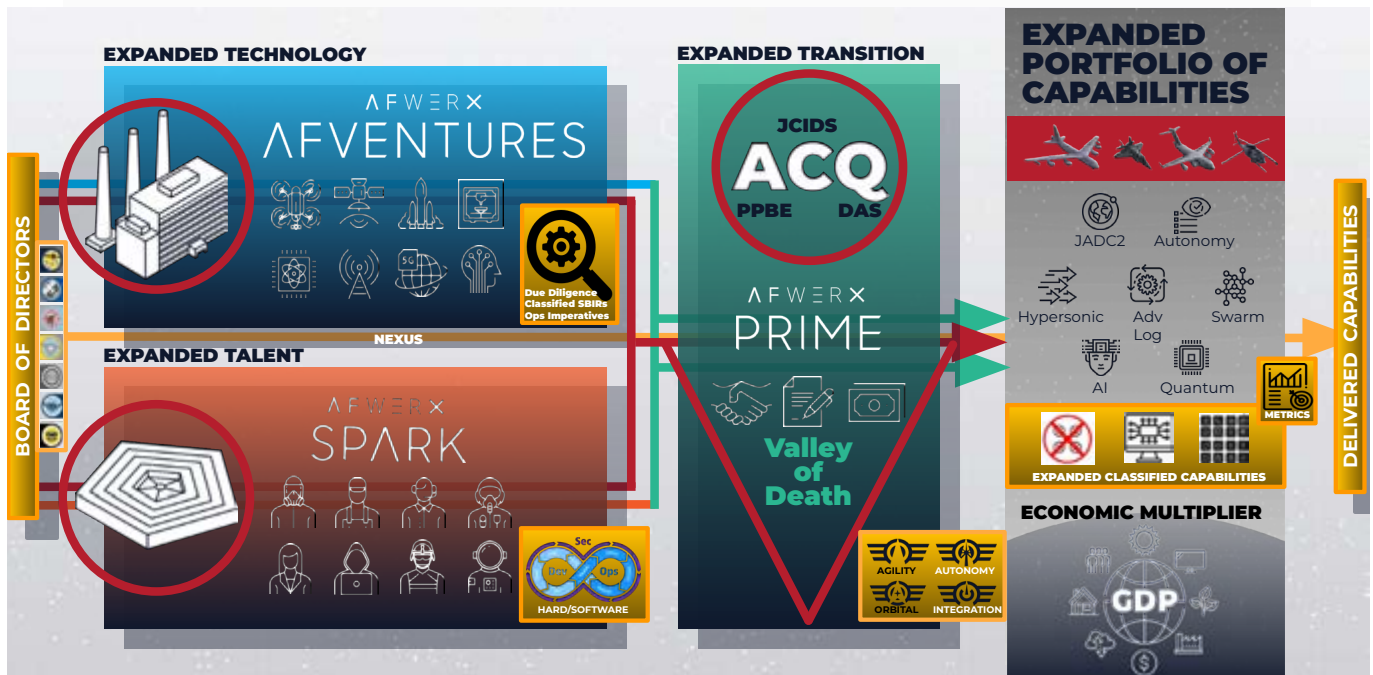
AFWERX (AFRL/RG) is a part of the Air Force Research Laboratory as One Lab supporting Two Services. Similarly, SpaceWERX is an organic part of AFWERX using shared processes and resources to support the U.S. Space Force. AFWERX reports to the Service Acquisition Executive and receives additional guidance from the AFWERX Board of Directors, whose members have existing authorities across operations, requirements, budget, and acquisitions. The AFWERX Director also serves as the Department of the Air Force Chief Commercialization Officer.



AFWERX 3.0 LAUNCH

As an innovative learning organization driven to accelerate change in the Department of the Air Force, AFWERX will release a series of new initiatives in support of its 3.0 evolution.

AFWERX 3.0 will add five key lines of effort in executing its more than \$1 billion annual budget: 1) Increase funding opportunities aligned with the Department of the Air Force Operational Imperatives. 2) Create a nexus between AFWERX capabilities that better aligns government resources with industry outreach, laboratory expertise, operator engagement and acquisition tools to improve speed and rigor across what some acquisition experts call the "valley of death"—where innovative ideas do not find the necessary support to survive. 3) Expand existing tools through Open Topics, Specific Topics, and Strategic Funding Increase and Tactical Funding Increase (STRATFI/TACFI) with AFWERX AFVentures, increased end-user iteration through AFWERX Spark, and added opportunities for industry through AFWERX Prime. 4) Reduce barriers to conduct classified work for companies with novel concepts. 5) Improve the data architecture for rapid stakeholder feedback and process improvement.



Under this new approach, AFWERX 3.0 will add five key lines of effort aimed at expanding technology, talent, and transitioned capabilities. 3.0 changes are highlighted in gold. (U.S. Air Force graphic).

COL ELLIOTT LEIGH

As he prepares to take his new role December 15, 2022, the incoming AFWERX Director, Col. Elliott Leigh said, “I am thrilled to see the new ways that AFWERX 3.0 will support Department of the Air Force priorities, Airman and Guardian innovation and industry commercialization by building on the amazing foundation created by the AFWERX team and ongoing senior leadership support.”

In 2017, AFWERX 1.0 launched as a means of connecting Airmen with innovative ideas in academia and industry through cultural transformation. This established a foundation for unprecedented collaboration that greatly expanded the networks of Airman innovation and their connectivity to external stakeholders to bring in new ideas and technology transition pathways.

In 2020, AFWERX moved to the Air Force Research Laboratory, or AFRL, with the director of AFWERX reporting to the Air Force Service Acquisition Executive to execute more deliberate acquisition activities. During that first year, a single AFWERX 2.0 was created by combining AFWERX 1.0 with AFVentures, Agility Prime, U.S. Space Force innovation activities (later SpaceWERX), and the AFRL Small Business Innovation Research and Small Business Technology Transfer, or SBIR/STTR, Center of Excellence. The move consolidated these innovation organizations to create efficiencies and focus on a more comprehensive acquisition tool.

AFWERX AFVentures provided improved access to external technology, talent and capital. AFWERX Spark empowered innovation at the operational edge, and AFWERX Prime accelerated emerging technology markets using military missions and resources. The impact of AFWERX 2.0 cut across traditional and non-traditional measures of success, from enabling the first Airman flight of an electric aircraft, to accelerating hundreds of companies through Phase III transition to end-user funding after starting with a small business seed contract, to seeing over \$27 billion in post-SBIR award private investment to portfolio companies, to adding more than 2,200 new companies to the AFWERX portfolio since the Open Topic approach launched.

Incoming director Leigh previously served as a materiel leader at Space Systems Command prior to joining AFWERX as its military deputy. While integrating into his new role, Leigh said he has been impressed with the rapid advances in innovation made possible through AFWERX processes.

“I’m amazed at what we can achieve through the SBIR program, and we are doing this at scale,” Leigh said. “We are mobilizing a workforce of small businesses, tens of thousands of Americans, a strategic war reserve of innovators in the private sector. We’re making rapid advances across every technology and mission area in the Department, and in the process, we are changing a culture to propel innovation. This organization gets right after the Chief of Staff of the U.S. Air Force’s top priority of accelerating change and the Secretary’s Operational Imperatives.”

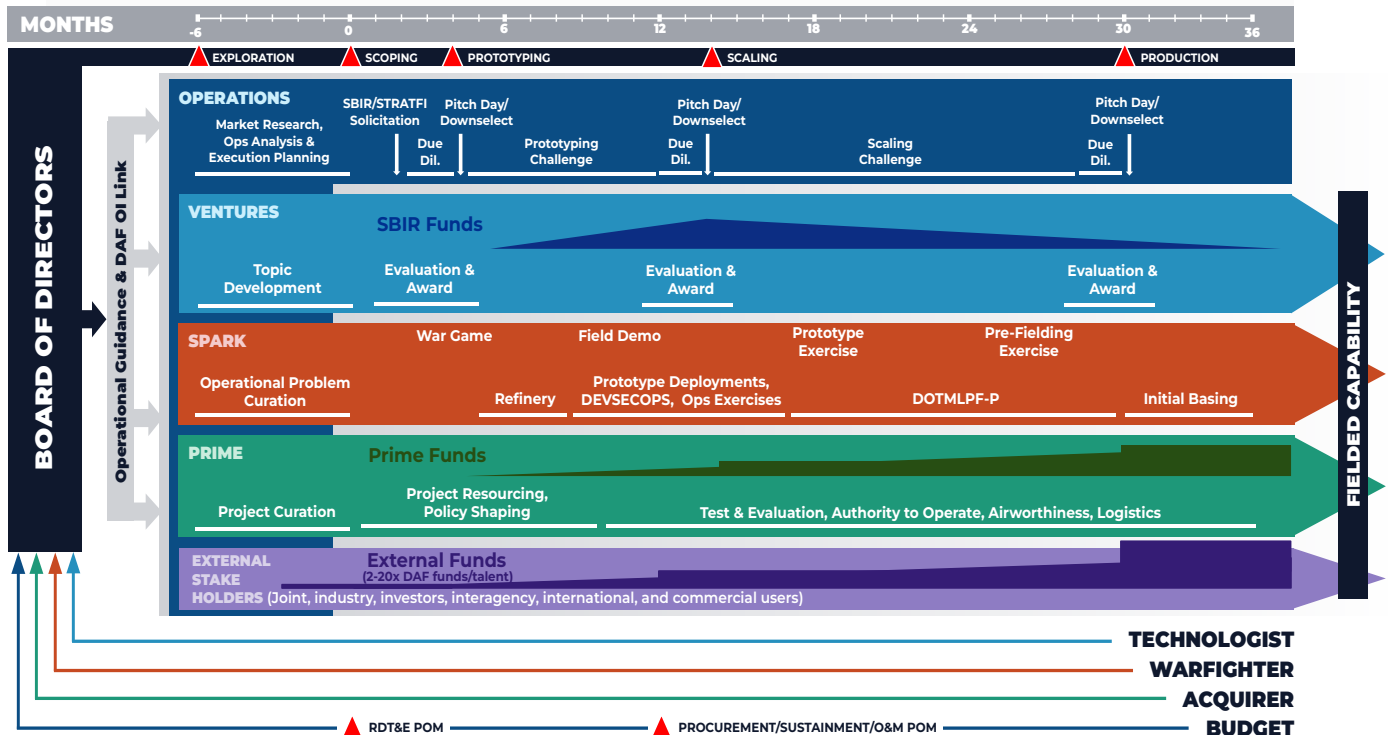


COL ELLIOTT LEIGH | USAF
INCOMING DIRECTOR
AFWERX

A NEXUS OF TOOLS FOR PROJECT SYNCHRONIZATION

While AFVentures, Spark, and Prime operate independently for a number of their core functions and frequently target transitions at the user and wing level, a closer synthesis between these capabilities enables more effective top-down innovation. By harnessing the talent and innovative ethos of its three organizations (i.e., AFVentures, Spark, and Prime), AFWERX plays a critical role in modifying or establishing new Programs of Record that effectively transition war-winning technology to the warfighter.

With early identification of Department of the Air Force problems aligned to Operational Imperatives, AFWERX can quickly synthesize clear problem curation during exploration, award many very small contracts for scoping that lead to prototype contracts, and eventually a few large contracts for scaling to production all in 24-36 months to a fielded capability.



AFWERX 3.0: FOCUSED TO COMPETE

By using military problems to accelerate commercial technologies (AFVentures), empowering innovation at the operational edge (Spark), and priming emerging commercial markets using military missions and resources (Prime), AFWERX 2.0 gave the DAF powerful tools to compete and win against agile adversaries. To remain focused on and competitive in the most critical elements of the evolving strategic environment, AFWERX 3.0 links senior warfighter, technologist, and acquisition leaders to powerful AFWERX talent and tools via regular Board of Directors support, while retaining the disruptive approach innate in the innovation corps that inspired the creation of AFWERX.



Col Nathan Diller, the outgoing AFWERX Director, said, "It has been incredible to see so many Airman and Guardian innovation experiments evolve into institutionalized programs that are not only adding amazing new capabilities to the force, but maybe more importantly, they are creating more agile structures for how we accelerate the development of the future force."

OVERVIEW

MISSION

Identify, acquire and integrate innovative capabilities into the USSF while cultivating partnerships among the nation's Space Guardians and top problem solvers.



SPACEWERX DIRECTOR
LT COL WALTER MCMILLAN

SPACEWERX PROGRAM OVERVIEW

LAUNCH

On Aug. 19, 2021, the Department of the Air Force introduced SpaceWERX. The program is designed to play a vital role in pursuing innovative technologies while also closely aligning its efforts with space operators and acquisition professionals in the Space Force. SpaceWERX creates a platform for space operators, lab engineers, and acquisition professionals to collaborate with the brightest minds in academia and industry. The program also will use proven tools across the AFWERX enterprise such as the SBIR Open Topic, Challenge platform, Strategic Funding Increase (STRATFI) initiative, and Prime program to further its mission.

SPACEWERX VIRTUAL LAUNCH EVENT



19 PHASE II SBIR CONTRACTS AWARDED

AFWERX kicked off the newest innovation operation's mission through a Space Pitch Day SBIR Phase II opportunity focused on space technologies. During the virtual launch event, 19 small businesses each secured \$1.7 million Phase II Small Business Innovation Research contracts to advance their cutting-edge space technologies. Nearly two dozen small firms pitched their space and satellite technologies to judges, in hopes of receiving a Phase II SBIR contract.

This pitch day event culminated in investment through several SpaceWERX predecessor initiatives, including the Space Force Accelerator portfolio, which includes the Catalyst Space Accelerator and the Hyperspace Challenge. The total investment from these programs by the end of 2021 toward nontraditional space-related technology and businesses has now reached more than \$259.5 million. This in turn has garnered an additional \$1.3 billion from private-sector investors.

Some examples include:

OrbitFab, the company developing "Gas Stations in Space", was first discovered through a SpaceWERX predecessor program. Through subsequent touchpoints with SpaceWERX, the company has gone on to receive a STRATFI investment of \$12 million alongside investment by both Lockheed Martin Corp. and Northrop Grumman Corp.

Slingshot received a STRATFI award to facilitate the delivery of two key products: a Digital Space Twin, and the deployment of the virtual satellite training laboratory using their cutting edge virtual space environment.

Orbital Sidekick received a \$16 million STRATFI award to accelerate the deployment of six advanced hyperspectral imaging (HSI) satellites with edge-processing capabilities, and to integrate its Spectral Intelligence Global Monitoring Application (SIGMATM) platform with the USAF Advanced Battle Management System (ABMS).

RS21, an analytics company, is applying its oncology algorithm and analytics from the health domain toward prediction of Spacecraft health. Through the SpaceWERX pipeline, the company received a SBIR Phase II to mature its technology. This has prompted interest by Space System Command's Satellite Test Program and by the AF Safety Center.



Image courtesy of Orbital Sidekick

Orbital Sidekick received a \$16 million STRATFI award to accelerate the deployment of six advanced hyperspectral imaging (HSI) satellites with edge processing capabilities.

SUPPORT TO THE WARFIGHTER

NorthStrat's GENESIS automates the process of allocating and tracking satellite resources to improve efficiencies and save four Space Operations Squadron (SOPS) mission planners time, while reducing the mission risk associated with the over-allocation of resources.

Saber Astronautics' Space Cockpit provides 3D visualization that is designed to take complex astrodynamics concepts and make them quick and easy for USSF Operators to use, cutting training time from seven days down to 45 minutes.

A.I. Solutions' ObsSIM simulates the ground and space-based sensors of the Space Surveillance Network (SSN), allied nations and commercial networks to produce low-cost, physics-based, simulated space surveillance sensor observations of Resident Satellite Objects (RSOs).

Bluestaq's Sentinel open-source astrodynamics tools provide an immersive space operations experience with the overlaying of constructive model and simulation data onto live backgrounds (also referred to as a Live, Virtual and Constructive (LVC) environment) for U.S. Space Command.

Data Fusion & Neural Networks' Alert Management System (AMS) and Ephemeris Abnormal Catalog Update (eACU) Plus+ capabilities provide detections of abnormal unmodeled events on the full space catalog in near-real-time. This

system helps to reduce limited manpower to monitor the space environment, characterize abnormal catalog updates, fuse multiple catalogs together, and alert on activities/situations of interest.

SPACE FORCE ACCELERATORS

The Space Force Accelerators Program was founded in 2017 to fuel innovation in the U.S. Space Force. Funded by the Air Force Research Laboratory Space Vehicles Directorate and now part of SpaceWERX, the program discovers and advances seed-stage technologies in the commercial and academic sectors to help government customers advance their missions.

The program does this using two keystone startup accelerators: the Catalyst Space Accelerator (<https://catalystaccelerator.space/>), executed under a Partnership Intermediary Agreement (PIA) between the AFRL in New Mexico and the Catalyst Campus for Technology Innovation (CCTI), and the Hyperspace Challenge (<https://hyperspacechallenge.com/>), executed through a Partnership Intermediary Agreement (PIA) between the AFRL in New Mexico and the Central New Mexico Community College (CNM). These accelerators are designed to foster nontraditional partnerships for the Department of Defense within the commercial and academic innovation ecosystems to promote rapid acquisition of innovative, dual-use space technologies.

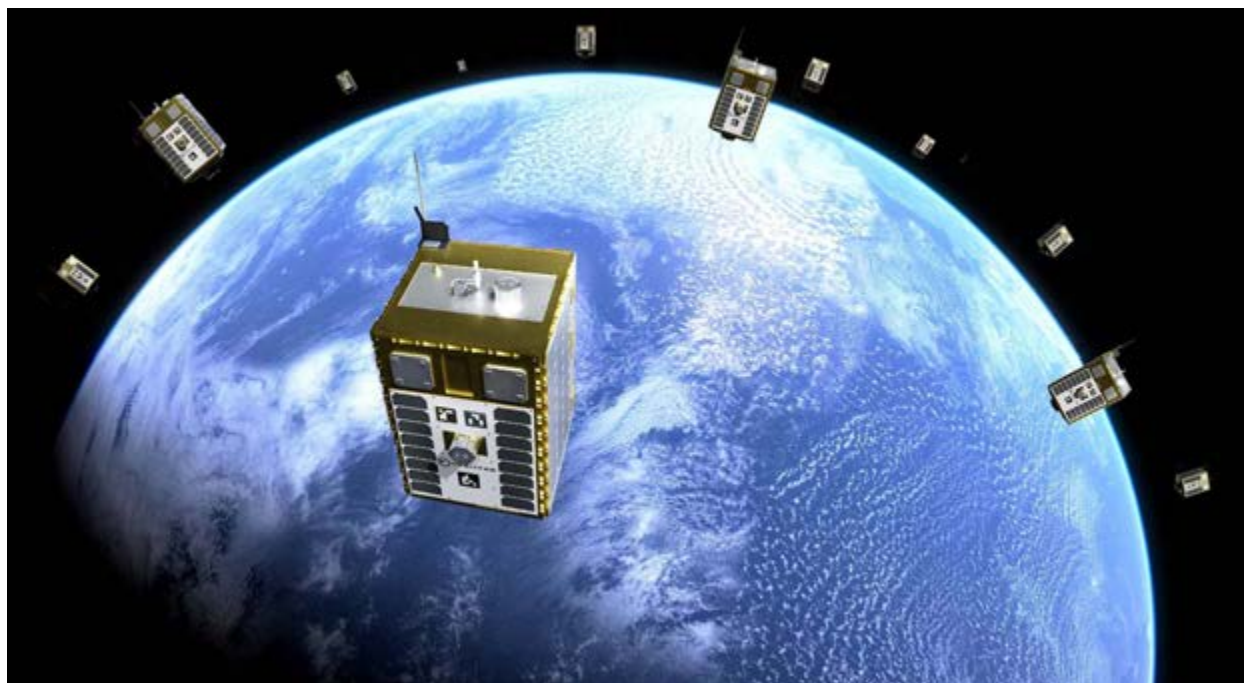


Image courtesy of OrbitFab

OrbitFab, the company developing "Gas Stations in Space", was first discovered through a SpaceWERX predecessor program.

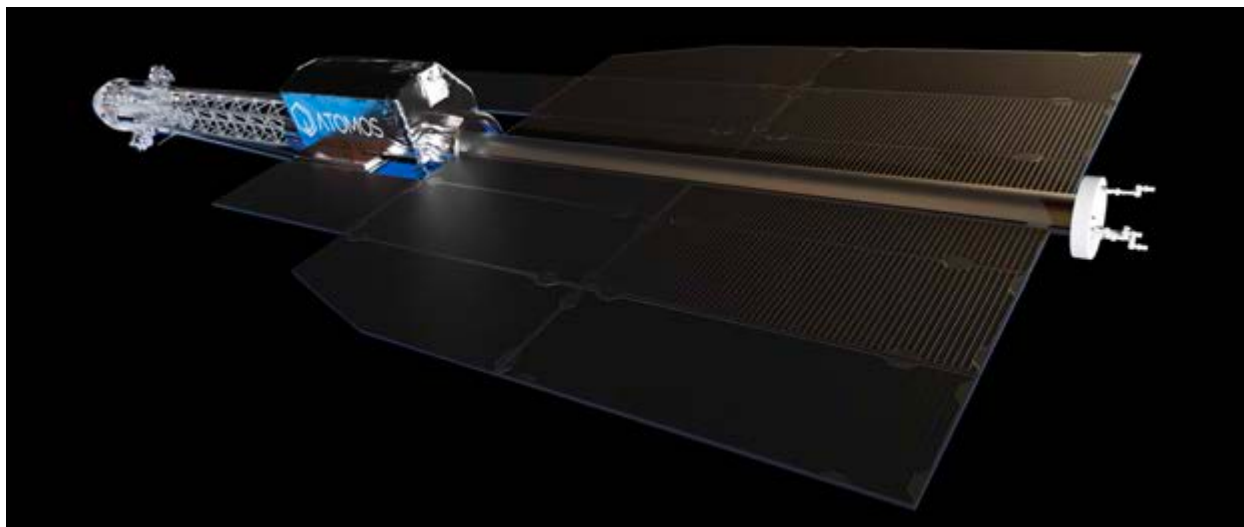


Image courtesy of Atmos Space

Atomos Space received \$5 million of funding to advance in-space transportation services.

Calendar year 2021 marked the seventh and eighth cohorts for Catalyst Space Accelerator and the fourth cohort for Hyperspace Challenge. Each program continues to incorporate lessons learned from previous rounds and experiment with new offerings. Highlights for each program are summarized below.

The two themes addressed by Catalyst Space Accelerator in 2021 were On-Orbit Servicing, Assembly and Manufacturing (OSAM) and Digital Engineering for Space Applications to include modeling and simulation. Each theme included approximately eight use cases from government organizations, providing participating companies broad exposure to a range of possible government needs.

Over the course of the eight cohorts, 62 companies have participated, and more than 150 Department of Defense discovery meetings have taken place. In the time since the accelerator, those 62 companies have collectively won 226 contracts, representing approximately \$200 million in follow-on contract funding (commercial and Defense Department) and approximately \$242 million in follow-on private investment funding. These companies have added 502 new jobs, bolstering the nation's economy.

The Catalyst Space Accelerator was key to a few recent successes. OrbitFab (a 2020 cohort company) went on to be a Space Force Pitch Day winner and signed a Cooperative Research and Development Agreement (CRADA) with the Air Force Research Laboratory for On-Orbit Refueling Technology. Additionally, Atomos Space received \$5

million in investment funding to advance in-space transportation services.

The Hyperspace Challenge supported several topic areas in 2021 including:

- rapid initial orbit determination
- smart sensing and machine learning for ground based remote sensing of space objects
- leveraging microgravity for military/commercial applications and products
- rocket cargo technology for agile global logistics
- quantum sensing for location and em field detection
- on-orbit servicing, assembly and manufacturing (OSAM)

In addition to the 13 participating companies, Hyperspace Challenge expanded to include a full cohort of 11 universities. RS21, an Albuquerque-based data engineering company recently awarded a SBIR Phase III contract with the USSF, has been awarded a Basic Ordering Agreement (BOA) for the Data Readiness for Artificial Intelligence Development.



Image courtesy of RS21

RS21 has been awarded a basic ordering agreement for the Data Readiness for Artificial Intelligence Development.

SPACEWERX PROGRAM OVERVIEW

With more than four cohorts completed to date, 61 teams and 38 problem sponsors have participated. In the time since the challenge, those teams have received 70 government contracts.

HYPERSPACE CHALLENGE WAS KEY TO THE SUCCESS OF:

- **CrowdAI (2018 Cohort member)** who received a \$249 million Blanket Purchase Agreement from the Department of Defense Joint Artificial Intelligence Center.
- **RS21 (2020 cohort member)** has been awarded a Basic Ordering Agreement (BOA) for the Data Readiness for Artificial Intelligence Development (DRAID). The award was made on behalf of the U.S. Department of Defense (DOD) Joint Artificial Intelligence Center (JAIC) and has a \$241 million ceiling across task orders over five years.

ORBITAL PRIME LAUNCH

Space Prime is the first SpaceWERX Prime program that seeks to “prime the pump” of the commercial space market and drive investment into a nascent space market sector.

Space Prime leverages a diverse industry

partnership engagement strategy to identify budding space technology sectors that, if “primed,” could advance U.S. national security and economic prosperity.

Prime engagement is not limited to government investment, but also allows SpaceWERX to address key policy concerns and offer testbeds and platforms to advance capabilities.

Space Prime’s mission statement is to “accelerate transition of technologies and architectures that enable a sustainable space infrastructure and preserve an open and prosperous space domain.” By partnering with industry, the USSF hopes to combine government resources with commercial innovation to effectively tackle real-world challenges, eventually transitioning these pioneering technologies to aid the warfighter.

SpaceWERX, in conjunction with AFWERX and the Space Force, launched Orbital Prime on November 4, 2021. As congestion and debris threaten the long-term sustainability of the space domain, Orbital Prime will transition agile, affordable, and accelerated On-Orbit Servicing, Assembly, and Manufacturing (OSAM) space capabilities to build the foundation for space logistics while preserving the global commons.



Stock image by © 2022 Storyblocks.com

On November 17, 2021, Orbital Prime launched an out-of-cycle Phase I STTR Open Topic for the following three tech tracks: 1) space debris approach and remote proximity operations; 2) space debris acquisition; and 3) disposal or reuse of space debris.

KEY OBJECTIVES FOR ORBITAL PRIME:

- **Develop the OSAM market and partnerships:** Orbital Prime will help stimulate a safe and secure domestic OSAM market and supply chain through partnerships with academia, industry, investors, interagency, and allies. These partnerships will reduce technical, regulatory, and financial risk.
- **Aggressively pursue emerging technologies:** On November 17, 2021, Orbital Prime launched an out-of-cycle Phase I STTR Open Topic for the following three tech tracks: 1) space debris approach and remote proximity operations; 2) space debris acquisition; and 3) disposal or reuse of space debris.
- **Rapidly transition on-orbit capability:** Using several AFWERX tools, Orbital Prime aims to demonstrate Active Debris Remediation (ADR) with dependable commercial partners and transition to an enduring, agile, and accessible ADR service.

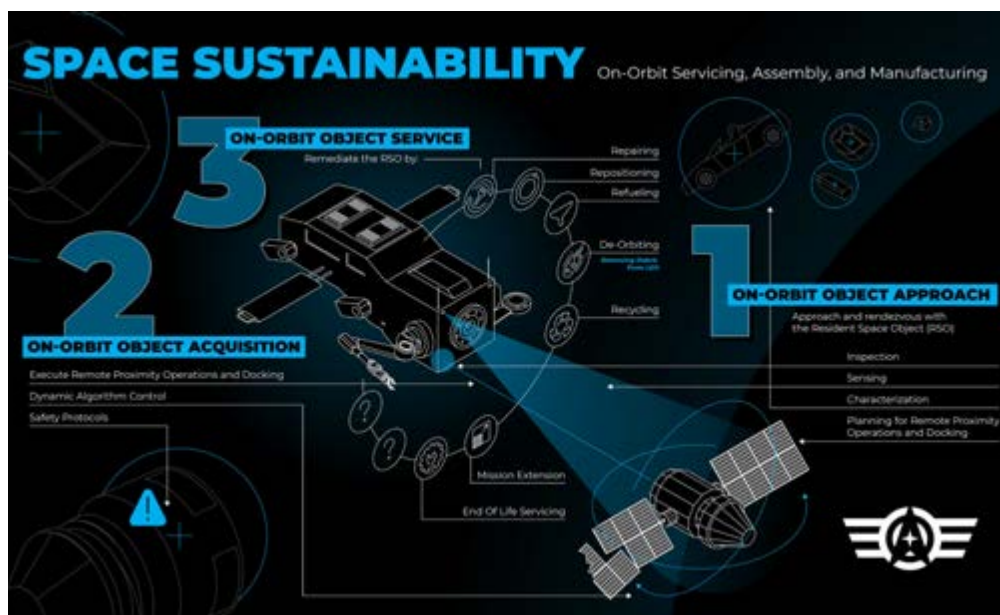
NEAR-TERM ACTIVITIES:

- **STTR Phase I:** Between the Nov. 17, 2021, opening of the STTR solicitation and its Feb. 17, 2022, closing, the Orbital Prime team led six Ask-Me-Anything (AMA) webinars. These webinars provided education and training on the STTR process from a wide range of technical and functional subject matter experts to support the small businesses and research institutions who submitted proposals.

Additionally, the Orbital Prime team provided matchmaking between small businesses and research institutions.

- In May 2022, SpaceWERX announced it had selected 125 industry teams from 27 states for the Orbital Prime program's first phase. Each team received a \$250,000 Small Business Technology Transfer (STTR) program contract to expand their concepts and perform early design work. Under the STTR contracts, the teams—made up of a small business paired with an academic or nonprofit institution—must deliver a product or study within 150 days. They also will compete for a Phase II award of up to \$1.5 million supporting development and prototyping. The new contract awards have allowed SpaceWERX to kick off a new series of Ask-Me-Anything sessions, which began in September and will likely continue through February 2023.

- **SBIR Open Topic Call (Fall 2022):** A follow-on SBIR Open Topic in October 2022 provided additional funding options to Orbital Prime companies.
- **Advanced Research Agreement:** Additional contract mechanisms and university outreach programs will be leveraged through the Air Force Research Lab's Space Vehicles Directorate.





AFWERX ADVENTURES



Photo courtesy of Joby Aviation

OVERVIEW

MISSION

Transform the Department of the Air Force's capabilities and industrial base by attracting technologies, talent, and capital from the nation's greatest investors, companies, universities, and research institutions.

STRATEGIC CONTEXT

Today the majority of research and development is based on commercial instead of government requirements. Additionally, the last several years have seen a notable rise in venture capital funding flowing towards the aerospace and defense sector. Harnessing the full power of the American and allied innovation ecosystem for competitive advantage demands a cultural transformation, particularly given the rapid pace of technology development and the growing percentage of dual-use technologies created without government-driven requirements. If properly designed, the private and government collaboration can affordably accelerate emerging technologies for peace and prosperity.



ADVENTURES
MAJ AMANDA REBHI

AFVENTURES PROGRAM OVERVIEW

OVERVIEW

Private investment comprises over 80% of America's Research & Development funding, and small businesses with promising commercial technologies often do not seek to work with the government. AFVentures taps into this market to bring defense-relevant, cutting edge commercial technologies into the DAF. AFVentures leverages these small business-generated technologies to meet operational needs by creating simple, easy-to-use pathways for dual-use innovation and private investment. As part of the process, AFVentures brings together government technologists, operators and acquirers with small businesses, investors and academia.

Private investment comprises **80%** of U.S. R&D funding today - and AFVentures seeks to tap into this key source of new technologies.

To enable small businesses to scale and mature the most promising technologies, AFVentures leverages government funds of increasing value. This process allows small businesses to transition from prototyping to fielded systems (crossing the 'valley of death'). Partnership is imperative, and AFVentures works to reduce barriers to entry and attract the best technology to solve DAF problem sets.

Since the launch of AFWERX 2.0, AFVentures has increased the value of the DAF SBIR/STTR program to DAF end users and small businesses. AFVentures is delivering more awards faster than ever to small businesses, with 1,685 contract awards annually since FY2020 (vs. 525 annually in FY15 - FY18) and time to award for Open Topic down 62% versus pre-AFWERX. In total, AFVentures has added over 2,200 new companies to the DAF's small business portfolio since the launch of the Open Topic, and is adding new companies at a 2.7x faster rate than pre-AFWERX. This rapid increase in the DAF small business portfolio has attracted the attention of DAF customers and end users, which has led to more non-SBIR, follow-on government contracts with AFVentures' small business portfolio than ever before. DAF non-SBIR Phase III contract funding is up by 330%, indicating that the portfolio is

having increasing impact on Airman and Guardian capability. Private investors have invested over \$27 billion in AFVentures SBIR/STTR portfolio companies since AFWERX 2.0 launch, enabling portfolio small businesses to scale. Currently, AFVentures has over \$1.8 billion in contracts in its portfolio across 1,050+ small businesses.

In FY2022, AFVentures has made several important improvements to extend its impact. As of January 2022, AFVentures merged with the former SBIR Center of Excellence (now the Specific Topic program) to bring the entire DAF SBIR/STTR program into one organization. This change creates new synergies by allowing AFVentures to develop common tools to engage with small businesses and enable transition, leverage and standardize Specific Topic and Open Topic mechanisms to target top DAF problem sets, create common standards/policies, and build a common analytics infrastructure. In parallel, for the first time, AFVentures invited the entire DAF to participate in the Specific Topic Program, enabling any end-user/customer organization across the DAF to compete for funding to deliver a SBIR or STTR topic to solve a specific problem set. As promised, AFVentures closed the Legacy SBIR/STTR Program effective Sept. 30, 2022, committing \$120 million across 144 efforts. Additionally, AFVentures has launched an enhanced due diligence process across all SBIR/STTR awards as well as a new Open Topic annual cycle to provide predictability to small businesses seeking to compete for an Open Topic award.

AFVENTURES SUCCESS SNAPSHOT

Phase III Contracts
+330%
Funding Annually

\$27B+
private investment in
SBIR portfolio companies
since AFWERX 2.0 launch

Open Topic
Phase I time
to award
-62%
Versus
3 years prior

3.2x*
number of
annual awards
FY20-22 vs FY15-18

2,287
small businesses
Added to our
portfolio since
Open Topic launch

*Open Topic increased capacity through 2019, so it was removed from this metric since it doesn't belong in the pre-Open Topic FY15-18 baseline period or the fully ramped FY20-22 current period.

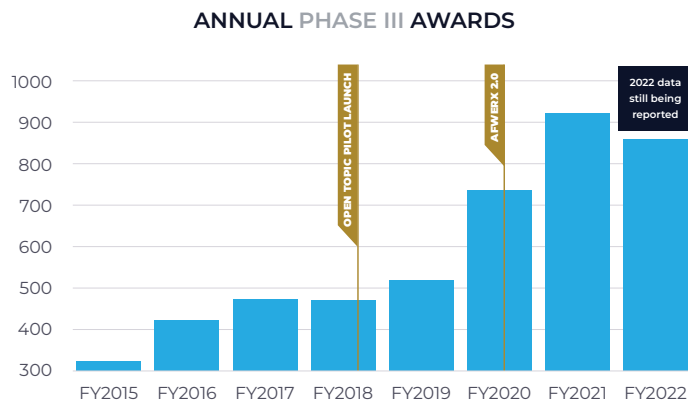
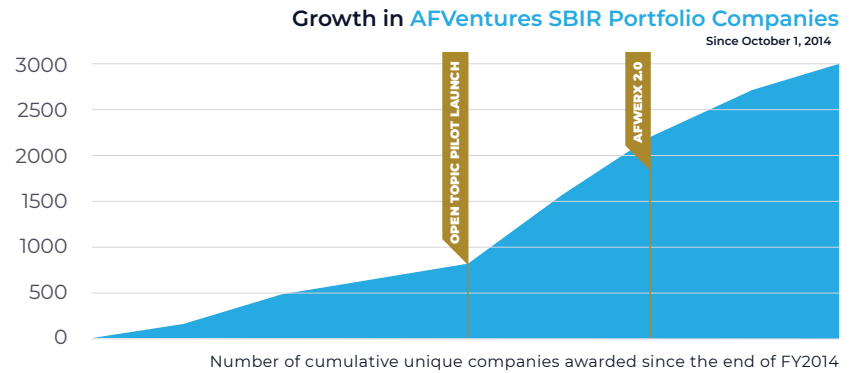
AFVENTURES PROGRAM OVERVIEW

\$1.8B
in Contracts Under Management Across **1,050+** Small Businesses

1,685
Annual Awards Since FY20 Up 3.2x vs. Pre-Open Topic

64 DAYS
Open Topic Phase I Time to Award (vs **171 days** pre-AFWERX)

2,200+
Companies Added to DAF Portfolio Since Open Topic Launched

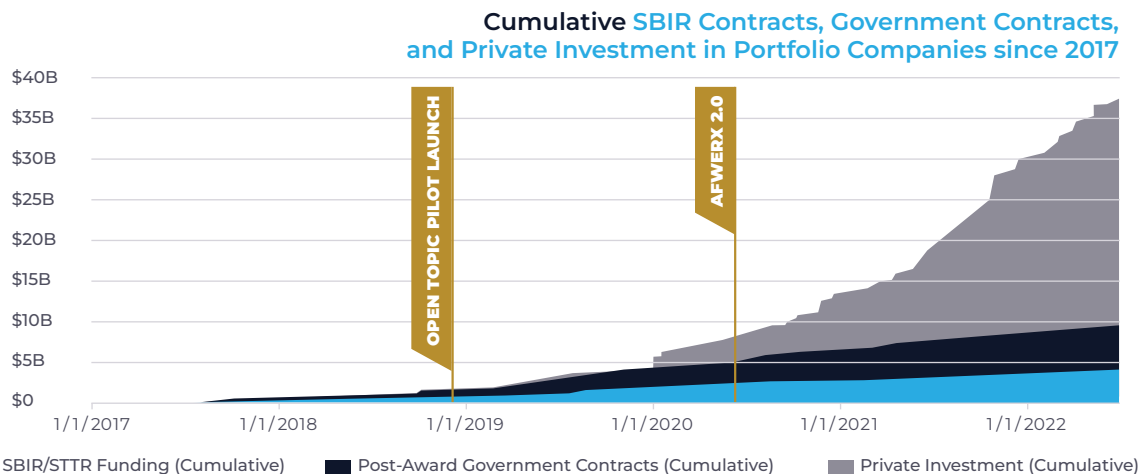


+330%
Increase in Annual Phase III Award Funding

26
Portfolio Companies Achieved Valuations Over **\$1B** Post-AFWERX Award

554
Companies Have Won Post-SBIR Award Government Contracts Worth **\$2.9B** Since AFWERX 2.0 Launched

603
SBIR Portfolio Companies Have Won **\$27.3B** in Private Investment Since AFWERX 2.0 Launched



Only includes government contracts or private investment after each company's first post-2017 SBIR/STTR award. For additional details, see page 28.

SBIR INTRO

The SBIR/STTR program is divided into three phases:

Phase I: AFVentures awards companies short-term contracts for between \$75,000 - \$180,000 over three to nine months to develop concepts, test feasibility, and identify potential DAF customers.

Phase II: AFVentures awards small businesses with feasible concepts up to \$1.7 million to develop a prototype through research, development, test and evaluation based on Air and Space Force needs. If a business has already done a feasibility study, it can apply for a Direct-to-Phase II (D2P2), where it competes for a Phase II without a prior Phase I.

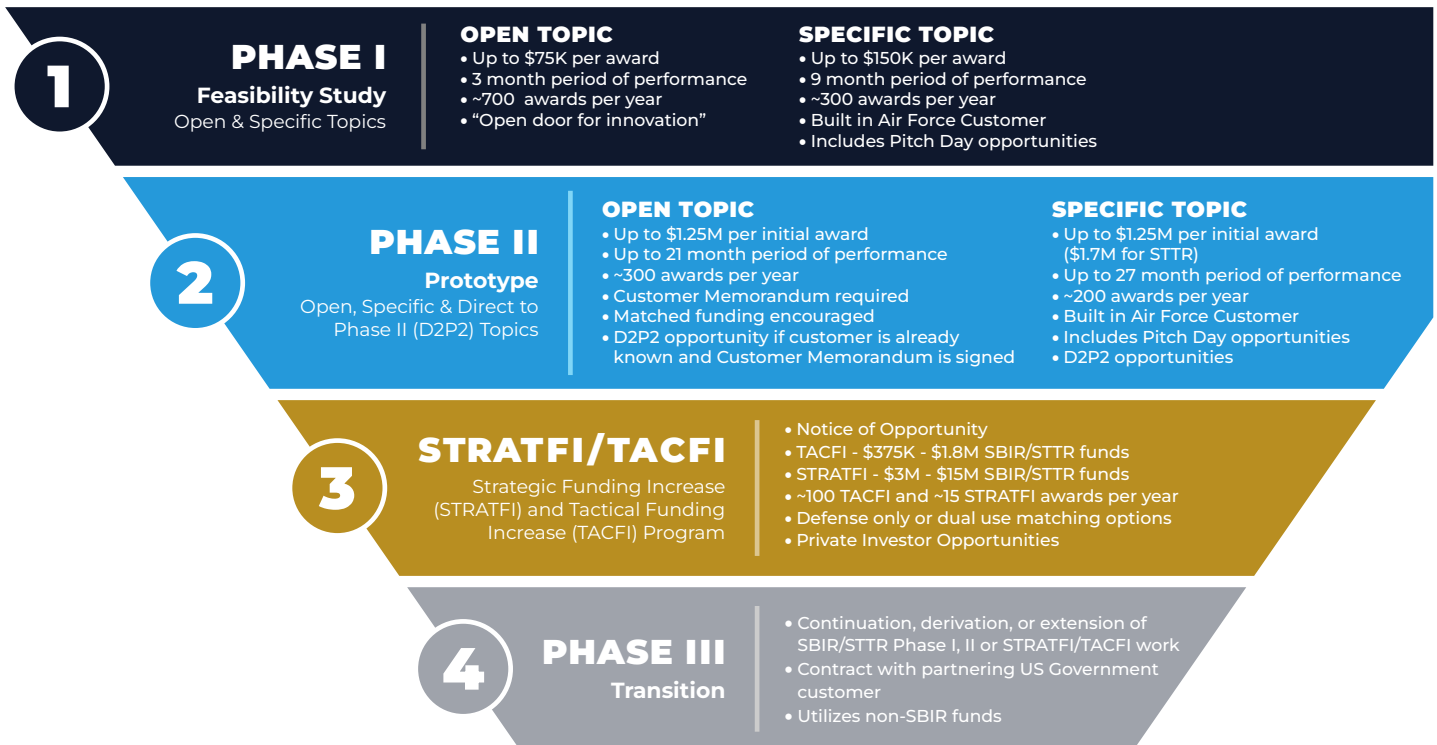
STRATFI/TACFI: In an effort to help bridge the two-year budget cycle “Valley of Death” in a fast-paced tech market, the Strategic Funding Increase (STRATFI) and Tactical Funding Increase (TACFI) Programs provide supplemental, scaled funding as follow-on Phase II awards. Small businesses that have been awarded a Phase II contract within the last two years are eligible to apply for this opportunity. This award at a critical time ensures Phase II development

transitions, derisked by investment from multiple partners.

Phase III: The SBIR/STTR Phase III is often referred to as the commercialization phase. It includes work derived from an effort under a prior SBIR/STTR funding agreement, but the work is funded by a source outside the SBIR/STTR program. Phase IIIs are one of the key elements of the SBIR/STTR program to small businesses and customers, since among other benefits government customers can issue Phase III awards as sole source contracts to Phase I/II awardees. Phase III awards are one success metric that AFVentures uses because they indicate that the technology has received funding to enable transition to end users.

AFVentures divides Phase I and II efforts into the Open Topic and the Specific Topic:

Open Topic: In the Open Topic, industry submits technology solutions that can meet a defense need and describes the benefit to the warfighter in the proposal. The Air Force then evaluates whether or not to conduct a feasibility study on the proposed



project. If the DAF end user and customer are interested in the project post-feasibility study (Phase I), they sign a Customer Memorandum indicating their intent to work with the small business on transitioning the proposed technology to warfighters.

Once the small business has a Customer Memorandum in hand, they can compete for the opportunity to prototype their solution. During Phase II, or the prototyping phase, the small business works directly with a TPOC, or Technical Point of Contact to build and adapt the solution to fit DAF needs. To make small businesses aware of key technology focus areas, the Open Topic program publishes end-user submitted DAF Focus Areas to the small business community.

Specific Topic: This program seeks innovative solutions for a particular problem specified by a DAF end user. In many cases, these topics do not have potential for dual use because the requirements are specific and clearly defined by the DoD. Overall, Specific Topics have clearly-defined requirements and a stated Air Force or Space Force customer. Small businesses are able to directly propose solutions to specific DAF needs, and upon award of a Phase I, Phase II, or D2P2, will work with that specified end user to address the capability gap or problem statement put forward in the solicitation.

OPEN TOPIC OVERVIEW

The Open Topic program's mission is to invest in emerging technologies to deliver capabilities

that meet DAF priorities by leveraging the SBIR/ STTR annual budget and a team of driven acquisition professionals. The Open Topic program is technology-agnostic and encourages industry to submit any innovative solution that can potentially solve a DAF need. This program focuses on dual-use technologies that have both commercial viability and defense applications to ensure long-term scalability. Additionally, this program often funds solutions with existing or proven commercial applications that require research and development to integrate into DAF missions.

In FY22, the Open Topic program implemented a new annual cycle, departing from the Office of the Secretary of Defense (OSD) cadence. This allows Open Topic to schedule two Phase I and two Direct-to-Phase II solicitations evenly spread throughout the year. This new cycle is planned around resources, system outages, and federal down days to ensure the schedule is predictable, repeatable, and consistent for small businesses. The Open Topic continues to attract significant industry interest, with a record-breaking 2,400+ small business proposals in the recent 22.4 cycle.

In FY23, the Open Topic program will continue to build a predictable, repeatable, accountable program. The program seeks to improve transparency with industry and reduce knowledge barriers for startups and companies already familiar with government contracts. Other notable changes planned for next year will include improving small business experience, consisting of an update to focus areas, changes to proposal feedback, and a matchmaking program.

OPEN TOPIC PROGRAM DATA



SPECIFIC TOPIC PROGRAM DATA



SPECIFIC TOPIC OVERVIEW

The Specific Topic Program seeks innovative solutions for a particular problem set defined by an Air or Space Force end user or customer. The customer organization is responsible for evaluating small business proposals to ensure the work meets customer needs, as well as issuing contract awards. Small businesses are able to directly propose solutions to specific DAF needs, and upon award, work with the end user to address the problem statement. Additionally, Specific Topics are generally solicited in the Defense Department SBIR/STTR Broad Agency Announcement (BAA) solicitation cycle.

In FY 2022, the Specific Topic team managed delivery of 181 different topics across 13x customer organizations. The Specific Topic Program was integrated into AFWERX/AFVentures, bringing program management for the entire DAF SBIR/STTR program into one organization. The Specific Topic team made programmatic adjustments to align with the AFVentures vision and direction. First, the Specific Topic Program was revamped to enable participation from across the DAF, where previously the vast majority of Specific Topic funding was used for AFRL initiatives. This resulted in topic submissions across three Major Commands (MAJCOMs) and three centers within AFMC, in addition to AFRL. Second, the program implemented enhanced cost, schedule, and performance tracking for the Specific Topic Program to enable management across hundreds of expected topics per year. This tool now provides AFVentures and AFWERX with unprecedented execution oversight.

In FY2023, to align with the SecAF's Operational Imperatives, AFVentures will launch a new Topic Selection Board to ensure topic selection and funding aligns with DAF priorities. This board will ensure both technical and operational considerations are weighed when selecting which Problem Statements enter the BAA Solicitation.

STRATEGIC FUNDING INCREASE (STRATFI)/TACTICAL FUNDING INCREASE (TACFI) OVERVIEW

In 2020, AFWERX established the Supplemental Funding Pilot Program (including STRATFI/TACFI) under AFVentures. This effort was envisaged to help bridge the technology transition “Valley of Death” by providing supplemental, scaled funding to the most promising initiatives. To be eligible, a small business must have been awarded a Phase II contract within the last two years. For a TACFI, companies may receive between \$375,000 and \$1.8 million in supplemental SBIR funding if matched one-to-one with other government funding or private funding. For a STRATFI, companies may receive between \$3 million and \$15 million if matched either (1) one-to-two with other government funding or (2) one-to-one with other government funding along with one-to-two with private funding, providing up to \$60 million to get the most promising Phase II technologies into the hands of the warfighters.

The program has expanded to scale Phase II efforts to achieve better technology transfer by de-risking development with investment from multiple partners. In its maiden year, the program awarded 20 STRATFIs, contributing \$62.5 million in SBIR funds, along with \$55.5 million in other government funds and \$12.3 million in private funds.

The following year, in FY2021, AFVentures introduced the Tactical Funding Increase program (TACFI) and established a permanent pathway for supplemental funding to propel the most promising SBIR Phase II efforts to Phase III or other avenues for transition. For the 2021 program year (PY21), AFVentures selected 99 TACFIs and 16 STRATFIs, for \$290 million in SBIR funds, and a total of \$324 million in other government matching funds. In a testament to the broad commitment to the Supplemental Funding Program, the PY21 programs also had a remarkable \$282 million in private matching funds.

AFVENTURES PROGRAM OVERVIEW

For program year 2022, AFVentures has further scaled the program and is reviewing 126 supplemental funding program applications: 101 for TACFI and 25 for STRATFI. The team has implemented a new, web-based tool to streamline inputs and enable easy stakeholder review of packages. These applicant programs will be selected based on individual merit, impact of the technology to the Air Force or Space Force, and the commitment of the DAF customer acquisition organization/end

user. In the case of STRATFI, the programs also require endorsement at the Program Executive Officer (PEO) level.

With program year 2023 beginning to take shape, AFVentures is raising the bar and shifting focus to seek out and fund programs with the greatest possible impact to the Department of the Air Force's strategic vision. AFVentures is further increasing its selectivity among the submissions, while codifying and standardizing its processes.

MAKING BIG BETS ON GREAT IDEAS

STRATEGIC & TACTICAL FUNDING INCREASE PROGRAM: STRATFI | TACFI

PURPOSE

1 Catalyze relationships between Air Force and Space Force end-users and acquisition professionals, private-sector innovators, and investors.

2 Bridge the capability gap between current SBIR/STTR Phase II efforts, resulting in SBIR/STTR Phase III scaling efforts that facilitate the delivery of strategic capabilities for the Department of the Air Force.

TACFI

Tactical Funding Increase
\$375K-\$1.8M

STRATFI

Strategic Funding Increase
\$3M-\$15M

ELIGIBILITY

Small Business Concern (SBC) must meet **ALL** of the following criteria.

1. Company is considered a SBC and eligible for a SBIR/STTR award
2. SBC is on an active DAF SBIR/STTR PII or completed a DAF SBIR/STTR PII within 2 years of Capability Package Submissions
3. The subject PII effort has not already been awarded a second (AKA "sequential") PII
4. At least 90 days have passed since the beginning of the associated PII execution
5. At least 90 days have passed since the last Capability Package submission
6. SBC is not executing a prior STRATFI effort at the time of submission
7. Anticipated work is to be performed in the United States

MATCHING OPTIONS

	Defense-Only	Dual-Use
TACFI	1:1 SBIR/STTR: Gov	1:1 SBIR/STTR: Private
STRATFI	1:2 SBIR/STTR: Gov	1:1:2 SBIR/STTR: Gov: Private

Notice of Opportunity → AF Customer RFP Release and Contract Award

PY21 STRATFI/TACFI RESULTS

★ **16** STRATFI enhancements awarded
99 TACFI enhancements awarded

\$ **\$290M** in SBIR funds

\$324M in matching government funds

\$282M in matching private funds over a four-year period of performance

PROGRAM OUTCOMES

AFVentures' goal is to use a range of funding tools to enable small businesses to deliver and scale capabilities to end users across the DAF. The team achieves this by opening the door, both for DAF-wide users to provide specific problem statements for Specific Topics and for companies to adopt their innovative technologies for DAF use via the Open Topic.

AFVentures Small Business Programs Support DAF-wide Users

DAF-wide end users/customers form the most important part of the AFVentures SBIR/STTR program. In FY2022, the Open Topic made 955 awards, spanning all Air Force Major Commands and the US Space Force, validating that the AFVentures approach is reaching DAF-wide. Specific Topic supported 541 awards spread across 11 different AFRL organizations, AFMC, and Space Systems Command. The 115 STRATFI/TACFI program year FY21 awards were made to small businesses supporting end user organizations across all MAJCOMs.

NUMBER OF OPEN TOPIC PHASE II PROJECTS BY MAJCOM

Air Force Materiel Command (AFMC) 200 (39%)	HQ Air Force (HAF) 19 (4%)
Air Combat Command (ACC) 76 (15%)	Air Mobility Command (AMC) 14 (3%)
Air Force Special Operations Command (AFSOC) 63 (12%)	Air National Guard (ANG) 12 (2%)
Air Education and Training Command (AETC) 37 (7%)	Space Operations Command (SpOC) 10 (2%)
Space Systems Command (SSC) 35 (7%)	Pacific Air Forces (PACAF) 6 (1%)
Air Force Global Strike Command (AFGSC) 33 (6%)	United States Air Forces Europe (USAFE) 4 (1%)
	Air Force Reserve Command (AFRC) 3 (1%)

NUMBER OF SPECIFIC TOPICS BY AFRL TD/OTHER GROUPS

AFRL/RX 50 (24%)	AFRL/711HPW 7 (3%)
	AFRL/CRI 6 (3%)
AFRL/RV 32 (15%)	AFRL/AFOSR 5 (2%)
	AFRL/RD 4 (2%)
AFRL/RI 24 (11%)	PEO DIGITAL 2 (1%)
	AFSC 3 (1%)
AFRL/RQ 18 (9%)	AFTC 2 (1%)
PEO-AFNWC STRATEGIC SYSTEMS 19 (9%)	AFCEC 1
AFRL/RY 16 (8%)	AFLCMC/EB 1
AFRL/RW - 9 (4%)	AFLCMC/RSO 1
USSF - 9 (4%)	AFRL/RS SDPE 1

NUMBER OF STRATFI/TACFI AWARDS BY MAJCOM

Air Force Materiel Command (AFMC) 39	Air Combat Command (ACC) 8
Air Education and Training Command (AETC) 11	HQ Air Force (HAF) 7
Air Force Special Operations Command (AFSOC) 11	Pacific Air Forces (PACAF) 4
Air Mobility Command (AMC) 9	Air Force Global Strike Command (AFGSC) 3
USSF 9	Air Force Reserve Command (AFRC) 1
	United States Air Forces Europe (USAFE) 1

SUCCESS STORY: BRAINGU

In 2020, **BrainGu** partnered with the USAF to produce WIDOW (Web-based Information DOrnant Warfare), a mission planning application that increases the speed, organization, and accuracy of planning tasks through real-time coordination and visualization of mission details. WIDOW is now designated as the official USAF mission planning cell tool. It is built in DoD Platform One and the code is 100% government-owned. As of 2022, WIDOW fulfills the tactical planning requirement for the Advanced Battle Management System (ABMS), which is the DAF contribution to JADC2.

BrainGu also offers Platform Concierge Services such as Big Bang as-a-Service (BB-aaS), Developer Experience as-a-Service (DevX-aaS), and Mission Application as-a-Service (MA-aaS), which are enabled by Structsure™, BrainGu's proprietary DevSecOps Platform. With Structsure™, BrainGu is creating a sustainable common environment that enables operator-driven mission application development from concept to combat in hours, not months. Due to the success of the Platform Concierge Services, BrainGu was awarded a \$15 million STRATFI award in August 2022 to accelerate the development and commercialization of Structsure™ which is now being used as the initial DevSecOps platform for ABMS at classified and unclassified levels.

SUCCESS STORY: BLUESTAQ

In February 2021, **Bluestaq** received \$280 million in Phase III funding to roll out its unified data library (UDL) to Space Force users and to expand the technology to allow data sharing across multiple classification levels. The UDL is designated as the Space Force single source for managing data from operational space systems, making it the central location to find and access data, enable superior data analytics, and strengthen data security. With the UDL platform, Air Force and Space Force users, other Federal Government users, commercial companies, academic institutions, and allied governments have the ability to purchase space situational awareness (SSA) products, redefining how the enterprise space community buys and sells commercial SSA data. In recent news, Bluestaq was the enabling technology for the Afghanistan Airlift, providing the ability for the U.S. Northern Command and Air Mobility Command to track flights in and out of Kabul in real time. According to Dr. Rebecca "Becca"

Decker, Bluestaq Chief Operating Officer, "In 2019, Bluestaq was awarded a Direct to Phase II SBIR contract to rapidly develop an e-commerce platform for space data, the SDA Marketplace. The AFWERX investment provided Bluestaq with the seed funding to accelerate the architecture design and launch the global data market in 12 months. Two years later, over 30 data providers worldwide have adopted the SDA Marketplace as a channel to sell space data to government, commercial and academic consumers across the globe."

TRANSITION AND CAPABILITY DELIVERY

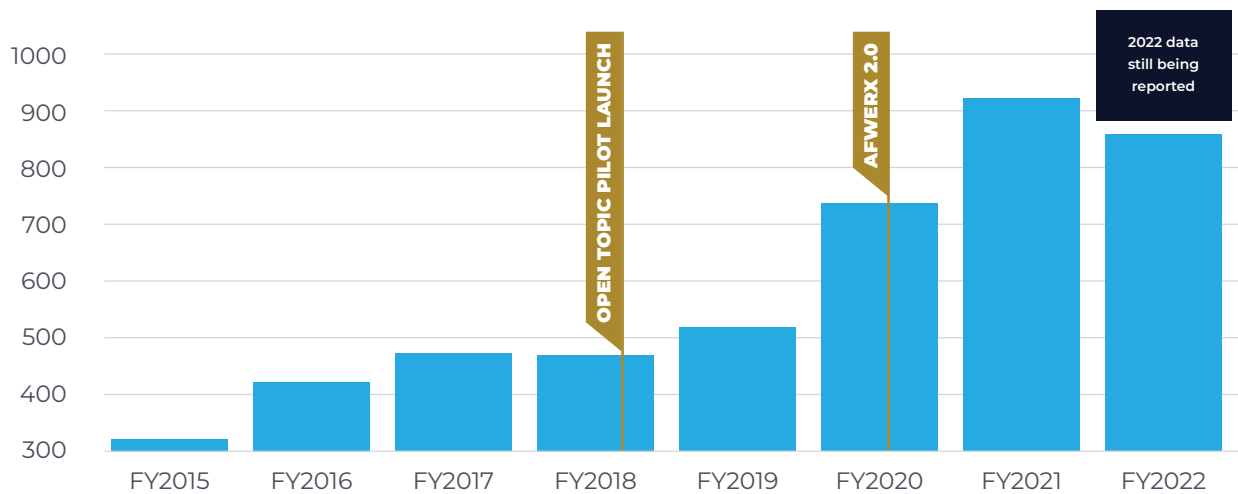
One of AFVentures' key goals is to bring non-traditional defense companies with high readiness, defense-applicable technologies into the portfolio to solve DAF problem sets. One way AFVentures measures whether portfolio company solutions are getting integrated and scaled is by tracking follow-on government contracts. AFVentures SBIR/STTR portfolio companies are receiving record amounts of customer organization funded follow-on contracts. This indicates that the developed technologies are valuable—and transitioning into customer use. The value of Phase III government contracts, which are funded by customer organizations and derived from Phase I/II work, is up 330% in FY2021 versus the pre-Open Topic baseline (FY15 - FY18). This represents an increase from \$293 million to \$980 million annually. *Please note that AFVentures is not yet reporting FY2022 numbers due to data lag in contract reporting, but the trend appears to be continuing in FY22. AFVentures manually reviews these Phase III contracts to ensure they are not erroneously entered.*

82%

of post-SBIR Award Contract Winners have had 5 or fewer DAF SBIR awards

AFVentures also tracks how well SBIR/STTR portfolio companies do in receiving any government contract—Phase III or not—after their SBIR/STTR award. This reveals whether AFVentures portfolio companies are scaling to deliver broader capability across the DoD ecosystem, post SBIR/STTR. In total, AFWERX portfolio companies have received \$1.9 billion in post-award government contracts in FY2021, and \$2.9 billion since the launch of AFWERX 2.0 in May 2020. In FY2022 alone, 82% of

ANNUAL PHASE III AWARDS



post-SBIR contract award dollars awarded to DAF SBIR portfolio companies have gone to companies with five or fewer SBIR awards in the past five years. This suggests that the AFVentures approach to investment is attracting new entrants able to deliver capabilities to the DAF.

SUCCESS STORY: DZYNE TECHNOLOGIES

DZYNE Technologies received a SBIR Phase II award in 2020 for \$1.6 million to deliver research and development for SPPAIDS, the Small Package Precision Air Inexpensive Delivery System. The prototype aircraft is a low-cost air-deployable system designed to improve small-payload precision delivery capability at long standoff ranges. DZYNE signed an \$89 million Phase III R&D contract with AFRL to develop swarms of air-launched unmanned gliders for precision payload delivery to the battlefield. The inexpensive, reusable unmanned aircraft is intended to deliver 25 pounds (11.3 kilograms) of payload, including “sensitive electronics such as handheld radios or delicate medical supplies” to support “combat search and rescue, personnel recovery and special operations.” The aircraft is expected to deliver the payload to a 10x10ft (3x3m) target zone from a standoff range of 100 miles (161 kilometers).

SUCCESS STORY: SLINGSHOT AEROSPACE

Slingshot Aerospace’s trainer enables Space Force operators to intuitively grasp concepts around advanced orbital mechanics by combining real time mapping of objects with physics-based simulations

to show how missions will behave in the real space environment. Slingshot Aerospace received a 2021 \$25 million STRATFI award from Space Systems Command and SpaceWERX for its digital twin next generation orbital simulator and related training laboratory pilot. The original Phase II award was given to Slingshot in 2020 to develop its Virtual Space Situational Training Notebook. Slingshot has received several AFWERX SBIR awards since 2019 for its solutions and prototypes, bringing data analytics visualization and task management tools to the warfighter. Four training organizations are planning to adopt the simulator: Basic Military Training (BMT), National Security Space Institute (NSSI), the 319th Combat Training Squadron, and the 533rd Training Squadron.

PRIVATE INVESTMENT

AFVentures portfolio companies need capital to scale and cross the Valley of Death. By leveraging private capital, either as matching funds for project-based co-investment (TACFI/STRATFI) or to fund businesses with dual-use technologies, AFVentures can expand available funding for portfolio businesses and reduce funding gaps caused by an extended period before award. The opportunity for private capital investment after receiving a SBIR/STTR award also incentivizes small businesses to adapt their technology for DAF use, creating an ever-increasing number of small businesses interested in working with the DAF. To measure private sector commercialization without self-reporting,

AFVENTURES **PROGRAM OVERVIEW**

AFVentures pulls data on venture capital investment from Pitchbook. Since the launch of AFWERX 2.0, AFVentures SBIR/STTR portfolio companies have received a total of \$27.3 billion in private investment. This includes any private investment after the company's first SBIR/STTR award, where the company has had a SBIR/STTR award since 2016. This compares to \$2.4 billion in SBIR/STTR contracts during the same period. Of this investment, \$7.3 billion went to 184 companies whose first DAF SBIR award ever occurred after AFWERX 2.0 launch-meaning these brand-new portfolio companies have garnered substantial investment over the last 2.5 years. In total, 26 AFWERX SBIR/STTR portfolio companies have achieved valuations of \$1 billion or more.

SUCCESS STORY: ORBITAL SIDEKICK

Orbital Sidekick (OSK) was awarded a 2020 STRATFI contract for \$14 million from SBIR and Space Force, plus private investment, to realize production in CY2023. OSK has been working with multiple commercial partners, along with the AFRL Space Vehicle Directorate, to implement a low-cost space-based hyperspectral data infrastructure that allows operators to monitor unique asset packets from space, across the globe, on a daily frequency. OSK received its first award, a \$75,000 Phase I, in 2018

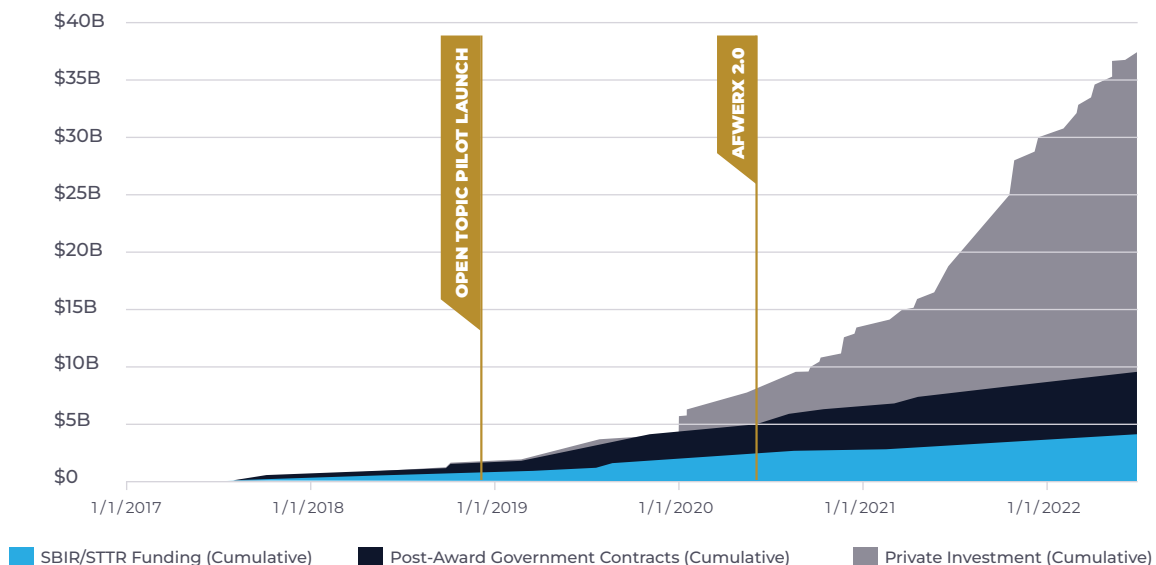
followed by Phase II in March 2019.

OSK continues to attract investment from Energy and Defense sectors, including a 2021 Series A to support its plan to transition to and expand satellite operations to achieve full commercialization.

AFVENTURES SMALL BUSINESS PORTFOLIO - DRIVING GROWTH

AFVentures has successfully expanded the number of small businesses working with the Department of the Air Force, enabling the DAF to onboard cutting-edge technology from small businesses that may otherwise never have considered working in the defense sector. By attracting more and more businesses, AFVentures creates a flywheel of success, creating more competition for SBIR/STTR awards and continually improving the quality of small business offerings. Since the launch of the Open Topic in 2018, AFVentures has grown the size of the DAF's small business portfolio by over 2,200 companies - and the size of the portfolio is growing at a 2.7x faster rate than before. This is accomplished by providing pathways for the most promising businesses to win large government awards via the STRATFI program, by reducing barriers to entry, and by conducting extensive outreach.

Cumulative SBIR Contracts, Government Contracts, and Private Investment in Portfolio Companies since 2017



Cumulative SBIR/STTR awards, non-SBIR government contracts, and private investment since Jan 1 2017. Only includes private investment/government contracts after each company's first post-1/1/2017 SBIR award. Private investment data sourced from Pitchbook; government contract data sourced from USASpending. Private investment deal data includes all private deals after a portfolio company's first DAF SBIR/STTR award. Only seed round, VC, angel investment, IPO/public, mergers/acquisitions, PE growth, PIPE, corporate investment, and buyout/LBO deals are included. Other deal types such as debt are not included.

AFVENTURES PROGRAM OVERVIEW

Receiving timely funding—especially for early stage companies—is critical to enable small businesses to continue operations and retain talent so they can deliver good outcomes. Since launch, Open Topic has driven a 62 percent reduction in average time to Phase I award, with 99% of Phase I awards made within 180 days. Phase II time to award has also decreased 45 percent, from 228 days pre-Open Topic to 125 days on average for Open Topic awards, with 71 percent awarded within 180 days. While Open Topic time to Phase I award has increased to 84 days in FY21, the team plans to reduce this timeframe with the launch of the new annual Open Topic schedule. Similarly, with the Specific Topic team now part of AFVentures, AFWERX expects time to award to be reduced significantly for Specific Topic awards in FY23, as topic managing organizations are guided to deliver awards within a 90-day timeline.

AFVentures also conducts extensive outreach to small businesses via its Engagements team, which delivers communications campaigns and engages with small companies at dozens of events across the United States. AFVentures holds dozens of small-business facing webinars and online sessions, in addition to wide-reaching, in-person engagements across 14 states nationwide in 2022 alone.

A core AFVentures principle is encouraging small businesses to scale so they can be better positioned to deliver mission capability to the joint force. AFVentures wants companies to eventually grow out of needing SBIR awards, because they are seeking

larger contracts for their technology to fulfill a defense capability need. In total, 76 percent of Open Topic and 52 percent of Specific Topic FY2022 awards went to companies with five or fewer previous DAF SBIR/STTR awards.

2,700+

Portfolio companies awarded FY18 - FY22

171 Days

Phase I time to award (2016 - 2018)

ENGAGEMENTS BY THE NUMBERS

7,801

webinar attendees since mid-2021

7x

major communications campaigns in FY22

30+

SBC-facing products created

25+

total events attended across 14 states

62%

REDUCTION

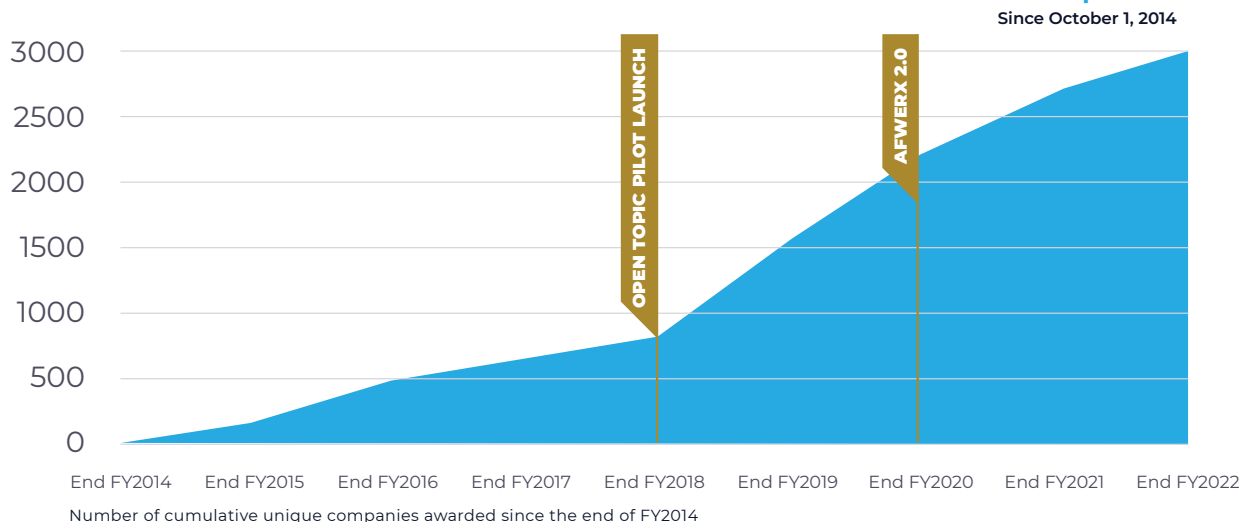
64 Days

Phase I time to award (Open Topic all time)

76%

of Open Topic awards went to companies with 5 or fewer previous SBIR/STTR awards

Growth in AFVentures SBIR Portfolio Companies



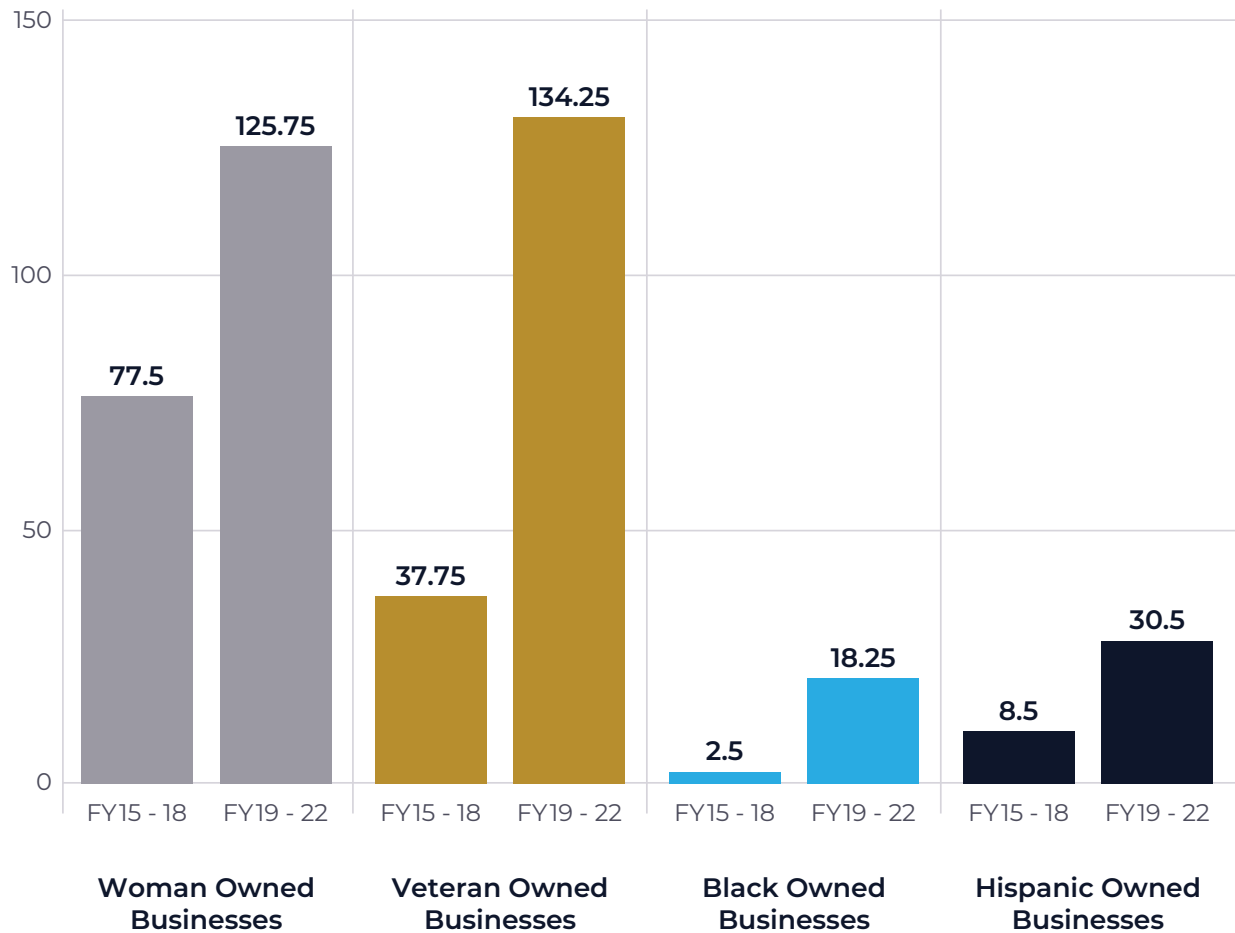
AFVENTURES SMALL BUSINESS PORTFOLIO - INCREASING DIVERSITY

AFVentures invites small business founders from all backgrounds to consider participating in the SBIR/STTR program. From fiscal years 2018 through 2021, AFVentures supported increasing growth for businesses owned by women, veterans, and minorities (as self-reported in the federal awards database SAM.gov). In FY15-18, 78 woman-owned businesses received SBIR/STTR awards each year; this grew to 126 per year in FY19-22. The number of veteran-owned businesses experienced even more

growth, increasing 256 percent from an average of 38 companies awarded per year in FY15-18 to 134 per year in FY19-22. The number of minority-owned businesses awarded per year grew from 71 to 154 companies, including an increase from 3 to 18 for Black American-owned businesses and an increase of 9 to 31 for Hispanic American-owned businesses. As it grows, AFVentures expects the diversity of small businesses to continue to grow organically and incrementally as the organization explores programs to attract talent from all communities.

SELECT SMALL MINORITY-OWNED BUSINESS CATEGORIES

AVERAGE AWARDS ANNUALLY





OVERVIEW

MISSION

Spark relentlessly inspires and enables Airmen and Guardians to unleash their potential and to drive capability development that increases the efficiency, effectiveness and quality of life of the warfighter.

STRATEGIC CONTEXT

Innovative Airmen and Guardians will drive the future success of the Department of the Air Force. All too often, Airmen and Guardians face cutting-edge challenges with equipment and procedures that are either obsolete, tailored to the wrong problem, or simply ineffective. While so far these inefficiencies have largely remained little more than a source of frustration for men and women in uniform, they threaten to undercut the Air and Space Force's ability to win a future fight against a dangerous and motivated adversary. Across all ranks, regions, and missions, Airmen and Guardians must routinely challenge the status quo and aggressively seek to apply unique experience and skills to improve the DAF. There are innumerable opportunities for innovation to solve critical warfighting needs, but grassroots solutions are rarely able to make the leap from idea to execution. Innovators within the force, or "intrapreneurs," need resources including training, funding, and access to scaling mechanisms in order to refine and implement their vision. Spark provides connective tissue for Airmen and Guardians to both improve their creative thinking and work with like-minded peers, and operates through a decentralized structure to draw on the greatest possible pool of innovators. Spark resources, including expertise, funding, and specialized innovation processes, have proven to be crucial in transitioning a variety of technological and procedural breakthroughs into production and execution. Further, other AFWERX developmental activities stand to benefit through the rapid feedback loops and tighter integration with end users afforded by the Spark ecosystem.



Photo by Staff Sgt. James A. Richardson Jr.



SPARK
COL MARTIN SALINAS

SPARK PROGRAM OVERVIEW

METHOD

AFWERX Spark empowers innovators and accelerates results through three major lines of effort: growing and **connecting** the innovation network; **developing** innovation competencies in Airmen and Guardians; and **supporting** innovators as they pursue and implement their ideas.

MAJOR LINES OF EFFORT

Spark Network Branch

This branch focuses on building, empowering and mobilizing innovation networks to promote culture change and increase collaboration, information sharing and mutual support across the Department of the Air Force. **Spark Cells**, decentralized teams of operators at Air and Space Force installations around the world, incentivize the development of grassroots solutions to DAF challenges and provide the support necessary to implement them. **Operational Innovation Cells** execute at the Major Command (MAJCOM), National Guard Bureau (NGB), and Center level; these cells focus on DAF operational priorities and identifying cross-cutting initiatives, applying their deep knowledge of DAF corporate processes to scale more and better grassroots solutions to the field. The **Spark Collider Program** connects industry partners, mainly recipients of SBIR/STTR Phase I and II funding, with government customers, subject matter experts, and end-users through a series of tailored networking events. The **Spark Augmentee Program** mobilizes large cohorts of DAF talent to support major AFWERX undertakings, such as SBIR/STTR evaluation sprints.

Spark Development Branch

This branch focuses on developing Airmen and Guardian innovators through curriculum and experiential learning. The **Spark Fellowship** and **Defense Ventures Program** place military innovators into key nodes in the innovation ecosystem. This helps emerging innovators hone their skills, provides value to the host programs and companies, and offers useful networking opportunities. AFWERX Spark also supports innovation training to DAF personnel by funding

partner initiatives such as the **Design Warfare** and **Spartan-V** non-traditional Design Thinking courses, and **Project Arc**, which embeds Scientists, Technologists, and Engineers (STEs) inside operational units.


Spark Catalyst Branch

This branch supports DAF innovators through facilitation, advocacy, and the development of common collaboration and productivity tools. The **Spark Tank** competition identifies, supports, and celebrates high-performing DAF innovators; Airmen and Guardians submit ideas through a force-wide crowdsourcing platform for the chance to pitch to senior DAF leaders and industry experts on stage annually during the Air Force Association Warfare Symposium. **The Refinery** accelerates grassroots innovations within the Department of Defense by bringing Minimum Viable Products (MVP) closer to an operational capability. **VISION** is a collaboration and project management tool developed with input from hundreds of DAF stakeholders across the innovation ecosystem that helps tactical level innovators manage their projects and connects them to similar projects happening across the force.



By bridging the gap between STEs and operators, Project ARC prepares the DAF to execute the rapid technology adaptation and exploitation required to win in a future near-peer and peer conflict. Twelve Jedi, two trainers, and five Project ARC admin team members are pictured in front of the F-22 display at the USAF museum during a just-in-time training program at Wright Patterson AFB.

108
Spark Cells Worldwide



SPARK CELLS TO DATE:
108 teams worldwide


- ▶ **4** in-person ecosystem events assembled **281** government members from **62** bases
- ▶ **51** Operational Innovation Cells, including one at every MAJCOM, AFIMSC, ANG and others

(based on 2022 events)

AFWERX SPARK PROVIDED
(to date)

\$6M

- ▶ **25** innovation efforts with MAJCOM sponsorship
- ▶ **6 Virtual Colliders**
 - ▶ **412** industry
 - ▶ **407** government participants
 - ▶ Expanded collaboration and future networking



AUGMENTEE PROGRAM
(in 2021 & 2022)

- ▶ **2,960** evaluators
- ▶ **\$1.78 Billion** Research Development Test & Evaluation funds for the Department of the Air Force



INTERNSHIPS
(in 2021 & 2022)

- ▶ **287** interns
- ▶ supported **117** projects
- ▶ **17** DAF organizations

★ FELLOWSHIPS

- ▶ Hosted **7** cohorts of Fellows since 2020
- ▶ **157** Fellows from every MAJCOM with diverse range of backgrounds:
 - GED to PhD
 - O1-05
 - E4-E9
 - GS8-15
 - engineers
 - program managers
 - pilots
 - flight line operators
 - maintainers

DEFENSE VENTURES FELLOWS SINCE 2020

- ▶ **317** Fellows ▶ **17** Cohorts
- ▶ Participants:
 - Army
 - Navy
 - Air Force
 - Space Force
 - Marines
 - Coast Guard
 - Defense Intelligence Agency (DIA)
 - National
 - Geospatial-Intelligence Agency (NGA)
 - Defense Advanced Research Projects Agency (DARPA)
 - Office of the Secretary of Defense (OSD)
 - Defense Threat Reduction Agency (DTRA)
 - Reserve/Guard
- ▶ **40,000+** hours industry immersion with Industry Partners
- ▶ Hosted by:
 - Hosted by **125** companies
 - **46** venture capital
 - **71** tech startups
 - **4** incubators
 - **1** FFRDC



SPARK INNOVATION TRAINING

- ▶ **10** Design Warfare courses
- ▶ training **150** personnel
- ▶ **9** MAJCOMs
- ▶ **2** Services
- ▶ **37+** bases

PROJECT ARC

31
Airmen and Guardians

9
operational bases to date

SPARK TANK

- ▶ **879** ideas submitted since 2020
- ▶ ranging from improving maintenance capabilities to streamlining CSS workflow processes
- ▶ **22,437** votes
- ▶ **3,593** crowdsourced comments from the innovation community

VISION

developed in under **7 months**

2532
projects

3,248
users to date

SPARK NETWORK BRANCH **(CONNECT)**

The **Spark Network Branch** focuses on building, empowering and mobilizing innovation networks to promote cultural change and increase collaboration, information sharing and mutual support across the Department of the Air Force.

Tactical Innovation Cells (“Spark Cells”) are a decentralized network of innovation cells at Air and Space Force bases around the world that enable Airmen and Guardians to execute locally generated ideas and projects. The first Spark Cell began at Travis Air Force Base in California in 2016, and there are now 108 worldwide. **Operational Innovation Cells** operate at the MAJCOM, NGB, and Center levels; these cells focus on DAF operational priorities and identifying cross-cutting initiatives, applying their deep knowledge of DAF corporate processes to scale more and better grassroots solutions to the field.

AFWERX Spark serves as the connective tissue linking all of these cells by promoting increased communication, collaboration, and awareness of available innovation tools and resources via recurring virtual and in-person touchpoints. In 2022, AFWERX Spark hosted four in-person ecosystem events that brought together 281 government members from 62 bases and 51 Innovation Cells. And finally, AFWERX Spark presented as a tech exhibitor at the 2022 AFA Air, Space & Cyber Conference alongside 13 Spark cells over three days.

See a sampling of DAF Innovation Projects, broken out by MAJCOM, beginning on page 37.

The **Spark Collider Program** provides virtual and in-person events to connect industry partners to government customers, SMEs and end users. These events typically focus on a mission or technology vertical and serve as an accelerator to connect AFVentures Open Topic SBIR/STTR Phase I and II companies to customers and scaling partners. In 2022, three standard and one ‘reverse’ style virtual colliders were held. In the standard colliders, companies pitched products in the areas of Health,

CONNECT

108 Spark Cells

15 Operational Cells

2,960 Trained Augmentees



Flight, and Training to prospective government customers. These single-technology-focused events brought together a total of 86 small businesses and approximately 140 government participants. In ‘reverse’ colliders, government organizations pitch their challenges to curated groups of SBIR/STTR companies, and those companies return in roughly a month with pitches for tailor-made solutions to those problems; this first ‘reverse’ collider included 4 such government organizations, all of whom received at least one relevant tailored solution pitch.

The **Spark Augmentee Program** mobilizes large cohorts of decentralized DAF talent to tackle hard challenges; most notably, the Augmentee program has sourced upwards of 2,960 Subject Matter Experts to accomplish over 17,981 evaluations for the AFVentures SBIR/STTR Open Topic. In 2021 and 2022, evaluators sourced by the Spark Augmentee Program evaluated proposals representing over \$1.78 billion of proposed Research Development Test & Evaluation for the Department of the Air Force. Further, the Augmentee program acts as a flywheel and natural onramp for other AFWERX programs, as it is open to all DAF members and offers scalable levels of involvement based on a member’s available bandwidth.



SPARK DEVELOPMENT BRANCH **(DEVELOP)**

The **Spark Development Branch** focuses on developing Airmen and Guardian innovators through curriculum and experiential learning. The following programs are in the Development Branch portfolio.

The **Spark Internship Program** helps to produce the next generation of Airmen and Guardian innovators by empowering and connecting USAFA and AFOTC cadets to innovation efforts at AFWERX and throughout the DAF innovation ecosystem. Interns are placed into programs where they can apply their skills and knowledge to innovation efforts and collaborate with experienced innovation enablers who provide mentorship and guidance. Interns bring back not only valuable experience and sharpened knowledge of innovation tools and resources, but also an expanded network of innovation teammates on whom they can rely on in their future roles as officers. In 2021 and 2022, AFWERX hosted 287 interns who supported 117 projects across the DAF.

See a sampling of AFWERX Internship projects on page 47.

The **AFWERX Fellowship** is a four-month experiential innovation training program that immerses Airmen and Guardians into the innovation ecosystem. During this time, fellows take on key responsibilities within the AFWERX team and receive structured curriculum on innovation topics such as design thinking, agile acquisitions, and emerging collaboration tools. Fellows return to their units armed with the tools and network to “accelerate change.” Through 7 cohorts since 2020, AFWERX hosted 157 fellows from every MAJCOM and a diverse range of backgrounds (GED to PhD; O1-O5, E4-E9, GS8-GS15; engineers, program managers, pilots, flight line operators, maintainers, and more).

The **Defense Ventures Program (DVP)** is an industry immersion program that was launched in 2020. The program—administered by Shift, a Silicon Valley tech startup—identifies emerging innovators from across the U.S. military through a competitive-application process and places them into short-term work environments within small businesses and venture capital firms across the United States. The program allows active duty service members to gain industry experience with new technologies and management styles, to develop professional relationships throughout the tech industry, and to bring innovation back to the DOD and their home units. 317 Fellows and 17 Cohorts have participated in the program since 2020, with participation from the Army, Navy, Air Force, Space Force, Marines, Coast

Guard, Defense Intelligence Agency (DIA), National Geospatial-Intelligence Agency (NGA), Defense Advanced Research Projects Agency (DARPA), the Office of the Secretary of Defense (OSD), Defense Threat Reduction Agency (DTRA), and Reserve/Guard totaling more than 40,000 hours of industry immersion with Industry Partners. Also since 2020, 125 companies (46 venture capital, 71 tech startups, three Accelerators, one Federally Funded Research and Development Center (FFRDC), and three large companies) have hosted those 317 fellows.

See Defense Ventures Program Spotlight on page 48.

Innovation Training - Through the facilitation of non-traditional Design Thinking curriculums, installations across the USAF and USSF are seeing success in igniting an innovation culture and equipping Airmen and Guardians with tools and mindsets needed to successfully validate, implement, and scale ideas. The flagship one-month course, **Design Warfare**, and one-week condensed course, **Spartan-V**, were developed by Airmen at Global Strike Command and AFWERX Spark has helped to scale the course throughout the DAF. During the past year, 10 Design Warfare courses were conducted, training 150 personnel across nine MAJCOMs, two Services, and more than 37 bases.

Project Arc started in July 2020 as a grassroots movement to address limitations highlighted in the Air Force’s Science and Technology 2030 Strategy and the 2019 National Defense Strategy. Its goal is to embed Scientists, Technologists and Engineers (STEs) inside operational units to solve technical problems and practice the teaming necessary to execute rapid technology adaptation, and exploitation required to win in a future near-peer and peer conflict. During the first year, 31 Airmen and Guardians across nine operational bases demonstrated the asymmetrical, non-linear impact that on-site STEs can have on the department’s ability to accelerate change at tactical, operational, and strategic levels. As with the Design Warfare and Spartan-V courses, AFWERX supports the implementation and scaling of Project Arc; however, AFWERX cannot take credit for the visionary leadership and founding of the program.

See Project Arc Spotlight on page 49.

SPARK CATALYST BRANCH **(SUPPORT)**

The **Spark Catalyst Branch** supports DAF innovators through facilitation, advocacy, and the development of common collaboration and productivity tools.

The **Spark Tank** competition, which began in 2018, identifies, supports, and celebrates high-performing DAF innovators. Every Airman and Guardian has the opportunity to submit ideas through a force-wide crowdsourcing platform. The top teams have the opportunity to pitch their ideas to senior DAF leaders and industry experts on stage during the annual Air Force Association Warfare Symposium. Spark Tank has reached impressive levels, with 879 ideas submitted since FY2020, ranging from improving maintenance capabilities to improved operations and communication via more than 22,437 votes and 3,593 crowdsourced comments from the innovation community. The 2022 Spark Tank Trophy was awarded to Senior Master Sergeant Brent Kenney from the 52nd Fighter Wing at Spangdahlem Air Base in Germany for his winning idea, **Project Arcwater**. This solution is a simple, green, expedited way to save energy and provide clean drinking water by using solar fabric and extracting via atmospheric water harvesting or through environmental water harvesting to the agile combat employment mission. Several other finalists received DOD contracts and are currently being implemented to improve critical Air Force and Space Force capabilities.

See Spark Tank Spotlight on page 50.

The **Refinery** connects Airmen and Guardian innovators with relevant stakeholders and resources in the larger Department of Defense ecosystem to develop their grassroots projects. The principal objective is to further develop tactical project prototypes and adopt the right operational

SUPPORT

879 Spark Tank Submissions since 2020

Support Enterprise Platforms (VISION)

Spark Refinery (Spring '22)



capabilities into the larger force. This is made possible through the Refinery's curated process, partnerships, and refinement of the ecosystem's acquisition pipeline. Criteria for projects that can enter the Refinery dictate that it

must be a grassroots project (originated by Airmen and Guardians) at the Minimum Viable Product (MVP) stage or later with a potential user pool larger than one unit or base. Projects must have the potential to either influence the institution or gain institutional adoption.

Championed by AFIMSC and designed by a small business (Mobilize), **VISION** is a collaboration and project-management tool that was developed with input from hundreds of DAF stakeholders across the innovation ecosystem. The platform enables innovators at the tactical level to collaborate by deploying a matching algorithm that connects innovators to similar projects based on key words and themes. Each new submission funnels up to a Spark Cell, or manager, to help coach the innovator and push the project from idea to operational capability. This IL4 capability was developed in under seven months and now boasts over 2,532 projects and 3,248 users. The platform is available to all Department of the Air Force members today and has the capability to rapidly scale to other federal agencies; achieving this scale will enable unprecedented Joint collaboration and unlock invaluable data insights for DAF.

See VISION Spotlight on page 52.





U.S. Air Force photo/1st Lt. Karissa Rodriguez

Low-Cost Threat Emitter (LCTE)

Innovator Team: Maj. David Coyle and Lt. Daniel Treece

Sponsor Organizations: ACC

Problem: Threat emitters are an integral part of aircrew training; however, there aren't enough of them due to their large size and cost. More emitters are needed to replicate the density and fidelity of a real-world threat environment for pilots.

Solution: Large threat emitters can be supplemented by an in-house designed solution that leverages commercially available equipment. The Low-Cost Threat Emitter (LCTE) utilizes only a tripod and desktop computer-sized hardware.

Impact: The LCTE can be assembled and moved by just one airman and requires only an external generator for power. The LCTE provides more dynamic training due to its mobility, and costs less than 1/10th of a large emitter, resulting in a 99.7% cost reduction to the Air Force. ACC is planning to field LCTEs to training ranges in order to achieve the desired threat density at a reduced cost.

Accelerating Pilots to Combat Ready Aviators Challenge

Project Lead: Ms. Andrea Hagen

Sponsor Organizations: ACC/A5X (contributing partners - AETC, AFGSC, AFLCMC/WNS)



Problem: The overall effectiveness of current pilot training programs across the Air Force is limited by a widening gap between the capabilities of primary training aircraft and those of the advanced fighter aircraft that pilots currently operate.

Solution: The AFWERX Challenge process enabled ACC, AETC, AFGSC, and AFLCMC/WNS to combine efforts in solving this problem. The MAJCOMs sourced solutions from industry to enhance the training feedback loop, modernize learning tools to provide a better learning experience, and facilitate ease of collaboration and communication among the pilot training and development communities.

Impact: Through the AFWERX Challenge process in 2021, 208 industry submissions were down-selected to seven demonstrations. The demos provided a low-cost way to see the proposed solutions in action and allowed ACC to narrow the field down to two proposals for further evaluation. This process allowed for rapid solution sourcing from industry at a much lower cost than for traditional methods.

F-35 Engine Trailer Alignment with Lasers

Project Leads: Tech Sgt. Travis Rogers and Tech Sgt. Dakota Belcher

Sponsor Organization: 56 FW



Problem: Alignment of F-35 Engine Trailers can be time consuming, with some instances taking upwards of eight hours to properly align. These lengthy processes directly contribute to delays in sortie generation and pilot graduation.

Solution: This laser system, consisting of a laser attached to the trailer rail and a receiver to the aircraft side, allows the user to see how far out of alignment the trailer is.

Impact: It reduces trailer alignment time to 15-25 minutes across skill levels, at the low cost of \$85 per instance. With a projected F-35 end strength of over 1700 airframes, and engine removal occurring approximately every 8-9 months, this alignment device could save 850 annual work hours across the fleet.

Developing Airmen With Games (DAWG)

Project Lead: Matthew Correia

Sponsor Organization: Eaker Center

Problem: A RAND Corp. 2019 study (Improving 21st Century Skills in the U.S. Air Force) suggests that Total-Force Airmen lack sufficient critical thinking and problem-solving skills. It details the need to change the Air Force's learning construct towards "higher-order" thinking through project-based learning.

Solution: Developing Airman With Games (DAWG) integrates a modified video self-modeling technique with adaptive and guided performance-driven

feedback to accelerate mastery of critical skills and create more compelling learning scenarios. Performance data and observational data can be utilized in assessments.



Impact: DAWG is the application of sound, proven educational practices through game-based learning. It addresses the key tasks laid out in "Improving 21st Century Skills in the U.S. Air Force," transforms the Airman professional development process, and builds better Airmen with Air Force Foundational Competencies and Core Values.

PME-OutLOUD! Audio-Enabled PME

Project Lead: Maj. Melissa Holt

Sponsor Organization: 59 MDW



Problem: Current PME materials do not incorporate an audio format for auditory learners in an out-of-classroom training environment.

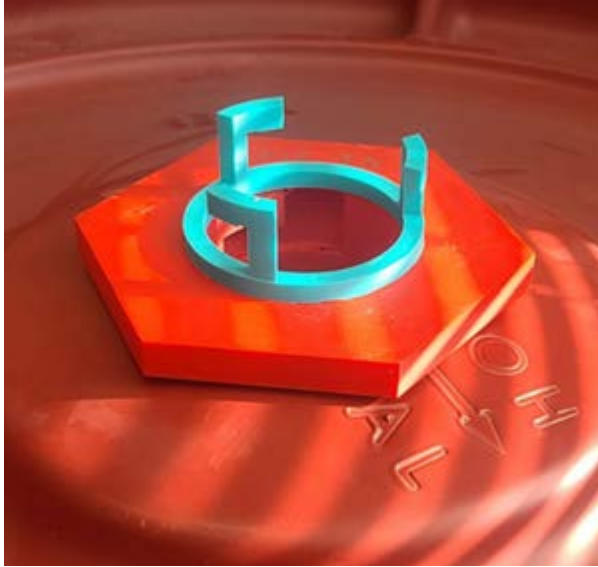
Solution: PME-OutLOUD! allows learners to facilitate their study of Professional Military Education (PME) via an audio/podcast platform.

Impact: PME-OutLOUD! augments PME material, enabling Airmen and Guardians who are auditory learners to better understand the texts.

B-52 Engine Heater Inlet Adapter

Project Leads: Tech Sgt. Adam Vasas and Capt. Matthew Matuszak

Sponsor Organizations: 5 AMXS/Atomic Spark



Problem: Extremely harsh winter conditions in Minot, N.D. and unsecured engine heater pipes can cause moisture to build up in the B-52 engines. This can result in the engines freezing prior to takeoff, leading to a lost sortie and an NMC B-52.

Solution: A 3D printed adapter (soon to be 3D printed out of metal after more R&D) securely connects the engine heater hose to the engine cover, preventing moisture and foreign objects from entering the engine.

Impact: This prevents B-52 No Go status due to engines freezing during harsh weather conditions, enables B-52 operations in extreme arctic conditions while preventing nuclear triad OPLAN implications, and significantly reduces maintenance hours required to unfreeze the B-52 engines.

Go-Comm Kit - Slight, Lightweight, and Low-Cost Internet Kit

Spark Cell: Rapid Capes (Dyess Spark)

Sponsor Organization: 7th Communications Squadron

Problem: Agile Combat Employment (ACE) and Bomber Task Forces (BTF) frequently deploy to infrastructure-less airfields. Setting up secure communications at these locations requires hundreds of thousands of dollars, thousands of pounds on pallets, and several hours to set up.

Solution: Go-Comm kit uses a combination of COTS equipment to provide NIPR and a communication network anywhere in the world. Go-Comm costs hundreds of dollars, fits in a backpack, and can be operational 20 minutes after landing. Go-Comm receives internet from local cell networks or Starlink satellite systems.

Impact: The prototype is operational and has been tested on a B-1 ACE, B-52 BTF, and a C-130 deployment. In all three instances, the kit was hailed as a massive improvement over previous systems and is now COA #1 on B-1 missions. The stage 1 prototype costs \$1,500 and replaces a \$5,500 system, with an increase of 50 percent max users.



VISION: Virtual Innovation Support Integration Operations Network

Project Lead: Dustin Dickens

Sponsor Organizations: AFIMSC-AFWERX-AFMC



Problem: DOD does not have a system to manage, track, and collaborate on innovation projects.

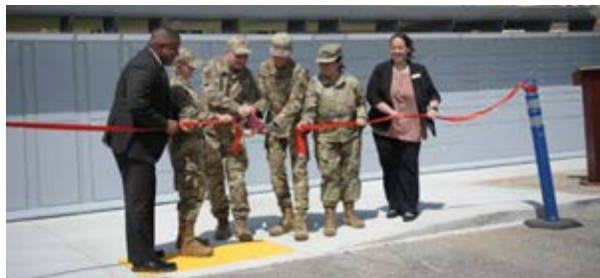
Solution: VISION provides an end-to-end innovation ecosystem tool allowing project entry, management, education, team establishment, collaboration, chat, analytics, task management, and tracking of innovation ideas while reducing redundancies.

Impact: It reduces duplication of efforts, focuses innovators, consolidates like innovations, enhances team engagement, leads to effective project management, and increases DOD collaborations.

Intelligent Lockers (Smart Lockers)

Project Leads: Senior Airman Ricardo Morales and Pitman Kennedy

Sponsor Organizations: AFIMSC/Ventures



Problem: Airmen, especially shift workers, were frequently unable to access their parcels outside of normal duty hours and were constrained by post office operations.

Solution: A secure mail locker system on installations available to Airmen and Guardians living in dorms. The systems give residents convenient access to their mail and packages while freeing up space and

reducing mail processing times at installation post offices.

Impact: It results in improved quality of life for dorm Airmen by providing convenient access to mail and packages regardless of work schedule through a state-of-the-art system that assures quick and secure deliveries. Parcel delivery is simplified and requires reduced storage space, timelines and personnel.

MVP - Humanoid Engageable Kinetic Training Robot (HEKTR)

Project Lead: Tech Sgt. Bryan Trumet

Sponsor Organizations: AFSFC/S3T

Problem: In their weapons training and qualification, Security Forces Defenders have been using outdated technology with static paper targets.

Solution: HEKTR brings Defender training into the modern era and enhances muscle memory through the use of realistic moving training targets.

Impact: Better training creates better and more effective Defenders and Airmen. AFSFC has been working with MVP to develop articulating arms capable of raising a weapon, phone, pen, cup, etc. for the Defender to make a judgment on whether there is a threat or not.



Agility for Firefighters

Project Lead: Joseph Suddarth, GS-12

Sponsor Organizations: 96 Civil Engineering Squadron, AFIMSC

Problem: Firefighters are currently using heavy and outdated gas-powered rescue tools that pose safety and long term health risks.

Solution: Exchanging gas-powered tools for energy-saving and environmentally friendly electric equipment to improve firefighters' ability to respond and save lives.

Impact: Easier to control and lighter than gas-powered equivalents, electric equipment reduces fatigue and facilitates improved communication amongst responders.

Battery commonality reduces equipment familiarization requirements and eliminates gas storage on rescue vehicles.



Advanced Collaboration Enterprise Services

Project Lead: Col. Jim Mattey

Sponsor Organizations: 513 Air Control Group,
United States Space Command



Problem: DOD possesses many excellent capabilities that are stove-piped, limiting the department's ability to conduct multi-domain operations. The current DOD digital infrastructure is unable to provide seamless integration due to too many interoperable systems that need to be connected over disadvantaged, low bandwidth networks.

Solution: Advanced Collaboration for Enterprise Services, or ACES, is a capability that streamlines communications by reducing human error and increases the speed of data sharing of real-time updates between command and control.

Impact: Overall, ACES enables accelerated collaborative communications within the warfighter and CCMD requirements across multiple domains, high and low bandwidth, different data formats, devices and coalition partners.

Digital Dent Measuring and Mapping

Project Leads: Capt. James H. Broucek and
Senior Master Sgt. William Harris

Sponsor Organizations: 302 AW, 302 MXG



Problem: The current approved Air Force process for measuring aircraft dents and damage from bird strikes, hail, FOD incidents, and more requires a manual time-consuming documenting process with very tight tolerances. Just one hailstorm at a base can generate over \$600,000 in additional manpower costs over several months to manually map dents on damaged aircraft, which remain stationary until fixed. This cuts into an air crew's ability to maintain currency and qualification training.

Solution: This project consists of changing the Air Force-wide approved dent measuring process and incorporating a commercially available dent mapping system currently used by major US airlines to accurately measure dents and map their location on the aircraft.

Impact: The digital dent mapping system significantly decreases the manpower bill, eliminates human error, and accelerates aircraft back into service by saving time at multiple points of the dent repair process. Currently in use for C-130s, this technology is scalable across all Air Force and DOD wide aircraft that still have a manual dent measuring process.

CV-22 Nucleated Foam Engine Wash

Project Leads: Mr. Michael Flanders (AFSOC/A4) and Mr. Patrick Ford (SAF/IEN)

Sponsor Organizations: AFSOC/A4 and SAF/IEN



Problem: AFSOC's CV-22B platform historically suffers engine performance and reliability issues, in many cases as a result of excess particle (sand/dirt) ingestion during austere landings. This requirement drives added risk and maintenance personnel-hours, increased aircraft down time, and reduced aircraft availability.

Solution: AeroCore technology nucleates or "stretches" water molecules to create an expanding foam which is produced using commercial or mil spec detergents. The foam expands throughout the engine resulting in a chemical and mechanical cleaning action that increases engine efficiency, including but not limited to, engine performance, compressor speed, reduced fuel consumption, improved reliability and reduced task time.

Impact: The V-22 Program Office (PMA-275) eliminated the turbine wash requirement for CV-22B aircraft using AeroCore technology; this reduced task time by 852.5 hours (turbine wash), saved approx. 2000 personnel-hours annually and returned 228 hours in aircraft availability! AFSOC plans to expand efforts to include AC/MC-130J aircraft at Cannon, Hurlburt and Kirtland to leverage existing CV-22B support locations.

No/Low-Code App Development Platform

Project Lead: Master Sgt. Erik Olson

Sponsor Organizations: AFSOC/A8I

Problem: There is a rapidly growing demand for new methods of data collection, storage, processing, and presentation. Current methods require significant funds, training, and expertise to quickly develop, secure, and deploy individualized applications.

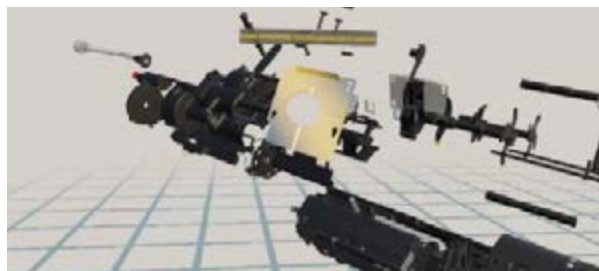
Solution: AFSOC has deployed an open source, No-Code platform that enables users to rapidly build, test, and deploy applications hosted on CloudOne that can be securely accessed via government and personal devices. The eWDR platform leverages a vendor-sustained and -licensed open source code base called Joget, which provides agility in capability development from no-code to low-code, and beyond via Java-based plug-ins.

Impact: eWDR enabled one flying squadron to eliminate 21 hours of manual data transcription annually with reduced errors rates. Ultimately, eWDR will allow Airmen to rapidly react to change and solve their problems with an approved cloud-based platform that allows for rapid innovation.

30mm VR Trainer

Project Lead: Tech Sgt. Darrell Fullove

Sponsor Organizations: 492 SOTRSS



Problem: The AC-130J Aircraft/gun training room has limited availability, which prevents students from experiencing enough hands-on training. This results in a lack of proficiency with the 30mm weapon system.

Solution: The trainer incorporates VARJO virtual reality headsets with 4K eye tracking and room mapping (no controller, full functionality of hands in VR space) to allow students to manipulate the gun (expand to examine individual parts, see the inner workings of the gun while it cycles, run select checklists) in the VR space that would otherwise require a physical aircraft to be set aside for static use.

Impact: 3 CBIs and 1 Ground Training event for a total of five hours of training per student is estimated to total 170-300 hours of training per year. The 30mm VR Trainer will accomplish the same training with 120 total training hours annually, resulting in a 50-180 hour reduction in training requirements and aircraft hours.



Airfield Autonomy Initiative

Project Lead: Master Sgt. Austin Barkdoll

Sponsor Organizations: 305 MXG JB MDL, N.J.

Problem: Redundant, non-value-added tasks carried out by maintenance organizations reduce the workforce's ability to solve complex problems and generate aircraft.

Solution: The initiative studies the potential use of automated vehicle technology to take over manned tasks for sweeping, snow removal, lawn mowing, perimeter patrol, material handling, parts delivery, and towing.

Impact: Dependent on scale, autonomous vehicle technology could save tens of thousands of man-hours annually and free Airmen to solve complex problems.

Hyperscience

Project Lead: Lt. Abigail Costea

Sponsor Organization: 316th LRS

Problem: The current PCS process requires members to fill out forms, then sit with TMO personnel to manually enter all the data into their systems. Hard copies then have to be maintained for records disposition.

Solution: Hyperscience processes the initial data entered and alerts the member about any missing

information. Once all information is present on the forms, Hyperscience sends the documents to all the agencies requiring the data.

Impact: Hyperscience saves 880 hours annually by automating one task in a single TMO office. It also cuts down on lost productivity by not requiring members to leave their place of duty to complete TMO tasks.

CareStarter- EFMP pilot program

Project Lead: Maj. Theresa Mavity

Sponsor Organization: 60 MDG

Problem: FedNet (a database for finding medical care) is only 40 percent reliable, forcing EFMP staff to google providers. This creates an inability to meet Congressional mandates regarding services provided to EFMP families.

Solution: CareStarter revolutionized the care provided for EFMP families by providing an improved database of providers and resources for EFMP families' needs.

Impact: CareStarter's lowest increase in available resources was 325 percent, including resources FedNet did not list at all. It significantly decreased workload on staff and gave families a reliable resource list and a "CareMap" to inform families of the quality and types of resources.

192 FW: F-22 Special Mission - Agile Combat Employment



Photo by Sgt. 1st Class Carlos Lazo

Problem: The USAF Agile Combat Employment construct remains logistically cumbersome and heavily airlift dependent. For example, the most recent F-22 Immediate Response Force (IRF) rapid movement required a force of 300-plus personnel and seven heavy lift cargo aircraft to support 12 aircraft. These large scale movements create a spike in detectable signature which is non-compatible with most Global Strike and/or Special Operations missions.

Solution: This project develops multi-function F-22 pilots capable of agile response (small force, low detectable signature) focused on contested/denied combat evolution in support of low observable strike and Joint Special Operations Command missions. This proposed solution focuses on multi-function pilots with the capability to execute short duration, independent, isolated, self-sustaining operations with basic aircraft maintenance and troubleshooting skills, secure communications (to receive mission orders/amends) capability and aircrew flight equipment field sustainment.

ANG Investment: \$75,000

157 ARW: KC-46 Aircraft Maintenance Practices Efficiency Study

Problem: The KC-46 aircraft is a new weapons system and is a derivative of the commercial Boeing 767. It is one of the few aircraft in the USAF inventory required to maintain FAA (Federal Aviation Administration) certification. Maintaining FAA certification has driven a drastic increase in scheduled maintenance requirements, which has increased overall man-hour execution to nearly five times that of the KC-135. With the KC-46, 35 maintenance man-hours were provided per flying hour. This was a sharp increase compared to previous non-FAA regulated KC-135, which had 5 maintenance hours per flying hour. The KC-135 tracked an average

of 74.2 hours/month of non-mission capable maintenance hours for scheduled maintenance, the KC-46 documented 584.5 hours/month; an 800% increase. These maintenance rates are severely degrading KC-46 mission capability rates across the Air Force.

Solution: A third-party contractor, Delta Airlines Technical Operations (Delta TechOps), evaluates KC-46 maintenance practices, compares them to commercial practices and FAA guidelines, assists in identifying efficiencies, and makes recommended courses of action, areas of improvement, and/or changes in maintenance practices. The intended outcome is to reduce maintenance operation's input while increasing operational and readiness output by streamlining aircraft maintenance practices as efficiently as possible.

ANG Investment: \$125,000

106 RQW: C-130J Engine Maintenance Run VR Training

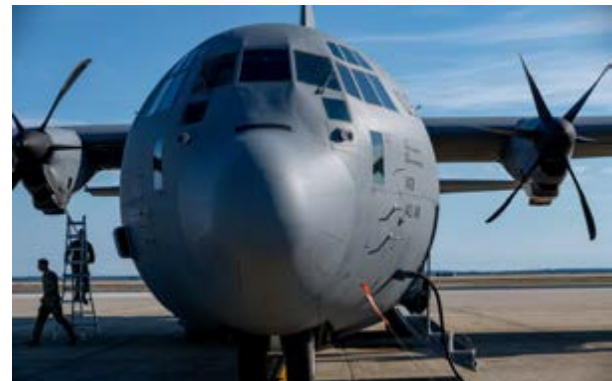


Photo by Tech. Sgt. Deirdre Salvas

Problem: Current allotments for engine run training courses for the C-130J are limited and low in supply. The demand for these courses prevents units from accomplishing skill-level upgrades within the required timeframe. Additionally, the only engine run training available at home station is on aircraft. Engine run qualified personnel only utilize on-station aircraft to accomplish engine run proficiency training, which limits aircraft availability.

Solution: Engine run VR training can give engine run personnel unlimited practice across all situations, normal and emergency, regardless of aircraft availability. Utilizing the VR trainer will also negate any additional risk involved to the aircraft and personnel with live engine runs.

ANG Investment: \$40,400

JPARC - Preparing the Warfighter for the Pacing Threat

Project Lead: Tech Sgt. Isaac Butler

Sponsor Organization: 354 Fighter Wing

Problem: During the RED FLAG exercise, JPARC has traditionally been unable to challenge USAF, Joint & Coalition forces with realistic, threat representative problems to solve because of a lack of native jamming capabilities for training.

Solution: Iceman Spark coordinated with JFWORX (AFRL) to develop a Synthetic Aperture Radar (SAR) jammer to allow RED FLAG and local pilots to train for threats expected in a near-peer fight.

Impact: This saves \$1 million per year normally paid to the Army's Threat Systems Management Office (TSMO) for an average of 26 minutes of jamming. This provides an in-house capability to jam SAR on 5th Generation Aircraft for training at RED FLAG and for local F-35s (Eielson AFB) & F-22's (JBER). Further, it gives Air Force, joint & coalition forces the opportunity to train how they will fight in a near-peer adversary conflict.

Automation and Low Code / No Code Capabilities

Project Leads: Master Sgt. Phillip Barry

Sponsor Organizations: Tesseract

Problem: The future state of mission operations at almost every level will require a more responsive cyber force and rapid solutions to software mechanisms. Increased proliferation of Airmen coders remains the most viable pathway, yet the barrier to entry as a coder and skilled Airman in her/his assigned AFSC remains a difficult task to achieve.

Solution: The development of a shared repository and communication platform for both software solutions such as low-code/no code tools and automation products will serve as an opportunity to capitalize on a talent-driven workforce and a cooperative effort to enable the force. Additionally, it will offer a solution to reduce redundancy of effort across the force.

Impact: The concept has produced a Minimum Viable Product (MVP) effort that developed multiple application solutions in only 4 months time at a single location. Included in this effort is an application to replace the e-SSS that has been shared and leveraged in the A4 community. In total, the applications in their minimum state have saved an estimated 72 hours per month in administrative processes.

Fabricated Ice Breaking Apparatus

Project Leads: Tech Sgt. Nicholas Cavanaugh

Sponsor Organizations: 354th FW



Problem: Eielson Air Force Base was impacted by an anomalous winter storm and received the third largest rainfall on record, creating a four-inch layer of ice on exposed pavements, and shutting down flying operations. The 354th Civil Engineering Squadron (CES) Snow Barn was charged with removing the ice and snow from the runway so flying operations could resume. Despite tireless efforts by the snow barn removal team, Eielson's traditional equipment proved ineffective and slow at removing the ice buildup.

Solution: CES leadership contacted Iceman Spark for support in prototyping an idea brought forward by their engineers. Iceman Spark contacted the Maintenance's Metal Technician section to assist in creating a device that could scrape ice off of the taxiways and runways. Within 30 minutes of the request the Metals Tech team, led by Tech Sgt. Brian Kolk, designed and briefed the concept for the Fabricated Ice Breaking Apparatus (FIBA). Metals Tech jumped into action and created two revolutionary ice-scraping forklift attachments in only 44 hours.

Impact: These devices proved invaluable in supporting the snow barn's efforts to get Eielson's runway operational again. Previous projections indicated that the runway was going to be shut down for at least two weeks, but by using these devices the Eielson team was able to restore airfield viability a week faster. This ensured that 48 combat-coded F-35s were returned to full mission capability, and ready to project air power.

FMS-3600 Tent and Vent

Project Leads: Master Sgt. Jacob Moniz

Sponsor Organizations: 31st MS



Problem: There is currently no ability to paint replacement F-16 aircraft panels with FMS-3600 on station. Panels must be sent to a Belgian aerospace company for paint application, leading to risk of delays based on logistics and their work schedules.

Solution: This program reconfigures mobile paint equipment (Clayton Tent and Vent) system to accommodate new FMS-3600 coating in order to enable paint replacement in-house.

Impact: Since implementation, a total of 11 panels and one wing have been painted. One aircraft has been deemed fully mission capable 111 days ahead of schedule.

Project Rubicon

Project Leads: Tech Sgt. Sheldon Fowler

Sponsor Organizations: 52nd LRS



Problem: Mispacked pallets increase risk of weight shift in aircraft, possibly leading to mishaps.

Solution: This provided simple, low-cost mistake proofing to guide human-in-the-loop operators.

Impact: Palletized items are self-contained within the solution, which leads to an 80% reduction in preparation time. This has the potential to save 1,497 hours annually if implemented.

Bomb Lift Torque Tool

Spark Cell: Wyvern Spark

Project Leads: Senior Airman Daniel Marrero and Tech Sgt. Adam Rentsch

Sponsor Organizations: 31 MXG

Problem: MJ-1 and MHU bomb lift biannual inspections require torque verification of the equipment's yoke nut. When verifying torque on the nut, the complete assembly spins, greatly complicating the completion of the task.



Solution: An adapter tool holds the assembly still while verifying nut torque.

Impact: The adapter reduced nut torque verification time by 90 percent in comparison to the previous method of utilizing a wheel chock and wall technique.

Non-Compliant Fuel Tanks

Project Leads: Mr. Mark Miller

Sponsor Organizations: 100th CES

Problem: 95 percent of above ground heating-fuel storage tanks are non-compliant, with 20 requiring replacement. At the current rate of investment, 20 tanks will take nine years to replace.

Solution: This collaboration with local vendor, AFCEC/DET 4, and the UK Defense Infrastructure Organization (DIO) resulted in a redesigned and simplified fuel storage tank.

Impact: It saved approximately \$1.6 million dollars in acquisition costs and reduced procurement time for tanks from 9 years down to 18 months.

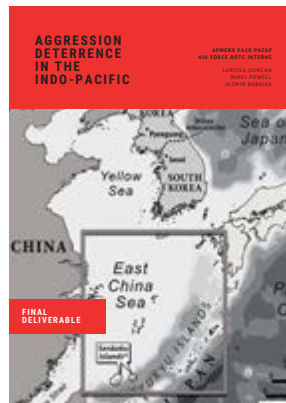
INTERNSHIP **ACTIVITIES**

Additive Manufacturing

Cadets gained insight into the different ways that the Air Force is leveraging additive manufacturing and 3D-printing technologies. Cadets applied their design knowledge to create a repository of aviation support component designs for the Spark Cell additive manufacturing ecosystem.



SBIR/STTR Evaluation Matching Cadets gained a deep understanding of the AFWERX SBIR/STTR Open Topic process and how it serves as a funding source to test out innovation initiatives with small businesses. Cadets leveraged their data management and computer science knowledge to create algorithms that would streamline the evaluator matching process to SBIR/STTR proposals.



Aggression Deterrence

Cadets supported the PACAF/A9 team to outline Indo-Pacific Aggression Deterrence strategies and recommended Courses of Action. Cadets leveraged their research analytic skills and computer science skills to create an Aggression Deterrence Game Theory model which they briefed to PACAF leadership.



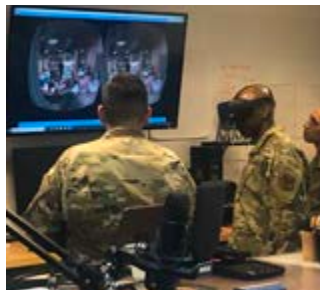
Space Acquisitions

Cadets worked with the Space Rapid Capabilities Office (RCO) to take a deep look at the Space Acquisitions Valley of Death problem. Cadets leveraged their research analytics skills to identify how the Space RCO can

help bridge the gap and aid space industries to cross the Valley of Death.

Agility Prime Cadets gained insight into AFWERX's Agility Prime program and the acquisitions process. They leveraged their research analytics skills to conduct market research into the eVTOL market and conducted customer discovery on dual-use applications within the Air Force.

AR/VR Pilot Training Cadets experienced first hand how the Air Force is transforming pilot training by leveraging Augmented Reality and Virtual Reality technologies. Cadets supported the Euro-NATO Joint Jet Pilot Training (ENJJPT) Program at Sheppard Air Force Base by applying their video editing skills to transform AR/VR content into training scenario videos. These videos are then used by student pilots to enhance their training without having to get into an actual aircraft.



Suicide Prevention Cadets worked with the AMC Innovation Office to research how existing technologies can aid in suicide prevention within the force. The cadets leveraged their research analytics skills by conducting customer discovery to identify what would lead to an improved quality of life for AMC members and what technological tools AMC can leverage in their suicide prevention efforts.



DEFENSE VENTURES SPOTLIGHT

The **Defense Ventures Program (DVP)** is an industry immersion program launched in 2020. The program, which is administered by Shift, a Silicon Valley tech startup, identifies emerging innovators from across the U.S. military through a competitive application process and places them into short-term work environments within small businesses and venture capital firms across the United States. The program allows active-duty service members to gain industry experience with new technologies and management styles, to develop professional relationships throughout the tech industry, and to bring innovation back to the Department of Defense and their home units. The program includes a curriculum and speaker series that focuses on acquisitions, venture capital, entrepreneurship, and emerging technologies.

GAINING INDUSTRY EXPERIENCE

Since 2020, 317 Fellows and 17 Cohorts have participated in the program, with involvement from the Army, Navy, Air Force, Space Force, Marines, Coast Guard, DIA, NGA, DARPA, OSD, DTRA, and Reserve/Guard totaling more than 40,000 hours of industry immersion with industry partners. During that same period, 125 companies (46 venture capital, 71 tech startups, three accelerators, one FFRDC, and three large companies) have hosted those 317 fellows. Each cohort has about 55 hours of additional programmed events and curricula to support the immersion experience. Cohorts are made up of 20-25 fellows from the E-5 to O-6 level, with the majority at the E-7 and O-5 level. Since the program's inception, applications to the Defense Ventures Program increased 179 percent, while selection quality for participation remained intact with a selection rate of 56 percent. Fellows participate in a variety of high-impact activities while at their host companies. These include evaluating startup pitches at Venture Capital firms, identifying dual-use technology applications, introducing companies to military subject matter experts, conducting due diligence for venture investment, and working with startup founders directly on strategy and special projects.

ENDURING RELATIONSHIPS WITH INDUSTRY

Since 2020, 125 companies (46 VCs, 71 tech startups, four incubators, one FFRDC, and three large companies) have hosted 317 fellows. The program shifted to virtual between 2020-2021, which allowed corporate partnerships hubs to develop in California, Texas, Washington, New York City, and Boston. The program has since transitioned to a combination

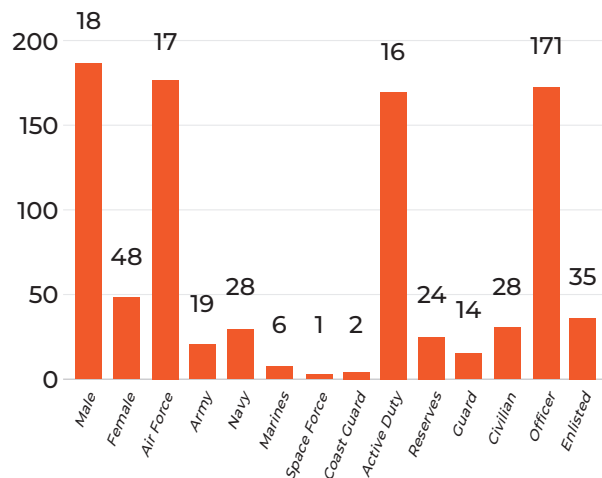
of virtual and in-person based on regional opportunities.

The DVP Industry Partner network grew 216 percent in 2021, with 51 percent of VC partners and 40 percent of tech startups having participated in more than one cohort of fellows. Many fellows create incredible value at their host firms, from being "employee #5" to sourcing deals that VC firms eventually invest in.

BRINGING INNOVATION BACK TO THE DOD

The Defense Ventures alumni community is strong: the 90th percentile of the most engaging consumer and community tech products are benchmarked by retaining at least 50 percent of monthly active users, and the DVP virtual platform has achieved a rate of nearly 70 percent. Following the fellowship, alumni have gone on to work on the White House COVID Response and taken on important innovation positions at Project Morpheus, AFWERX, Air Force Futures, and the Office of the Chief of Staff of the Air Force. Fellows complete an Innovation Manifesto at the end of the program, and those artifacts have gone on to be presented at conferences, shared with commanders, or published. A community-driven effort by DVP alumni resulted in the creation of a Special Experience Indicator for the Air Force, and a similar effort is underway for the Navy. Fellows have gone on to take on special assignments upgrading the technology on the F-22 program as well as tactical improvements like adding DocuSign to PDFs, adding new project management technologies, and bringing in partners like Major League Hacking to create a program to track flying currencies across an operations group.

APPLICANTS BY DEMOGRAPHICS



PROJECT ARC SPOTLIGHT

Project Arc started in July 2020 as a grassroots movement to address limitations highlighted in the Air Force's Science and Technology 2030 Strategy and the 2019 National Defense Strategy, and has been supported by AFWERX since its inception. The program's mission is to embed Air and Space Force Scientists, Technologists, and Engineers (STEs) inside operational units to solve technical problems. By bridging the gap between STEs and operators, Project ARC prepares the DAF to execute the rapid technology adaptation and exploitation required to win in a future near-peer and peer conflict. During the first year, 31 Airmen and Guardians across nine operational bases demonstrated the asymmetrical, non-linear impact that on-site STEs can have on the department's ability to accelerate change at tactical, operational, and strategic levels. eight operational units participated: 15th Air Wing Joint Base Pearl Harbor-Hickham, 56th Fighter Wing Luke Air Force Base, AETC Detachment 24 Join Base San Antonio, 509th Bomber Wing Whiteman Air Force Base, 621st Contingency Response Wing Travis Air Force Base, 1st Special Operations Wing Eglin Air Force Base, Spectrum Warfare Wing Eglin Air Force Base, and 316th Wing Joint Base Andrews.

OPERATIONAL IMPACTS

The 31 participating STEs solved 17 operational gaps with technology, saving the department an estimated \$550K per year and 21K man-hours per year in the effort to arm DAF units for peer conflict. These projects included the following:

- An STE embedded in the 350th Spectrum Warfare Wing demonstrated that a contractor machine learning software solution utilized by the Wing does not meet operational requirements. The program was subsequently cut, along with its \$500K per year sustainment cost.
- An STE embedded in the 621st Contingency Response Wing automated all training forms, such as AFF 2875s, for TDYs and Exercises; this will save the Commander's Support Staff an estimated 600 hours of administrative work per year, which can be refocused on operations planning.
- An STE embedded in the PACAF Logistics Readiness Squadron cut the duration of the squadron's monthly inventory process from 8 hours to 20 minutes by automating routine tasks and demonstrating the effectiveness of weight-based systems; this improvement will

save an estimated 5 man weeks per year.

- An STE at Pilot Training Next (PTN) won a weeklong datathon competition to leverage AI to optimize pilot training. This STE beat out a four-member AFIT-USAFA team and three-member Test Wing team and attributed the win to working directly alongside pilots at PTN.
- Two STEs located at different Arc locations worked together to develop a software prototype for a centralized repair facility work order management system. Headquarters Air Force A4 Logistics (HAF/A4L) is investigating the prototype's potential to scale across the enterprise, which could save an estimated 15K man hours per day.
- An STE at Luke Air Force Base built and field tested a remotely powered, controlled low-cost threat emitter. This product replaced a \$6 million commercial threat emitter at a fraction of the cost (less than \$30,000).
- An STE at Hickam Air Force Base built a secure database for the Emergency Operations Center to track a developing water contamination crisis on Joint Base Pearl Harbor-Hickam in less than three hours; live data in the database drove the commander's decision calculus on evacuations.

PATH FORWARD

Following the recommendation of the Chief Scientist of the Air Force (AF/ST) and the Office of the Assistant Secretary of the Air Force for Acquisition, Technology and Logistics (SAF/AQ), Project Arc conducted another six-month BETA test phase and is currently partnering with senior Air Force Leadership to institutionalize this program.



Project ARC team members at the USAF museum at Wright-Patterson AFB.

SPARK TANK SPOTLIGHT

SPARK TANK 2022

Spark Tank 2022 kicked off on the new Guardians and Airmen Innovation Network (GAIN) platform in August 2021 and received 184 submissions from across the DAF. A new method for voting was used in the Wild Card round, with 16,273 votes cast, to narrow down the field to the top two Wild Card submissions advancing them to the quarter-finals. Overall, 29 total submissions advanced to quarter-finals in November, where the top 15 were selected to advance to the semifinals. Six finalists were selected and received pitch coaching and innovation training at AFWERX Vegas before making their final presentations at the 2022 Air Warfare Symposium. The Spark Tank 2022 panel included celebrity judges representing both senior military leadership and civilian experts. Ten ideas were also selected for the new Just Do It (JDI) category, which rapidly implements promising ideas that have prototypes ready for testing and fielding.

SPARK TANK 2023

Spark Tank 2023 campaign was launched on the GAIN platform in June 2022 and received 237 submissions from across the DAF. Voting in the Wild Card round produced 14,472 votes to narrow down the field to two Wild Card submissions, advancing them to the quarter-finals in November 2022. Details and highlights from the 2023 semi-finals and finals are forthcoming.

SPARK TANK HIGHLIGHTS

Spark Tank involvement does not terminate after the final competition. Finalists, semi-finalists and JDIs receive AFWERX's full support beyond their year of competition. Here are highlights of project accomplishments as of Sept. 30, 2022:

- The Spark Tank 2022 winner, Project Arcwater, is successfully validating prototypes in various regions across DAF and nearing the scaling phase.

- Master Sgt. Justin Bauer from the 355th Fighter Wing at Davis-Monthan Air Force Base, Arizona, was awarded the 2021 Spark Tank trophy for his idea, "Innovative Approach to C-130 Wheel Repair."
- 3-D Printer/Battery Cell Extractor Tool (BCET), a 2020 finalist, was scaled across the C-17, KC-46 and C-37. Scaling to the C-5 is in progress. A F900 3D printer, authorized to print nonstructural aircraft parts, was purchased and installed at JB Lewis-McChord, Washington. Zero battery cells have been damaged since BCET established operations.
- M1 Cargo Parachute Release, a 2019 finalist, completed testing and engineering compliance checks. The parts are in queue for Defense Logistics Agency (DLA) stocklisting. In March 2022, the project also received 3D printing approval as a stopgap measure until the parts are stock listed, ensuring this project is fielded at a critical time for cargo airdrop.

SPARK TANK 2021 FINALISTS

Next Gen Debrief: Augmented Reality Debrief Environment: A Luke AFB team, in partnership with Arizona State University's Luminosity Lab, developed the Next Gen Debrief. This technology uses augmented reality systems to create a shared environment in which mission participants debrief in a virtual scene, projected into their current environment.

Improving Commander's Support Staff Workflow with Office 365: Using Office 365 tools, a United States Air Force Academy (USAFA) team designed and deployed a ticketing system to manage submissions, track status updates, monitor communication and ensure resolution.

SPARK TANK BY THE NUMBERS



Innovative Approach to C-130 Wheel Repair:

To address C-130 wheel shortages, Master Sgt. Justin Bauer designed a heating element that fits the wheel and only heats the portion required by technical data. Weighing three to five pounds, this element needs 120 volts of electricity, making it usable at any DOD facility.

Inner Ear Bone Conduction Communication:

Bone conduction technology removes ambient noise and voice constraint when operating in loud or Mission Oriented Protective Posture (MOPP) conditions by allowing augmented sound through external microphones, allowing the wearer to hear surrounding noise.

VIPER Hot Refuel Kit: The VIPER Hot Refuel Kit takes existing petroleum oil and lubricant components and configures them into a small, hot-pit-ready package, eliminating the need to transport refueling trucks. A custom “sled” built to carry the components doubles as secondary containment to eliminate environmental impact.

SPARK TANK 2022 SEMI-FINALISTS

- Blood Delivery by Unmanned Aerial Vehicle - Air Combat Command (ACC)
- Developing Airmen and Guardians with Games for Enhanced Readiness (DAGGER) - Air Education and Training Command (AETC)
- Project Hermes - Air Force Digital Recall Roster - AETC, Wild Card
- Go-Comm Kit, Air Force Global Strike Command (AFGSC)
- Sustaining the B-52 Ejection System, AFGSC
- Air Force Live Integrated Test Environment, Air Force Materiel Command (AFMC)
- F-22 Project FoX, AFMC
- Digital Dent Mapping, Air Force Reserve Command (AFRC)
- Any Airmen Can Build Their Own Secure App!, Pacific Air Forces (PACAF)
- Modern Logistics System for Air Force, PACAF, Wild Card
- Preparing the Warfighter for the Pacing Threat, PACAF
- Reliable & Resilient Thule Power, Space Operations Command (SSC)
- Aerial Tow Rehookup - Novel Range Extension, United States Air Force Academy (USAFA)
- Custom Facemasks for Fighter Pilots and Beyond, USAFA
- Project Arcwater - Water and Power from Thin Air, United States Air Forces in Europe - Air Forces Africa (USAFE-AFAFRICA)

SPARK TANK 2022 JUST DO IT

- "Spotty" Bar - Safer Process, Faster Solution - AMC
- Every Second Counts When Saving Someone's Life - SSC
- Space Control Interactive Procedures Interface - SpOC
- KC-135 Fuel Systems Virtual Tour - AMC
- Oil Cart Trailer - USAFE-AFAFRICA
- MAC-T (Mobile Alternative for Canopy Trailer) - ACC
- PME-OutLOUD! Audio-Enabled PME - AETC
- AM Focus - AETC
- C-130 Engine Oil Pan Hoist - AFRC
- Mid-Air Collisions & Electronic Flight Bags - AFSOC

SPARK TANK 2022 FINALISTS

Project Arcwater: Water and Power from Thin Air: A team from Spangdahlem Air Base has developed a simple, green, expedited way to save energy and create clean drinking water out of thin air using solar panels, water harvesters, and AC/heating tools.

Custom Facemasks for Fighter Pilots and Beyond:

A USAFA dental services officer proposed using computer-aided design, advanced 3D imaging, and printing technology to make oxygen masks for pilots that meet fit, form, and function requirements.

Aerial Tow Rehookup: Novel Range Extension:

A USAFA cadet proposed towing assets behind a “mothership” aircraft for such possible applications as extending loiter time by towing ISR assets into combat areas, aerial recharging of eVTOLs, and towing of supersonic platforms or stealth assets.

Blood Delivery by Unmanned Aerial Vehicle: A medical services officer at Langley AFB proposed using commercially available Unmanned Aerial Vehicle technology to quickly and efficiently deliver lifesaving blood to critically wounded personnel in combat areas.

Developing Airmen and Guardians with Games for Enhanced Readiness (DAGGER):

A team from AETC proposed that DAF personnel can provide proven educational practices through game-based learning using commercial off-the-shelf video games in various training environments to address AF Core Competencies.

F-22 Project FoX: Pilots from Edwards AFB proposed a way to increase the F-22's competitive edge by using the Open Systems Architecture Rack (OSA) upgrade to quickly develop and test new mission systems software capabilities. This approach would cut delivery times, increase combat capabilities, and reduce costs.

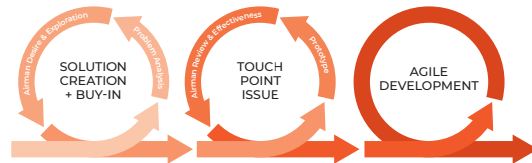
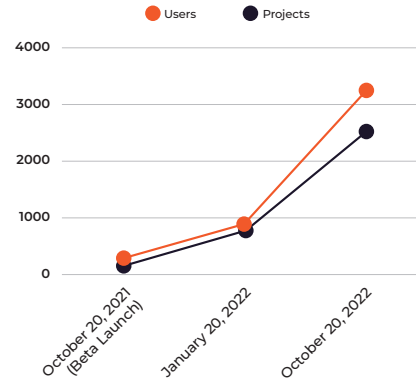
VISION SPOTLIGHT

VISION (VIRTUAL INNOVATION SUPPORT INTEGRATION OPERATIONS NETWORK)

VISION 2021: Spark launched VISION in October 2021 to increase scalability, collaboration, and transparency within the Defense Department. For the DOD to adapt and compete in the midst of a fast-moving technology revolution, an innovation and advancement platform open to all servicemembers with potentially useful ideas is necessary. Users from across the department, applying creative solutions to problems they face in their everyday work, can upload ideas to VISION and rapidly augment the department's range of agile and affordable capabilities. The platform offers specialized tools for project management, collaboration, and reporting, while providing advanced security using a CAC-enabled IL4 environment. It also emphasizes transparency throughout the development lifecycle. VISION members use the platform to collaborate, develop and execute innovations and improvements at scale, while gaining buy-in and resources from across the ecosystem. These resources include testing and feedback from every MAJCOM and more than 200 diverse stakeholders, as well as access to small business funding from AFWERX and Air Force Installation and Mission Support Center (AFIMSC). VISION was fully implemented Air Force-wide in 2021 and has the potential to be quickly scaled up to all of the DOD; Spark is finalizing contracting with the Air and National Guard and has begun to collaborate with Navy, Army, National Security Innovation Network (NSIN), and Defense Innovation Unit (DIU). The program has already yielded scalable, data-driven solutions tailored to the specific needs of Defense Department/military innovation and process improvement initiatives; more than 3,000 intrapreneurs from throughout the Air Force have uploaded over 2,000 projects. In addition to stimulating and enabling innovation at a grassroots level, VISION provides leadership with strategic foresight in the innovation landscape, which will enable more efficient allocation of resources. As it grows, VISION will allow the Defense Department to innovate and improve rapidly while sharing critical information with joint branches, maintaining the US military's innovation edge.



VISION USERS AND INITIATIVE GROWTH



Small business SBIR Phase I R&D direct to SBIR Phase III to customize with Member-driven engagement throughout (Company: Mobilize, HQ: Denver, CO).

MVP was finalized in 2021 and was developed in less than seven months while partnering on a new pipeline with Platform One (fastest on record).

PROJECTS



PHASE BREAKDOWN



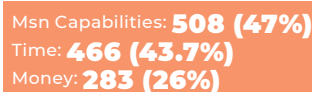
PROJECT TYPE SPLIT



TOP TECHNOLOGY TYPES



TOP 3 ROI CATEGORIES





OVERVIEW

MISSION

Prime expands technology transition paths to accelerate emerging dual-use technology markets by leveraging government resources for rapid and affordable fielding, attracting and optimizing external funding and talent.

STRATEGIC CONTEXT

The Prime division specifically addresses the threat posed by the nation's competitors gaining dominance and leverage over an emerging technology sector. The Prime division's focus is to identify and accelerate emerging dual-use technology markets that are critical to future U.S. and DOD strategic capabilities. Many times, the nation's high technical maturity in an emerging sector is still insufficient to drive adoption based on regulatory, financial, supply chain, infrastructure, or even cultural hurdles.

Removing these hurdles could be the difference between the emerging sector being captured by an adversary or creating a game-changing U.S. advantage. Traditional acquisition approaches often have difficulty adopting radically new technologies with rapid design and product release cycles, particularly when they require new concepts of operation and career fields. The Prime division's work in overcoming bureaucratic barriers is key in protecting the Department of the Air Force's technology markets and investing in the future of the United States.



Photo courtesy of BETA Technologies



PRIME

LT COL THOMAS MEAGHER

METHOD

AFWERX Prime identifies emerging dual-use technologies with growing industry and investor interest. Agility Prime, the first Prime program launched in April 2020, is focused on emerging transformative vertical lift aircraft, including electric Vertical Takeoff and Landing (eVTOL) aircraft in the Advanced Air Mobility (AAM) sector. These aircraft use distributed electric or hybrid propulsion for crewed, optionally crewed, or autonomous missions. As the systems mature toward certified commercial operations, Agility Prime identifies opportunities for early government adoption with the intent of rapid procurement and fielding. By providing collaborative mitigation to technical, regulatory, and financial risks, Agility Prime intends to provide focus and support to increase opportunities and likelihood of commercial viability for this emerging market sector while simultaneously advancing military capability. To do so effectively, Agility Prime has investigated specific focus areas that will prove the transformative effect of these vehicles, due to: 1) lower maintenance cost and time, through mechanical simplicity; 2) improved safety and declining personnel demands, using autonomy; 3) affordable quantity, based on potential mass production; 4) improved acoustics, employing distributed propulsion; and 5) greater flexibility and reduced infrastructure needs, with runway independence.

MAJOR LINES OF EFFORT

Government test resources and subject matter experts are available for technical risk reduction, airworthiness assessments reduce regulatory risk, and contracts for early adoption reduce financial risk.

Technical risk reduction

Agility Prime leverages unique government assets—test ranges, safety certifications, and military missions capable of logging steady flight hours—to build confidence in the technology, attract investors, and expedite domestic commercialization.

Regulatory and cultural risk reduction

Agility Prime conducts early airworthiness reviews that provide risk assessments to meet military certification requirements. The airworthiness team collaborates with the other services, the Federal Aviation Administration (FAA), NASA, and companies to identify high risk areas to FAA certification and makes test recommendations to produce supporting engineering artifacts. This has resulted in the first Air Force airworthiness authorization for crewed electric aircraft, a first for the DOD.


Financial and fielding risk reduction

The program awards contracts for early testing and dual-use-case development by providing revenue to start-up companies for flying their aircraft prototypes. The Agility Prime test team observes or directs these flight tests to assess current capability to meet potential missions and determine life cycle sustainment requirements. The planned result is early fielding. All told, the program has awarded 23 Other Transaction Authority (OTA) and Small Business Innovation Research (SBIR) contracts to 15 companies in addition to 250 Small Business Technology Transfer (STTR) contracts to small business/research institution partnerships.




8 FULL-SCALE eVTOL FLYING PROTOTYPES

- **HIGHEST RANGE:** BETA, 255 miles
- **HIGHEST ALTITUDE:** Joby, over 11,000 feet
- **HIGHEST SPEED:** Joby, in excess of 205 mph
- **HIGHEST ENDURANCE:** BETA, 2 hr 2 min flight



BETA



JOBY

7B
Over \$7B in commercial investment

23
23 contracts awarded to 15 companies

Over 250 small business and university contracts for research and development

250

5
5 exercises complete or planned

32 companies applied to the Air Race

32

100
Over \$100M AWARDED

Simulator Locations

3

400+
Over 400 flight tests

PROGRAM MILESTONES

- **APR 20:** Program launch
- **JUN 20:** First two companies to Air Race phase 3
- **JUL 20:** Airworthiness baseline for electric aircraft
- **DEC 20:** First company achieves airworthiness
- **JAN 21:** AETC Det 62 established for ops/maintainer training
- **MAR 21:** First crewed eVTOL airworthiness in DoD
- **AUG 21:** 4 flying prototypes—first experiments
- **DEC 21:** Remotely piloted flight
- **MAR 22:** First Airman electric flight
- **JUN 22:** First piloted electric aircraft landing on Air Force base

BUDGET

- **FY20 \$25M** Congressional Add
- **FY21 \$25M** Congressional Add
- **FY22 \$57M** RDT&E, **\$54M** Congressional Add
- **FY23 \$72M** RDT&E **\$12M** O&M/Proc

MILITARY UTILITY

- Distributed/austere operations
- Potential reduced fossil fuel use
- Increased aircraft availability
- Reduced maintenance/parts
- Improved acoustic signature

LIFE CYCLE COST/UTILITY ANALYTICS WITH:

- **6** MAJCOMs / All Services
- **66** Use Cases
 - Assessed by **20** operators, **6** months
 - Base/distributed logistics, CSAR

DEMONSTRATED PERFORMANCE/ OPS

- Over **400** flight tests
- Beta: **255** NM, Joby: **154** NM flights
- **5** Exercises complete/planned
- Lift C-130 rapid transportability
- Kittyhawk medevac use demo

Photos courtesy of BETA Technologies and Joby Aviation

PRIME 2.0 ACHIEVEMENTS

In FY2021, Agility Prime's federal, state, and local government partners worked with the program and its small business partners to continue creating the infrastructure to advance eVTOL technology. Joby and BETA established advanced flight simulators in Washington D.C. and Springfield, Ohio, strategically allowing for increased exposure to advanced air mobility and the vertical lift industry. The Springfield-Beckley Municipal Airport already is home to the Ohio Unmanned Aircraft Systems (UAS) Center and SkyVision, a Ground-Based Detect and Avoid system enabling beyond visual line of sight (BVLOS) operations in partnership with the Air Force Research Laboratory and the state. The City of Springfield, Dayton Development Coalition (DDC), and JobsOhio have worked closely with AFRL to support its Agility Prime efforts and the region's growing AAM industry. On Sept. 22, 2021, the Defense Department announced it would award Springfield, Ohio, a \$6 million grant to support the creation of the National Advanced Air Mobility Center of Excellence (NAAMCE) at the Springfield-Beckley airport. Later, on Aug. 23, 2022, state and local leaders participated in a groundbreaking ceremony for the new facility at the DDC's Advanced Air Mobility Industry Forum.

In May 2021, Deputy Defense Secretary Kathleen H. Hicks toured the Austin, Texas, defense-innovation ecosystem and saw the cutting-edge defense technologies being developed by AFWERX-supported small businesses. In July of that year, AFWERX and Defense Innovation Unit officials briefed U.S. Rep. Adam Smith, chairman of the House Armed Services Committee, on eVTOL-development efforts. Col. Nathan Diller, director of AFWERX, highlighted the close collaboration between

AFWERX and the Defense Innovation Unit (DIU), including the transition of DIU's early eVTOL efforts with Joby Aviation and the eventual shift of the work to the Air Force under AFWERX Agility Prime. Diller also addressed the initial targeted military use cases for eVTOL air vehicles. Later, Smith, along with AFWERX and DIU officials, toured the Palo Alto, California, facilities of Archer Aviation and Kittyhawk Corporation.

Additional 2021 highlights for the Agility Prime program include several major milestones alongside key partners. In September, Archer Aviation announced a collaborative strategy that will allow Prime to test and investigate Archer's Maker eVTOL for Air Force use cases. BETA Technologies also enjoyed significant success: in May, BETA's ALIA aircraft was awarded the first-ever airworthiness approval for human flight from the DAF, and ALIA reached record-breaking range and altitude accomplishments in July. Elroy Air secured \$1.7 million in TACFI dollars to continue developing its Chaparral aircraft, while Joby Aviation's pre-production prototype aircraft generated 65 terabytes of test data. Kittyhawk Corp. also teamed up with Prime personnel for two historic flight-test milestones with its Heaviside aircraft: the first-ever medical evacuation exercise with an electric aircraft in May, and the first-ever USAF-piloted flight of an eVTOL vehicle when Captain Terrence McKenna remotely piloted the Heaviside via its Buddy Box system in December. Moreover, in collaboration with LIFT Aircraft, Agility Prime completed an initial portability test on the HEXA aircraft, disassembling and transporting the eVTOL between Ohio and Texas testing sites, and late September saw the unveiling of Moog Aircraft Group's SureFly S250 eVTOL. These



Archer Aviation takes to the skies with first hover flight of Maker aircraft.

Photo courtesy of Archer Aviation

2021 highlights demonstrate that Agility Prime empowers its partners for success. Additionally, 2021 saw several flight simulators established by Joby, BETA, and LIFT and placed throughout the country, strategically allowing for outreach and increased exposure to advanced air mobility and the vertical lift industry.

Just as in 2021, 2022 brought several milestone achievements for the Prime division. In March 2022, Agility Prime made history alongside BETA Technologies with the first Airmen flights of an electric aircraft, just before Agility Prime celebrated its second birthday on April 27, 2022. Agility Prime also continued the Air Race (an Innovative Capabilities Opening) through the end of 2022; the solicitation includes a Phase I Request for Information for Solution Brief, a Phase II Company Engagement, and a Phase III Request for Prototype proposal, and candidates must align with at least one of Prime's three focused Areas of Interest. Moreover, the program also gained national media attention when Agility Prime partners LIFT Aircraft, Joby Aviation, and Wisk Aero were featured on CBS's 60 Minutes. In September 2022, Prime released an RFI for autonomy technologies in preparation for the launch of its third Prime initiative: Autonomy Prime. Also in September, AFWERX signed a Memorandum of Understanding (MOU) with the Federal Aviation Administration (FAA) to formalize the partnership and document interagency collaboration to support and advance the hybrid and electric aircraft industry. In addition, more interagency collaboration occurred with the US Army, the US Marine Corps, and NASA.

TESTING & EXPERIMENTATION: PRIME EFFORTS

The Prime division of AFWERX provides a unique take on flight testing and capabilities experimentation. By teaming with Agility Prime, businesses gain government assistance through subject matter experts, flight test engineers, and government testing resources as well as government funding through SBIR/STTR and dedicated program funding. Many of the SMEs working for Prime possess backgrounds in military service, contracting, engineering, and logistics. Companies testing with Prime support have access to government testing facilities such as wind tunnels, environmental testing facilities, military airspace, and more.

In addition, the collaboration between Prime and its partners is a strategic investment for the DAF: it allows the Defense Department to gauge these aircraft for military utility while also evaluating risk on both a military level and a civilian level.



Photo by Air Force Staff Sgt. Jack Sanders, DOD

Deputy Secretary of Defense Kathleen H. Hicks piloting the HEXA eVTOL simulator in Austin, Texas in May 2021.

These aircraft will eventually provide never-before-seen technologies to both the warfighter and to the commercial markets, and by Prime's early involvement and investment throughout the testing and experimentation phase, AFWERX is ensuring an enduring operational advantage for the United States.

Ultimately, this combination of DOD and industry resources in areas of testing and experimentation allows companies developing eVTOL/AAM capabilities to build a stronger relationship with regulatory and certification authorities such as the FAA and ideally obtain a commercial certification to operate their vehicle in an accelerated timeline. Agility Prime's success in testing and experimenting AAM vehicles through their partners proves that their methods are working, and as prototypes progress into certifiable aircraft to be mass-produced, Agility Prime will continue to push the boundaries of the possible for these aircraft.

Agility Prime established several key partnerships with additional DOD organizations in 2021, including the United States Marine Corps, the United States Army, and the United States Navy Test Pilot School, as well as the FAA and NASA.

CONTRACTING: PRIME EFFORTS

The Agility Prime contracting approach utilizes both SBIR/STTR program contracts and an Innovative Capabilities Opening (ICO), known as the Air Race, which enables Other Transaction Authority (OTA) contracts. The Air Race enables contracting at a rapid pace to suit the development timeline and structure of potential partners. Rather than a traditional government requirements specification, Agility Prime utilizes three Areas of Interest to assess multiple solutions and vehicle characteristics from across industry. The Air Race remains open through Dec. 16, 2022, enabling continued assessment of market entrants.

There are three primary stages of the Air Race, including a submission to the request for information, company engagement with the Agility Prime team, and a request for prototype proposal.

Phase 1) Request for Information and Solution Brief: A short presentation and specifications on to showcase products, enabling, or related capabilities to Agility Prime. The Agility Prime team evaluates the solution against the Areas of Interest individually.

Phase 2) Company Engagement: In-depth discussions and interaction with the Agility Prime team on the proposed solutions.

Phase 3) Request for Prototype Proposal: If the proposed solution satisfies an Area of Interest, the Agility Prime team invites the company to submit a written proposal for potential award of a contract.

At the close of 2022, 32 companies have applied to the Air Race, and Agility Prime holds 23 total SBIR or OTA contracts with 15 companies, in addition to over 250 STTR contracts. Agility Prime also leverages \$7 billion in private investment in the sector, and 2

Agility Prime companies went public through SPAC deals.

AIRWORTHINESS: PRIME EFFORTS

In order to accelerate growth of the commercial transformative vertical flight market, Agility Prime drafted a unique airworthiness plan approved by the Air Force Technical Airworthiness Authority in July 2020. Timely airworthiness assessments, required for any aircraft or air system owned, leased, operated, used, designed or modified by the DOD, are key to the program’s ability to assess and advance the emerging aviation sector.

The Agility Prime airworthiness plan utilizes an independent review team of retired Air Force certification experts with over 30 years of experience in the field. The team provides a risk-based technical assessment of the vendor’s design rather than a comprehensive certification audit of nearly 1,000 criteria in MIL-HDBK-516C, the airworthiness certification criteria DoD Handbook. This repeatable process provides rapid airworthiness assessments and populates a knowledge base of the certification status of this emerging technology.

By partnering with FAA certification authorities (an arrangement formalized by the Memorandum of Understanding signed in September 2022), Agility Prime is providing valuable design maturity insight to the FAA, who is currently developing the certification standards and means of compliance for electric vertical takeoff and landing aircraft. Additionally, this partnership should develop reciprocity agreements between the civil and public aircraft certification authorities in order to accelerate the fielding of these systems to both the private sector and the Department of Defense.

In 2021, Agility Prime facilitated airworthiness

Area of Interest 1	Area of Interest 2	Area of Interest 3
<p>Focus: Personnel Movement</p> <ul style="list-style-type: none"> • Payload: 3-8 personnel • Range: Greater than 100 miles • Speed: Greater than 100 mph • Endurance: Greater than 60 minutes 	<p>Focus: Short Range Movement</p> <ul style="list-style-type: none"> • Payload: 1-2 persons (equivalent) • Range: Greater than 10 miles • Speed: Greater than 45 mph • Endurance: Greater than 15 minutes 	<p>Focus: Cargo Aircraft, Crewed or Uncrewed</p> <ul style="list-style-type: none"> • Max Takeoff Weight: > 1,320 lb • Payload: Greater than 500 lb • Range: Greater than 200 miles • Speed: Greater than 100 mph • Endurance: Greater than 100 minutes

Multiple vendors have met or exceeded these capabilities during initial flight test.

approvals to Joby, BETA, Kittyhawk, and LIFT, followed by Moog in November 2022, enabling advancements towards increased testing opportunities and design reviews. Agility Prime and several companies initiated additional airworthiness reviews or approval expansions, enabling increased opportunities and company approvals in coming years.

“We at the FAA are very privileged to partner with the Air Force and AFWERX on Agility Prime. Already it has awarded millions of dollars of contracts and established an airworthiness process for eVTOL ORBs.”

- FAA Administrator (Dec 20)

TRAINING: PRIME EFFORTS

In October 2021, the Air Education and Training Command stood up Detachment 62 in collaboration with Agility Prime. This group is intended to establish training and certification standards for the emerging eVTOL market, as these aircraft present unique challenges never before seen in the aviation sector. As the Air Race progresses and various partners approach commercial readiness, AETC Det 62 allows the DAF to determine the safety requirements that these aircraft must meet in order to obtain a type certification from the FAA.

Det 62's mission is to come alongside Agility Prime's test and experimentation team to oversee test exercises, advise partners on the development of training processes and curriculum, and ultimately drive operator certification standards. As Prime learns alongside its partners, Det 62 will establish core competencies for pilots while assessing risk and potential learning approaches.

Then, as both government and private-sector stakeholders are concerned that the limiting factor for eVTOL utility may be the high demand for pilots, Det 62 intends to use their library of resources to train pilots within the Force, multi-capable Airmen (MCA), for emerging AAM aircraft. Eventually, the training syllabi that Det 62 are currently building and polishing will become integrated into routine skill-building practices for Airmen operators of these aircraft.

However, Det 62 is not only developing the training requirements and curriculum itself; it is

researching and measuring how quickly prospective pilots can learn the Simplified Vehicle Operations (SVO) approach adopted by many Prime partners by observing and gathering real-time data during trial training seminars. This two-tiered process allows Det 62 to continually self-evaluate as it creates the optimal training methodology for a successful deployment of this new technology. Det 62 collaborates with AFWERX, Air Force Research Laboratory, NASA, the FAA, industry leaders, and major Air Force commands as they initiate a new era of pilot training methods and procedures.

After Det 62's launch, the detachment provided support for several key Agility Prime testing initiatives, including Captain Terrence McKenna's first USAF-piloted flight of an eVTOL with partner Kittyhawk.

Significantly, Det 62 has also laid the groundwork for simulator delivery with eVTOL training requirements research. Simulators provided by partners such as Joby, BETA, LIFT, and Kittyhawk will provide a stimulating testing environment for pilots-in-training.

USE CASES

One of the main lines of effort for the Prime division is to evaluate military utility while assisting commercial partners in addressing civilian needs, working towards the ultimate goal of maximum operational advantage for the United States in the AAM arena. Numerous use cases, both military and civilian, have been explored for the technology being developed by Agility Prime partners.

Agility Prime uses an iterative approach to use case refinement throughout the program, including analytics, operator feedback, informed flight testing, and experimentation. The approach enables a rigorous and informative approach to initial use case feasibility and operations.

Agility Prime analytics has engaged 10 organizations across the DAF and Joint Force, identifying 66 potential use cases. Using Multi-Attribute Tradespace Exploration (MATE), an approach pioneered by the Massachusetts Institute of Technology, the Agility Prime team grouped use cases into 15 common mission types and four mission models, assessing the optimum mission capabilities and best value for using Agility Prime vehicles.

During 2021, 20 operators from across six commands in the Air Force conducted initial use case evaluations for multiple contractors, providing mission suitability, forecasts, and recommendations for use of Agility Prime vehicles.



In future operations, eVTOL vehicles could provide Quick Reaction Forces a dynamic multi-modal capability to respond to and protect strategic nuclear assets.

Key recommendations included continued operations assessment during rapid commercial development to understand the future government use and investment recommendations along with further refinement of eVTOL tactics, techniques, and procedures.

The analytics and initial operator assessments enable the Agility Prime Integrated Test Team (ITT) to inform the future testing and experimentation focus for coming years, enabling collaborative testing to near-term feasible use cases and technology maturation. Several use cases provide significant benefits for both government and commercial operations in the near term and forecast technical maturity. AAM vehicles can offer short/mid-range logistics support for both personnel and equipment. For the warfighter, these aircraft could provide transport of maintenance personnel, tools, or parts among several operating locations. In the commercial sector, many partner VTOLs seek to fulfill the Air Taxi Mission, which aims to ease the stress of future transportation in congested areas and major cities. Other partners are pursuing a business model focused on transportation cargo, drastically reducing delivery times and opening up new opportunities for middle-mile and last-mile logistics.

Moreover, these aircraft can aid government communications relay and surveillance while improving commercial disaster response. VTOL vehicles—whether autonomous, remotely-piloted, or manned—could assist with search-and-rescue

operations and supply delivery. Both the government and commercial sectors can benefit from utilizing AAM vehicles for first response, whether in firefighting, medical transport, or delivery of supplies. By facilitating collaboration between government and industry, Agility Prime accelerates the timeline from research and experimentation to mass production and market use of these key technologies. This strategic investment benefits both the DOD and the commercial sector, allowing for the most efficient approach to the development of emergent AAM aircraft.

TOP AGILITY PRIME USE CASES

- Personnel Movement
- Cargo Transportation
- Personnel Recovery
- DV Transportation
- Logistics Under Attack
- Rapid Aircraft Maintenance
- Urban Mobility
- Disaster Response
- Base Operations and Support
- Communications Relay
- Missile Field Support
- Emergency Response
- Test Support
- Training Range Support
- Search and Rescue

MAJOR 2021 ACCOMPLISHMENTS

Justification for Partner Inclusion:

The companies highlighted below do not represent a complete list of aviation startups in partnership with AFWERX Agility Prime; however, if a company is featured below, it has achieved a Phase III SBIR contract, reached Phase III in the Agility Prime Air Race ICO, or has obtained funding through the STRATFI or TACFI programs.

Archer Aviation

In September 2021, the Air Force and eVTOL aircraft developer Archer Aviation Inc. announced the establishment of a collaborative strategy to investigate the technical readiness and suitability of the Maker eVTOL aircraft for Air Force purposes. This agreement calls for Palo Alto, California-based Archer to provide DAF and AFWERX Agility Prime data from certain flight tests for the purposes of furthering DAF's understanding of Maker's capabilities, systems, and development progression. Additionally, Archer and Agility Prime will conduct airworthiness testing of Archer's demonstrator aircraft, Maker. The agreement paved the way for key FY22 activity, including Federal Aviation Administration (FAA) special airworthiness certification in November 2021, as well as Archer's first successful hover flight in December 2021.

BETA Technologies

In May 2021, the Air Force awarded airworthiness approval to BETA Technologies' ALIA aircraft, marking DAF's first-ever approval for an eVTOL vehicle capable of carrying personnel. These developments enable Air Force acquisition professionals and operators to make data-driven decisions informed by real assessments of military utility. Additionally, the company's aircraft simulation and training facilities allow Air Force pilots and engineers to experience electric vertical flight by training with and testing the ALIA aircraft in a variety of potential mission sets and scenarios.

In April 2021, BETA conducted the first interstate flight of their ALIA eVTOL aircraft between its Plattsburgh, N.Y., hangar and testing facility and its headquarters at Burlington International Airport in Burlington, Vermont. Additionally, BETA achieved both range and altitude records in July 2021, when ALIA traveled 205 miles at 3,000 feet.

FY22 saw more progress for the BETA ALIA. In January 2022, the US Army expanded its interest in BETA, signing a new contract for extended flight testing support. Following a feature in the *New York Times* in April 2022 and raising \$375 million in Series B funding, BETA signed a deal with LCI for up to 125 ALIA aircrafts. Later, in August 2022, Bristow placed a firm order for 5 ALIAs, with an optional 50 additional aircraft.



Photo courtesy of BETA Technologies

The U.S. Air Force has awarded the first airworthiness approval for a crewed electric aircraft to BETA Technologies, a partner in the AFWERX Agility Prime program.

AIR FORCE AWARDS FIRST AIRWORTHINESS APPROVAL FOR HUMAN FLIGHT IN AFWERX AGILITY PRIME ELECTRIC AIRCRAFT PROGRAM

Published May 5, 2021

By Air Force Research Laboratory Public Affairs

WRIGHT-PATTERSON AIR FORCE BASE, Ohio (AFRL) – The U.S. Air Force has awarded the first airworthiness approval for a manned electric aircraft to BETA Technologies, a partner in the AFWERX Agility Prime Program. This enables BETA to begin flying its ALIA aircraft in the Agility Prime program. The airworthiness award from the Air Force is the latest milestone in BETA's test program after recently entering its next phase of flight testing.

"U.S. Air Force engineers spent more than a year examining BETA's ALIA aircraft, evaluating its design and flight capabilities against the demanding MIL-HDBK-516C standard," said Camron Guthrie from BETA. U.S. Air Force personnel and subject matter experts evaluated the aircraft's design and maintenance requirements along with the company's operations and flight test plans.

"Electric aviation is a National Security priority and fortunately this was recognized early by the Air Force. The speed and efficiency of the Air Force Agility Prime program to support sustainable electric aviation has been remarkable," said Kyle Clark, BETA's founder and CEO. "The people and expertise that the Air Force has brought to the electric aviation industry and specifically our ALIA program is accelerating the development of incredibly capable, safe and reliable aircraft."

With this airworthiness, the Air Force will have access to the first of its kind, manned 7,000-pound class electric aircraft, and first of their kind immersive eVTOL simulators located in Washington, D.C. and Springfield, Ohio.

"This agreement will enable Air Force acquisition professionals to make data driven decisions informed by real assessments of military utility," said Col. Nathan Diller, AFWERX Director.

BETA's aircraft simulation and training facilities allow Air Force pilots and engineers to experience the future of electric vertical flight by rehearsing and testing the ALIA aircraft in a variety of potential mission sets and scenarios. The advanced urban air mobility technology simulator near the Air Force Research Laboratory in Springfield, Ohio, provides easy access to the Air Force's greatest technical experts and acquisition professionals. The Washington, D.C. facility provides an ideal venue for future operational concept developers across the Air Force, joint force, and interagency to conduct research, assessing the opportunities of the electrified future. These state-of-the-art simulators are physics based and include weather, emergency

handling, and mission scenarios with multiple aircraft.

Agility Prime seeks to expand technology transition paths to accelerate emerging dual-use markets by leveraging government resources for rapid and affordable fielding. In a first-of-a-kind arrangement, AFRL engineers used unique equipment and analysis capabilities to conduct structural testing on the ALIA aircraft. This valuable data will advance the flight test program safely while providing valuable insight to the Air Force on a unique and novel aircraft design.

"Agility Prime is about creating a new path to adopt advanced technologies in the Department of Defense by working with innovative companies like BETA in ways that enable new markets," said Diller. "The engineering, test, and acquisition professionals in Air Force Materiel Command have phenomenal expertise to help accelerate this and other emerging markets."

In March, BETA advanced to the next phase of its flight testing program, completing an interstate flight with ALIA from its Plattsburgh, New York home airport test facility to the company's headquarters near Burlington International Airport in Vermont.

To abide by Federal Aviation Agency protocols concerning the flight of experimental aircraft beyond designated test areas, BETA completed rigorous testing to ensure reliable and predictable aircraft performance. In the same week that ALIA flew its first interstate flight, BETA also set a new record for range and altitude in ALIA of 130 nautical miles and 8,000 feet respectively.

BETA added to its growing customer list securing agreements with BLADE and UPS for its ALIA aircraft and charging stations. BETA partners now span medical, logistics, defense and passenger segments.

USAF AND BETA TECHNOLOGIES MAKE HISTORY WITH FIRST AIRMAN FLIGHT OF AN ELECTRIC AIRCRAFT

Published March 14, 2022

By Air Force Research Lab, AFWERX

WRIGHT-PATTERSON AIR FORCE BASE, Ohio (AFRL) – United States Air Force pilots Hank "Hog" Griffiths and Maj. Jonathan Appleby flew BETA Technologies' electric vertical takeoff and landing (eVTOL) aircraft, ALIA, as the first-ever Airmen to fly an electric aircraft with a military airworthiness March 9.

This milestone, which took place at BETA's Plattsburgh, New York, hangar and testing facility—just 35 miles from its South Burlington, Vermont headquarters—is the culmination of a two-year partnership between BETA and the Agility Prime program. Since partnering in 2020, Air Force

engineers have worked alongside BETA's flight test team to develop and refine the ALIA aircraft to make electric aviation a reality. ALIA has made significant technical advancements throughout the partnership. In addition to last week's achievement, in 2021, BETA was also awarded the first Air Force airworthiness approval for an electric aircraft with personnel on board. The partnership is currently operating under a Phase II Small Business Innovation Research (SBIR) contract.

The ALIA aircraft, which has been in development for over three years, is fully electric with zero operational emissions. Though it was created to be a cargo carrier, fitting a pilot and three standard pallets, the aircraft can seat up to five passengers, plus a pilot. ALIA is a nod to the Arctic tern, which travels further than any other migratory bird and demonstrates remarkable capability in transporting from pole to pole each year, covering nearly 25,000 miles. With ALIA, BETA has thus targeted a range of 250 nautical miles and a current top speed of approximately 150 knots, with a recharge time of under an hour and a wingspan of 50 feet. In addition to the aircraft, BETA is also rolling out a cross-country charging infrastructure to power electric transportation. To date, the company has more than 60 charging stations online or in development from Vermont to Arkansas, with additional sites planned.

Griffiths, AFWERX Airworthiness and Test Lead and Chief of Engineering, commended BETA on building an innovative company culture while developing their aircraft.

"BETA has developed a unique eVTOL air system that is the complete package and includes an air vehicle and charging network that will surely compete well in this emerging competitive market," said Griffiths. "However, that is not surprising for a company that has embraced aviation; every employee is encouraged to take flight training, and their office spaces overlook their hangar where all of the BETA magic is happening. It has been a pleasure to work and fly with such a motivated and innovative group of people."

Before completing this historic test flight, Griffiths and Appleby underwent extensive safety and preparedness training. They completed intensive aircraft academics ahead of their arrival in South Burlington, having received comprehensive ALIA manuals and additional materials compiled by the BETA engineers who built the aircraft. Ground school for both Air Force pilots commenced on March 7. These sessions covered every aspect of piloting ALIA, including individual courses on its structures, batteries, electric motors, flight controls, aerodynamics, and avionics as well as preflight and extensive safety training. On March 8, both pilots underwent simulator training, where they were able to fly the exact test flight route planned for the demonstration.

Following this training, on March 9, Griffiths and Appleby took turns piloting ALIA for several flight demonstrations, becoming the first Air Force pilots to fly in a eVTOL aircraft. In the aircraft with Griffiths and Appleby, respectively, sat BETA test pilot Camron Guthrie and Lochie Ferrier.

"It was a blessing and honor to conduct the first Airman flight for the Air Force in the ALIA-250 which was designed, built, and maintained by the dedicated professionals of BETA," said Appleby. "Special thanks to Josh Lane and Agility Prime for coordinating the test approval and execution and the entire BETA team for providing our training and letting us fly their aircraft. I am excited to watch BETA continue to develop their revolutionary aircraft for civil and military use cases and grateful for the opportunity to experience electric flight."

Griffiths spoke to the value of this demonstration to the future use case determinations and certification of eVTOL aircraft for both defense and commercial application.

"Today's Air Force qualitative evaluation flight is the first of many that we will be doing with BETA Technologies and our other Agility Prime vendors," Griffiths said. "In addition to accelerating these company's path to FAA type certification by providing access to USAF engineering expertise and test infrastructure, we are also evaluating these prototypes for opportunities to utilize them for unique military missions. We need government pilots to accomplish those evaluations and this is the first step in developing the training and experimentation plans to do so."

Kyle Clark, BETA founder and CEO, expresses his excitement for BETA's continuing partnership with the USAF through Agility Prime.

"For over two years, we've worked hand-in-hand with the Air Force Agility Prime team to refine our electric aircraft, and we've made great progress together," said Clark. "It's an honor to have Hank Griffiths and Major Appleby fly our aircraft, and we're humbled by the Air Force's continued support and confidence in our engineering. This flight signifies an important milestone, providing the opportunity for a clean future for our nation's military and a path to fossil fuel independence."

Col. Nathan Diller, Director of AFWERX, noted that milestones such as this accomplishment are furthering the AFWERX Agility Prime mission to accelerate capabilities for both commercial and defense use.

"The first flight of a service member in an electric aircraft with a Department of Defense airworthiness marks a key milestone in expanding the safety, affordability, availability, and sustainability of air travel," Diller said.

Elroy Air

Elroy Air partnered with the Air Force first in 2019 through a Direct-to-Phase II (D2P2) Small Business Innovation Research (SBIR) contract, then with AFWERX Agility Prime in 2021 through a SBIR Phase III contract. In addition to their current Phase III contract, Elroy Air has recently been awarded a Tactical Funding Increase (TACFI) in the amount of \$1.7 million, as well as a Cooperative Research and Development Agreement (CRADA) with the Naval Postgraduate School to best understand how Chaparral's dual-use capabilities can meet the needs of the armed forces. Unlike several other Prime partners, Elroy's aircraft is intended to move cargo, not people; the Chaparral's design presents opportunities for transforming logistics across the commercial, humanitarian, and defense sectors.

Elroy started 2022 strong with the unveiling of their pre-production model hybrid-electric VTOL aircraft, the Chaparral C1, in a virtual event on January 26. Then, in March 2022, Elroy partnered with FedEx to begin testing the Chaparral for unmanned cargo

delivery. Elroy later secured \$1.7 million in TACFI dollars alongside its existing Phase III SBIR contract, allowing the company to promote operationalization of the Chaparral (including rapid deployment capabilities, maintenance, and reliability).

Joby Aviation

AFWERX Agility Prime announced during its Dec. 10, 2020 Accelerate event that it had completed an airworthiness evaluation report of Joby Aviation's design for the Air Force Technical Airworthiness Authority. The report provides input to the U.S. Air Force Special Airworthiness Process for Contractor-Owned, Contractor-Operated aircraft and opens a path to enable the Joby aircraft to fly under Air Force contract. Joby's first pre-production prototype generated 65 terabytes of test data in 2021, flying more than 5,300 miles, including demonstrating significant range of their eVTOL aircraft to date, at 154.6 miles on a single charge. Joby's FY21 activity paved the way for key FY22 activities, including DAF and FAA approval for a second pre-production

“I think there is tremendous capability in the commercial world. I'll give you an example: Elroy Aircraft. They are strictly a commercial company, but they have developed a cargo UAV that can fly 300 miles and carry 300 pounds of payload. So for logistics, this would be fantastic. And if the government literally can just buy something commercial off the shelf, we don't have to pay for the development. It is paid commercially.”



- Secretary of Defense for Research and Engineering (OUSD(R&E)), Ms. Heidi Shyu, on 6 April 2022 at the Subcommittee on Emerging Threats and Capabilities

Photo courtesy of Elroy Aircraft



Photo courtesy of Joby Aviation

Agility Prime partner Joby Aviation begins NYSE trading.

prototype eVTOL vehicle. The second aircraft builds upon the team's success and enables Joby's flight testing in 2022, paving the way for the company's path to crewed operations and civil certification.

In December 2021, Joby received FAA Special Airworthiness Certification for a second pre-production prototype aircraft, as well as US Air Force Airworthiness Approval just six days later. Several weeks later, in January 2022, Joby's eVTOL achieved a new speed milestone, flying the aircraft in excess of 205 knots (235 miles per hour) and more than 11,000 feet above mean sea level. March 2022 saw Joby receive a Phase III OPA Award, and in May 2022, Joby announced acoustic data resulting from NASA testing. In August 2022, the Emerging Technology Combined Test Force (ET-CTF) at Edwards AFB made the first electrical infrastructure upgrades to a USAF base to support test and operations of the Joby eVTOL, progressing the company towards military utility.

Kittyhawk

The Air Force awarded Kittyhawk airworthiness approval in 2021. This designation allowed the Heaviside aircraft to undertake further flight testing under Air Force direction. In May 2021, AFWERX Agility Prime and Palo Alto, California-based Kittyhawk conducted their first operational exercise, a medical evacuation testing series that demonstrated Heaviside's remote piloting capabilities, logistical control, and personnel recovery. The exercise allowed the team a chance to generate and gather a rich catalog of data to inform dual-use utility at the prototype stage that will inform future developmental and fielding decisions. The 2021 test and evaluation enabled key activities, including the Heaviside completion of its first beyond visual line of sight (BVLOS) flight over a two-week period in November 2021 and participation in the Ohio Advanced Air Mobility Showcase held at the Springfield-Beckley Municipal Airport. Kittyhawk



Photo courtesy of Kittyhawk

Kittyhawk's Heaviside aircraft

pilots used Skyvision, a ground-based detect-and-avoid system, to safely integrate Heaviside with other air traffic.

Another significant milestone came in December 2021, when Kittyhawk partnered with the Agility Prime test team to conduct Buddy Box testing and develop a training curriculum for the Heaviside aircraft. This testing culminated in the first USAF-piloted remotely-operated flight of an eVTOL vehicle.

LIFT Aircraft

In March 2021, the Air Force collaboratively tested and completed an initial operational evaluation of the HEXA vehicle's portability in a HC-130J as a precursor activity to Exercise Bushwhacker, with crews disassembling, packing, transporting, unloading, and reassembling the HEXA before putting it through its paces. The evaluation utilized transportation between one of the key initial government testing sites at the Springfield-Beckley Municipal Airport in Ohio to the Austin-Bergstrom International Airport in Texas. The FY21 work sets up continued evaluation of the HEXA aircraft for future configurations and both civil and military applications, especially with contingency response, airfield operations, and short-range logistics in multiple environments.



Photo courtesy of LIFT Aircraft

LIFT Aircraft's HEXA eVTOL has 18 independent electric motors and propellers that are the only moving parts needed for perfectly stable, controlled flight.

AFWERX AGILITY PRIME COMPLETES THE FIRST USAF-PILOTED FLIGHT OF AN EVTOL VEHICLE WITH PARTNER KITTYHAWK

Published January 20, 2022

By Air Force Research Lab, AFWERX

WRIGHT-PATTERSON AFB, Ohio – Capt. Terrence McKenna, an Air Force Reserve pilot with the 370th Flight Test Squadron and the Test and Experimentation Lead for AFWERX Agility Prime, participated in remote pilot in control (rPIC) training on the Heaviside aircraft at the Kittyhawk Corporation's facility in Palo Alto, California from Dec. 13-17, 2021.

The training culminated in the first government remote piloted flight of an electric Vertical Takeoff and Landing (eVTOL) aircraft when he successfully flew the Heaviside via the Buddy Box System.

Named for the English engineer, physicist, and mathematician Oliver Heaviside, the Heaviside is Kittyhawk's current flying model. This aircraft's maximum takeoff weight is approximately 880 pounds. Heaviside can travel at speeds of roughly 180 miles per hour, but most significantly, it remains quiet: only about 35 decibels at 1,500 feet above ground level, which is slightly louder than a whisper and about 100 times quieter than a helicopter.

A training feature of the Heaviside is the Buddy Box setup, which is a secondary remote controller wired to a primary controller. This system is intended for the use of an instructor and a student; the trainee handles the remote console, operating the aircraft as an external pilot while the instructor provides supervision and support.

During the week in California, McKenna primarily concentrated on operating as the external pilot in a manual flight mode, rather than operating the ground control system in automated operations. Days 1 and 2 focused on ground academics, including simulation training, preflight checklists, and exposure to the Heaviside's systems.

Inclement weather initially kept the aircraft grounded, but on Day 3, after completing several flights on smaller remote aircraft, McKenna successfully piloted the first USAF flight of an

Agility Prime sponsored vehicle, navigating the Heaviside at Kittyhawk's test site. By the end of the day, McKenna had conducted 3 successful flights, focusing on vertical maneuvers, takeoff and landing, manipulation on all axes, auto-hover, and manual flight.

McKenna described that the Buddy Box allows pilots to get a feel for what the aircraft is capable of as it moves through the sky.

"It's a different paradigm for operating the aircraft," McKenna said.

While McKenna indeed learned to remotely pilot the Heaviside, a crucial objective of the weeklong exercise was to evaluate and improve the training plan itself for future operations. To monitor and evaluate McKenna's training process, the Air Education and Training Command (AETC) sent out Detachment 62 personnel to lend their experience with developing flight training plans. The Det 62 team worked closely with Kittyhawk and the Agility Prime test team to draft an initial syllabus for McKenna for test and training. The team coordinated with Kittyhawk's analysts, as well as Agility Prime, to observe, gather data, review training processes, and conduct detailed debriefs along the way. Moreover, Brittney Tough, Kittyhawk's Senior Flight Training Manager, also served as an asset to government flight test teams.

Days 4 and 5 concluded the week by training McKenna on fixed-wing flight, outbound and inbound transitions to vertical flight, and flying full profiles. McKenna reported enthusiastic satisfaction with the tested training methods from Agility Prime, AETC Det 62, and Kittyhawk.

"I feel very confident in the training [including] pre-study, ground academics, simulation work, and surrogate flights to get us to this point," McKenna said.

Overall, McKenna praised the teamwork necessary to achieve this milestone flight.

"We're establishing the interaction and the processes to make sure everything is done in a safe manner," he said. "It's a great way to accelerate innovation, supporting industry and keeping up with them. It's been a great team effort."



Photo courtesy of Kittyhawk

Air Force awards 4th Agility Prime airworthiness approval to Kittyhawk.

In April 2022, LIFT was awarded a Phase III contract with Agility Prime, which led to ramped-up testing campaigns at Eglin AFB. There, at Duke Field, the HEXA became the first eVTOL to fly at a military airfield. Later, in July 2022, the HEXA achieved a new test milestone: remotely-piloted flight for approximately 10 minutes at about 50 feet. August 2022 then saw LIFT receive a STRATFI award, enabling them to continue iterating upon their design and performance.

Moog

In late September, as FY21 wound to a close, AFWERX Agility Prime partner Moog Aircraft Group unveiled its SureFly S250 eVTOL vehicle. The SureFly S250 is a two-seat, all-electric, multi-rotor vehicle capable of crewed or uncrewed flight using eight independent propulsion motors. Plans call for the vehicle to be modified to a hybrid power electric system. In its work with Moog, the Air Force will focus on supporting vehicle aerodynamics, pilot interfaces, and system safety, as well airworthiness support for unmanned operations. Completing the military airworthiness process through the Air Force will allow the SureFly S250 to continue flight-test experimentation at an Unmanned Aerial System (UAS) test site in Springfield, Ohio, later in FY22. The Air Force anticipates its work with the Moog SureFly S250 will provide a more in-depth understanding of hybrid electric power system technology, as well as Moog's aircraft control systems.

In FY22, Moog partnered with Army DEVCOM for CFD support. In September 2022, Moog completed its airworthiness report through Dayton Aerospace, which led to Moog obtaining its Military Flight Release (MFR) in November 2022, officially kicking off the Springfield Test Campaign.

Photo by Dennis Stewart



Moog at the FlyOhio eVTOL showcase at the Springfield-Beckley Municipal Airport in Ohio in November 2020.

“The committee commends the Air Force for prioritizing the Agility Prime program and believes that continued investment in this technology will help to maintain the country's global leadership in the eVTOL market.”

- House Armed Services Committee
2022 NDAA Report

AUTONOMY PRIME LAUNCH

AFWERX Prime announced the release of its Autonomy Prime Request for Information, or RFI, Sept. 9, 2022. With this announcement, AFWERX began industry-facing research as it prepared to launch a new “Prime” program focused on the collaborative development of autonomy technologies with industry to accelerate military adoption.

The program follows the philosophy of Agility Prime: collaborative risk reduction across the industry to accelerate the development and implementation of emerging technologies critical to national security. This new Prime will support Operational Imperatives 3 (Moving Target), 4 (Air Dominance), and 5 (Resilient Basing), addressing the DAF's need for increased autonomy development.

Autonomy Prime, while still in its formative stages, will focus on rapid autonomy testing and transition capability or “proving ground,” which will seek to remove roadblocks that prevent rapid, affordable and iterative testing of autonomy in aircraft, as well as potentially spacecraft and ground vehicles. This proving ground consists of a robust process to access, test, iterate, and mature industry's autonomy technologies for the DAF. The program plans to introduce challenges focused on key technology gaps identified by AFWERX. Companies will then execute demonstrations or tests at the proving ground to compete for funding and subsequent acquisition opportunities, which could allow them to transition into Air Force field capabilities. The proving ground will include the physical locations where the Department of the Air Force executes tests along with digital twins incorporating modeling and simulation work.

Autonomy Prime will leverage internal talent as well as bolster interagency collaboration across the DAF, DARPA, Joint, and industry to establish infrastructure, expertise, procedures, and data surrounding meaningful autonomy development.



AFWERX
OPERATIONS

OVERVIEW

MISSION

Empower the AFWERX ecosystem through communication, technology, talent, and infrastructure to ensure strategic alignment and innovatively accelerate change across the Department of the Air Force.



OPERATIONS
DR SEAN GIBBONS

Photo by Airman 1st Class Kevin Sommer Giron

OPERATIONS **OVERVIEW**

METHOD

AFWERX Operations anticipates and provides dynamic and agile capabilities to ensure AFWERX's ability to transition commercial technologies to the hands of the warfighter. By leveraging multiple communications channels, innovative workflow technologies, the talents of Airmen and Guardians across the Department of the Air Force, and by creating an infrastructure that allows efficiencies in AFWERX efforts, Operations provides the support system that strengthens AFWERX and helps AFWERX work effectively with stakeholders and industry.

MAJOR LINES OF EFFORT

AFWERX HUMAN RESOURCES

AFWERX is geographically spread out across twenty-five states with 155 assigned military and civilian personnel. AFWERX Human Resources works diligently to hire and shepherd talented personnel through the required processes so that when they arrive, they are able to immediately impact AFWERX efforts and contribute to the needs of their respective divisions.

RECENT HIRING EVENT SUCCESS

857 Total Applicants	394 Applicants Referred for Consideration
154 Applicants Selected for Interviews	129 Applicants Accepted Interviews
10 Number of Interview Panels	6 Days of Interviews (extended from 5 due to quality of applicants)
53 Job Offers Extended (including 9 military spouses)	45 Accepted Job Offers (including 9 military spouses)

AFWERX IT/TECH TEAM

The AFWERX IT Tech Team supports and augments the AFWERX staff and user community by empowering them to perform their jobs with innovative technology and tools. AFWERX users range from internal to external stakeholders, including core AFWERX personnel, contractors, National Guard, Reserves, and individuals in other military organizations. The support across various stakeholder groups is essential to the continued growth of AFWERX as needs and priorities evolve.

The AFWERX IT Tech Team support covers five main areas:

1. Customer Support
 - Help Desk support for AFWERX and AFRL Google Workspace Suites
 - Help Desk support for AFWERX Web Services
2. Project Management Coordination
 - Project Tracking
 - AFWERX Technology Board (ATB) Support
3. Technical Ecosystem Support
 - Development of Applications and Tools
 - Deployment of new development tools
 - Provisioning of new users and organizations
 - Maintenance and Configuration of Google Workspace
4. Marketing Support
5. Analytics

Significant Events and Projects

The AFWERX IT Tech Team successfully executed a number of efforts to meet divergent needs. The team established, deployed, migrated, and provided the AFWERX domain Google Workspace Suite, the first DOD migration for Google for its type. Authorization To Operate (ATO) was obtained for AFWERX use of the Google Workspace Suite and Salesforce, allowing for efficiencies in cross-team workflows. This included a full Security Admin center with alerts and dashboard functions.

IT Policies were established to ensure workflow efficiencies and consistent operation methods. The team provided evaluation, configuration, deployment, and training for applications used by all of AFWERX, including SmartSheet, Google AppSheet, and Google Tables.

Other efforts included the following:

- Coordinated with the DAF ACT Covid-19 team to keep accounts active

- Partnered with AFRL/PA on website compliance and security policies for AFWERX owned WordPress sites (AFWERX.com, SpaceWERX.com)
- Established an issues ticket system with Salesforce to support the AFWERX Help Desk processes
- Coordinated Mobile Device Management planning and rollout developed for use on iOS and Android devices, tested with select AFWERX users - completed rollout to all AFWERX Organizational Units
- Developed and deployed a STRATFI/TACFI Capability Package Ingest and Review application utilizing AppSheet
- Developed an application tool for the administration of the AFWERX Strategic Planning Calendar
- Created and deployed a Google Tables Agile Toolkit for use with App and Web Development teams
- Developed and deployed the AFWERX Directory, which includes a locator capability
- Designed and Developed the AFWERX Intranet
- Conducted Security Assessment Review to find and mitigate cyber security risks
- Conducted an audit of all AFWERX Memorandums of Authorization (MOAs) and created a Google Tables MOA Tracking application

TOTAL HELP DESK CASES



AFWERX CHALLENGES

AFWERX Challenge is an expanded market research program that matches solutions from individuals, startups, small businesses, large enterprises, academia, and research labs to

Department of the Air Force prioritized problems. Challenge utilizes design thinking workshops, crowdsourced ideas, collaborative events and showcases, and flexible contracting pathways to accelerate ideas towards demonstrated and deployed solutions that benefit the warfighter. The Challenge process took a brief pause to better align funding and acquisition authorities to improve transition to the warfighter.

Steps of the Challenge process

- 1. Discovery**
 - Conduct introductory discussions with sponsor team about the topic
 - Perform background research
 - Hold a Scoping Workshop to define key planning elements of the Challenge
- 2. Challenge Definition**
 - Conduct outreach to solicit participation from SMEs from industry, academia, and government/military for the Challenge Definition Workshop
 - Design and facilitate a collaborative workshop that enables a core constituency of SMEs to define the specifics of the Challenge problem
- 3. Open Innovation Challenge**
 - Design and launch a crowdsourcing campaign
 - Conduct advertising and marketing to attract the best solutions from industry and academia
 - Open solicitation to collect ideas over 6-8 week period
 - Review submissions and select a subset to advance to the Showcase Event
- 4. Showcase**
 - Conduct meetings for selected submitters to perform pitches to enable deeper demonstration of potential solutions to the sponsor team and allow for questions, discussion, and iteration on ideas
 - Plan, prepare, design, and facilitate a Showcase Event that brings together selected solution providers with potential government and military customers, venture capitalists, and industry integrators
- 5. Contract**
 - Award contracts to selected solution providers for deployment, development, demonstration, prototyping, or scaling of solutions

CHALLENGES BY THE NUMBERS



SHOWCASE DETAILS

2021

Revolutionizing USAF Flightline Operations:

- 117 selected for showcase from 640 submissions across 3 challenges
- 3 Challenges:
 - Airfield Maintenance and Repair
 - Aircraft Maintenance Operations
 - Flightline Security

High-Speed Vertical Take-Off and Landing Concept

- 35 selected for showcase of 218 submissions
- 11 companies selected for initial contracts

Mixed-Reality Air Refueling Training

- Joint Challenge with Strikewerx
- 24 selected for showcase from 113

2020

Sky High Relief

- 22 selected for showcase from 68 submissions
- \$1.5M for 10 awards

Reimagining Energy for the DOD

- 179 selected for showcase from 1056 submissions across 6 challenges
- 6 Challenges
 - New Warfighting and Operational Equipment Not Dependent on Fossil Fuels
 - Data Availability for Improved Planning and Decision Making
 - Energy Culture, Policy, and Education
 - Energy Transmission and Distribution
 - Fixed and Mobile Energy Generation
 - Fixed and Mobile Energy Storage
- 8 solutions were selected for initial contracts totaling \$1.6M with AFRL Transformational Capabilities Office

Emergency Aircrew Response

- Joint Challenge with Strikewerx
- 17 selected for showcase from 49 submissions
- 3 contracts awarded

Integrated Respirator Info System

- 15 selected for showcase from 63 submissions

Engage Space

- 178 selected for showcase from 908 submissions across 4 challenges
- 4 Challenges
 - Global Space Transport and Delivery
 - Space Asset Resiliency
 - DOD-Commercial Partnerships
 - Persistent ISR

Accelerating Pilots to Combat-Ready Aviators

- 63 selected for showcase from 243 submissions

Base of the Future

- 368 selected for showcase from 1933 submissions across 6 challenges
- 6 Challenges
 - Empowering Airmen and Family Wellbeing
 - Enabling Technologies for Reverse Engineering and Additive/Agile Manufacturing
 - Culture of Innovation
 - Base Security and Defense
 - Installation Resilience
 - Leveraging Operational Technology

Air Force Recruiting, Reimagined

- 43 selected for showcase from 88 submissions

USAF Future of Wargaming

- 24 selected from 75 submissions



SUCCESS STORIES SPOTLIGHT

Base of the Future Initiative

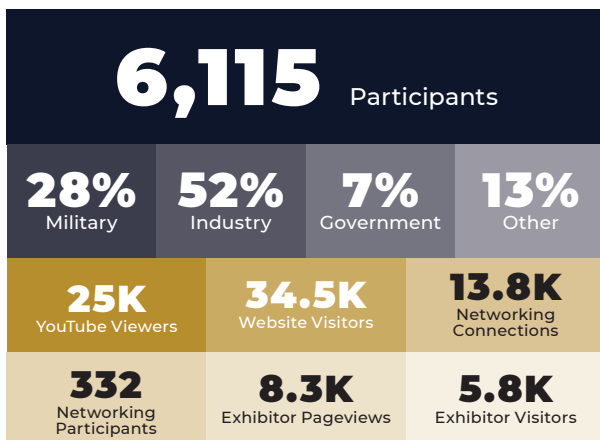
The intent of the Initiative was to support the rebuild of Tyndall AFB after Hurricane Michael in 2018. Six Challenges were developed as part of initiative to include Empowering Airmen and Family Wellbeing; Enabling Technologies for Reverse Engineering and Additive/Agile Manufacturing; Culture of Innovation; Base Security and Defense; Installation Resilience; Leveraging Operational Technology.

Challenge workshops were held in early 2020 and the Challenges were open for solution submissions approximately Mar-May 2020.



A showcase was held as part of AFWERX Fusion 2020 event, 28-30 Jul 2020. This was a 3-day virtual event that included keynote speakers, workshops, entertainment, and networking opportunities.

FUSION 2020 BY THE NUMBERS



Spotlighted solutions that were put on contract included the following:

- From *Leveraging Operational Technology* Challenge: \$1M contract issued to Ghost Robotics for a walking, sensing platform for persistent security
 - Prototype Walking Sensing Platform that can provide persistent security, clear buildings, and deploy 360 degree sensors throughout an objective. This technology has the potential to replace and exceed the capabilities of certain static defense equipment especially in a contingency, disaster, or deployed environment
- From *Base Security & Defense* Challenge: \$1.9M contract issued to Leidos for a mobile vehicle inspection system
 - The system helps inspectors search for weapons, contraband, undeclared cargo and other items of interest in trucks, cargo containers, and passenger vehicles. The Mobile Vehicle Access Control Inspection System, dubbed as VACIS M6500, expedites the time needed to check commercial vehicles from 15 minutes to a two-minute time frame.
- From *Empowering Airmen and Family Wellbeing*: \$250k contract awarded to Red Berry and Dataflowage for a platform that helps manage airman finance and wellness
 - DataFlowage has designed a platform that solves the data management needs of the Airmen wellness challenge. The Data Fabric collects a complete set of data about Airmen, their families and programs offered at bases. It organizes that data providing insights regarding the wellness of each Airmen and the entire force. Data enrichment is delivered by machine learning to provide real-time alerting in order to proactively tackle wellness issues.

ACE Challenge

The Ace Challenge is currently being developed to address Agile Combat Employment and Common Support Equipment needs. The event is sponsored jointly by MAJCOM ACE Tier 3 working group and AFRL Transformational Capabilities Office. There are four primary motivators for the Common Support Equipment concept: agile mobility, resiliency, sustainability, and multi-purpose functionality on the flightline. These capabilities will make it easier to manage logistics, provide redundancy, streamline training, and reduce costs.

AFWERX MARKETING AND COMMUNICATIONS

The AFWERX Marketing and Communications provided messages that inform, educate, and promote awareness among our diverse target audiences. Due to the unique requirements of each audience, our approaches were tailored according to the needs of each group. Using multiple media outlets, we increased our reach and continued to ensure that the AFWERX reputation as an advocate for better acquisition processes, small business engagement, and Airman and Guardian support remained strong.

Beginning in March 2020, AFWERX faced unprecedented challenges in its outreach efforts due to the pandemic. This led to a virtual pivot, and a cancellation of all in-person events. In their place, the outreach team led a series of virtual events, tailored toward reaching previously untapped groups and making it easier for underserved communities, including minority, veteran, and women-oriented organizations and universities to improve engagement and participation with AFWERX.

The Marketing and Communications group participated in a number of webinar events, increased the program's social media presence, generated success stories in written and video format, and improved the program's virtual footprint in order to better represent the Department of the Air Force AFWERX program to the communities it intended to reach.

The various efforts that the Marketing and Communications team supports include events, video production, social media outreach, web content, public awareness campaigns, and all the graphics, writing, and coordination that those efforts require.

Event Support

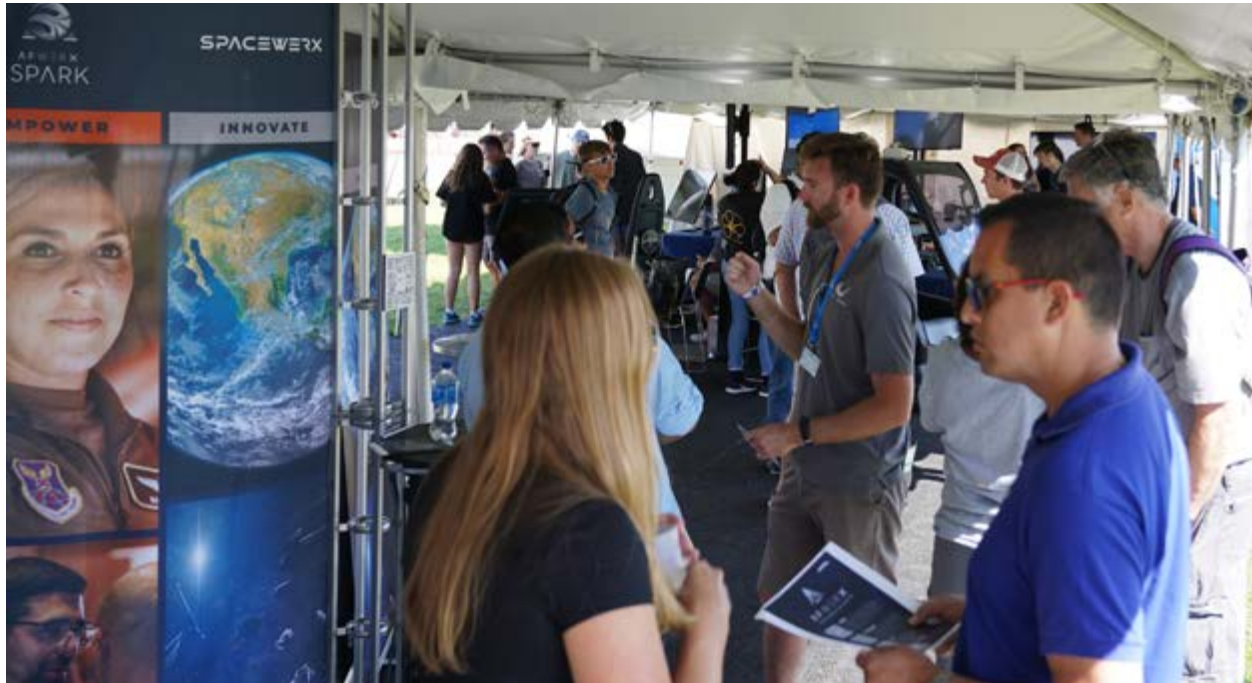
AFWERX participated in a number of outreach and training efforts during this period. In 2020, COVID-19 restrictions forced all events to be held virtually. Event support included weekly planning telecons, website creation, registration management, agenda creation, hotel blocking, on-site logistical support, post-event reporting, and social event booking. They leverage industry standard web-based applications, i.e., ZoomGov and EventSquid, as key tools for all aspects of event preparation to include promotion of events and associated information, registration of attendees, payment collection (when applicable), communication notices to attendees, creation of event surveys, and attendee reporting.

Events supported include the following:

- **Virtual Pitch Days | Multiple Dates**
- **Virtual AFMC Digital Campaign Industry Exchange Day**
- **Virtual SBIR Road Tours: Various Regions**
- **STTR HBCU Collider at BDPACON2020**
- **National Small Business Veterans Webinar Air Force SBIR/STTR Program Overview**
- **Tech Warrior Virtual OPS**
- **AFVentures Webinars** This event is open to Small Businesses and Government. Hosted 68 Webinars between April 2021 – September 2022
- **Phase II Onboarding Sessions |Virtual** AFWentures offers these webinars to Phase II companies to learn about deliverables submission, invoicing, contract modification, contract closeouts and other processes unique to this phase.
- **Solicitation AMAs | Virtual**



- **Cybersecurity Webinars**
 - Air Force Chief Information Security Officer (CISO). Every Tuesday, SBIR/STTR and Small Business Cybersecurity Ask-Me-Anything
 - DAF CISO's Blue Cyber Boot Camp
- **Virtual Spark Colliders** The Spark Collider is designed to help companies: a.) find government organizations interested in their developing products, b.) locate a government partner for TACFI or STRATFI awards, or c.) discover a government partner for Phase 3. An additional goal of the event is to educate DoD personnel about available resources and how to use them, accelerate the matching of DoD problems with viable solutions, and put projects on agile execution pathways.
- **AFRL Extremism Stand-Down | Virtual**
- **STRATFI/TACFI Webinars**
 - AFWentures - STRATFI/TACFI Small Business AMA Series
 - AFWentures - STRATFI/TACFI Government Only AMA Series|Virtual



Attendees at EAA's 2022 AirVenture in Oshkosh, Wisconsin discuss AFWERX with various members of the AFWERX team, including Marketing and Communications personnel.

• **AFVentures Augmentee Evaluator Training**

- **Oshkosh 2022 | In person** July 22 – 29, 2022
Each summer, more than 500,000 Experimental Aircraft Association Inc. members and aviation enthusiasts from 80 countries attend the weeklong EAA AirVenture Oshkosh at Wittman Regional Airport in Oshkosh, Wisconsin. This year's event included AFWERX personnel with support from the marketing and communications team. AFWERX booth space represented Agility Prime Partners, as well as all AFWERX divisions. The marketing team also supported multiple speaking engagements during the event.
- **AUVSI Xponential 2022 | In person** April 25-28, 2022
Xponential is a yearly gathering of global leaders and end users from the uncrewed systems and robotics industry. Founded on the belief that cross-pollination drives innovation, the event provides opportunities to connect and problem-solve with experts across markets and domains. AFWERX shared booth space with AFRL and coordinated speaking engagements for AFWERX personnel.
- **Spark Events | In person**
 - Spark Crossover, Lexington | June 21-24, 2022
 - Spark Summit 2022 | Las Vegas | Aug. 9-10, 2022

• **Social Media and Website Support**

AFWERX used a number of social media channels to deliver compelling and relevant content to increase program awareness. The platforms that AFWERX posts content to are LinkedIn, Facebook, Twitter, Instagram, and YouTube. AFWERX also uses email campaign options when appropriate to more precisely target recipients when a message is intended for a narrow audience. These posts and emails are used to communicate AFWERX developments related to policy or program changes; promote outreach activities, events, and other opportunities; solicit feedback from program participants; and increase advocacy for AFWERX from key stakeholders.

Social Media

Content was developed under one of two categories:

Shared Content: For AFWERX, shared content encompassed relevant industry news. Alerts were set up to be received as they happen, and were directed to a general AFWERX email account. At the start of, and periodically throughout each day, this email account was reviewed for any news items based on predetermined key phrases.

Planned Content: Planned social media content was developed by the AFWERX communications and marketing team to promote and communicate program activities, upcoming events, and material that highlighted the program philosophy and mission. A weekly planning calendar was produced and approved by leadership that provided a posting schedule and the content for each post. The Planned Content goal was to ensure that relevant posts occurred on a daily basis to keep AFWERX at the forefront of the Air Force and Small Business ecosystem.

Messaging and information that was shared via social channels publicized and promoted previously approved materials or information that was already made public. For example, success story graphics were created using quotes and images that were already approved by Public Affairs.

As a result of these efforts, all social media channels saw an increase in usage and reach, to include the following:

- Increased Followers since 2020
- LinkedIn 7,495 to 32,941 (4x increase)
- Facebook 1,563 to 5,409
- Twitter 3,463 to 8,630
- Instagram 281 to 3,203
- Facebook engagements doubled
- Instagram impressions increase threefold

No money was spent on social media advertising.

Website

The AFWERX website is a key component of communications efforts. It helps keep audiences up to date with program news and events, and provides a single location for vital details that describe program initiatives, processes, required forms, and access to supporting resources.

Information is clearly displayed, easily digestible, and relevant to the AFWERX mission and vision. The site has been designed to be responsive and easily navigated on mobile devices, and optimized to load quickly on any device.

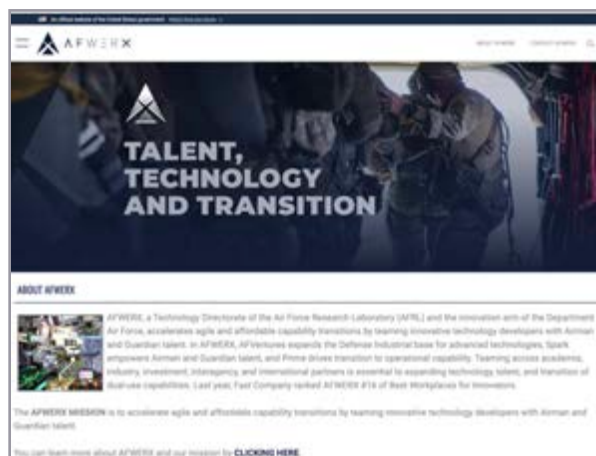
The Marketing and Communications team reviews the website to ensure material is as up-to-date as possible and coordinates with the Tech Team to update the site as needed. Every effort has been made to develop a constant flow of relevant content for the website.

Key features of the website include:

- Compliance with AFI 35-107 and other DoD and Air Force regulations as required

- Integration with the Defense Visual Information Distribution Service, DVIDS
- Program overview and details regarding leadership; organizational structure; processes; program announcements; and events such as webinars and conferences, and numerous other AFWERX-related events
- News and information
- Contact information, a program support form, and a list of frequently asked questions

Visit the website at <https://afwerx.com/>.



Editorial Support

The AFWERX Editorial Support team wrote and edited material for press releases, Success Story articles, program highlight articles, newsletters, annual overviews, and various other written communications. Content is written to clearly convey information according to industry standards, and the team strives to meet the information needs of a variety of audiences. They distill scientific or technological information for nontechnical audiences to help all stakeholders understand the AFWERX mission and how AFWERX efforts support DAF and DoD goals. Press releases detailed such program landmarks as the 2021 Space Pitch Day, Orbital Prime's launch, and Agility Prime's partnerships with private eVTOL developers. Success Story articles provided stakeholders with information about companies developing critical technologies with support from SBIR/STTR programs.

**EDITORIAL AND GRAPHICS
BY THE NUMBERS**

57	Infographics
38	Interactive PDF Pages
45	One-pager Overviews
14	Logos
21	Tradeshow Display Graphics
88	Annual Report Pages
10	Newsletters
13	Press Releases and Articles
582	Presentation Slides
881	Social Media Graphics
269	Web Banners

Graphics Support

The AFWERX Graphics team created graphics that visually clarify complex concepts. They also produced engaging images for Social Media, presentations, event displays, digital flyers, the AFWERX website, newsletters, and print publications. They adhere to all AFWERX branding guidelines, and provide support to all AFWERX Divisions.



Video Support

The AFWERX Marketing and Communications team produced videos to communicate small business successes and program highlights, as well as program

information vital to the small business community and stakeholders.

Videos were available via various platforms, including YouTube and DVIDS.

At the onset of the 2020 coronavirus pandemic, the Air Force heavily restricted air travel, impacting the video team's efforts to capture the successes of the AFWERX program. To mitigate this issue and to continue meeting expectations, the video team developed a virtual video kit that was sent to businesses and stakeholders to film their successes while recording the interview via the Zoom platform. The kit consists of an iPhone SE that captures video in 4k resolution, a tripod, a lavalier microphone, a ring light, and a laptop riser. A Success Story project showcasing NLign Analytics was the first to use the kit at Hill AFB with great success.

Highlights

Success Story: Figure Engineering has developed an innovative way to rapidly determine the health of coating removal solutions called SoluStat. SoluStat provides a direct method of measuring the process by following the electrons as they move through the chemical solution. It simulates a real part running through the process, revealing performance specifics in a fraction of the time without risking valuable aerospace parts. SoluStat provides capability to directly measure key aspects of material processes in a way previously not possible. <https://www.dvidshub.net/video/812788/figure-engineering-solustat>

Small Business and Prime Partnerships: "Lockheed Martin values the Air Force SBIR program, constantly allowing them the opportunity to collaborate and partner with the Air Force customer and leverage their R&D investment to achieve innovative technical solutions that benefit the warfighter. Being an active participant in the Air Force SBIR program has enabled Lockheed Martin to leverage their customers' investment in innovative research and development, bringing potential solutions to the technology roadmaps for many of their programs". <https://www.dvidshub.net/video/827615/primes-smalls-lockheed-martin-valley-tech-systems>

AFWERX FINANCIAL MANAGEMENT

The AFWERX Financial Division provides the highest quality financial services and products supporting Air Force Small Business, DOD customers, and AFWERX while maximizing effectiveness and efficiency for multiple program elements. Additionally, it ensures responsible stewardship and public accountability of resources and provides decision makers with accurate and timely financial information and decision support through strategic partnership, excellence, integration and continuous improvement of personnel, processes, and systems.

The AFWERX Financial Division is a model for AFWERX in both organizational efficiency and effectiveness, setting the standard on accountability, transparency and performance.

The AFWERX Chief Financial Officer is the financial authority for the Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (STTR) programs for the Department of Air Force (DAF). The AFWERX Finance Division centrally manages over \$1B annually within multiple program elements across the DAF to include planning, programming, financial reporting, and analyzing program resources to support innovation and build the United States industrial base through small business.

The Financial Division executes over 25% of the Department of the Air Force Research Laboratory's total obligation authority, seamlessly working across

the DoD to fund 4,000+ efforts annually. AFWERX FM finds success by focusing on people, hiring character and training skills. The RGF team is made up of positive attitudes, motivated and innovative out-of-the-box thinkers, self-starters, innovative and accountable team players, and self-confidence of work. AFWERX FM retains and grows its team by creating a positive and rewarding environment.

AFWERX Financial Management Milestones

- Executed \$1B for FY21 USAF & USSF SBIR/ STTR, Squadron Innovation Funds (SIF) & Tech Transfer; \$0 expired
- Implemented automation processes to generate funding documents, PR print to PDF, and Automated Time Attendance and Production System (ATAAPS) timekeeping reports, saving 1,000+ manhours per year. AFWERX FM was recognized by AFRL/FM Deputy Director as a leader in enterprise automation initiatives
- Championed 29 approved Acquisition Change Board requests totaling \$17M+, resulting in the transition of cutting-edge technology to the warfighter
- Accomplished 5 virtual Sprints, reviewing 1,000+ proposals for propriety of funds and automating 1,000+ PRs through innovative processes, resulting in ~\$600M in awards to US Small Businesses, which boosted economic growth and partnerships within the USAF and USSF

BUDGET GROWTH BY FISCAL YEAR (\$M)*



*DOES NOT INCLUDE THE AFWERX PRIME BUDGET

AFWERX HUBS



The AFWERX Hub in downtown Austin, Texas, is located in the Capital Factory.

The success of the AFWERX model has been predicated on new relationships and partnerships with academia, industry, investor, interagency, and international collaborators. In order for AFWERX to harness the aforementioned relationships, strategic regional positioning will be key. Key centers for regional innovation such as Austin, Texas; North Carolina's Research Triangle Park; Pittsburgh; or California's Silicon Valley offer turnkey access to the primary ingredients for innovation culture and opportunity due to their historic alignment with technology investment. Other areas of the United States may also provide promise for regional opportunity if they align with a compelling threshold of proximity to academic resources, appropriate industry activity, investor focus, interagency access, and local government commitment. It seems that COVID has begun to reshape some of the traditional tech hubs by providing additional opportunities for opening innovation centers across more locations.

Having an enduring presence is crucial to creating opportunities for sustainable local partnerships. Investors and tech startups are critical to maintaining the technological edge for innovation tech scouting. Schedule and predictability enable the industry partners to build trust in the government partners and assure that there is a sustainable pathway to success by doing business with the DOD. Small startups

and investors do not have the capital or patience to absorb schedule delays or deferred promises from the government. Any broken schedule or extended timeline may signal a lack of confidence in the technology or a breach of trust with the U.S. government. Either scenario could result in an error that prematurely defers private investment in good technology (thus extending a larger financial burden on the U.S. government for research and development), or dissuade similar industry partners from taking a chance with government partnership. Both scenarios are counterproductive to strategic national objectives of keeping promising American technology out of the hands of predatory adversary nations who intend to outpace the United States in a great technology power competition.

The ability to expand and contract into an area of interest is key to enabling AFWERX to follow technology cycles. AFWERX does not intend to invest or anchor into a location with hard asset brick-and-mortar locations; this allows AFWERX to keep pace with relevant movements in technology cycles while keeping costs low. AFWERX is also a mostly remote workforce, so enabling AFWERX to adjust numbers of membership work space as needed for a hybrid/mobile workforce allows AFWERX to remain relatively location agnostic and keep the aperture for talent open.



AFWERX Hub at the Capital Factory in Downtown Austin

Austin, Texas

AFWERX launched its Austin hub in June 2018. The hub is housed inside the Capital Factory, an entrepreneurial networking space in downtown Austin. A number of DAF senior leaders, including Air Force Chief of Staff General Charles Q. Brown Jr., have visited the AFWERX Austin Hub in recent years to witness the culture of innovation and teamwork present there. Col. Martin Salinas, AFWERX Deputy Director and Chief Operating Officer, leads activities on-site as the Austin team seeks to strategically

collaborate with the academic, investment, and industrial sectors of the city.

The Austin hub location is the forward, public-facing focal point for AFWERX operations in Texas. The space provides an innovative atmosphere for partnership-building activity with commercial industry and government stakeholders. It also provides the ideal setting for a briefing space for distinguished visitors, a rally point for AFWERX off-sites, and an intake space for public and private entities to seek information about AFWERX. As a collaboration space, it is ideal for facilitating engagement with local innovation partners such as Army Futures Command/Army Applications Lab, Defense Innovation Unit, National Security Innovation Network, Air Education and Training Command, and more.

The Austin hub is also a Senior Leader-led location for AFWERX. The success of this location is measured in part by influence, relationship building, and access to key stakeholders from the joint community, Air and Space Forces, and civic leaders. The hub has been the focal point for military senior leadership engagements culminating in visits from the SecAF, CSAF, CMSAF, JROC, and Office of the Governor of Texas. The hub will also be expected to engage with international military organizations for building innovation partnership capacity through international stakeholder engagements and overseas experimentation initiatives.



Leaders from the Joint Requirements Oversight Council receive a brief at AFWERX Austin

Dayton, Ohio

The AFWERX Dayton Hub opened in December 2020. Located near the downtown Dayton business district, it serves as a national hub of aviation innovation, making it an ideal location for an AFWERX presence. The innovation center fosters relationships between business owners, local universities and research institutions, capital investors, and the DOD to encourage innovation of new technological solutions.

The Dayton hub's close proximity to the research and development activity at Wright-Patterson Air Force Base bolsters its outreach potential. The base houses many program executive offices, along with the Air Force Research Laboratory headquarters, the Air Force Materiel Command headquarters, and functional AFWERX Finance, Contracting, and Legal divisions.

Additionally, Dayton's proximity to the Springfield-Beckley Municipal Airport makes it an ideal location for an AFWERX presence. This airport, critical to the Airworthiness Race between Agility Prime partnering companies, has been the site of several key testing activities on the road to commercial certification and raising public awareness of the AFWERX mission.

Additionally, the first eVTOL cargo certification was awarded in support of a "transportability" test for an eVTOL aircraft during a personnel recovery exercise initiative at Springfield-Beckley. The airfield offered proximity to the Air Force Mobility Command's Life Cycle Management Center, Air Transport Test Loading Activity (ATTLA) office team

to schedule an airworthiness evaluation of the eVTOL in its folded configuration. The folded aircraft was assessed as airworthy cargo on a military airlift aircraft. The test team planned to have an HC-130 aircraft, provided by the 563rd Rescue Group, fly from Davis-Monthan Air Force Base to Springfield-Beckley on March 23, pick up the prepared aircraft, and transport it to Bergstrom Airport in Austin, Texas. This operational evaluation opportunity was afforded by the proximity and availability of the aforementioned resources within the area of Springfield-Beckley and WPAFB.

Pittsburgh

The AFWERX Pittsburgh Hub was launched in January 2022. It is currently housed in the Swartz Center for Entrepreneurship, at Carnegie Mellon's Tepper School of Business. The hub is located next to CMU's Software Engineering Institute, a Federally Funded Research and Development Center that is a leader in cybersecurity and software development for the Defense Department. SEI can also accommodate workspace for sensitive and classified discussion.

Pittsburgh has a rich history of manufacturing and has stayed current by evolving that manufacturing focus to be one of the primary cities of innovation specific to Artificial Intelligence, Machine Learning, Robotics, and Infrastructure Technology. In addition to these technologies, Pittsburgh, thanks largely to the University of Pittsburgh and the University of Pittsburgh Medical Center, is an epicenter for Healthcare and Healthcare Technology Innovation.



To evaluate proximity and resource availability, an HC-130 aircraft provided by the 563rd Rescue Group flew from Davis-Monthan AFB to Springfield-Beckley Municipal Airport near Wright-Patterson AFB and the Dayton Hub to pick up an eVTOL for transport to Bergstrom Airport in Austin, Texas.

The Pittsburgh hub is able to be a conduit in the region - connecting all the integral stakeholders to advance great and important technology in America. As a collaboration space, CMU is ideal for facilitating engagement with local innovation partners such as Army Futures Command/Army Artificial Intelligence Integration Center, National Security Innovation Network, the ARM Institute - Advanced Robotics for Manufacturing, and much more.



The AFWERX Pittsburgh Hub at Carnegie Mellon

Washington, DC

Supporting a substantial footprint in the National Capital Region is essential to the success of AFWERX. As AFWERX strives to accelerate the adoption of emerging dual-use technologies, partnership with the joint, international, and interagency partners that work in the region is essential. To be successful, AFWERX is committed to collaborative tech adoption that builds flourishing commercial markets that are accessible to DOD in a way that creates greater affordability and broader national industrial capacity. Given these are emerging commercial markets, oftentimes there are regulatory hurdles across several agencies that industry must overcome to ensure there is an environment for these markets to thrive. AFWERX has already proven to be a key facilitator in providing data and risk mitigation measures for use across the interagency, creating fertile ground to grow these dual-use technologies while developing a properly-balanced regulatory approach that ensures protection without stifling innovation. Having a cadre of AFWERX innovators close to these interagency partners headquartered in the nation's capital is critical to mission success.

Besides the regulatory collaboration, the joint, international, and interagency community also represents a large population of potential early adopters for these dual-use technologies. In many cases, AFWERX projects cut across multiple services. Each year millions of dollars from other services go

towards AFWERX contracts. Additionally, given the dual-use nature of these technologies, many other government agencies can find key capabilities across the AFWERX portfolio that advance non-military government missions. Again, many of these agencies are significantly leveraging AFWERX contracts and even funding for Research, Development, Test & Evaluation, and procurement of this emerging tech. Lastly, it is important to remember the critical role of international partnerships in the security and prosperity of the U.S. and its allies. The dual-use portfolio has a unique attribute among technology portfolios developed in DOD organizations—these technologies could be sold for commercial use. As such, the breadth of international partnership cooperation could be much wider than might be possible in other DOD portfolios. These partnerships have the opportunity to not only grow the market for emerging technologies, but they could also provide critical capacity in times of natural disaster or contingency operations. Clearly the nation's capital is a nexus of activity for these joint, international, and interagency partnerships, and as such, it is a key area of operations for AFWERX in the development of a broader population of early adopters to mature these dual-use markets.

The AFWERX DC Hub operates primarily out of the Pentagon and the Basic Research Innovation Collaboration Center (BRICC), in a partnership with AFOSR and VT-Arc. The BRICC provides a collaborative environment for Airmen and Guardian-focused innovation training, Venture Capital engagement, research & data analytics, and technology transition & technology transfer (T2) pathway identification across the DOD. As AFWERX and the associated partnerships grow, there is the potential for additional collaboration locations in the NCR.



The Pentagon

Photo by Sgt. 1st Class Marisol Walker



The AFWERX Vegas Hub, located in the Howard Hughes Center

Las Vegas

The AFWERX Vegas Hub, located in Las Vegas, was opened on Jan. 11, 2018, by the Vice President of the United States, the Air Force Secretary, and the Air Force Chief of Staff. It is currently the DAF's largest innovation hub, providing approximately 25,000 square feet of collaborative space across two floors in the Howard Hughes Center, located one-third of a mile east of the world famous Las Vegas Strip. Most importantly, this hub is just miles away from the Air Warfare Center at Nellis Air Force Base, the center for Air Force combat airpower.

Former Vice Chief of Staff Gen. Stephen "Seve" Wilson stated, "The site is also a storefront... that is willing to take ideas from people who walk in off the street and have ideas to offer." Wilson said the location was chosen for numerous reasons: 1) "seven million people a year" go there, 2) it has proximity to two Air Force bases (Nellis & Creech), 3) huge consumer electronics shows are held in Las Vegas, 4) a big convention appears "every week" in the city, 5) the hub's proximity to Silicon Valley, Los Angeles,

"West Coast labs," and other West Coast pockets of innovation, 6) "and it's a destination unto itself."

The Vegas hub consists of event space, breakout rooms, coworking space, and a prototyping lab. It has provided a venue to connect thousands of people with the DAF, including academia, entrepreneurs from across the country, large defense contractors, and small businesses, among other groups. AFWERX Vegas serves as a physical hub for innovators to collaborate and accelerate results to the frontlines. At AFWERX Vegas, one of the ways innovators can bring solutions to life is through the AFWERX Challenge Process, which was developed at the Vegas hub. AFWERX Challenge is a new acquisition model to find solutions using nontraditional pathways to meet Air Force needs. Examples of two successes born out of the AFWERX Challenge process are the development of the new fighter pilot helmet (currently competing in a fly-off at Nellis AFB, NV) and the base of the future (currently being imagined, developed, and built at Tyndall AFB, FL).



Department of the Air Force Chief Scientists receive a brief at AFWERX Vegas



AFWERX Fusion event hosted by AFWERX Vegas

Los Angeles

The SpaceWERX hub in Los Angeles is poised to leverage a rich ecosystem of aerospace technology. Southern California has been home to aviation and aerospace research, development, and manufacturing since the early 1900s, spawning a generations-deep, well-educated aerospace workforce that continues to support the industry today. When NASA initiated its series of space-exploration missions in the late 1950s, aerospace companies in Southern California became primary partners. The Explorer 1 probe, Apollo command module, the Surveyor lunar landers, the Viking Mars landers, and all five space shuttles were built in SoCal. As a result, the region quickly became the country's economic hub for rocket and spacecraft design and construction. Concurrently, the Air Research and Development Command's Western Development Division was establishing the foundation for military space architecture. With this rich history in space technology development, Los Angeles is the ideal location for a SpaceWERX hub.

Los Angeles has played (and continues to play) a key role in serving the nation's space goals. Paired with the region's strong aerospace heritage, the emergence of new space companies means Los Angeles is poised to push the boundaries of the technology and business models that define the space industry. This is a prime ecosystem for SpaceWERX to access the top talent and technology from a strong university, industry, and government base.

The SpaceWERX hub operates primarily out of Los Angeles Air Force Base to maintain a close connection with the Space Systems Command, the center for Space Force acquisition activity. This location allows for access to some of DAF's premier space acquisitions experts and is also in close proximity to federally-funded research and development centers, such as the Aerospace Corp. and Rand Corp. Each plays a key role in maintaining U.S. space superiority and providing important space-policy analysis.



Photo by Van Ha

The SpaceWERX hub, located within Space Systems Command

North Carolina

AFWERX opened its North Carolina hub in October 2022 at the First Flight Venture Center, located in the heart of the state's Research Triangle Park. The North Carolina hub, under the strategic innovation and partnerships focus, is working to build strong partnerships with the military, state and local public safety, academia and industry.

The hub is already plugged in with the local Gryphon Spark Cell at Pope Army Airfield, Army Research Office (ARO), National Security Innovation Network (NSIN), NavalX Eastern North Carolina Tech Bridge, North Carolina Military Affairs Commission (NCMAC) North Carolina Military Business Center (NCMBC), North Carolina Defense Technology Transition Office (DEFTECH) and others. In addition, the hub is working towards an Educational Partnership Agreement (EPA) for AFWERX with the University of North Carolina System. The multi-campus system encompasses 16 universities and the North Carolina School of Science and Mathematics, the nation's first public residential high school for gifted students. The hub is focused on supporting

the efforts of each of the AFWERX divisions across North Carolina and the east coast.

The First Flight Venture Center, located in the heart of Research Triangle Park, has more than 30 years' experience successfully launching startups and promoting innovation across the state. The Research Park Triangle—which consists of Raleigh, Durham, and Chapel Hill—has a history and culture of entrepreneurship, accessibility, business resources, and tax incentives. Research Triangle Park is North America's largest research park and remains one of the most successful science parks across the globe.

North Carolina has the fourth largest military footprint in the country as well as an active network of companies, universities, governments, and economic development organizations. Furthermore, North Carolina has a strong innovation ecosystem with companies specializing in artificial intelligence/machine learning, unmanned systems, autonomous systems, data analytics, biotech and cybersecurity, plus many suppliers to the automotive and aerospace sectors.



The AFWERX North Carolina Hub, located within First Flight Venture Center



The AFWERX patch holds layers of meaning that represent the transformative goals of the organization that are well beyond technology innovation. AFWERX seeks a cultural change in the Department of the Air Force that transforms national defense capabilities and processes.

The phrase arched across the top, "Hoc Faciendum Est," has two meanings, both significant to the AFWERX Mission: 1) the Latin equivalent of "Get Things Done", meaning that AFWERX is an action-based organization transitioning fielded solutions for the warfighter, and 2) "This Must Be Done," meaning that the Department of the Air Force must embrace a culture that attracts talent, capital, and technologies from a breadth of stakeholders to accelerate change.

The binary code on the patch's left side represents the AFWERX founding date: January 11, 2018 (or 11 01 18, coded numerically). On this day, the Vice President of the United States and the Secretary of the Air Force publicly launched AFWERX at the Las Vegas Hub. Additionally, this binary code is a nod to the organization's duty to the cyberspace mission.

The four stars and the satellite on the right side of the emblem hold a twofold significance: 1) to symbolize the direct and public support AFWERX has received from the top 4-star leadership across the Department of the Air Force, and 2) to showcase AFWERX and SpaceWERX responsibility to the space mission, which is also represented by the satellite against a black background.

The triangular arrowhead-shape represents the support to the warfighter and the AFWERX mission of spearheading innovation for enduring strategic advantage. The gear surrounding the logo is similar to the logo of the Air Force Materiel Command, which is the machine that builds the tools used by the Department of the Air Force.

In the center of the patch is the AFWERX logo, a futuristic aerospace plane symbolic of AFWERX's support for the USAF and USSF air and space mission, as well as the three core divisions: AFVentures, Spark, and Prime. The "X" in the center is indicative of the "X-planes" that propelled aerospace technology, as well as the crossroads where multiple stakeholders meet to collaborate in building the future. The AFWERX text across the bottom is divided with miniature AFWERX logos into "AF*WE*R*X," or "Department of the Air Force, We Are X," to communicate that the Department of the Air Force can be the "X factor" that revolutionizes transportation, transforms national defense, creates entirely new industries, and breaks bureaucracy for the good of the nation.



AFWERX

2.0 PROGRAM OVERVIEW