



MISSISSIPPI DEFENSE DIVERSIFICATION INITIATIVE



Federal Labs Best Practices in Innovation, Tech Transfer and Community Engagement January 2018

**PROMOTING INNOVATION,
DIVERSIFICATION AND COOPERATION IN
THE MISSISSIPPI DEFENSE COMMUNITY**



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SOUTHERN MISSISSIPPI

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Mississippi Defense Diversification Initiative

Federal Labs Best Practices in Innovation, Tech Transfer
and Community Engagement
January 2018

MARTLET
STRATEGIES



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This material was prepared under contract with the National Security Technology Acceleration Support and Economic Diversification Efforts for the State of Mississippi, with financial support from the Office of Economic Adjustment, Department of Defense. The content reflects the views of the National Security Technology Acceleration Support and Economic Diversification Efforts for the State of Mississippi and does not necessarily reflect the views of the Office of Economic Adjustment.

Abstract

Federal Labs Best Practices in Innovation, Tech Transfer and Community Engagement

The system of US Government Laboratories is a network of the labs themselves, along with supporting organizations. This report focuses on Federal Labs who operate in the Defense sector and identifies best practices in innovation, technology transfer and community engagement.

As the Mississippi Defense Diversification Initiative is focused on the Blue Economy, National Security and Aerospace and Defense sectors, labs operating in those areas were reviewed.

Several common themes were identified across these organizations that, when present, did seem to contribute to success in innovation, tech transfer and community engagement. These organizations had clearly stated missions, excellent external communications and outreach; they built on extensive sector expertise and sought to solve real problems. They acted locally, while leveraging their regional, national and/or global reach.

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About this Report

This report was compiled for the Mississippi Defense Diversification Initiative (MDDI) to compile best practices and activities at Federal Labs across the US to inform MDDI's work with Federal Labs in Mississippi to promote local, regional and statewide economic development. As MDDI is focusing on three target sectors – the Blue Economy, Aerospace and National Security – particular attention was paid to other regions having clusters in those sectors.

A scan of Federal Labs was done to identify notable and successful activities in several areas including public private partnerships, community engagement, industry and sector collaboration, innovation inside the labs, university and lab relationships and successes in tech transfer and joint project/product development.

There are several types of organizations that could fall into the category of Federal Labs. For this report, the concentration is on labs that are run and funded by the US Government, but descriptions of other federal lab initiatives are included in the introduction below. In addition, some labs not operated by the government, but run by contractors (GOCOs) are included, as are some agency Centers of Excellence or similar entities because their practices and outcomes represent valuable lessons. Finally, there are public and private organizations that provide resources for Federal Labs, and many of those are identified in this report.

In cases where information has been taken from a website, the content may have been lightly edited for conciseness and print publication and links to all websites are included and acknowledged by reference.

The US Government Labs System – A Network of Resources

Department of Defense (DoD) Laboratories

DoD Laboratories engage in activities ranging from basic research through defense system acquisition support to direct operational support of deployed warfighters. These Laboratories are comprised of dozens of facilities across 22 states and employs tens of thousands of both civilian and military scientists and engineers, public employees and contractors.

Defense Laboratory Enterprise Research Directorate

The Office of the Assistant Secretary of Defense for Research and Engineering (OASD(R&E) grew out of the Research and Development Board formed with the Department of Defense in 1947. The OASD(R&E) has four directorates: Research, Systems Engineering, Rapid Fielding, and Developmental Test and Evaluation.

The [Defense Laboratory Enterprise Research Directorate](#) has policy and oversight responsibility for DoD programs in basic research, applied research, advanced development, and advanced components and prototypes. Its mission is detailed [here](#) and an extensive and [searchable directory](#) is available. The website of the Defense Laboratory Enterprise Research Directorate contains an extensive listing of the various sub-Directorates and outlines their activities.

Defense Innovation Marketplace

The [Defense Innovation Marketplace](#) is an initiative that brings together industry and DoD to foster collaboration and communication and meet the needs of industry to have current information on DoD investment priorities to help them plan their Independent Research and Development (IR&D) projects and provide DoD with insight into industry projects. The [website](#) details the resources and processes as well as a protected space to share proprietary IR&D summary reports.



➤ COMMUNITIES OF INTEREST

Within the Defense Innovation Marketplace, there are several [Communities of Interest](#) including the following that are aligned with Mississippi Defense Diversification Initiative target sectors:

- [Advanced Electronics](#)
- [Air Platforms](#)
- [Autonomy](#)
- [Energy and Power Technologies](#)
- [Ground and Sea Platforms](#)
- [Materials and Manufacturing Processes](#)
- [Sensors](#)
- [Space](#)
- [Weapons Technologies](#)

➤ THE TECHNICAL COOPERATION PROGRAM (TTCP)

The DoD Laboratories office also supports the department's engagement with [The Technical Cooperation Program \(TTCP\)](#), an international organization that collaborates in defense scientific and technical information exchange, program harmonization and alignment, and shared research activities for the "Five Eyes" nations (Australia, Canada, New Zealand, the UK and the US).

➤ **RAPID INNOVATION FUND**

The [Rapid Innovation Fund](#) provides a collaborative vehicle for small businesses to provide the department with innovative technologies that can be rapidly inserted into acquisition programs that meet specific defense needs. RIF is administered by the Office of the Secretary of Defense (OSD), Assistant Secretary of Defense for Research and Engineering (ASD R&E) and the Office of Small Business Programs (OSBP). A detailed [program overview](#) explains the bottom line goal of the Fund - to transition small business technologies into defense acquisition programs. Over \$1.4 billion was invested between 2011-2016, with 88% (486) of all awards going to small businesses and more than half going to SBIR recipients. Examples of successful projects detailed include:

- **Plasma Electrolytic Oxidation Nano-Ceramic Coating** (Air Force & IBC Materials): Demonstrated an improved nano-ceramic coating based on additive manufacturing, increasing the life and wear of missile launcher rails for F-15, F-16, and F/A-18 aircraft, reducing maintenance and downtime costs.
- **Extended Frequency Range Wide Band RF Distribution System** (Navy & Out of the Fog Research): Uses on a shipboard mast-mounted communications component that filters, blanks interfering signals so that very low level power signals of interest can be received. Manufactured by a Silicon Valley company and fielded an on Ships Signal Exploitation Equipment (SSEE) antenna.

Centers of Excellence

Many federal agencies have Centers of Excellence (COE) which may be run by the agency or a partner, including many that are managed by universities.

For instance, within the Department of Homeland Security, there are several science and technology [Centers of Excellence](#) that develop multidisciplinary, customer-driven, homeland security science and technology solutions and help train the next generation of homeland security experts. Below are three examples:

- [Coastal Resilience Center of Excellence \(CRC\)](#), led by the [University of North Carolina at Chapel Hill](#), conducts research and education to enhance the Nation's ability to safeguard people, infrastructure, and economies from catastrophic coastal natural disasters such as floods and hurricanes.
- [Critical Infrastructure Resilience Institute \(CIRI\)](#), led by the [University of Illinois at Urbana-Champaign](#), conducts research and education to enhance the resilience of the Nation's critical infrastructure and its owners and operators.
- [Maritime Security Center of Excellence \(MSC\)](#), led by [Stevens Institute of Technology](#), enhances Maritime Domain Awareness and develops strategies to support Marine Transportation System resilience and educational programs for current and aspiring homeland security practitioners.

Federal Labs Consortium



[The Federal Labs Consortium \(FLC\)](#) is a nationwide network of approximately 300 federal laboratories, centers, parent departments, and agencies that establishes strategies and opportunities for linking laboratory mission technologies and expertise with the marketplace. To accomplish its mission of assisting the movement of innovative federal research and development into the U.S. economy, the FLC

provides various resources including training and regional and national meetings so its members can obtain the resources they need to achieve successful technology transfer.

With a mission to support the Government's larger lab-to-market initiatives, the FLC website offers a robust group of technology transfer tools under the umbrella of the [T2 Toolkit](#):

- [FLC Learning Center](#) - a variety of training courses and instructional materials available on demand, through regional events, access to external resources
- [Technology Locator Service](#) - immediate, personalized search assistance and referrals to connect with federal laboratory expertise and technologies
- [T2 Mechanisms](#) – sample documents covering all types of agreements to facilitate partnerships and collaborations with Federal Labs
- [T2 Playbook](#) – a series of “plays” that can be used to navigate the commercialization process

[FLC Business](#) enables searchers to look across the entire system of hundreds of federal lab and facility profiles in a single search. It is a comprehensive search database, updated regularly, that allows users to easily search and view available federal laboratory profiles, equipment and facilities, programs, and funding opportunities. The database benefits users with its intuitive search capability, allowing the bank of information to be searched using various specifications such as technical area, geographic area or agency.

The FLC community is a vast network that is broken down by Consortium Members and Consortium Participants and includes academic institutions as well as industry. All of the FLC community has aggregated access to high-quality T2 tools, services, and connections for facilitating the commercialization process that no other organization offers. From industry partners to member laboratories and participants, being part of the FLC community is intended to open doors to federal resources and business opportunities that otherwise are not readily available.

[FLC Partners](#) are like-minded government and industry organizations, and academic institutions aimed at connecting federal innovations with industry to accelerate technology transfer. Partners include organizations like the [Association of University Research Parks](#), [Association of University Technology Managers](#), [TechConnect](#), [SSTI](#), [TechLink](#) and [Autoharvest](#), among others.

Federally Funded Research and Development Centers (FFRDCs)

A [report to Congress published in December 2017](#) on FFRDCs provides background on their current state. As they are not federally operated, they are not addressed in detail in this document, but the 2017 report provides extensive information on the 42 FFRDCs, their operations and focus.

By way of background and from this report: “The federal government supports research and development (R&D) that is conducted by a wide variety of performers, including federally owned and operated laboratories, universities, private companies, and other research institutions. A special class of research institutions referred to as federally funded research and development centers, or FFRDCs, are owned by the federal government, but operated by contractors, including universities, other non-profit organizations, and industrial firms. FFRDCs are intended to provide federal agencies with R&D capabilities that cannot be effectively met by the federal government or the private sector alone.

FFRDCs are required to have a long-term strategic relationship with the federal agency that supports them. This relationship is presumed to convey a number of benefits, including the ability of an FFRDC to recruit and retain scientific and technical expertise; an in-depth knowledge of, and the capability to rapidly respond to the R&D needs of the federal agency; and the capacity to offer independent and objective scientific and technical advice. Currently, 12 federal agencies sponsor a total of [42 FFRDCs](#). These FFRDCs provide R&D capabilities in support of federal agency missions in a broad range of areas—from energy and cybersecurity to cancer and astronomy. In FY2015, the federal government obligated \$11.1 billion or 8.6% of its total R&D spending to FFRDCs.”

University Affiliated Research Centers (UARC)

[University Affiliated Research Centers](#) are not-for-profit entities sponsored and primarily funded by the U.S. government to address technical needs that cannot be met as effectively by existing government or contractor resources.

An [Engagement Guide for working with UARCs](#) was published in 2013 and is designed to inform members of the DoD community about the Department’s strategic relationship with DoD-sponsored University Affiliated Research Center (UARC) laboratories that conduct science, technology, and engineering work on their behalf. The Guide provides information about the capabilities of the DoD UARCs (shown in the list below).

University Affiliated Research Centers

Primary Sponsor	University	UARC
Army	University of California at Santa Barbara	Institute for Collaborative Biotechnologies
Army	University of California at Santa Cruz	Ames Research Center
Army	University of Southern California	Institute for Creative Technologies
Army	Georgia Institute of Technology	Georgia Tech Research Institute
Army	Massachusetts Institute of Technology	Institute for Soldier Nanotechnologies
Navy	Johns Hopkins University	Applied Physics Laboratory
Navy	Penn State University	Applied Research Laboratory
Navy	University of Texas	Applied Research Laboratories
Navy	University of Washington	Applied Physics Laboratory
Navy	University of Hawaii at Manoa	Applied Research Laboratory
Missile Defense Agency (MDA)	Utah State University	Space Dynamics Laboratory
National Security Agency (NSA)	University of Maryland College Park	Center for Advanced Study of Language
National Security Agency (NSA)	Stevens Institute of Technology	Systems Engineering Research Center
STRATCOM	University of Nebraska	National Strategic Research Institute

National Institute of Standards and Technology (NIST)

A part of the Department of Commerce, the mission of [NIST](#) is to assist industry in the development of technology needed to improve product quality, to modernize manufacturing processes, to ensure product reliability and to facilitate rapid commercialization of products based on new scientific discoveries.

NIST publishes [summary reports on technology transfer from all Federal agencies](#) and the last year covered is 2014. The organization also manages the [Lab to Market](#)

initiative, funded by Congress to “increase the economic impact of federally-funded research and development by accelerating and improving the transfer of new technologies from the laboratory to the commercial marketplace.” NIST coordinates several interagency activities related to Lab to Market and has developed supporting tools and practices, including measurement and evaluation.



The [Small Business Innovation Research Program](#) (SBIR) program is managed by NIST.

NIST has partnered with Maryland’s [TEDCO](#) on a unique research-to-entrepreneurship program. The Maryland State Legislature created [TEDCO](#) in 1998 to facilitate the transfer and commercialization of technology from

Maryland's research universities and Federal Labs into the marketplace and to assist in the creation and growth of technology-based businesses in all regions of the State.

The TEDCO/NIST partnership runs [N-STEP, the NIST – Science and Technology Entrepreneurship Program](#). The goal of the program is to provide opportunities for motivated researchers to build upon the experience gained while working at NIST as they explore entrepreneurial careers. The Program is focused on commercialization of research that has been done at NIST. It also aids researchers that are interested in forming companies to independently pursue further translational research and develop technologies specifically related to NIST's mission, so that the technologies can be commercialized as products or services to benefit the public.

The pages that follow contain profiles of individual Federal Labs that may be informative to communities undertaking defense diversification activities that include working with local labs.

Department of Energy, Argonne National Laboratory

Located outside of Chicago, IL, [Argonne](#) is managed by [UChicago Argonne, LLC](#), for the [U.S. Department of Energy's Office of Science](#).

➤ TECHNOLOGY COMMERCIALIZATION AND PARTNERSHIPS

A primary objective of the U.S. Department of Energy (DOE) laboratories is to promote the economic interests of the United States by facilitating development, transfer, and use of federally owned or originated technology to industry for public benefit and to provide industry, state and local governments, and other federal agencies access to DOE resources to help them solve challenges and seize opportunities. Argonne's [Technology Commercialization and Partnerships Division](#) works proactively with Argonne research divisions and selected industry partners to develop commercialization strategies, seek partners with new applications and introduce advancements into commercial use through licenses and start-ups.

➤ COLLABORATION CENTERS

[Argonne Design Works](#) (ADW), the [Argonne Collaborative Center for Energy Storage Science](#) (ACCESS), and [National Security Programs](#) provide central points of contact for companies — ranging from large industrial entities to smaller businesses and startups, as well as government



agencies — to benefit from Argonne's world-class expertise, scientific tools, and facilities in the nano and energy storage fields. The centers provide a pathway to Argonne's fundamental research that is poised for development into practical products.

- [Argonne Design Works](#) provides customized access to fundamental research that can address industry's most enduring R&D challenges, as well as discovery science conducted at Argonne that is already poised for development into practical products. The chance to build on existing scientific discovery, as well as pioneer new discoveries, offers unique opportunities for businesses seeking to innovate with complex technologies. ADW will help speed discoveries to market, ensuring U.S. industry maintains a lead in the global technology race. Accessing the full potential of Argonne's resources, ADW offers a liaison that can navigate the complete spectrum of the laboratory's capabilities, cutting across all the diverse scientific fields represented at Argonne. This concierge approach will help industries benefit from access to cutting-edge facilities beyond the research budgets of most firms.

➤ PROGRAM FOR INNOVATORS IN ENERGY AND SCIENCE: CHAIN REACTION INNOVATIONS (CRI)

Developing a great idea into a technology that impacts the market and the world is difficult. Doing so with an energy- or science-based technology can seem nearly impossible. Complex technical challenges, long development cycles, expensive lab equipment, and impatient investors create high hurdles for even the most determined innovators to overcome, often leaving innovators feeling isolated.

[Chain Reaction Innovations](#) (CRI) is a new two-year program for innovators focused on energy and science technologies. Through an annual call, four to six teams are selected to join CRI. The goal of CRI is to give the nation's brightest energy and science innovators the best chance at success.

What sets Chain Reaction Innovations (CRI) apart from other area incubators is its ability to embed energy and science entrepreneurs in a national laboratory and give them hands-on support in using the cutting-edge research tools housed there. CRI matches innovators with Argonne scientists and engineers to collaborate on developing technologies and shows those innovators how to optimize the use of one-of-a-kind R&D equipment to expedite discovery and reduce the need for costly and timely trial-and-error testing.

Embedded innovators will have access to Argonne’s deep network of more than 1,600 multi-disciplinary scientists and engineers, as well as unique tools, including the Mira supercomputer and the nation’s highest-energy X-ray source, the Advanced Photon Source. While industry often contracts with Argonne to use its R&D tools and collaborate with researchers, the CRI program will provide an unprecedented level and continuity of access for two years that is beyond the means of small companies and startups. The ability to use office space at the laboratory will also put innovators in constant contact with leaders in scientific research to spur collaboration and cross-pollination of ideas from multiple science and engineering disciplines.

Project examples from Chain Reaction Innovations:

- [Development of a soot-free engine for heavy-duty applications](#)
- [Membrane-Free Electrochemical Devices](#)
- [A novel radioisotope battery made from nuclear waste](#)

By 2050, the world’s population will grow by 33 percent, much of it an emerging middle class that will contribute to energy demand that is five times greater than that of today. At the same time, leading scientists say we need to reduce greenhouse gas emissions by 80 percent. The only way to accomplish both is to develop revolutionary new technologies.

These technologies will create a more sustainable future and forever change the lives of the nearly 1.4 billion people who currently have no access to power and the billions more with unreliable power.



Department of Energy, Oak Ridge National Laboratory



Oak Ridge National Laboratory (ORNL) is home to—and a partner in—a number of Hubs, Centers, and Institutes including the [Consortium for Advanced Simulation of Light Water Reactors \(CASL\) Energy Innovation Hub](#), and a partner in the [Critical Materials Institute Energy Innovation Hub](#) (CMI). Established in July

2010, CASL was the first DOE Energy Innovation Hub, while CMI is the latest hub to be funded.

The [Science and Technology Partnerships Directorate](#) at Oak Ridge National Laboratory serves as the focal point for technology commercialization, entrepreneurship, business and economic development, and the furthering of Educational Instructional Partnerships for the Department of Energy as it relates to Oak Ridge National Laboratory. Their mission is to grow the economy by advancing technology commercialization of scientific discoveries at Oak Ridge National Laboratory and encouraging entrepreneurship while promoting business opportunities.

➤ INDUSTRY COLLABORATION

The Department of Energy’s first [Manufacturing Demonstration Facility](#), established at Oak Ridge National Laboratory located in Oak Ridge, TN, outside Nashville, helps industry adopt new manufacturing technologies to reduce life-cycle energy and greenhouse gas emissions, lower production cost, and create new products and opportunities for high-paying jobs. The facility focuses on additive manufacturing, carbon fiber and composites, lightweight metals processing, roll-to-roll processing, magnetic field processing, low temp materials synthesis and battery manufacturing. Aiming to attract industry partners, the MDF strives to make it easy to do business with them with a sample [CRADA](#) and a [partnership schema](#) focused around “Assess, Assist, Collaborate.” The MDF operates as a portal for manufacturing industries to access the extensive expertise and capabilities of ORNL. The MDF comprises laboratories located on the main campus of ORNL and well as two nearby offsite locations.

There are several success stories from the Manufacturing Demonstration Facility available [here](#), including the following:

- [Additive Manufacturing for Low Volume Bearings](#)
- [Viability of using carbon fiber reinforced ABS plastic and the Big Area Additive Manufacturing \(BAAM\) technology to rapidly manufacture molds for the precast concrete industry](#)

➤ **SMALL BUSINESS COLLABORATION**

The [Small Business Voucher](#) program facilitates access to the DOE national labs for American small businesses, enabling them to tap into the intellectual and technical resources needed to overcome critical technology challenges for their advanced energy products and gain a global competitive advantage. Its mission is to significantly increase the industrial impact of labs on the U.S. clean energy sector and the DOE national program operates annually with a competitive selection process. Eight DOE national laboratories will receive funding to partner with 38 competitively selected small businesses across the country in the latest round awarded in 2017. Read the [program overview](#). Move the insert – too hard to read across it



➤ **ROBUST PROGRAM SUPPORTING RESEARCH WITHIN THE LAB**

[Laboratory Directed Research and Development](#) (LDRD) supports cutting-edge research across ORNL. Its objective is to maintain the vitality of the Laboratory, enhance the Laboratory's ability to address future DOE missions, and to stimulate exploration at the forefront of science and technology. The program has three major components: the Director's R&D Fund, which develops new capabilities in support of the Laboratory's research initiatives, the Seed Money Fund, which is open to all innovative ideas that have the potential for enhancing the Laboratory's core scientific and technical disciplines, and the Named Fellowships, open to outstanding doctorate-level candidate scientists and engineers to achieve experience in areas of science and technology of national importance. LDRD projects are led by ORNL research staff members and often involve collaborations with university researchers.

Recent Success Stories at Oak Ridge National Lab include the following:

- [The Big Area Additive Manufacturing-CI system](#) was developed by ORNL researchers and Cincinnati Incorporated. BAAM-CI, a large-scale additive manufacturing platform, allows arbitrary geometric components to be 3-D printed on a scale 10 times larger than any other commercial system. The system's screw-extrusion technique also allows the BAAM-CI to deposit material 200 times faster than existing processes. BAAM-CI is also the first manufacturing project capable of depositing carbon fiber reinforced plastic into printed materials, endowing objects with greater strength and four to seven times the material's original stiffness. In addition, BAAM-CI remains more energy efficient than traditional manufacturing methods like stamping and blow molding. BAAM-CI also received an Editor's Choice award from R&D Magazine.

Funding for the project was provided by ORNL's Laboratory Directed Research and Development program and DOE's Advanced Manufacturing Office.

- [Hyperion, or Automated Behavior Computation for Compiled Software](#), was developed by a team of ORNL researchers. The product assesses and computes software or malicious behavior with precise mathematics to prevent inappropriate or illegal access to computer systems. Since adversaries often exploit a system's unknown behavior to accomplish their goals, Hyperion is constructed with the unique ability to identify and calculate all unknown inputs under all possible circumstances without any examining codes. A second feature allows Hyperion to capture, share and reuse malware analyst intelligence to detect and eliminate malicious behavior in future scenarios. Hyperion was [licensed](#) to Virginia-based R&K Cyber Solutions, LLC, in late 2014.

Funding for Hyperion was provided by ORNL's Laboratory Directed Research and Development program, Lockheed Martin, Applied Communication Sciences and DOE's Cybersecurity for Energy Delivery Services program.

National Aeronautics and Space Administration

[The Space Technology Mission Directorate](#) has prioritized funding opportunities for public-private partnerships to achieve NASA's goals of expanding capabilities and opportunities in space.

These solicitations increase focus on collaborations with the commercial space sector that not only leverage emerging markets and capabilities to meet NASA's strategic goals, but also focus on industry needs. Through "[Tipping Point](#)" solicitations, NASA is seeking industry-developed space technologies that can foster the development of commercial space capabilities and benefit future NASA missions. A technology is considered at a tipping point if an investment in a demonstration of its capabilities will result in a significant advancement of the technology's maturation, high likelihood of infusion into a commercial space application, and significant improvement in the ability to successfully bring the technology to market. These technologies should also bring substantial benefit to both the commercial and government sectors upon completion.



➤ INDUSTRY COLLABORATION

[NASA Research Park](#) (NRP) at NASA Ames Research Center in Silicon Valley is a world-class shared-use R&D and education campus for industry, academia, non-profits, and government. NRP provides a physical place for innovation and entrepreneurship and serves as a technology accelerator through fostering both informal and formal collaborations. Today the NRP houses over 70 industry and university partners, with commercially standard leases, onsite collaborating with NASA on a variety of technologies and disciplines. Incomplete sentence?

As a technology accelerator, the NRP is pursuing the White House goals, "Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses", as expressed in the October 28, 2011 Memo to Heads of Executive Departments and Agencies. The NRP has many startups, and five companies that started in the NRP with only intellectual property and a plan are now employing thousands in Silicon Valley including [Bloom Energy](#), Tibion, Apprion, Nanostellar and [Benetech](#).



NASA Research Park has been successful in creating a scalable and replicable collaborative, business and leasing model. The NRP worked closely with local, regional, state and federal elected officials in the planning for the NRP, securing a 5 million square foot entitlement for new onsite construction through the National Environmental Policy Act, completing

NASA's publication, [Spinoff](#), features stories of NASA technologies that are benefiting life on Earth in the form of commercial products. Over 2,000 spinoffs have been profiled since the publication began in 1976.



the approved Environmental Impact Statement process in 2002. Ames demonstrated the ability to utilize the Enhanced Use Leasing Authority (EUL – see note below) program to execute leases of existing building space to many technology start-ups and universities. Two large separate ground leases for new construction with Planetary Ventures LLC (Google) and University Associates LLC (University of California) have been started, where they design, build and maintain their buildings through the term of the lease.

NRP prospects (only R&D and educational organizations are considered) go through a thorough programmatic vetting/screening process. NRP's partnership selection criteria outlines "mission compatibility" and "program support capacity". Ames Senior Management and Pursuit Registry Board approve all prospects, as does NASA Headquarters, before a lease commences.

*Note: **Enhanced Use Lease (EUL)** is a method for funding construction or renovations on federal property by allowing a private developer to lease underutilized property, with rent paid by the developer in the form of cash or in-kind services. Currently, EULs are used by the Department of Defense and the Veterans Administration. Temporary authority has also been granted to the General Services Agency and the National Aeronautics and Space Administration. EUL authority is derived from Congress and is specific to each agency.*

The Army Corps of Engineers in Baltimore District has several [examples of successful EUL projects](#)

➤ INNOVATION IN TECHNOLOGY LICENSING

NASA has launched the [Automated Technology Licensing Application System](#) (ATLAS) as a listing of more than 1,400 technologies available to be licensed and has developed a new system to streamline the way NASA patented innovations are licensed to the private sector.

National Institutes of Health

➤ STARTUP CHALLENGE

In 2013, the National Cancer Institute (NCI), in partnership with the Center for Advancing Innovation (CAI), created a startup challenge model as a new way to move promising, early-stage NIH technologies to the market. Later that year NCI, CAI and a philanthropic partner, the Avon Foundation for Women launched the Breast Cancer Startup Challenge – a first-of-a-kind, international, university-based competition. This [white paper](#) describes how the Startup Challenge Model was used to create a challenge that successfully advanced a variety of breast cancer technologies from the discovery stage to commercialization. It also presents some best practices that the organizers learned through the process.

U.S. Air Force Labs

The [Air Force Research Lab](#) is leading the discovery, development and integration of warfighting technologies for our air, space and cyberspace force. Its many labs work on technologies such as missiles, unmanned and hypersonic vehicles, laser systems and high-power electromagnetics, and their breakthroughs can be found in all of today's modern military aircraft and weapons systems, including the C-17 Globemaster III, F-22 Raptor and B-2 Spirit. Projects underway include wearable and portable technologies for airmen/women and a drone technology that allows a person to fly more than one remotely piloted aircraft at a time.

Air Force Research Lab – Aerospace Systems Directorate

With headquarters at Wright-Patterson AFB, Ohio, and an additional research facility at Edwards AFB, CA, the [Aerospace Systems Directorate](#) leads the effort to develop and transition superior technology solutions that enable dominant military aerospace vehicles. Areas of focus include vehicle aerodynamics, flight controls, aerospace propulsion, power, rocket propulsion, aerospace structures, and turbine engines. Programs advance a wide variety of aerospace technologies including unmanned vehicles, space access, advanced fuels, hypersonic vehicles, future strike, and energy management.

- **PUBLIC PRIVATE PARTNERSHIP, REGIONAL COLLABORATION**
[Wright Brothers Institute](#) (WBI), Dayton, Ohio is partnered with the [Air Force Research Lab](#) (AFRL), a \$4B technology powerhouse, to energize world-class R&D collaborations and technology innovation.



Wright Brothers Institute operates several innovative programs:

- [Tec^Edge Innovation and Collaboration Center](#) (Tec^Edge ICC) was developed in partnership with its foundational stakeholder, the Wright-Patterson AFB, and operates as a neutral enabler and environment for multidisciplinary joint teams to come together in intense collaborations, which focus on complex problems and/or challenges.

Tec^ Edge leverages this work for the Dayton Region to stimulate and support growth of technology companies transfer of technology to commercial endeavors, science and mathematics education, opportunities facilitator and neutral ground for government, industry and academia teams to solve complex problems through intense collaborations.

The Wright Brothers Institute works closely with government agencies, academia, business – including small innovative R&D businesses, community and state organizations, and STEM students and teachers to establish R&D collaborations and strengthen the industrial base in technology areas of interest to the AFRL, national security and the public safety sector. [Click here](#) to read the Tec^Edge ICC brochure.

- [Tec^Edge Works](#) serves as a collaborative environment for hands-on [rapid prototyping](#) among government, industry and academia. Its unique physical space includes “collaboratories” that are spaces which can be easily reconfigured to suit a variety of needs, as well as a telepresence studio that enables face to face communications with experts and partners anywhere in the world.

Case studies in several areas including complex assemblies, design progression, printed circuit development, rapid prototyping, injection molding and what is UAV? illustrate the role that Tec^Edge plays in supporting Air Force needs in collaboration with WPAFB.

- [Tec^Edge Ventures](#) is a project to find and assist the Dayton Region in commercialization of technology originally developed for military use. They work to accelerate the path to markets – smarter and faster. [Click here](#) to read the Tec^Edge Ventures brochure.
- [IDEA Lab](#) is a collaborative process to explore and landscape the problem and solution spaces for technologies, insights, solutions, and partnerships and to share lessons learned in innovation and collaboration. [Click here](#) to see the IDEA Lab brochure.
- [Challenge Pavilion](#) is an open competition that awards a prize for the best solution to a posted problem. Award Challenges tap into the creativity of the world and have solved important Air Force Research Laboratory (AFRL) problems.

➤ **TECHNOLOGY TRANSFER AND INDUSTRY COLLABORATION**

Wright Brothers Institute is the lead organization for the Technology Development/Commercialization part of an overall DoD Office of Economic Adjustment(OEA) grant to Wright State University, OH.

WBI is testing a [market-driven commercialization model](#) supporting successful development of new, high-tech products, services and businesses in energy, environmental monitoring, human performance and agriculture. <http://wbi-icc.com/commercialization/techdevcom>

The [Technology Acceleration Project](#) (TAP) is The Entrepreneur Center’s (TEC) pilot project designed to transfer technology from research to market. Sponsored by the Air Force Research Laboratory (AFRL) and partnering with Wright Brothers Institute and the Commercialization Academy, TEC TAP is rolling out two parallel initiatives: Start-Up TAP and SBIR TAP.

The Air Force’s 711th Human Performance Wing (711HPW) used an [Information Transfer Agreement \(ITA\) to share software research with private companies](#), giving commercial companies access to its Vigilant Spirit Control Station software package, which allows operators to control multiple unmanned air vehicles (UAVs) at once. Because UAVs are piloted remotely, each comes with operator software from the manufacture; typically, software from the manufacturer is proprietary, meaning that customers can’t modify the software source code to customize its capabilities. Engineers in the 711HPW developed the software with a focus on improved human/machine interface and adaptability and it has been used in a variety of Air Force training and research and development activities. Today the software is an important research and development tool for both the Air Force and commercial UAV companies. Thee 711HPW has entered into five Information Transfer Agreements (ITAs) with different commercial companies, with several more in the pipeline. The agreements allow researchers from the companies to use the software while protecting the Air Force’s intellectual property rights.

Air Force Research Lab – Materials and Manufacturing Directorate

With headquarters at Wright-Patterson AFB, Ohio, and an additional research facility at Tyndall AFB, Fla., the [Materials and Manufacturing Directorate](#) develops new materials, processes and manufacturing technologies for use in aerospace applications. This includes aircraft, spacecraft, missiles, rockets and ground-based systems and their structural, electronic and optical components. With a host of modern materials and analysis laboratories, the directorate also provides quick reaction support and real time solutions to Air Force weapon system acquisition offices, field organizations and maintenance depots to solve materials related concerns and problems. The directorate plans, executes and integrates advanced manufacturing technology programs and affordability initiatives addressing manufacturing process technologies, computer integrated manufacturing and excellence through design for military needs. The directorate is also responsible for the Air Force technology programs that address environmental issues and provides materials expertise for airbase assets such as runways and infrastructures and technologies for aerospace expeditionary forces.

➤ **INNOVATION INSIDE THE LAB**

In addition to collaboration with the Wright Brothers Institute, AFRL has created a series of challenges for service members.

AFRL conducts three [challenges](#) a year: the Commander's Challenge; the Military Academy Challenge, vying teams from the Navy, Army and Air Force service academies; and the University Challenge, a competition between 10 selected universities. The annual [Commander's Challenge](#) bringing teams and leaders together from around the Air Force Materiel Command. In its 10th year, the competition attracts teams of junior personnel from around the country who focus on real world problems – the 2017 focus was “Precision Remote Resupply.” A senior AFRL scientist commented that “the challenge capitalizes on the human response to a competitive environment in order to generate innovation, while also professionally developing the Air Force’s next generation of innovators.”



USAF Special Operations Forces (SOF) experience considerable physiological and psychological stressors during training and while conducting military operations...Your objective is to “invent” a resupply device, manually or autonomously operated, controlled, or programmed to haul items on rough and unimproved surfaces.
AFRL Commander's Challenge 2017

➤ **COMMUNITY ENGAGEMENT**

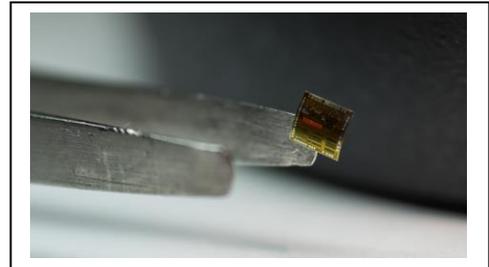
AFRL at both Wright-Patterson and Edwards has strong connections with the local community, particularly in STEM programs involving local educational institutions from middle school to high school:

- [In partnership with Wright State University](#), Wright-Patterson Air Force Base sponsors robotics tournaments for 9-14 year olds, and in 2018 will sponsor the *FIRST*® LEGO® League Ohio Championship Tournament. In these events, teams from across the state will demonstrate their engineering and problem-solving skills, critical thinking, teamwork, competitive play, sportsmanship, and sense of community. The [FIRST® LEGO® League](#) program is offered across the country and around the world.
- [AFRL partnered with local Carroll High School](#) to mentor and support an academic team at the 2017 International Genetically Engineered Machine (iGEM) competition. AFRL scientists worked with the team, who earned a gold medal at the competition.
- The 412th Test Wing's Experimentation Center for Ideas/Technology Exploration team, known as XCITE, hosted a [one-day innovation challenge](#) where engineers from around Edwards Air Force base partnered with members of Desert High School Robotics teams to come up with a solution to a real-world test problem. At the F-22 Combined Test Force, engineers routinely use a repair verification radar (RVR) to collect ground-based images of an F-22 Raptor. The RVR system uses radar technology to measure the signature of an F-22, which is essential to the fifth-generation fighter's stealth capabilities. The task for the three innovation teams was simple -- develop and present a solution to more effectively maneuver the RVR around the aircraft to collect RF imagery. The engineers at the F-22 Combined Test Force will now examine the winning team's concept further and see about implementing the project. This innovation challenge engages the base engineers with local high school students and gives the engineers training and experience working on a rapid development innovation project team, briefing leadership and then selling their idea. Robotics team students gained experience working with professionals on a real-world problem with real constraints, applying science, technology, engineering, and mathematics principals to learn about federal acquisition.

- Since 1999, Wright-Patterson has held organized [Job Shadow Days](#) pairing students with mentors from the base to inspire the next generation of innovators and get a firsthand look at what their future might look like.

➤ **TECHNOLOGY COMMERCIALIZATION AND PROJECT DEVELOPMENT**

A collaboration between the [Air Force Research Laboratory and American Semiconductor](#) has produced a flexible silicon-on-polymer chip with more than 7,000 times the memory capability of any current flexible integrated circuit on the market today. The manufacturing takes advantage of flexible hybrid electronics, integrating traditional manufacturing techniques with 3D electronic printing to create thin, flexible semiconductors that can augment efforts in wearable technology, asset monitoring, logistics and more.



US Air Force Sustainment Center, Hill Air Force Base, Ogden Utah

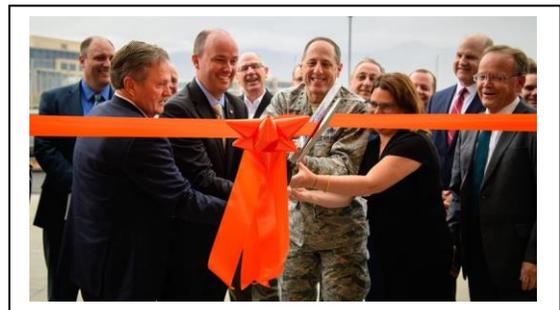
Hill AFB is an Air Force Materiel Command base and the host organization at Hill AFB is the 75th Air Base Wing. The 75th ABW oversees 1,000,000 acres and more than 1,700 facilities valued at \$4 billion while providing installation support for the Ogden Air Logistics Complex, Air Force Life Cycle Management Center, Air Force Nuclear Weapons Center, Air Force active duty 388th and Reserve 419th Fighter Wings and more than 50 mission partners that employs over 21,000 personnel. The base also has support responsibility for the operation of the Utah Test and Training Range. Located in Utah's west desert, the airspace is situated over 2.3 million acres of land and contains the largest block of overland contiguous special-use airspace in the continental United States.

➤ **ECONOMIC IMPACT REPORT**

The [2017 Economic Impact Statement](#) summarizes the installation's economic impact on the local community and reported that Hill AFB created approximately \$1.35 billion in jobs. The report showed that there were 25,500 total personnel within Hill AFB, including 5,785 military, 3,362 military dependents and 16,353 civilians. It indicated an annual federal payroll of \$1.38 billion and annual expenditures of \$665 million in 2017. The annual report was prepared by Hill AFB's Cost and Economics Division and was calculated using identifiable off-base local area spending from gross expenditures.

➤ **PUBLIC PRIVATE PARTNERSHIP SUPPORT**

In November 2017, the doors were officially opened to a newly constructed facility focused on inspiring innovation in industry. The [USTAR \(Utah, Science, Technology and Research\) Innovation Center](#) is a state-of-the-art facility designed to be an incubator and prototype lab serving aerospace and defense, advanced materials, composites and outdoor product sectors in Utah. It will also provide prototyping and reverse engineering capability for mature companies, including federal partners such as Hill AFB, as well as the academic sector to address current technology challenges.



The USTAR facility was constructed outside the installation's west gate in an area known as Falcon Hill Aerospace Research Park. Falcon Hill is the flagship project of the [Air Force Enhanced Use Lease](#) program and is one of the largest projects of its kind in the Department of Defense. The program allows the Air Force to lease land to a developer to create and lease commercial space and infrastructure.

U.S. Army Research Labs

The [U.S. Army Research, Development and Engineering Command](#) has several labs that focus on what land forces eat, wear, fire and drive. Its premier laboratory is the [Army Research Lab](#); however, all of its labs provide technological solutions for current operations and those that will be needed for the next generation.

Central to the U.S. Army's strategy is [ARL's Open Campus](#) business model which envisions the creation of a dynamic, cooperative science and technology ecosystem that links government assets with the global research community. Collaboration is centered on mutual scientific interest and investment by all partners.

Open Campus partners work side-by-side with ARL research scientists and engineers, share ARL's specialized research facilities, bring ARL researchers to their institutions to communicate a perspective on research conducted in federal laboratories, and become part of the broader DoD network. ARL is opening areas of its Adelphi Laboratory Center to host visiting scientists and engineers, including foreign nationals, and envisions future construction of new facilities to host partners, with laboratory and office space to serve academia and small businesses, and to incubate entrepreneurial startups.

The tools available to aid the laboratory in its collaborative endeavors through Open Campus include [Educational Partnership Agreements and Cooperative Research and Development Agreements](#), more commonly referred to as CRADAs. Educational Partnership Agreements, or EPAs, are used to encourage and enhance education and research opportunities with academia in science, technology, engineering and mathematics disciplines relevant to ARL science and technology programs. Under EPAs, visiting students have access to world-class research facilities and are able to work side-by-side with subject-matter experts in their fields of interest. In turn, ARL is able to increase the awareness and visibility of military developed technologies, which has the potential to assist in the commercialization of military technology.

➤ INNOVATIVE AND DIVERSE SECTOR COLLABORATIONS

Two labs are currently in operation under ARL's Open Campus initiative, both structured as University Affiliated Research Centers and funded largely by ARL.

[ARL West](#), established with its headquarters at the [University of Southern California](#) in April 2016, focuses on human information interaction and brings film and game industry artists together with computer and social scientists to study and develop immersive media for military training, health therapies, education and more.

[ARL South](#), housed at the University of Texas at Austin, focuses on developing strong research and development partnerships and collaborative activities with regional universities, start-ups and established companies within Texas to include surrounding areas in New Mexico, Louisiana and Oklahoma to jointly fill technical gaps in the areas of biosciences, cybersecurity, energy and power, intelligent systems and materials and manufacturing. The site is co-located at The University of Texas at Austin's [J.J. Pickle Research Center](#). <https://www.utexas.edu/research/off-campus-research-sites>

ARL Central and ARL Northeast are under development.

➤ SECTOR SPECIFIC COLLABORATION

Beyond the ARL Open Campus Initiative, the US Army Research Lab has [several university collaborations](#), including two focused on challenges the military faces in internet-connected, robot-rich congested and contested battlefields:

Through its [Internet of Battlefield Things Collaborative Research Alliance](#), (IoBT) the Army has assembled a team to conduct basic and applied research involving the explosive growth of interconnected sensing and actuating technologies that include distributed and mobile communications, networks of information-driven devices, and artificially intelligent services, and how ubiquitous "things" present imposing adversarial challenges for the Army. Alliance members leading IoBT research areas include University of

Illinois at Urbana-Champaign, University of Massachusetts, University of California-Los Angeles and University of Southern California. Other members include Carnegie Mellon University, University of California Berkeley and SRI International.

Through its [Distributed and Collaborative Intelligent Systems Collaborative Research Alliance](#), the Army will perform enabling basic and applied research to extend the reach, situational awareness, and operational effectiveness of large heterogeneous teams of intelligent systems and Soldiers against dynamic threats in complex and contested environments and provide technical and operational superiority through fast, intelligent, resilient and collaborative behaviors. Alliance members include the University of Pennsylvania as the lead research organization. Individual research area leads are MIT and Georgia Tech. Other consortium members are University of California San Diego, University of California Berkeley and University of Southern California.

The [Institute for Soldier Nanotechnologies](#) (ISN) is a team of MIT, Army and industry partners working together to discover and field technologies that dramatically advance soldier protection and survivability capabilities. Team members collaborate on basic research to create new materials, devices, processes, and systems, and on applied research to transition promising results toward practical products useful to the soldier. Army members of Team ISN also give guidance on soldier protection and survivability needs, and the relevancy of research proposed to address these needs. Army and industry partners share their expertise on how to convert promising outcomes of fundamental research into practical products that work in harmony with other soldier technologies, and which can be manufactured affordably in the quantities needed by our soldiers. Moreover, these collaborations help identify dual-use applications for ISN-derived technologies for firefighters, police officers, other first responders, and, indeed, the civilian community at large.

[Collaborative Technology and Research Alliances](#) are partnerships between Army laboratories and centers, private industry and academia that are focusing on the rapid transition of innovative technologies to the Warfighter to enable the Army's Future Force.

The collaboration between industry, academia and the government is a key element of the alliance concept as each member brings with it a distinctly different approach to research. Academia is known for its cutting-edge innovation; the industrial partners are able to leverage existing research results for transition and to deal with technology bottlenecks; the Army Research Laboratory's researchers keep the program oriented toward solving complex Army technology problems. Thus, multidisciplinary research teams are generating the complex technology needed to solve the Army's complex problems. This approach enables an Alliance to bring together world class research and development talent and focus it on Army-specific technology objectives for application to Army needs.

ARL has a history of successful collaborations bringing together the triad of industry, academia and government, dating back to the 1990s. There are currently four active CTAs: [Micro Autonomous Systems and Technology \(MAST\)](#), was awarded in 2008; Network Science (NS) CTA was awarded in 2009; and in 2010, the Robotics CTA and Cognition and Neuroergonomics (CAN) CTA were each awarded. In 2012, two Collaborative Research Alliances (CRA) were awarded: Electronic Materials, and [Materials in Extreme Dynamic Environments](#). The most recent award of a Collaborative Research Alliance in the area of Cyber Security was awarded in 2013.

U.S. Army Aviation and Missile Research Development and Engineering Center (AMRDEC)

The U.S. Army Aviation and Missile Research Development and Engineering Center (AMRDEC) is the Army's focal point for providing research, development, and engineering technology and services for aviation and missile platforms across the lifecycle. Headquartered at [Redstone Arsenal](#) in Huntsville, Alabama, AMRDEC has over 1.9

million square feet of laboratory space devoted to innovative work on sensors and electronics, propulsion systems, aerodynamic structures, modeling and simulation, life cycle software development and technical testing.

AMRDEC has laboratories at Fort Eustis and Hampton, Virginia, and Moffett Field, California, where Army and NASA aviation facilities, such as instrumented test ranges and wind tunnels, are used to support its role as lead service for rotorcraft science and technology.

With almost 40,000 employees and a vibrant surrounding ecosystem, Redstone Arsenal in Huntsville, Alabama is a garrison for a number of tenants including the [United States Army Materiel Command](#), [Army's Aviation and Missile Command](#), the [Missile Defense Agency](#) and the [Marshall Space Flight Center](#). It is the center of a complex network of government agencies and commands, advanced research, corporate partners, civilian organizations and the Redstone community.

➤ **INDUSTRY AND SECTOR COLLABORATION – HUNTSVILLE, AL**

[Cummings Research Park](#)

One of the world's leading science and technology business parks, Cummings Research Park is a model for transforming research into business success. With a vibrant mixture of Fortune 500 companies, local and international high-tech enterprises, U.S. space and defense agencies, a thriving business incubator, and competitive higher-education institutions, Cummings Research Park (CRP) is the center of attention for research and technology.

[Redstone Gateway](#) is a state-of-the-art office and mixed-use park being developed as a joint venture by the private sector in partnership with the U.S. Army and Redstone Arsenal. The 468-acre, master-planned project is located adjacent to Redstone in an integrated mixed-use environment which will help advance the missions of Redstone. As a public private partnership, the developers are committing that a portion of the funds from Redstone Gateway leases will go back to the Army and toward real property improvements on Redstone.

➤ **US ARMY, AUBURN UNIVERSITY, FAA COLLABORATION**

U.S. Army Aviation and Missile Research, Development and Engineering Center (AMRDEC) at Redstone Arsenal is collaborating with Auburn University and the Federal Aviation Administration to develop [innovative aviation learning and training modules using virtual, interactive and multimedia technology](#). Rapid prototyping of gaming technology tools will ensure that the computer-generated training environments are user-friendly and customizable. Under a Cooperative Research and Development Agreement with Auburn, AMRDEC's Software Engineering Directorate, Army Game Studio, will partner with Auburn University to develop gaming modules that can be implemented into the FAA's current curriculum for air traffic controllers. The project is through the FAA's Air Transportation Center of Excellence for Technical Training and Human Performance. The FAA's Center of Excellence program is a long-term, cost-sharing partnership between academia, industry and government. The FAA works with center members and affiliates to conduct research in airspace and airport planning and design, environment and aviation safety.

- The [Warrior Research Center](#) is led by Auburn's School of Kinesiology in the College of Education and includes research from engineering, industrial design, psychology, business, veterinary medicine and human sciences.
- [AMRDEC's Army Game Studio](#) has established capabilities in the development of virtual, interactive and multimedia technology used for outreach, recruiting, education and training.

U.S. Army Armament Research, Development and Engineering Center Picatinny NJ

Picatinny Arsenal is the Army's [Joint Center of Excellence for Guns and Ammunition](#). Located about 35 miles west of New York City, Picatinny has more than 1,010 permanent structures, including 64 laboratories, situated on the installation's nearly 6,500 acres, employing approximately 5,000 civilians, 160 military personnel and 1,000 contractors. Approximately one-third of these employees are engineers and scientists. An additional 440 employees work for Picatinny-affiliated organizations at Watervliet Arsenal, N.Y.; Rock Island Arsenal, Ill.; Aberdeen Proving Ground, Md., and Adelphi, Md.

Picatinny is a one-of-a-kind facility and operation that streamlines the acquisition process and delivers the armaments that warfighters need exactly when they need them - and at an affordable price. There are increasingly close partnerships with universities and industry partners, involving them in collaborative efforts early in the research and development process. Picatinny uses unique laboratories and special facilities to evaluate prototype designs, thus reducing development cycle time. These facilities are also available to contractors and other government agencies that are part of the national energetic consortium established by Picatinny and the Army Research Laboratory.

➤ STEM OUTREACH

[The Picatinny Science, Technology, Engineering and Mathematics \(STEM\) Education Office](#) has a responsibility to help create a technologically proficient society able to meet the nation's workforce needs. Their concern is not just for government labs, but also for the military, the industrial sector, and society in general and are proud to be a product of cooperation between private industry, the government, and the academic community. Providing assistance to schools, support for students and leadership in developing creative educational activities appropriate for the 21st century allows this center to insure preparedness through education.

U.S. Army Armament Research, Development and Engineering Center Watervliet Arsenal NY

For nearly 200 years, the [Watervliet Arsenal](#) has been the U.S. Army's only manufacturer of large caliber cannons. The Arsenal, known as "America's Cannon Factory," is the United States' oldest, continuously active manufacturing facility. Since the War of 1812, the Watervliet Arsenal has played an integral role in the defense of America and the protection of freedom and democracy. The site is a federally designated National Historic Landmark (NHL).



➤ GOVERNMENT, ACADEMIC AND INDUSTRY COLLABORATION

Situated in upstate New York's Tech Valley Corridor, [The Arsenal Business & Technology Partnership](#) was created in 1999 as a nonprofit entity, and has successfully attracted nearly \$100 million in federal and state government investment for the Arsenal campus. Its mission is to transform the site into a technology and business center, assuring the long-term sustainability of the Arsenal as both an economic force and a historical landmark. The partnership has been named by the U.S. Army as the site's exclusive economic developer.

The Arsenal Business & Technology [Campus](#) is a \$1 billion manufacturing complex made up of 72 buildings and 2.2 million square feet of space on 143 acres. With a workforce of 600 civilians, the Arsenal itself has annual sales of \$130 million for large bore cannon, armor plating and a wide variety of other military products.

The site is also home to Benét Laboratories, a Department of the Army Research and Development facility, part of the Armament Research, Development and Engineering Center. Benét is the Army's principal research and engineering facility for assigned weapon systems. Benét has a staff of 300 scientists, engineers and support personnel at the Arsenal. The co-location of Arsenal manufacturing and Benét Labs offers military and civilian business entities a one-stop shop for research, design, prototype development, full manufacturing, and long-term customer service.



The Arsenal focuses on six core technologies: machining capabilities, nanotechnology, advanced materials, national security/defense, cleantech, and information technology. It is the economic hub for business, academia and government in the region.

[The Michael R. McNulty Center for Veteran Entrepreneurial Activity](#) at the Watervliet Arsenal was opened in 2014 by the Arsenal Partnership and the New York State Small Business Development Center. It is an accelerator offering a shared space of resources for veteran entrepreneurs with access to the Arsenal Partnership's strategic partners and the services they can provide for a growing new business. There are four companies currently in the McNulty Center.

➤ **STRATEGIC REGIONAL ECONOMIC DEVELOPMENT ENGAGEMENT**

A key partner for the Arsenal Partnership is the [Center for Economic Growth](#) (CEG), a nonprofit, regional economic and business development organization that serves as the primary point of contact for businesses interested in growing in or moving to New York's Capital Region. CEG plays a vital role in creating a rich economic development environment throughout the region by creating world class transportation and logistical hubs, investing in anchor institutions, making the region an international gateway and helping to advance major economic development projects.

Other regional economic development organizations are partners as well, including Empire State Development, Albany County and the City of Watervliet.

U.S. Army Tank Automotive Research Development and Engineering Center (TARDEC)

The mission of [TARDEC](#) is to develop, integrate and sustain the right technology solutions for all manned and unmanned Department of Defense ground systems and combat support systems to improve current force effectiveness and provide superior capabilities for the future force.



Located in Warren, MI, the [National Automotive Center](#) (NAC) is a chartered organization continuing its 20+ year affiliation with the automotive industry, acting as the Army's focal point to leverage dual-use automotive technologies and development for application to military ground vehicles. Dual-use partners include automotive, trucking, and off-road vehicle manufacturers, their supplier base, and associations. The NAC links with these entities to build collaborative relationships based on mutual technical interests and legislative impacts, standards and research. Current focus areas include vehicle cyber security, vehicle autonomy, hydrogen power vehicles and their infrastructure, vehicle and infrastructure electronics architecture and vehicle energy efficiency.

There are a number of mechanisms in place to work with TARDEC, including SBIR, STTR, CRADAs and some that are unique to the automotive industry and listed [here](#).

Other organizations either supported by or closely collaborative with TARDEC include:

➤ **INDUSTRY ENGAGEMENT**

[The High-Efficiency Truck Users Forum](#) (HTUF) is a NAC funded program operated by [CALSTART](#) in partnership with TARDEC that brings truck original equipment manufacturers (OEMs), suppliers, fleets and other industry stakeholders together to ensure commercial product offerings are capable of meeting high-efficiency military requirements. The Forum provides an ongoing platform for stakeholder engagement and communications.

➤ **UNIVERSITY COLLABORATION**

[The Automotive Research Center](#) (ARC) is a university-based, U.S. Army Center of Excellence in Modeling and Simulation. TARDEC manages the center in partnership with The University of Michigan, Clemson University, Oakland University, University of Iowa, Virginia Tech University and Wayne State University. The ARC conducts basic and applied research projects each academic year based on current Army and TARDEC needs in alignment with TARDEC's 30-year strategy.

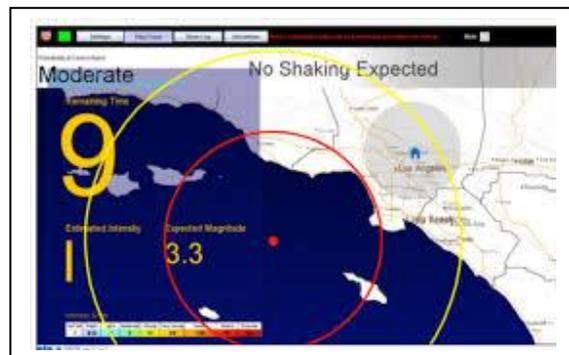


U.S. Geological Survey California Water Science Center

➤ **GOVERNMENT AND UNIVERSITY COLLABORATION USE CRADA**

The U.S. Geological Survey (USGS) has formed partnerships with both public and private entities to develop an earthquake early warning (EEW) alert system called [ShakeAlert](#). The system has the potential to have a significant impact because earthquakes pose a national challenge, with more than 75 million Americans living in areas of significant seismic risk. The Federal Emergency Management Agency (FEMA) has estimated that the average annual loss from earthquakes is \$5.3 billion.

The USGS, through its Cooperative Research and Development Agreement (CRADA) authority, collaborated with several organizations—including California Geological Survey, Caltech Seismological Laboratory, Berkeley Seismological Laboratory, USGS Menlo Park, USGS Pasadena, and the California Governor's Office of Emergency Services. This collaboration formed [the California Integrated Seismic Network \(CISN\)](#) to monitor earthquakes and collect data to support improvements to earthquake resilience. CISN also collaborated with other seismic networks, such as the Advanced National Seismic System (ANSS), to detect earthquakes' first wave (p-wave) and more damaging wave (s-wave). This collaboration enables USGS and ANSS to leverage their substantial investment in sensor networks, data telemetry systems, data processing centers, and software for earthquake monitoring activities residing in these network centers.



Software, including a user interface, has been developed by USGS and other collaborators such as CalTech, Washington, Berkeley and Oregon to receive signals from the networks, and identify and characterize an earthquake a few seconds after it begins. The software calculates the likely intensity of ground shaking that will result and delivers warnings of up to 30 seconds upon the first wave through its user interface to people and infrastructure in harm's way, triggering evacuations and the opportunity to seek shelter that may result in less fatalities and damage.

U.S. Navy Naval Research Lab

The [Naval Research Lab](#) (NRL) leads the Navy and Marine Corps in research for maritime applications as well as ocean, atmospheric and space sciences. It is organized in five directorates – four that conduct scientific research and a fifth called the Naval Center for Space Technology. NRL scientists and engineers are currently developing technologies like laser and directed energy systems and alternative and synthetic fuels, as well as an industrial human augmentation system and electromagnetic railguns.

➤ **Technology Transfer**

Need to add content that talks to how they are doing research with their own ee's and contractors

➤ **SUCCESS STORIES**

An Army veteran is making the world a safer place with a military technology developed to train bomb-sniffing dogs. The [Naval Research Laboratory](#) developed the mixed odor delivery device (MODD) for safely training explosive detection canines to detect homemade explosives. Homemade explosives are generally composed of two components, an oxidizer and a fuel; when mixed, the substance is volatile and at risk of detonation. Russ Hubbard, combat veteran and founder/CEO of Per Vivo Labs in Kingsport, Tennessee, [licensed the patented Navy device](#) and worked with his local K-9 police unit to perfect the final product, [Odor Trace](#). Odor Trace is a new training aid that keeps the individual components separated within a container, then mixes the released vapors to facilitate safe and effective canine training for detection of homemade explosives devices.

➤ **COMMUNITY OUTREACH**

The Navy has consistent themes for community outreach that includes some combination of the following at most locations: career fairs; cyber security camps; festivals, expos and demonstrations; *FIRST*[™] Robotics; "Girls Day Out" Summer Camp; internships and apprenticeships; IT Shadow Day; job shadowing; school tours and science fairs.

For example, the [Naval Surface Warfare Center Philadelphia Division \(NSWCPD\)](#) began implementation of the National Defense Education Program (NDEP)-supported science, technology, engineering, and mathematics (STEM) initiative in 2008. The organization works with schools in the School District of Philadelphia and in surrounding counties within the tri-state region of Pennsylvania, New Jersey and Delaware. Schools range from inner-city, large suburban and small rural schools. STEM initiatives which have been undertaken in Philadelphia include festivals and science fairs, classroom activities, outside classroom activities, mentorship and internship activities, and teacher and science and engineering training. NSWCPD partners with various universities and organizations to carry out these programs and is continuously looking for new opportunities to contribute to the development of talent within science, technology, engineering and mathematics. For more information click on [STEM Programs](#).

➤ **UNIVERSITY PARTNERSHIPS**

The Naval Surface Weapons Center is one of the many Navy organizations with a track record of strong university partnerships. Recently announced is a [project between NSWC-Crane and Purdue](#) on polymers. The mechanism is a CRADA, through the [NSWC's T2 Office](#). The goal of the agreement is to develop innovative analytical methodologies to overcome the complexity of material characterization, building on

expertise that Purdue has in ambient sampling and mass spectrometry techniques and drawing on expertise at the Cooks' Aston Laboratory of Mass Spectrometry at Purdue University.

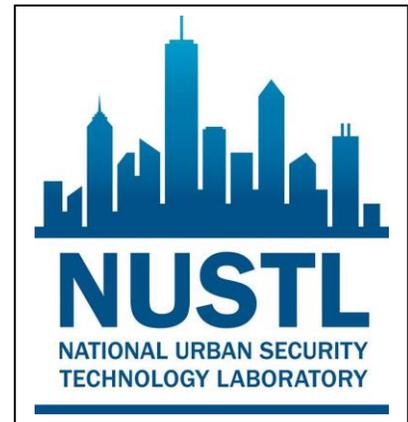
➤ **AVAILABLE TECHNOLOGIES**

As with other labs, NRL posts the [technologies available for commercialization](#) and provides resources on how to access them and how to work with NRL.

Department of Homeland Security National Urban Security Technology Laboratory (NUSTL)

[National Urban Security Technology Laboratory](#) (NUSTL) serves as a central and trusted federal resource to support the successful development, evaluation and transition of homeland security technologies into field use for law enforcement, fire and other emergency response agencies. Staff experts work side-by-side with the nation's first responders to effectively plan and execute tests, evaluations and assessments of existing and emerging technologies.

The laboratory also works to enhance first responder capabilities by partnering with stakeholders to develop viable solutions to radiological and nuclear threats. NUSTL's Radiological/Nuclear Response and Recovery (RNRR) Team strategically invests in R&D that can characterize and manage a radiological incident, save lives and minimize the impacts on communities through incident stabilization and radiological clean-up.



➤ **INNOVATION INSIDE THE LAB**

NUSTL was the first component within DHS to be awarded a U.S. patent for an invention conceived by its employees. [Patent #7781747](#), [dubbed the Citizen's Dosimeter](#), is a high-tech plastic card that would be as convenient and affordable as a subway card, with the capability to measure the amount of radiation on a person or in a given area.

➤ **INDUSTRY AND SECTOR COLLABORATION**

[The New York Area Science and Technology Forum \(NYAST\)](#) is a consortium of federal, state and local government organizations, first responders, academia and private sector groups that regularly meet to promote and discuss advances in science and technology applications. Quarterly NYAST topical meetings provide an opportunity for the membership to interact and network across the homeland security community and provides a unique opportunity to gather feedback from field operators, drawing out their most pressing issues and needs in homeland security. NUSTL has conducted 41 NYAST forums with more than 1,000 active NYAST members from all levels of the government, academia, first responder and law enforcement agencies, as well as the private sector, to discuss pressing issues in homeland security and the latest advancements in science and technology. [Click here](#) to view the NYAST fact sheet.

➤ **TECH TRANSFER AND JOINT DEVELOPMENT**

[Metronome Software](#) received a \$749,930 SBIR award for a joint project to develop a technology solution to enhance the security of mobile device-based sensor systems used by first responders. Partners in the project include DHS S&T's [Mobile Security](#) R&D program, administered by its Homeland Security Advanced Research Projects Agency [Cyber Security Division](#), and the [Next Generation First Responder \(NGFR\) Apex](#) program, managed by S&T's [First Responders Group](#).

National and Regional Organizations Supporting Innovation

[The National Defense Industrial Association](#)

NDIA, comprised of its [affiliates](#), [chapters](#), [divisions](#), and 1,600 corporate and 85,000 individual members, is a non-partisan, non-profit, educational association that has been designated by the IRS as a 501(c)3 nonprofit organization - not a lobbying firm - and was founded to educate its constituencies on all aspects of national security.



[NDIA Divisions](#) facilitate government and industry interchanges, offering a wide array of opportunities to contribute ideas, recommendations, and to participate in objective studies and analyses with government. The divisions maintain close contact with representatives of appropriate government agencies and through their constructive counsel have become institutions in American defense-industry relationships.

[NDIA chapters](#) offer the opportunity for individual and business coordination with regional military commands and working levels of the federal government and they work to foster communication and collaboration among members around defense and national security requirements and needs. There are currently 28 chapters across the country, including several where the blue economy, aerospace and national security clusters are strong:

- [First Coast](#) (Northeast FL, Georgia (includes Naval Air Station Jacksonville, Naval Station Mayport, Kings Bay Naval Base, Camp Blanding Joint Training Center, Naval Aviation Depot Jacksonville and Marine Corps Blount Island)
- [Greater Tampa Bay](#) Chapter (Tampa, FL) (includes MacDill Air Force Base, US Central Command, US Special Operations Command and other DoD activities)
- [Gulf Coast](#) (Niceville, FL) (includes Eglin AFB)
- [Red River Regional](#) (Louisiana, Arkansas, Texas, and Mississippi) (includes various military installations)
- [San Diego](#) (San Diego)
- [Wright Brothers Regional](#) (Dayton, OH) (Wright-Patterson AFB)

NDIA, its divisions and chapters produce highly targeted events that are relevant to its members and partners.

[National Center for Defense Manufacturing and Machining](#)

Through a substantial group of “alliance partners”, NCDMM seeks to deliver innovative and unbiased manufacturing solutions that produce real and substantial results through trusted, collaborative relationships with customers, partners, government, academia, and industry to advance innovative manufacturing technologies.

Manufacturing USA

[Manufacturing USA](#) brings together industry, academia and government partners within a growing network of advanced manufacturing institutes to increase U.S. manufacturing competitiveness. Each of the [14 institutes is a public-private partnership](#) that focuses on promoting robust and sustainable manufacturing research and development in a specific, promising advanced manufacturing technology area.

The institutes catalyze cooperation between U.S. companies and researchers from universities and federal laboratories to rapidly develop ideas and inventions into products and processes that can be used by U.S. manufacturers. By involving small and large U.S.-based companies, the Manufacturing USA institutes stimulate the formation of manufacturing ecosystems, building advanced capabilities into the domestic supply chain so that new

technologies developed in the U.S. are manufactured here in the U.S. rather than in other countries. Each institute works to ensure that American workers are trained for the high-paying jobs needed to manufacture these new technologies.

Examples of Manufacturing USA Institutes:

➤ **[America Makes \(Youngstown, OH\)](#)**

America Makes is a national accelerator and the nation's leading collaborative partner for technology research, discovery, creation, and innovation in additive manufacturing and 3D printing designed to increase US competitiveness..

➤ **[Advanced Robotics Manufacturing Institute \(Pittsburgh, PA\)](#)**

The Advanced Robotics for Manufacturing (ARM) Institute is a Pittsburgh-based, nationally-known, public-private partnership founded by Carnegie Mellon University. ARM actively develops, demonstrates and facilitates early adoption of robotic solutions in an effort to grow the national manufacturing ecosystem. ARM focuses on critical growth sectors that are ripe for rapid adoption of robotics in manufacturing, including aerospace, automotive, electronic, textiles, logistics and composites.

➤ **[Institute for Advanced Composites Manufacturing Innovation \(Knoxville, TN\)](#)**

IAMCI is a diverse public/private partnership that validates manufacturing technologies that respond to private industry's need for faster and more cost, material, and energy-efficient composite manufacturing, including recycling at the end of product life. IACMI's research and development programs are driven by major industry participation with a focus on reducing technical risk and developing a robust supply chain to support a growing advanced composites industry.

➤ **[Lightweight Innovations for Tomorrow \(Detroit, MI\)](#)**

LIFT is an industry-led, government funded consortium. By reimagining processes and procedures, this highly linked and leveraged network is facilitating technology transfer into supply chain companies and empowering the lightweight metals workforce. Focus is on modeling and simulation, metrology, design materials, material processing and lightweighting.

Mechanisms for Federal Research and Development Projects

Federal labs and agencies and the Federal Lab Consortium provide sample forms and support resources for the types of instruments used to document partnerships and relationships for tech transfer and research. Below are the most common.

- **[Small Business Innovation Research \(SBIR\)](#)**: Administered by NIST, this highly competitive program encourages domestic small businesses (fewer than 500 employees) to engage in federal research/research and development (R/R&D) that has potential for commercialization.
- **[Small Business Technology Transfer \(STTR\)](#)**: This program provides funding opportunities in the federal innovation (R&D) arena providing for joint venture opportunities for small businesses and nonprofit research institutions.
- **[Cooperative Research and Development Agreements \(CRADAs\)](#)** are established between federal laboratories and commercial, academic or association partners to facilitate technology transfer between the parties for mutual benefit. Under a CRADA, the partner may contribute resources such as personnel, services, property and funding to the effort. The government may contribute all of the above except funding. Each lab/agency has its own version of the CRADA and the Federal Lab Consortium offers an online course called the CRADA Developers Guide.

- Test Service Agreement (TSA): TSAs allows commercial entities to utilize the unique capabilities of government labs. The government is reimbursed for operational and equipment expenses but cannot compete with private industry. DoD laboratories may make available to any person or entity (including universities), on a reimbursable basis, laboratory services for the testing of materials, equipment, models, computer software, and other items. [Here](#) is an example of the Army's TSA.
- Ground Vehicle Systems Other Transaction Agreement (OTA): The OTA is designed to attract non-traditional defense companies/industries, who are interested in doing business with DoD agencies to develop prototype efforts to best support ground vehicle system technologies.
- [U.S. Army Manufacturing Technology](#) (MANTECH): Army ManTech program submissions focus on products and processes that reduce manufacturing costs and production risks in key technology areas. Life cycle cost reduction and sustainability improvement of current systems support critical S&T efforts unique to the Army's Advanced Manufacturing Technology Initiatives (AMI).
- Rapid Innovation Fund (RIF): The goal of RIF is to accelerate transition of innovative technologies that resolve operational challenges or save significant costs for acquisition programs.
- Educational Partnership Agreements (EPA): Allow educational institutions and academic researchers the opportunity to access equipment and resources which may be unavailable at the institution. These agreements also provide opportunities for students and faculty to work on research projects and support students' engagement in math, science and technology. Encourages institutions to enhance study in scientific disciplines at all levels of education. Examples for the [Army](#) and [Navy](#).
- [Independent Research & Development](#) (IR&D) is a technical research and development effort by industry that is not sponsored by or required in performance of a contract. It consists of projects that are within the areas of basic and Applied Research & Development and other concept formulation studies. Contractors are permitted to recover a portion of their IR&D costs by including them as an allowable indirect expense on government contracts to the extent that those costs are allocable and reasonable. In addition, DoD permits major defense contractors to include allowable IR&D costs as indirect expenses on defense contracts to the extent that the IR&D activities are of potential interest to DoD.

DoD Technology Licensing – TechLink and MilTech

Federal Labs and agencies have licensing programs that give companies opportunities to acquire rights to inventions and copyrights. Licenses may be nonexclusive or exclusive, depending on the nature of the intellectual property and the business fields to be actively pursued by the licensee. Many labs and agencies actively promote technology available for licensing including [NASA](#) and the [Naval Research Lab](#).

Over 5,000 DoD inventions are available for licensing and searchable through the [TechLink Center](#). TechLink is a U.S. Department of Defense Partnership Intermediary, with a partnership agreement between the Air Force on behalf of the DoD Office of the Secretary of Defense. The program is managed by the Air Force Research Laboratory at Wright-Patterson AFB, Dayton, Ohio.

TechLink is a center within Montana State University's Office of Research and Economic Development and serves as the university's main outreach arm to the high-tech sector in the state, region, and nation. For an overview of TechLink's various activities, see <http://www.montana.edu/techlink>.

TechLink's "Defense TechLink" program is DoD's primary national partnership intermediary for technology transfer and it has been helping the DoD establish licensing and other technology transfer agreements with U.S. industry since 2000.

Economic Impact Analysis of DoD Technology Licensing

In 2016, TechLink conducted a DoD-wide study of the SBIR/STTR program's economic impact. Read the Economic Impacts from DoD License Agreements With U.S. Industry 2000-2014 National [here](#).

The DoD-wide economic impact study follows TechLink studies of the economic impacts of the [Air Force](#) and [Navy](#) SBIR/STTR programs, which showed the very large return on investment of these programs. The prior studies were the first to reveal the impressive successes that resulted from SBIR/STTR funding. The Navy study showed that branch's \$2.3 billion investment in SBIR Phase II contracts with small businesses result in \$44.3 billion in economic activity, including \$14.2 billion in new product sales and \$4.9 billion in tax revenue.

Also located at Montana State University, [MilTech](#) is a DoD Partnership Intermediary whose mission is to accelerate the transition of new technology to the U.S. Warfighter. Since 2004 MilTech has performed over 150 technology acceleration and transition projects for every military service and joint and special commands. MilTech works directly for DoD Program Managers from all four services, OSD, and Joint and Special programs who require assistance with product development, technology scouting, market research, manufacturing systems, or supply chain development. MilTech reports [success stories](#) in several areas.

Association of University Technology Managers (AUTM)

[AUTM](#) is a nonprofit organization that brings together universities, research institutions and teaching hospitals around the world as well as businesses and government organizations to support and advance academic technology transfer globally. AUTM has created a fee-based [Global Technology Portal](#) that allows members to market their technologies and features university technologies available for licensing. AUTM also produces a comprehensive [Technology Transfer Practice Manual](#).
