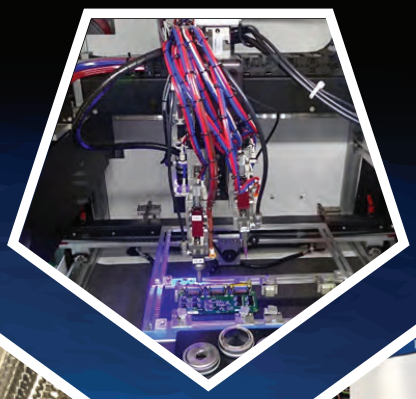
Department of Defense Manufacturing Technology Program

December 2021

65TH ANNIVERSARY

Building Back a More Resilient Industrial Base


Front Cover Photos (clockwise from upper left):

Next Generation Head Protection for Warfighters (see p. 6)
Automated Printed Wiring Assembly Production to Replace Manual Processes (see p. 27)
World Class 200 mm Silicon Carbide Reactor Assures U.S. Substrate Supply (see p. 16)
Production of Aircraft Engine Inlet Ducts at Lower Cost (see p.14)
Automated Defense System Production Using Robotics

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RESEARCH
AND ENGINEERING

Over the past century, U.S. national and economic security have relied on a robust American industrial base armed with the advanced manufacturing technologies needed to rapidly and affordably deliver critical products and systems. Today, our country faces new challenges impacting our daily lives at home, not only from great powers and regional adversaries, but also from infectious disease and cyberattacks. Despite unprecedented threats, we face unmatched opportunity. America must lean forward to deliver the manufacturing capabilities needed to build back a resilient U.S. defense industrial base and modernize our military.

For 65 years, the DoD Manufacturing Technology (ManTech) Program has been the Department of Defense's (DoD) primary mechanism for staying at the forefront of defense-essential manufacturing capability. Through focused investments in cost-effective, risk-mitigated manufacturing, development and sustainment of defense systems, the DoD ManTech Program is helping equip our forces with the best systems possible, made by Americans.

The examples in this brochure illustrate the ongoing benefit of the DoD ManTech Program on strengthening U.S. manufacturing technology and the industrial base. This year's center article is written in celebration of the 65th anniversary of DoD Manufacturing Technology Program authorized by Congress on August 10, 1956.

This brochure also provides an update on the DoD Manufacturing Innovation Institutes (MIIs). The DoD MIIs are revitalizing the U.S.'s domestic manufacturing capacity through joint public-private partnerships that enhance America's strategic competitiveness while enabling the military of tomorrow. The DoD ManTech Program continues to make significant investments in the DoD MIIs, to ensure the U.S. defense industrial base can produce needed parts and systems, maintain healthy and secure supply chains, and train the skilled U.S. workforce.

Today's DoD ManTech Program continues to play a crucial role in fostering innovation to meet the challenges of our changing world and to ensure our nation maintains its competitive edge. We are pleased to present you with this year's DoD ManTech Program brochure as we collaborate to enhance our military's strength and technological advantage.

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The Department of Defense Manufacturing Technology Program

WHAT? The Department of Defense Manufacturing Technology (DoD ManTech) Program was originally created to further national security objectives through the development and application of advanced manufacturing technologies and processes. The Program is composed of the Military Service and DoD Agency (or "Component") ManTech investment programs executed by the Army, Navy, Air Force, Defense Logistics Agency (DLA), Missile Defense Agency (MDA), and the Office of the Secretary of Defense (OSD).

WHY? The U.S. Military capability depends on our ability to ensure technological advantage over our adversaries. We must always be prepared to respond to challenges in a manner that is innovative, agile, robust, resilient, and affordable. The DoD Manufacturing Technology (ManTech) Program meets these challenges with a focus on cost effective, risk-mitigated manufacturing development and sustainment of defense systems.

***VISION:** A responsive world-class manufacturing capability to affordably and rapidly meet warfighter needs throughout the defense system life cycle.*

HOW? Although DoD ManTech has a singular mission and shared strategic vision across the Military Services, Defense Agencies, and OSD, each Component uses its own organization-specific processes, mandates, and procedures to select and execute their investments and initiatives.

***MISSION:** The DoD ManTech Program anticipates and closes gaps in manufacturing capabilities for affordable, timely, and low-risk development, production and sustainment of defense systems.*

The directors and senior managers of these programs coordinate through the auspices of the Joint Defense Manufacturing Technology Panel (JDMTP). The JDMTP is chartered to identify and integrate requirements, conduct joint program planning, and develop joint strategies. The OSD ManTech Program administers the DoD ManTech Program by providing central guidance, direction, and support to the Component ManTech Programs.

Along with providing oversight to the DoD ManTech Program, the OSD ManTech Program also manages two investment portfolios: the Manufacturing Science & Technology Program (MSTP) and DoD Manufacturing Innovation Institutes (DoD MIIs). There are nine DoD MIIs: America Makes (the national additive manufacturing institute), Manufacturing Times Digital (MxD, digital manufacturing and cybersecurity institute), LIFT (lightweight materials institute), the American Institute for Manufacturing Integrated Photonics (AIM Photonics), NextFlex (the flexible electronics institute), Advanced Functional Fabrics of America (AFFOA), BioFabUSA (advanced regenerative manufacturing institute), Advanced Robotics Manufacturing (ARM institute), and BioMADE (bioindustrial manufacturing institute).

This brochure highlights twenty-seven ManTech Program successes of the Services and Agencies, provides a center article on the 65th ManTech Anniversary, lists the 2020 and 2021 nominations for the Defense Manufacturing Technology Achievement Awards, and includes a special insert with updates on the nine DoD Manufacturing Innovation Institutes.

Army ManTech Demonstrates Agile Manufacturing Cell with Improved High Energy Buried Arc Welding for Vehicle Structures

The Challenge:

The Army faced a critical need to reduce risk and improve weld quality for two of its combat vehicles: the Armored Multi-Purpose Vehicle (AMPV) and the M109 Paladin Integrated Management (PIM) self-propelled howitzer system. These weld quality issues resulted from the use of manual welding practices using traditional techniques that are not specialized for thick aluminum plate applications, such as AMPV and PIM. Welds failing inspection result in time-consuming and expensive re-work.

The manufacturing cell with robotic welder and high-capacity positioning system (Photo credit: BAE Systems)

ManTech Response:

- Demonstrated an automated manufacturing cell equipped with a robotic welder
- The robotic welder utilizes a specialized thick-plate welding process for aluminum combat vehicles
- A high-capacity positioning system can orient whole vehicles for favorable welding conditions
- A suite of sensors and software enable process automation
- Approximately 70% of the heavy welds for the AMPV hull are performed by the cell

Impact:

- Reduced risk in the production of aluminum combat vehicles
- Improved vehicle protection with consistent, high quality welds
- Reduced vehicle heavy weld time by up to 80%
- Reduced manual welding operations
- Weapon Systems Affected: AMPV and PIM self propelled howitzer system

Addressed a critical ground vehicle manufacturing need to mitigate weld quality issues for the Armored Multi-Purpose Vehicle

PARTICIPANTS

Army ManTech; DEVCOM Army Research Laboratory; BAE Systems; PM Mounted Armored Vehicles (MAV); Lincoln Electric Automation

Army ManTech Enables Novel Ultra-Strong Low Cost Film Manufacturing Technology for Superior Warfighter Protection

The Challenge:

Current unidirectional polyethylene material used in personal protective equipment had reached a plateau with regard to mechanical and ballistic performance. Conventional technologies offer improvements but at a higher production cost, because higher performance generally requires slower, longer, more expensive manufacturing processes. This presented the government with challenges of affordability for increasing Soldier protection.

Next Generation Head Protection using ultra-high molecular weight polyethylene (UHMW PE) film

ManTech Response:

- Developed novel ultra-high molecular weight polyethylene (UHMW PE) film material with advanced manufacturing technologies that offer significantly reduced cost to performance ratio
- Leveraged internal R&D investments in competing companies to integrate PE film as an alternative material
- **ManTech Investment: $4.6M**

Impact:

- Successfully scaled up manufacturing technologies and transitioned UHMW PE to Soldier protective equipment applications
- Demonstrated 40% weight reduction over current unidirectional PE materials
- Resulted in a 20% reduction in weight of the Integrated Head Protection System and a life cycle cost avoidance of approximately $80M

ManTech transitioned materials to increase ballistic performance and reduce weight for next generation head protection and body armor systems

"ManTech generated a significant breakthrough in advanced polyethylene material manufacturing technology that is now revolutionizing personal protective equipment. These advanced materials are the future and are enabling next level rifle helmet and body armor protection"

- COL Joel Babbit, PEO Special Operations Forces Warrior Systems

PARTICIPANTS

Army ManTech; PEO Soldier Project Manager Soldier Survivability; Product Manager Soldier Clothing and Individual Equipment; DEVCOM Soldier Center; DSM Dyneema

Army ManTech Implements Additive Manufacturing for New Build, Remanufacturing, and Life Extension of Weapon Systems Components

The Challenge:

Additive Manufacturing (AM) technology is seen as a viable process for part repair and reduction in the logistics trail for rapid response items, but parts currently manufactured and repaired in this way have to be approved for integration into weapons systems. Additive manufacturing methods require further maturation to be reliable or repeatable enough to pass acceptance criteria, and require more empirical evidence of properties and performance to be documented, which is needed to prove that these processes yield results for acceptance and use.

The 25mm gun mount supporting the gun barrel on the Bradley Fighting Vehicle as a demonstrator for the cold spray repair process (Army photo)

ManTech Response:

- To develop and qualify additive fabrication and repair processes as viable methods to build and repair weapons systems components
- Implement three separate additive technology thrusts supported by this effort: Cold Spray (CS), Laser Engineered Net Shaping (LENS), and Laser Powder Bed Fusion (L-PBF)
- Address information management and assurance, equipment calibration, standards & quality, the AM body of knowledge, raw materials, build monitoring, and modeling and simulation
- **ManTech Investment: $13M**

Impact:

- Enabled the Army to provide additive solutions for new and existing hard-to-source or damaged weapon systems components
- Increased readiness and reduction of logistical footprint through AM capability to supply components
- 10% to 50% cost savings and up to 50% reduction in lead time for component repairs compared to purchasing new equipment was achieved
- Repaired components from the following systems: Abrams, Bradley, M88/M60, Apache, M1, and M109A6 weapon systems

Addressed mission readiness and cost by enabling additive manufacturing repairs as compared to new acquisition of spare parts

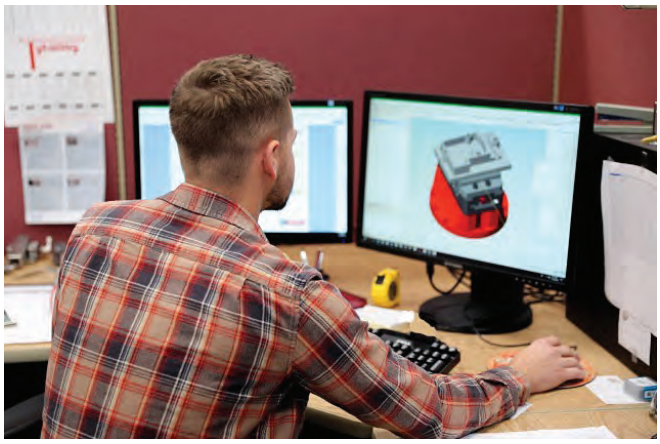
PARTICIPANTS

Army ManTech; DEVCOM Armaments Center; DEVCOM Army Research Laboratory; DEVCOM Ground Vehicle Systems Center; Anniston Army Depot; Honeywell

Army Uses Smart Machining Solutions to Drive Down Cost and Deliver Better Weapons to Soldiers

The Challenge:

One of the challenges faced by many of the manufacturing and machining facilities within the government is the ability for journeyman programmers and machinists to keep up with advances in tooling and production processes. Often, production engineers use either outdated vendor catalogues or on-the-job experience to select cutting tools, cutting parameters and process mechanics.



ManTech Response:

- Demonstrate best value subtractive manufacturing processes while aiding the production engineer for “first part correct”
- Connected the digital thread between design and manufacturing
- Overcame a data interoperability challenge by using select standards, such as ISO 13399, which allows tooling vendors to plug their library of tools into a government solution
- Taught junior operators how to operate specific tools more quickly

Reduced component weapon system manufacturing lead time and cost while maintaining quality and capability

Impact:

- Implemented five smart machining modules that enabled users to choose the best tools and materials for each project and document the manufacturing process
- Demonstrated 20% reduction in cycle time while increasing tool life by 5X
- Reduced tool inventory at Watervliet Arsenal by 40%
- Produced components for the Army’s large caliber weapon systems including ground vehicles, artillery, and mortars

PARTICIPANTS

Army ManTech; DEVCOM Armaments Center; Watervliet Arsenal and Rock Island Arsenal Joint Manufacturing Technology Center (JMTC); Subsystem Technologies, Inc.

Army ManTech Delivers Manufacturing Enhancements to the Joint Air-Ground Missile System (JAGM)

The Challenge:

The JAGM missile utilizes a multimode seeker to provide precision point and fire-and-forget targeting day or night in adverse weather, battlefield obscured conditions and against a variety of countermeasures. Use of unique, specialized materials pose a challenge to manufacturing that can cause unexpected schedule delays. Multi-mode seekers are relatively expensive to manufacture using current production methods. Some of the high costs are associated with the significant amount of touch labor involved. Other factors including integration cost, exotic material use and optical alignment have historically driven up the cost of multi-mode seekers.

The JAGM provides improved fire-and-forget air-to-ground missile capability for rotary wing aircraft and unmanned aerial systems (Army Photo)

ManTech Response:

- Developed affordable manufacturing solutions for complex missile seeker components
- Improved interfaces, production methods and materials using novel manufacturing methods and imaging technologies

Impact:

- Successfully implemented manufacturing improvements that allowed JAGM contractor delivering materials to meet Low-Rate Initial Production (LRIP) delivery schedule.
- Improved yield of critical missile seeker material from 40% to 95%
- Reduced production lead time of key missile seeker components by 6X

"If you're getting shot at and your line of sight goes off the target, your missile misses. JAGM can start off using the laser, then transition to the radar portion and still hit the target if the crew has to use evasive maneuvers."

- Mr. Michael Kennedy, Experimental Test Pilot

Reduced lead time and improved yield to enable timely production of a key missile system across the Department of Defense

PARTICIPANTS

Army ManTech; DEVCOM Aviation & Missiles Center; PM Tactical Aviation and Ground Munitions (TAGM) Joint Air-to-Ground Missile (JAGM); Lockheed Martin; Parker Hannifin

Navy Success Story

Navy ManTech Demonstrates Significant Manufacturability Improvements for F-35 EOTS Integrated Dewar Cooler Assemblies

The Challenge:

Manufacturing and integration of nBn (n-type absorption layer, Barrier layer, and n-type contact layer) detector material and nBn focal plane arrays (FPAs) were high technical risks to modernize the F-35 Lightning II Electro-Optical Targeting System (EOTS) / Infrared System. ManTech addressed four key initiatives to dramatically reduce cost, improve capacity, and diminish the risk for program transition – all critical in meeting electro-optical sensor cost and production rate metrics.

Expand die on tape | Automated die clean on tape | Automated final inspection | Pick and place

ManTech Response:

- Enabled transition from 4-inch to 6-inch nBn wafer substrates, which allows for more die per wafer and results in reduced cost
- Demonstrated discrete process improvements to lower the detector die and FPA cost and drive performance metrics
- Improved the FPA process yield and manufacturability
- Demonstrated batch process improvements to lower the cost of the dewar cooler assembly
- Implemented nBn detector material, which resulted in increased performance and reduced sustainability cost
- **Navy ManTech investment of $2.3M;** leveraged more than $20M in Santa Barbara Focalplane independent research and development funding and capital investments

Impact:

- Enabled total savings per unit of over $26K
- Provides three times more detector die per wafer and lower cost of production ($6.5K per unit savings)
- Decreased touch and span time, increased capacity and throughput, and reduced manual tooling ($6.5K per unit savings)
- Decreased touch time, increased throughput, and reduced rework and yield loss ($12K per unit savings)
- Decreased touch and span time, increased capacity and throughput, and dramatically reduced solder voids ($1.4K per unit savings)
- Decreased EOTS start-up time by ~25% and increased EOTS reliability by ~4.3%
- Demonstrated commitment by Santa Barbara Focalplane to meet EOTS sensor cost and production rate metrics

Reduced cost per unit by over $26K, providing acquisition savings of nearly $62M to F-35 program

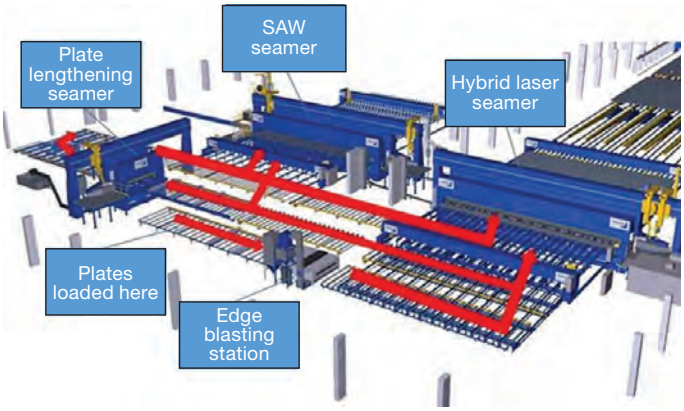
PARTICIPANTS

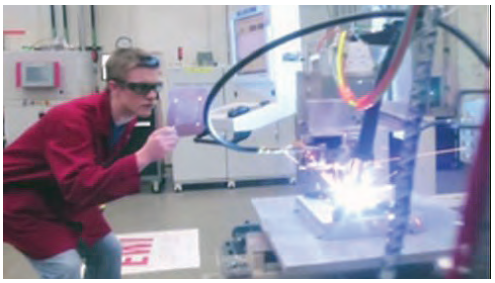
Office of Naval Research Navy ManTech, AFRL Manufacturing and Industrial Technologies Div., F-35 Lightning II Joint Program Office, Navy Electro-Optics Center (EOC) at Penn State; Applied Research Laboratory Electro-Optics Division, Santa Barbara Focalplane (a Lockheed Martin Missiles and Fire Control business)

Navy ManTech Increases Shipbuilding Efficiency by Improving Joining Process

The Challenge:

Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) introduced a new panel line to improve productivity in ship manufacturing in April 2020. Hybrid laser arc welding (HLAW) was identified as a means to minimize distortion and rework costs by reducing welding heat input used to join metals. New welding processes used in shipbuilding are required to be characterized and accepted by NAVSEA for shipbuilding applications. HLAW will significantly reduce the labor, cost, and span time from heat-related distortion caused by legacy welding processes on thinner plates.





ABOVE: *The HLAW project validated process parameters and enabled qualification for use in construction of multiple naval platforms*

LEFT: *Ingalls' HLAW system will increase productivity of its thin-plate panel line*

ManTech Response:

- Addressed the issue of welding heat input, distortion, rework, and all associated costs resulting from the welding of thin plate materials during ship construction
- Produced process and parameters that enabled the integration of HLAW into Ingalls' new panel line
- Demonstrated HLAW application for use in the production of naval platforms
- Developed and validated HLAW welding parameters across multiple material types and thicknesses used in the construction of naval platforms
- Demonstrated through execution of in-depth fatigue and standard mechanical testing that HLAW performance exceeds that of comparable welding processes
- Coordinated with NSWCCD to leverage the new process of using similitude for system validation
- **Navy ManTech investment of $2.4M**

Impact:

- Developed and validated HLAW welding parameters for three common thicknesses for the three most common materials used in ship construction at Ingalls
- Reduced the amount of distortion in welded panels
- Reduced welding labor required for ship construction by 76%
- Reduced fitting labor by 33% on panel line
- Reduced five-year cost of Navy platforms at Ingalls Shipbuilding by over $23.3M

Estimated five-year savings of $23.3M for all naval platforms constructed at Ingalls by using HLAW

PARTICIPANTS

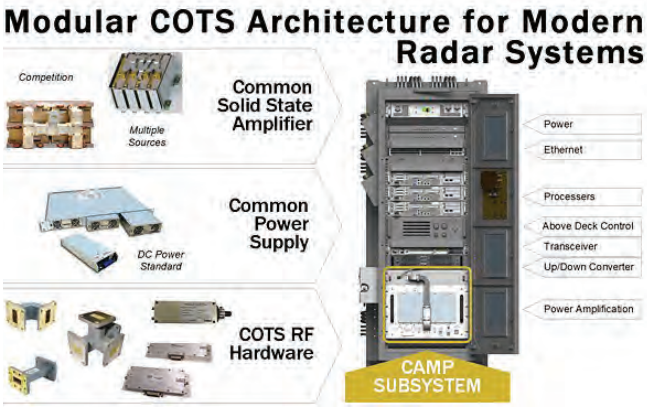
Office of Naval Research Navy ManTech; Naval Shipbuilding and Advanced Manufacture (NSAM) Center; Naval Surface Warfare Center, Carderock Division (NSWCCD); Huntington Ingalls Industries – Ingalls Shipbuilding; Edison Welding Institute

Navy ManTech Demonstrates Open Architecture with Modular Building Blocks for Affordable Radars

The Challenge:

Power tube amplifiers and high-voltage power supplies are unique to each radar design and represent the most expensive and unreliable components of previous generation in-service radars. Solid state amplifiers (SSA) and low voltage power supplies (LVPS) now replace these components, respectively, and apply to multiple radar designs. ManTech produced SSA and LVPS components that successfully demonstrated the immediate potential to implement modern radar mission requirements in a single open architecture based on common, configurable building blocks.

Open architecture radar designs that use modular building blocks with software configurability can readily adapt to evolving Navy requirements



ManTech Response:

- Provided baseline SSA and LVPS components for Next Generation Surface Search Radar (NGSSR), which will be installed on all Navy surface ships
- Addressed high-cost component reliability with a common, modular solution
- Prototyped, tested, and evaluated a modern radar architecture using open and common power supplies and high-power amplifier (HPA) / SSA from multiple vendors
- Provides multiple benefits over legacy components, including lower cost and higher reliability
- **Navy ManTech investment of $5.8M**

Estimated to yield $93M in procurement and total life-cycle savings

Impact:

- Reduced procurement cost by $200K/hull
- Reduced total life-cycle cost by $50M due to improved reliability of solid-state components over tube components
- Provided baseline components for NGSSR, which will replace numerous legacy radars including the BridgeMaster E series and other commercial-off-the-shelf radar systems
- Ultra Electronics Ocean Systems (UEOS) to provide 35 NGSSR systems to PEO IWS 2.0 in first yearly delivery
  - In addition, 200 NGSSRs will be integrated in at least 200 Navy surface combatants (backfit or new construction), beginning with LHA 8 in May 2021, followed by 25-30 NGSSR insertions over the following 6 years

PARTICIPANTS

Office of Naval Research Navy ManTech; Navy Electronics Manufacturing Productivity Facility (EMPF); Ultra Electronics Ocean Systems (UEOS); Program Executive Office Integrated Warfare Systems 2.0

Navy ManTech Uses Artificial Intelligence (AI) and Machine Learning (ML) to Improve Planning Accuracy

The Challenge:

The DDG 51 Production Bill of Material (PBOM), an immensely complex, hierarchical data structure used to represent General Dynamics Bath Iron Works' (BIW's) manufacturing processes, is vulnerable to human error that results in increased ship costs and delivery delays. Specifically, PBOM errors cause incorrect routing of material, excessive handling to re-inventory material, and re-planning production work to the appropriate time and place. Conventional and manual efforts to conduct PBOM data quality assurance are inadequately effective given the complexity of this data and the rapid rate of production.

Application of artificial intelligence (AI) and machine learning (ML) at BIW in May 2021 improves PBOM data quality and reduced DDG 51 construction costs

Implementation of the PBOM AI software system at BIW in early 2022 will support DDG 51 construction starting with hull DDG 134

ManTech Response:

- Analyzed the issue of increased shipbuilding costs due to inherent errors in the DDG 51 PBOM
- Developed an artificial intelligence (AI) and machine learning (ML) application that automatically detects patterns and anomalies within the PBOM data
- Demonstrates successful application of AI/ML technology in the shipbuilding industry by significantly reducing error
- Generalized AI/ML error detection approach applicable to other manufacturing domains with Big Data integrity issues
- **Navy ManTech investment of $977K**

Impact:

- Improved business efficiency by reducing product disruption costs due to PBOM errors without introducing high costs associated with large-scale manual checking
- Reduced the number of PBOM errors and associated bill change requests by 50% for six DDG 51 hulls
- Total savings over a five-year period of $4.2M (average $700K savings per ship)

Implementation of ManTech-developed technology will reduce DDG 51 acquisition costs by $4.2M over five years

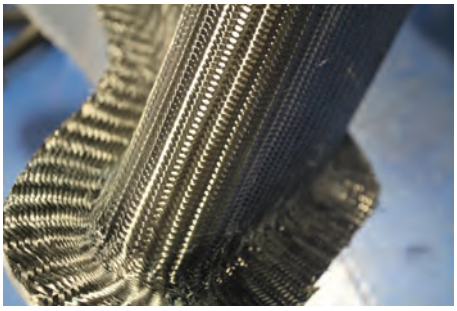
PARTICIPANTS

Office of Naval Research Navy ManTech; Penn State Applied Research Laboratory - Institute for Manufacturing and Sustainment Technologies; BIW; PEO Ships/PMS 400D

Air Force ManTech Demonstrates Cost and Manpower Savings with New Engine Inlet Duct Fabrication Method

The Challenge:

The legacy prepreg autoclave engine inlet duct on the Kratos XQ-58A Valkyrie low-cost attritable air vehicle was manpower intensive and costly to fabricate. Shape Memory Polymer (SMP) tooling, automated preform overbraiding and vacuum-assisted resin transfer molding (VARTM) infusion processes were a possible solution to manufacturing the duct at a lower cost.



LEFT: *S/N 001 braided preform*

ABOVE: *Complex braided duct geometry*

RIGHT: *Fully infused braided inlet duct fuselage installation*

ManTech Response:

- Air Force ManTech conducted a cost benefit analysis of the current prepreg autoclave process and the automated overbraid and vacuum-assisted resin transfer molding (VARTM) infusion processes
- AF ManTech and its partner companies iterated towards an acceptable overbraid fiber orientation architecture that was infused with a low cost epoxy resin on an SMP mandrel
- Fabricated 5 ducts to date which meet the 2 critical component load cases, satisfy outer and inner mold line requirements within established tolerances, adding negligible weight with minimal porosity

Significantly reduced time and cost for XQ-58A engine inlet duct fabrication

Impact:

- Reduced skilled labor hours by 67%
- Reduced overall duct cost by 57% per duct for an order of 100 units
- Kratos purchased twelve inlet ducts fabricated with automated overbraid VARTM process to integrate in XQ-58A vehicles

PARTICIPANTS

Cornerstone Research Group; A&P Technology; SpinTech Holdings Inc.; Kratos Unmanned Systems Division; Hawthorne Composites; Air Force ManTech

Air Force ManTech Delivers Flightworthy Additively-Manufactured Part to the Air Force

The Challenge:

Low-demand components and sporadic need are often difficult to obtain through conventional supply chains. The Air Force only requires three to five F100 oil sump cover replacements per year. Lead time for receiving this part is often more than 18 months through conventional supply chains. Air Logistics Centers could overcome these challenges with their own additive manufacturing capability.

Additively-manufactured F110 oil sump cover

ManTech Response:

- An Air Force ManTech program known as Pacer Edge produced and delivered four flight-worthy additively manufactured parts to Oklahoma City Air Logistics Complex
- AF ManTech evaluated manufacturing process and part for technical maturity and deemed it suitable for its intended use.
- Demonstrated capability will lead to next step in spiral development: Additive Manufacture and delivery of two TF-34 oil sump housings

Impact:

- Reduced manufacturing lead time of F111 oil sump cover by 83% (from 18 months to 3 months) by using Additive Manufacturing over conventional manufacturing
- Spiral development approach laying groundwork for organic Additive Manufacturing capability for the Department of the Air Force for Alloy 718

Demonstrated additive manufacturing capability to cut delivery time for low-demand items with sporadic need by 83%

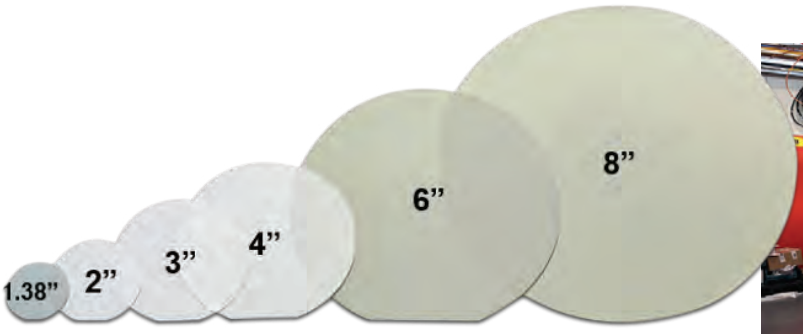
PARTICIPANTS

Air Force Life Cycle Management Center Propulsion Directorate; General Electric Additive Manufacturing; Air Force Rapid Sustainment Office; Air Force Sustainment Center and Air Force ManTech

Air Force ManTech Develops a World Class Silicon Carbide Substrate Manufacturing Capability

The Challenge:

Assured access to Silicon Carbide (SiC) substrate supply has been prohibitively difficult due to the inability of companies to secure the necessary crystal growth intellectual property, scientific expertise and long term financial commitment. Production of SiC substrates requires a high temperature (~2200°C) sublimation process that was fraught with technical challenges associated with micropipes, doping, polytype control, diameter expansion and crystalline defects. The DoD has invested heavily to overcome these barriers and commercialize SiC substrate technology.



30mm to 200 mm (1998 to 2020)

200 mm SIC CVD Reactor

ManTech Response:

- Demonstrated world's first 200mm SiC substrate
- Scaled and matured manufacturing process for 200mm SiC to Manufacturing Readiness Level 8
- Reduced 200mm dislocation density by 83%
- Tripled throughput of the SiC substrates
- Demonstrated Absolute Zero™ (micropipe-free) 100-mm and 150-mm SiC substrates
- Improved access to world class capability

SiC substrates can now be manufactured with improved cost, quality & diameter

Impact:

- SiC substrates are critical to the development of several radar and electronic warfare systems in development throughout the Department of Defense including: the Next Generation Jammer, Three-Dimensional Expeditionary Long-Range Radar, Surface Electronic Warfare Improvement Program and many others
- Gallium nitride (GaN) /SiC power amplifiers double the range for detection of airborne threats
- Enabled radars with increased range, volume search and reduced aperture size
- GaN/SiC has 5-10X the power density, operates at higher voltages, increased efficiency, improved thermal conductivity, reduced chip size and lower cost for a given power than GaAs systems

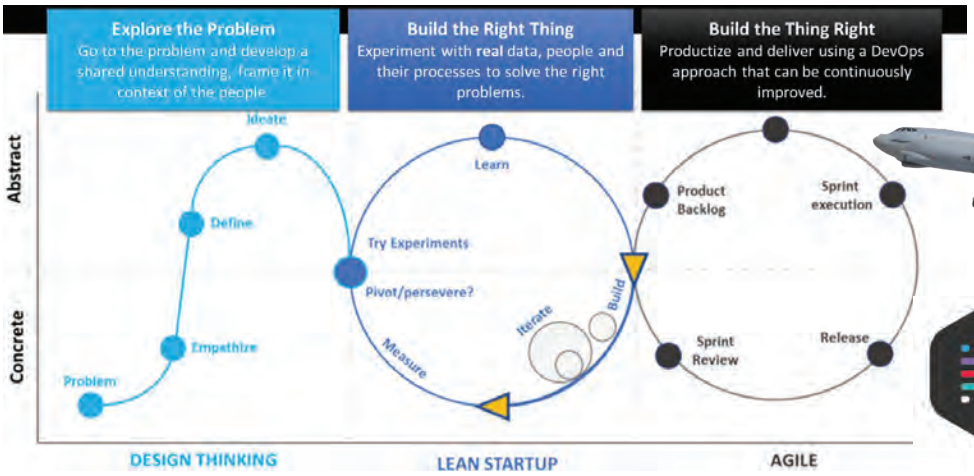
PARTICIPANTS

Air Force Research Lab (AFRL) - RXM/RYD/RQQ, Naval Research Lab (NRL), and II-VI, Inc.

Air Force ManTech Digital Greenhouse Brings Rapid Solutions for B-52

The Challenge:

Digital transformation of legacy replacement parts for military aircraft requires increasingly sophisticated enterprise-wide solutions with access to data and model handling capability. Acquisition and sustainment processes can be improved by taking maximum advantage of digital technologies and a user-driven, agile methodology to streamline business practices, accelerate business process improvements, and enable advanced acquisition concepts. The B-52 program is executing several modifications as fully digital acquisitions, having started from a paper baseline.



milHub
Program Execution Platform

ManTech Response:

- Redesigned systems engineering reviews to be all-digital for the Commercial Engine Replacement Program (CERP)
- Partnered with Army Engineer Research and Development Center to provide a secure, flexible, open platform integrated with engineering tools (MilHub)
- Established procedures for the CERP Original Equipment Manufacturer to submit Contract Data Requirements List deliverables to the environment
- Established access to Government-owned technology stack DoD High Performance Computing

Impact:

- Provided a blueprint for future modification programs with legacy data issues
- Provided a bridge to AF Product Lifecycle Management implementation
- Systems Program Office will more efficiently complete multiple studies/analyses, resulting in $5M-$10M savings annually
- MilHub under exploration by B-1 and other AF programs with similar needs

Enabled fully digital B-52 engine replacement aquisition program

PARTICIPANTS

Anautics Inc.; Aras Corp; Army Engineer Research and Development Center; Maui High Performance Computing Center; Air Force ManTech; Air Force Research Lab Aerospace Systems Directorate; Air Force Life Cycle Management Center Bombers Directorate

DLA Success Story

DLA ManTech Demonstrates Reduced Size, Volume, and Weight of the Meal, Ready-to-Eat (MRE)

The Challenge:

The Subsistence Network ManTech project supports an effort to replace the current pre-formed meal bag with a new package utilizing Horizontal Form Fill and Seal (HFFS) films. The effort provides multiple benefits to the Warfighter, including reduced package size, weight, and packaging waste. The focus of the initiative is to demonstrate that the HFFS package is economical, easy-to-open and can survive military distribution.

Horizontal Form Fill and Seal (HFFS) machine

HFFS MRE opaque front and translucent formed bottom

ManTech Response:

- Validated HFFS MREs produced with polymer films provided by industry partners and verified conformance to MRE performance criteria (package integrity, transportability and user acceptability)
- Verified reduced volume, weight, waste and projected cost of HFFS MRE
- Identified changes to meal bag characteristics, assembly performance requirements and test methods needed for Assembly Contract Requirements (ACRs)
- **ManTech investment of $71K for materials with 100% labor cost shared from MRE assemblers**

Subsistence Network HFFS decreases freight costs, and reduces packaging waste and labor costs during MRE assembly process

Impact:

- Maintains 3-year shelf life, insect resistance, transportability and airdrop capable (testing ongoing by USDA and DEVCOM-SC)
- Reduced average volume (cubic inches) by 30%; from 280 to 198 cubic inches
- Reduced average weight in pounds by 4%; from 1.54 pounds to 1.48 pounds
- Operational test results revealed HFFS meal bag received significantly higher ratings for size and weight
- Implemented into MRE 43 production: CY22 pending final review and approval of ACRs

PARTICIPANTS

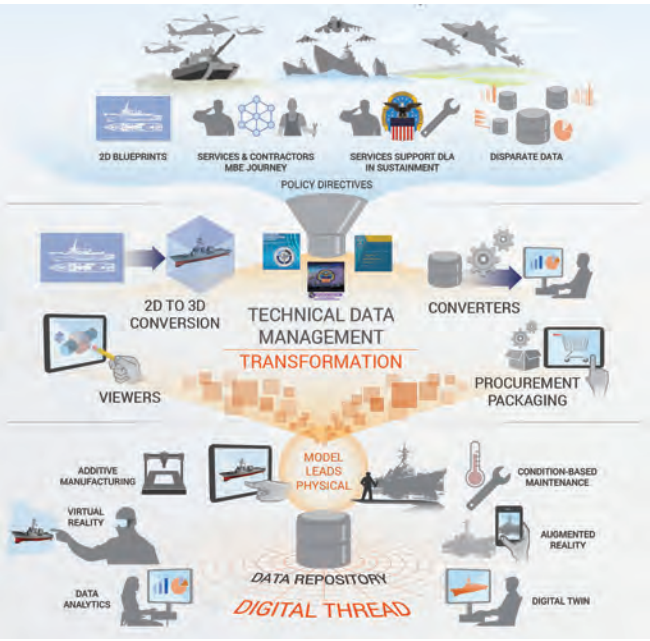
DLA ManTech; AmeriQual Foods; Wornick Foods; Sopakco Packaging; US Army Combat Capabilities Development Command – Soldier Center, Combat Feeding; US Department of Agriculture Center for Grain and Animal Health Research; Cadillac Products Packaging Company; Phenix Specialty Films & Packaging

DLA ManTech Develops Model-Based Enterprise (MBE) Approach to Assist Small and Medium Manufacturers (SMMs)

The Challenge:

The Military Services and the Tier 1 suppliers are generally capable of building a Model-Based Engineering (MBE) digital thread/digital twin approach into their product life cycle – from design to manufacturing, to sustainment, and to end of life processes. However, this is often not the case for lower tier manufacturers, many of whom supply items to DLA, and ultimately, the Warfighter. These SMMs need assistance from DLA to build a digital thread/digital twin for the items they supply.

ManTech Response:



- DLA R&D worked with the Military Services to replace 2D PDF Technical Data Packages (TDPs) with a model-based TDP for the A-10 aircraft
- Currently leveraging 3D technical data from the USAF KC135 weapon system to produce a near real-time collaboration tool to bring DLA, the engineering authority, and the supplier into the same digital workspace
- Future efforts to build on the KC135 effort and apply it to the Paladin Howitzer weapons system by engaging with suppliers of Paladin components to convert up to 50 NSNs to model-based TDPs, prove that the new TDPs work, then get the Army Engineering Support Activities (ESAs) concurrence to use the model-based TDPs
- DLA plans to develop a cloud-based, AI-enabled, searchable, query-able digital repository to seamlessly link disparate contract, engineering, quality, and supplier data

Impact:

- Enables small and medium manufacturers (SMMs) to access a low-cost, cloud-based, Product Lifecycle Management (PLM)/ Product Data Management (PDM) system(s)
- Enabled DLA and the Military Services to complete an end-to-end digital thread across the defense supply chain
- Demonstrated to the cognizant ESA that the model-based TDP can be the authoritative TDP
- Improved Warfighter readiness with more efficient real-time 3D technical data directly from the Military Services
- Significantly influenced MIL-STD 31000 that puts emphasis on 3D tech data elements and definitions
- Significantly influenced OSD Systems Engineering's Digital Strategy

Lowers costs of procurement by increasing competition and decreasing Non-Recurring Engineering (NRE) requests

PARTICIPANTS

DLA ManTech OSD; Military Services; Logistics Management Institute (LMI); Rapid Global Business Solutions Inc. (RGBSI); suppliers

ManTech Celebrates 65 Years of Manufacturing Excellence

This year represents the 65th anniversary of the formal establishment of the DoD Manufacturing Technology Program ("DoD ManTech Program"), created in 1956 as a Congressional mandate and written into Title 10 of the United States Code (10 U.S.C.). A major revision of Title 10 was enacted by Congress on August 10, 1956, and today, Section 2521 of 10 U.S.C. remains the law that provides direction and authorization for today's ManTech Program. It states that the Secretary of Defense shall establish a Manufacturing Technology Program focused on broad, defense-relevant technologies which are beyond the risk of industry, and that the Under Secretary of Defense for Research and Engineering (USD(R&E)) shall administer the program.

Since 1956, the DoD ManTech Program has successfully delivered critical manufacturing capabilities – both for the DoD and for the Nation. These manufacturing capabilities have ranged from the first numerically controlled machine tools for military aircraft in the 1950's (still in use today) to microelectronics, precision laser-guided technology, reverse-engineered legacy parts, composite parts, windows and domes, electro-optic sensors and systems, radar and targeting systems, and high temperature metal alloys.

DoD ManTech and the JDMTP – Working Together

For 65 years, the goal of the DoD ManTech Program has been to look beyond the normal risk of industry and to help provide the crucial link between technology invention and industrial applications. The program actively coordinates its component program activities through the Joint Defense Manufacturing Technology Panel (JDMTP). The JDMTP is responsible for establishing a process to effectively transition technology by identifying and prioritizing requirements for advanced manufacturing technologies and processes, conducting joint program planning, and developing joint strategies for the ManTech programs of the Army, Navy, Air Force, Defense Logistics Agency (DLA), Missile Defense Agency (MDA), and the Office of the Secretary of Defense (OSD). The JDMTP enhances collaboration which enables the DoD components to build premium DoD systems.

DoD ManTech Components Optimize Materials and Manufacturing to Achieve F-35 Air Dominance

The F-35 Lightning II aircraft is a prime example of how the DoD ManTech structured investment portfolio has helped our military build the world's most dominant, stealthy fighter jet with the greatest air superiority and strike capability. The F-35 provides elite electronic warfare and intelligence, surveillance, and reconnaissance capabilities. The Army, Navy, Air Force, and OSD ManTech programs have synergistically made investments to produce the F-35 that include:

1. Army ManTech and DoD MSTP joint efforts to result in associated focal plane array technology being used in the Electro-Optics Distributed Aperture System (EODAS) and the Electro-Optics Targeting Systems (EOTS)
2. Navy ManTech funding efforts to improve the performance and reduce the weight of the EOTS – a high-performance, lightweight, multi-functional system for precision air-to-air and air-to-surface targeting
3. Navy and Air Force ManTech joint efforts to improve the affordability of F-35 infrared components
4. Air Force ManTech funding of critical sensors systems, composites, and high temperature metals to enable operation in harsh airborne environments
5. Air Force efforts to improve the F-35 agnostic battery using Congressional funding
6. MSTP-funded efforts to automate the installation of F-35 boot material that successfully reduced labor and waste and eliminated adhesive mixing, application, and vacuum bagging operations during assembly

DoD Manufacturing Technology Benefits to F-35

Manufacturing Quality/Yield

- Composite weapons bay door
- Automated assembly processes
- Inlet duct drilling
- Fastener insertion
- Mold-in place
- Active Electronically Scanned Array (AESA) Radar
- Electro-Optical Targeting System
- Turbine blade castings
- Advanced manufacturing propulsion initiative

Quick Reaction Support

- Quikseal technology
- Advanced canopy technology

Sensors

- EO/IR sensor protection
- RF-fiber optic link
- Flexible electronics
- F-35 fuselage mold issue

Specialty Coatings

- Tier II inspection tool (handheld imaging)
- Canopy inspection
- THz coating thickness measurement

Metals Research

- Assisted defect recognition
- Incorporating residual stress into design, manufacturing, and sustainment
- Flow forming of aerospace components

Composites

- BMI wing layup
- Polymer matrix composite defect prediction (Stator 2)
- F135 Stator NDI methods

$3.2B Cost Avoidance for F135, Extruded Seals, and AESA Radar . . . Alone!

DLA Success Story

DLA Small Business Innovation Research (SBIR) Modernizes the Flexible Fuel Cell

The Challenge:

The Naval Air Systems Command (NAVAIR) upgraded performance standards for the UH-1Y Venom helicopter to include fuel cells with crashworthy, ballistically-tolerant, self-sealing characteristics to improve flight safety and aircraft survivability. Their challenge was to meet or exceed the new MIL-DTL-27422F fuel cell requirements without adding weight and ensuring biofuel compatibility. According to NAVAIR and the DLA, fuel cells are a top three supply chain issue for every aircraft. Response Technologies' new design not only improves fuel cell availability, but it also reduces maintenance time, and its self-sealing capability provides a level of protection that makes the aircraft safer for Warfighter operations.

Response Technologies' UH1Y flexible fuel cell is a successful example of advanced manufacturing integration in the DoD supply chain

ManTech Response:

- Qualified seamless, crashworthy, ballistically-tolerant and self-sealing fuel cell that is universally fuel compatible and environmentally sustainable for the H-60 and UH-1Y platform
- Addressed and overcame the risks and concerns associated with advanced manufacturing techniques by meeting priorities for the DoD rotorcraft market and by certifying the cell under the rigorous standards of MIL-DTL-27422F
- Developed an additive manufacturing 3D reinforced composite process to print cell structure

Enables Force readiness and modernization

Impact:

- Decreased weight by 20%
- Reduced total ownership costs by 40% and procurement costs by 20%
- Cut manufacturing lead time from months to days
- Shortens timeline for new product designs by 8X using the technologies derived
- Potential to eliminate the need for aromatics in fuel for self-sealing

PARTICIPANTS

DLA SBIR; Response Technologies, a Bell-Textron Company

DLA Small Business Innovation Research (SBIR) Revolutionizes Materials Production with UniMelt® Technology

The Challenge:

Superalloys such as Nickel and Cobalt-based alloys are strategic materials critical to top priority weapons systems. Dependence on foreign sources for such materials can jeopardize the nation's security during times of surge. The United States retains large amounts of these superalloys in the form of non-conforming components, machine waste and end of life parts from retired aircraft. These waste streams are untapped domestic sources for strategic superalloys, and can be recycled economically, restoring the material's original properties for military use.

UniMelt® – the world's first high volume microwave plasma production system transfers commodity inputs into high value powder products

ManTech Response:

- 6K Inc. developed patented high volume microwave plasma production system
- This UniMelt® plasma spheroidizing system upcycles end-of-life components made from nickel-based superalloys (e.g., scrap metals) into premium powders
- Powders are purified enough for stockpiling and refined enough for advanced manufacturing processes such as Additive Manufacturing (AM)
- By recycling non-conforming parts and manufacturing waste into new material, 6K Inc. is providing a means to make AM alternatives sustainable

Impact:

- Recycled materials (scrap metals, used batteries, used powders) lead to lower cost
- Plasma-based production system for advanced nanomaterials enables 70% reduction of CO2, 70% reduction of energy use, and no hazardous waste
- Ensures domestic source of high-purity metal powders, some of which can replace virgin material
- Ability to process waste streams from the AM industry – converting used, spent, and oversized powder to premium aerospace grade spherical powders
- Domestic source for defense stockpiling

Improves material availability and reduces foreign dependence

PARTICIPANTS

DLA SBIR and 6K Inc.

OSD ManTech Helps Develop Portable X-Ray Detectors for the Dismounted Soldier

The Challenge:

Prior to effort, Explosive Ordnance Disposal Soldiers depended on bulky, fragile digital x-ray imaging technology adopted from glass-based medical images or obsolete analog x-ray film.

Fully flexible paper-thin digital x-ray imager

ManTech Response:

- Demonstrated flexible, digital x-ray arrays using a bond and release manufacturing process
- Established partnership with commercial manufacturer dpiX to develop a domestic supply chain for flexible, digital x-ray arrays
- Utilizes flexible arrays for increased ruggedness compared to the more traditional rigid arrays

Impact:

- Reduced unit weight by 50% from 15-20 lbs. to 9 lbs. with developed system
- Reduced edge measurement of flexible x-ray arrays from 0.5-1.0” to 0.187” and thickness from 0.75-1” to 0.5”
- Established a domestic Department of Defense supply chain which reduced reliance on overseas supply chains

Improved ruggedness and reduced size and weight of X-ray arrays while establishing a domestic DoD source for flexible display arrays

PARTICIPANTS

DoD Manufacturing Science and Technology Program office; United States Army Research Lab; Defense Threat Reduction Agency; NextFlex Manufacturing Innovation Institute; Xerox Palo Alto Research Center; dpiX, LLC; and Arizona State University; Flexible Display and Electronics Center

OSD ManTech Develops Military Grade Polymer Gradient Index Lenses

The Challenge:

Glass lens technology increases weight to military grade optics and reduces soldier reaction time. Additionally, difficult-to-manufacture complex lens shapes hampers development of new optical designs.

GRIN lenses meet urgent need for domestic source

New material solutions with less weight and greater design flexibility can potentially reduce size of military optics

ManTech Response:

- Additive manufacturing approach to the manufacturability of the polymer GRIN lens that reduce optical design complexity with improved performance and fewer lenses within a housing
- Demonstration systems with reduced weight and increased field of view capabilities are planned over the next six months
- Produces prototype polymer Gradient Index (GRIN) lenses with high degree of freedom to allow significant optical design flexibility

Impact:

- Potential for up to 50% weight reduction compared to traditional glass lens
- Multi-source domestic manufacturing capability currently demonstrated
- Prototype lenses have shown high performance levels (80% of theoretical diffraction limit to date)
- Polymer GRIN lenses provide increased situational awareness compared to traditional glass lenses
- Transition/Implementation Program: Advanced Fire Control Technology, PM Abrams, and PM Soldier Lethality IDEAS Program

Reduced production cost of polymer GRIN lenses needed for military optics while establishing a domestic manufacturing source

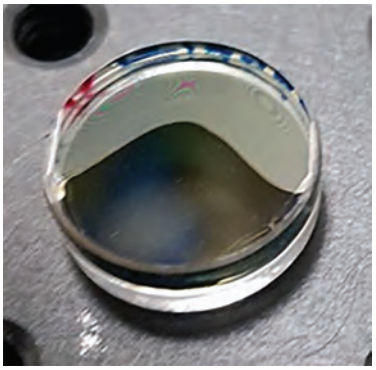
PARTICIPANTS

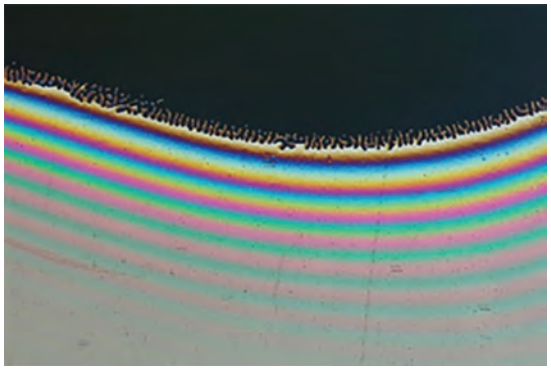
DoD Manufacturing Science and Technology Program office; United States Army DEVCOM C5ISR Center; NanoVox; PeakNano

OSD ManTech Assists Improvements of Circular Polarizers for Color Day Cameras

The Challenge:

There were no commercially available visible spectrum circular polarizers that could affordably meet either optical performance or environmental survivability requirements for military platforms.





Established two US commercial vendors for compliant circular polarizers for color day cameras with minimal high temperature delamination failures

ManTech Response:

- Achieved broad-wavelength, broad-angle isolation efficiency performance requirements for military specifications
- Investigated edge seal epoxy procedures to drastically improve sealant ability and cosmetic quality
- Increased quality and reduced cost of manufacturing circular polarizers using new optical measurement and automated film cutting equipment

Impact:

- Realized program goals for performance, survivability and cost reduction
- Projected requirement of 54k units has savings potential of $45M on a $3.75M DoD MSTP investment
- Established a domestic Department of Defense supply chain
- Increased survivability of transition programs by reducing environmental signature of color day camera systems
- Transition/Implementation Program:
  - US Army M1 Abrams ECP1b – CPS GPS
  - US Army M2 Bradley ECP2b – CIV
  - US Army Next-Gen Combat Vehicle
  - US Navy MH-60R & MH-60S (MTS/AAS-44C(V)1)
  - US Air Force Predator B & Reaper (MTS-B)
  - US Army Gray Eagle – MTS/CSP
  - US Army MX Gimbaled Sensors, AWAPSS

Increased manufacturability of military-grade circular polarizers for color day cameras at a significant cost savings and established DoD supply chain

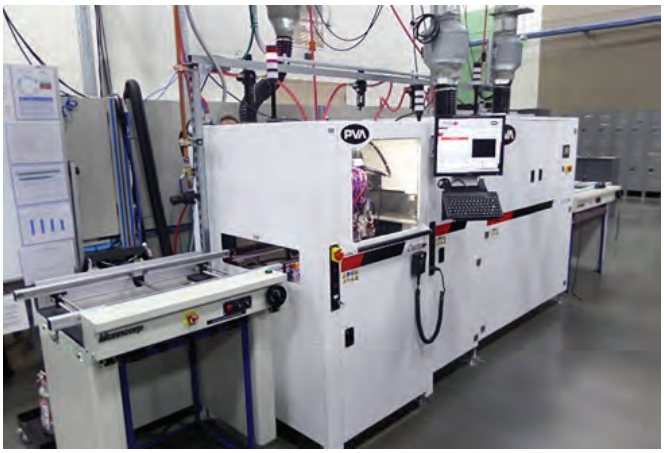
PARTICIPANTS

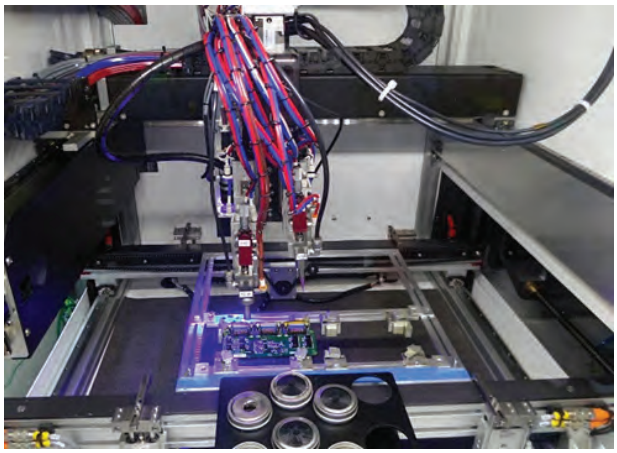
DoD Manufacturing Science and Technology Program office; United States Army DEVCOM C5ISR Center; American Polarizers Inc.

MDA ManTech Uses Automated Staking and Coating of Printed Wiring Assemblies to Reduce Process Variation, Cycle Time and Cost

The Challenge:

The staking and coating operation for Launch Vehicles at Northrop Grumman manually applied staking and coating to Printed Wiring Assemblies. This was a manual process that had process variation potentially impacting repeatability. Automation needed to be implemented to remove the variability of manual operations.





ManTech Response:

- Eliminated process variation
- Eliminated deviations in quality
- Scalable to support growth with no additional cost

Impact:

- 90% reduction in cycle time
- 50% reduction labor hours

Reduced process variation, cycle time and cost

PARTICIPANTS

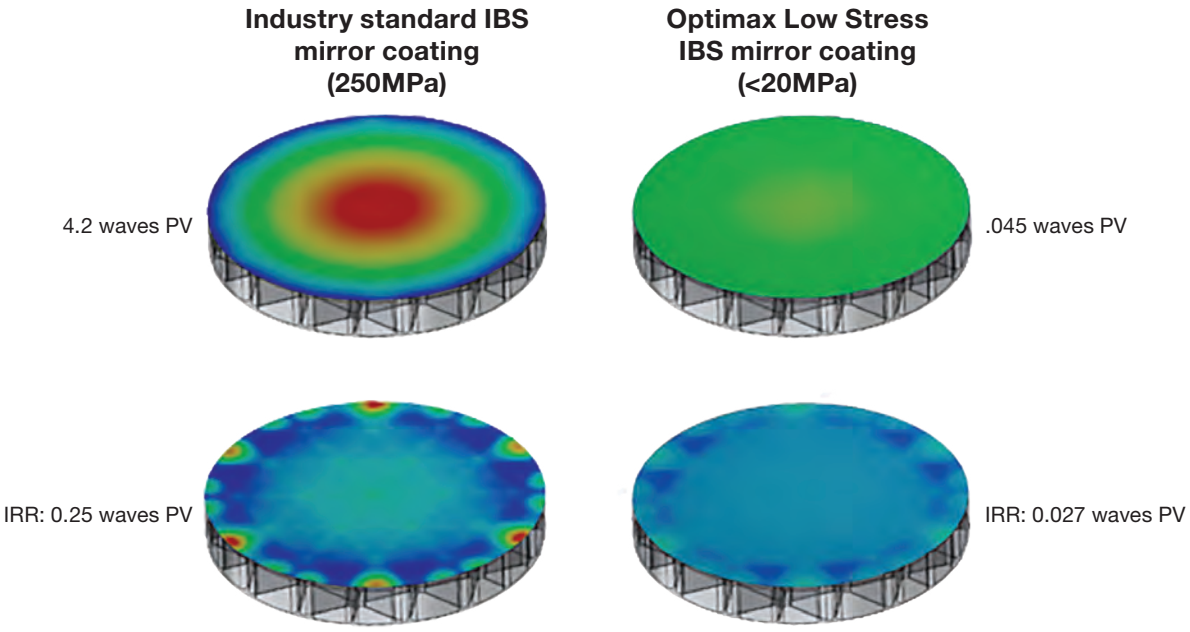
Missile Defense Agency; Northrop Grumman

MDA Success Story

MDA ManTech Improves Wavefront Control in Directed Energy Systems via Low Stress Ion Beam Sputtered Coatings

The Challenge:

High power Directed Energy laser systems require some of the most challenging optics in the world. Optimax has developed multi-layer dielectric coatings that significantly improve the wavefront performance of mirrors in the system (more power in the bucket) by reducing stress in the mirror coatings by an order of magnitude. The mirror coatings developed have high reflectivity (>99.998%), low absorption (<5 ppm), high laser damage threshold (>1 MW/cm2) and an order of magnitude lower stress than other commercially available coatings.



Multi-layer dielectric coatings significantly improve wavefront performance of laser system mirrors

ManTech Response:

- Developed low stress Ion Beam Sputtered coatings, an enabling technology for lightweight Directed Energy mirrors
- Low stress IBS coatings improve power in the bucket while reducing optic and system weight

Impact:

- Order of magnitude reduction in coating stress
- Order of magnitude improvement in mirror wavefront after coating
- 1064 nm: <5 ppm absorption, >1 MW/cm2 laser damage threshold

PARTICIPANTS

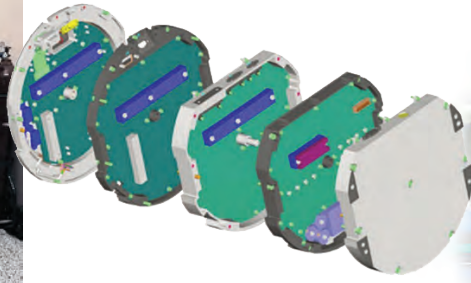
Missile Defense Agency; Optimax

MDA ManTech Improves Circuit Card Assembly Quality

The Challenge:

BAE Systems Electronic Systems, Endicott, N.Y. was challenged with a difficult manufacturing transition of a complex MDA circuit card assembly program from Nashua, N.H. Multiple production issues were encountered after the transition due to a steep learning curve that resulted in two major production stoppages. BAE Systems needed to develop a strategy and execute an improvement plan that returned the program to a high level of manufacturing excellence.

Plasma surface treatment



CCAs Manufactured by BAE Systems

BAE Systems employee at solder workstation

ManTech Response:

- Analyzed independent audit data to determine root cause of poor performance and developed a new strategy based on 5 foundational elements of manufacturing excellence: *Process Execution, Requirements Flow, Requirements Implementation, Corrective and Preventive Action, and Configuration Management*
- Made significant capital investment in a dedicated Space Manufacturing production line that included an expanded and optimized Surface Mount Technology (SMT) capability and improved Conformal Coating (CC) operation with Plasma Surface Treatment prior to CC application
- Performed 3 phases of a Controlled Build process with Lockheed Martin over a 3-year period with more than 850 improvement actions completed

Impact:

- Significant improvement in Delivered Quality with consecutive months of 100% performance
- Closed delivery and compliance gaps to meet contractual requirements
- Achieved >70% reduction in Customer Corrective Action Reports (CARs) with no Customer CARs issued over a 20-month period
- Completed multiple continuous improvement projects resulting in >70% reduction in Inspection/Test Findings Per Unit during the assembly process
- Restored customer confidence

Focused on high performance manufacturing for an MDA program circuit card assembly operation

PARTICIPANTS

Missile Defense Agency; BAE Systems Electronics Systems; Lockheed Martin

Joint Service/Agency Success Story

DLA ManTech and Army Demonstrate Additively Manufactured Parts for Joint Biological Point Detection System (JBPDS) for Warfighter

The Challenge:

The Joint Biological Point Detection System (JBPDS) is currently in use by the Army and Navy, and has the ability to detect and presumptively identify Biological Warfare Agents (BWAs) and collect and save samples for later laboratory analysis. DLA manages many spare components for the JBPDS, including the Biological Agent Warning Sensor (BAWS) Intake and Exhaust Plugs. The BAWS Plugs are essential for minimizing exposure of the internal components of the BAWS 4/4+, that provides the first step of detection for the system to ambient air during storage and transport. These two spare parts have been historically difficult for the field and Depot to obtain. DLA ManTech has demonstrated the suitability of alternative BAWS Intake Plugs and Exhaust Plugs produced by Additive Manufacturing (AM). These AM parts will be added to the DLA supply chain and the AM TDP will be used for future production.

The JBPDS relies on the BAWS Intake and Exhaust Plugs to protect the sensor (left), which detects potential biological warfare agents. It is used by the Navy in the shipboard variant (center) and the Army in the shelter variant (right).

AM alternative BAWS Intake Plug (top) and Exhaust Plug (bottom) with improved desiccant interface

ManTech Response:

- Demonstrated suitability of AM to produce two hard-to-obtain JBPDS parts at the Army DEVCOM Chemical Biological Center
  - Prototyped and tested AM alternative parts
  - Produced TDP for future production
  - **DLA ManTech investment of $251.1K**

Additively-manufactured alternative JBPDS parts increased availability and reduced cost by 80-90%

Impact:

- Projected cost reduction of 80-90% from $788 and $360 to $70/unit
- Increased availability in DLA supply chain
- Eliminated a supply availability issue for BAWS 4/4+ repair at Depot
- Improved interface for desiccant packs to eliminate exact-size requirement
- Increased readiness of Biological Integrated Detection System (BIDS) and Nuclear Biological Chemical Reconnaissance Vehicle (NBCRV)

PARTICIPANTS

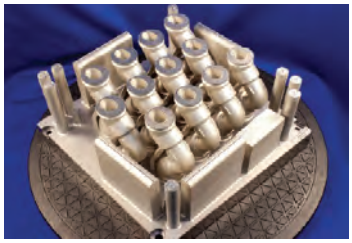
DLA ManTech; U.S. Army Futures Command (AFC) Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC); Naval Surface Warfare Center (NSWC) Crane

DLA and Army ManTech Demonstrate Additive Manufacturing (AM) Capability to Respond to Supply Shortages

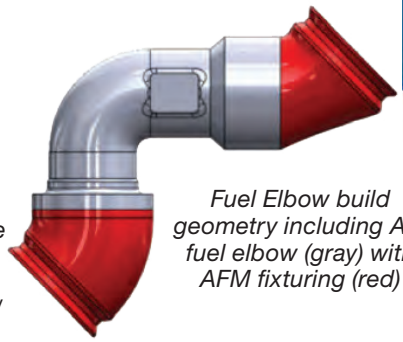
The Challenge:

Quality escapes due to manufacturing issues are a serious problem for defense systems with limited sources of supply. Supply shortages driven by these manufacturing issues can seriously limit mission capability. Additive manufacturing provides the capability to rapidly manufacture parts to mitigate these supply issues. DLA and the US Army Program Management Office Utility Helicopters recently encountered such an issue with a 90 degree fuel elbow used on the UH-60 Black Hawk Helicopter.

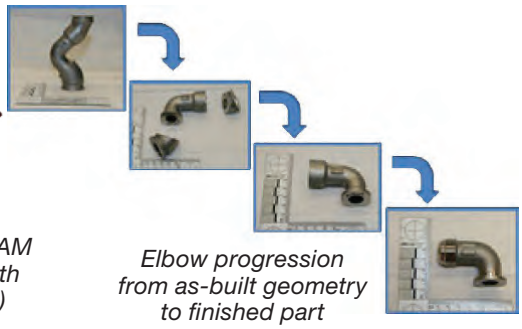
- Over-drilling of the internal passageway by the original equipment manufacturer (OEM) led to a shortage of the elbows across the industry.
- The resolution requires a manufacturing process change: To prevent similar manufacturing issues to the OEM, drilling operations for internal diameter/surface finish should be avoided.



Additive manufacturing build plate including 12 AM fuel elbows with abrasive flow machining (AFM) fixturing as well as tensile/fatigue/ microstructure coupon preforms



Fuel Elbow build geometry including AM fuel elbow (gray) with AFM fixturing (red)



Elbow progression from as-built geometry to finished part

ManTech Response:

- DLA and Army designed, built, and tested AM fuel elbows via laser powder bed fusion using 316L feedstock in order to exercise the Airworthiness Qualification Process for AM parts with the end goal of a limited airworthiness release and flight test of AM fuel elbows on the UH-60 planned in FY22
- Produced AM fuel elbows with the intent of meeting requirements of MS20762-12
- Demonstrated the design flexibility of additive manufacturing to rapidly mitigate supply chain issues
- **ManTech Investment: $400K**

Impact:

- Demonstrated the capability to use AM to rapidly design and fabricate parts to supplement the traditional supply chain
- Exercised the Airworthiness Qualification Process for AM parts in order to streamline the process for future parts
- Authored Society of Automotive Engineers Aerospace Material Specifications (SAE AMS) for 316L laser powder bed fusion feedstock and parts. These specifications will be available across the Department of Defense upon program completion
- Weapon Systems Affected: UH-60 Black Hawk

Demonstrated AM capability to supplement the traditional supply chain while mitigating quality issues associated with AM parts

PARTICIPANTS

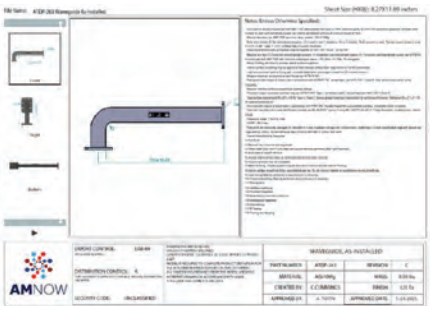
DLA; Army ManTech; DEVCOM Aviation & Missile Center Systems Readiness Directorate; US Army Program Management Office Utility Helicopters; National Center for Defense Manufacturing and Machining (NCDMM); Pennsylvania State University Applied Research Lab (PSU ARL); Redstone Test Center (RTC)

Joint Service/Agency Success Story

DLA and Army ManTech Demonstrate Additive Manufacturing (AM) for RADAR Waveguides

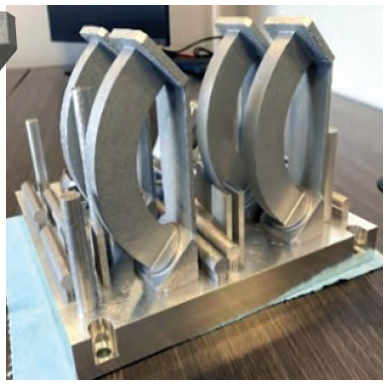
The Challenge:

Traditional Radio Frequency Waveguides, used in RADAR and in SATCOM systems are low quantity, long lead items built by a handful of industry producers. This DLA and Army ManTech effort explores the use of the Defense Industrial Base (DIB) and Organic Industrial Base (OIB) facility (Rock Island Arsenal) and Government engineering. This effort looks at the creation of electronic data packages for Waveguide parts and demonstration of AM to rapidly produce long lead items. These components are critical in the microwave transmission path of a specific RADAR system and offers expansion to other RADAR and SATCOM systems.



Converted 2D drawings to 3D TDPs

Identified and developed industry sources



Several waveguides on AM build tray at Rock Island Arsenal (each vendor has different layout)

Tech exchange with multiple sources

ManTech Response:

- Additive Manufacturing Model Based Design, Technical Data Package, 3D design, and testing for Radar Applications
- Designed AM Waveguide utilizing M&S tools to predict performance
- Developed an AM supply chain (DIB & OIB) for waveguides
- Manufactured concepts at several industry sources and Army's Rock Island Arsenal
  - Integrating "Internet of Things" (IOT) device with vendors
  - **Army ManTech $1.3M, DLA S&T $135K**

Demonstrated use of advanced engineering and manufacturing capabilities to create RADAR waveguides to solve long lead-time and other supply chain challenges

Impact:

- Use of Model Based Systems Engineering
- Expanding Army and DLA's capabilities and parts databases
- Rapid part production with immediate application to fielded platforms
- Process/application can be applied to many SATCOM and Radar
- Demonstrated electronic TDP (eTDP) use; for JAMMEX inclusion
- Demonstrated rapid TDP to part production
- Developed both the Organic and Defense Industrial Bases to enhance readiness and responsiveness

PARTICIPANTS

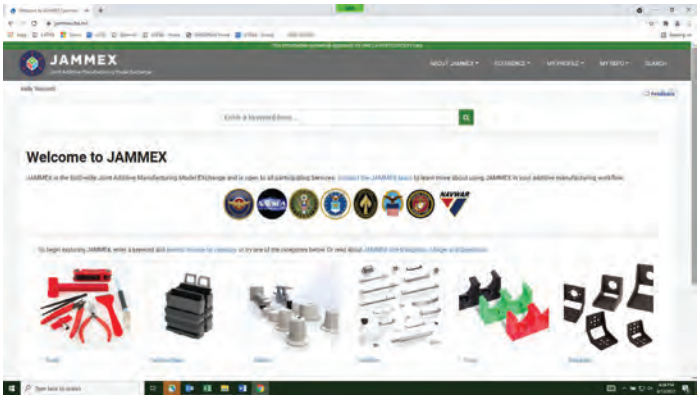
DLA ManTech; Army ManTech; Army DEVCOM C5ISR and AvMC; NCDMM; The Barnes Global Advisors; Rock Island Arsenal; Georgia Tech Research Institute, Advanced Engineering Solutions; Tobyhanna Army Depot

OSD ManTech Program and DLA Launch Joint Platform to Share Additive Manufacturing Data

The Challenge:

Additive Manufacturing (AM) allows the DoD to 3D print military products quickly, cost-effectively, and oftentimes at point-of-demand. As each Military Service increases their use of AM technology, there are an increasing number of print files and data being generated. Currently, each service creates their own silo of information that can be used internally but there was no common tool to allow for collaboration across a potential user base or with other Military Services. A secure, simplified tool was needed to enable sharing and leveraging of AM 3D data files and models across Military Services to meet DoD needs.

Stopgap surgical face mask – 3D and original view, example of the kinds of parts with data available in JAMMEX



JAMMEX simplified interface – easy to search and find what is needed

ManTech Response:

- OSD ManTech demonstrated the Joint Additive Manufacturing Model EXchange (JAMMEX) in a production environment
- System was developed with input from stakeholders across the Services
- Development project team received National Association of Manufacturers “Manufacturing Leadership Award” for JAMMEX project
- **OSD ManTech funding of $1,750K**
- JAMMEX transitioned as a fully operational tool and is now owned by the Defense Logistics Agency

Impact:

- Entered 600+ 3D Models in the system to include models and technical data that support weapon systems
- More than tripled the number of users across all Services since launch
- Incorporated 31 COVID 19 Personal Protective Equipment Models to support pandemic response efforts
- Provided ease of access with offline viewer; ability to retrieve saved models when in expeditionary environment with little or no connectivity

Increased efficiency and readiness through the sharing of 3D print files across DoD

PARTICIPANTS

OSD ManTech; Joint Additive Manufacturing Working Group (with tri-Service members, MDA, DLA, SOCOM and other defense agencies); DLA; America Makes; NCDMM; Quotient, Inc.; Identify3D, Inc.

DEFENSE MANUFACTURING TECHNOLOGY ACHIVEMENT AWARD NOMINATIONS

The Defense Manufacturing Technology Achievement Award (DMTAA) is awarded to ManTech teams who demonstrate outstanding performance in executing and delivering ManTech solutions for DoD. The Joint Defense Manufacturing Technology Panel would like to recognize these teams for their hard work and congratulates the winners of the 2020 and 2021 DMTAA, to be announced at the 2021 Defense Manufacturing Conference.

2020 DMTAA Nominations

✱ Indicates winner

Technology Enabler

The primary advancement is in software, hardware, firmware, data management, and related activities

Project Title	Service / Agency	Subpanel
High Yield Infrared Focal Plane Array (HYIRFPA)	OSD	Electronics
Joint Additive Manufacturing Model Exchange (JAMMEX)	DLA & OSD	Advanced Manufacturing Enterprise (AME)
Low Profile Radio Frequency (RF) Metaferrite Devices	Army	Electronics
✱ Development of Large Diameter Silicon Carbide Substrates	Air Force	Electronics

Cost Reduction / Rate or Safety Improvement

Projects where the primary objective is to reduce cost, increase rate or provide significant safety methodology for manufacturing production or sustainment

Project Title	Service / Agency	Subpanel
ManTech Low Cost Hybrid Fairings	Navy	Composites
VIRGINIA Class Submarine Alternative Coating and Surface Preparation Solutions for Air-System Ball Valves	Navy	Metals
HLAW Process Verification and Implementation for Ship Production	Navy	AME/Metals
Cornerstone Research Group - Rapid Manufacturing of Carbon/Carbon	MDA	Composites
Advanced Thermal Control for JAGM Seeker Transceivers	Army	Electronics
✱ Agile Manufacturing Cell with High Energy Buried Arc Welding for Vehicle Structures	Army	Metals

Enhancing Military Capability

ManTech projects which result in system and sub-system enhancements to improve military performance

Project Title	Service / Agency	Subpanel
* Novel Ultra-Strong Low Cost Film Manufacturing Technology for Superior Warfighter Protection	Army	Composites
Additively Manufactured Crashworthy, Ballistically Tolerant, Self-Sealing Aircraft Fuel Cells	DLA	Composites
Lightweight Small Caliber Ammunition Manufacturing	Army	Metals

Readiness Improvement

Manufacturing technologies where the primary benefit is readiness

Project Title	Service / Agency	Subpanel
* Hatchable Cold Spray Technology for Naval Shipyards and Marine Corps Depots	Navy	Metals
Universal AM Process Monitoring For Rapid Part Validation	DLA	Electronics
Additive Manufacturing for New Build, Remanufacturing, and Life Extension of Weapon Systems Components	Army	Metals

Supply Chain Improvement

Develop manufacturing technologies, processes, or workforce improvements that enhance efficiency (cost) and effectiveness (quality) of the supply chain

Project Title	Service / Agency	Subpanel
Applied Market Intelligence for Defense Acquisition (AMIDA)	DLA	N/A
* Integrated Casting Ordering Network (ICON) Portal Enhancement and Supply Chain Development	DLA	Metals
Model Based Supply Chain Reporting and Analysis of Production Test Results	DLA	N/A
Low Cost Freeform Prism Eyepieces	Army	Electronics

Photos of the 2020 Achievement Award Winners are on the following pages

2020 DMTAA Award (Technology Enabler): Development of Large Diameter Silicon Carbide Substrates (AF Team)

2020 DMTAA Award (Cost Reduction / Rate or Safety Improvement): Agile Manufacturing Cell with High Energy Buried Arc Welding for Vehicle Structures (Army Team)

2020 DMTAA Award (Enhancing Military Capability): Novel Ultra-Strong Low Cost Film Manufacturing Technology for Superior Warfighter Protection (Army Team)

2020 DMTAA Award (Readiness Improvement): Hatchable Cold Spray Technology for Naval Shipyards and Marine Corps Depots (Navy Team) (2 Award Winners not pictured)

2020 DMTAA Award (Supply Chain Improvement): Integrated Casting Ordering Network (ICON) Portal Enhancement and Supply Chain Development (DLA Team)

2021 DMTAA Nominations

*** Indicates winner**

Technology Enabler

The primary advancement is in software, hardware, firmware, data management, and related activities

Project Title	Service / Agency	Subpanel
* Production BOM QA Using Artificial Intelliegnce	Navy	AME

Cost Reduction / Rate or Safety Improvement

Projects where the primary objective is to reduce cost, increase rate or provide significant safety methodology for manufacturing production or sustainment

Project Title	Service / Agency	Subpanel
Circular Polarizers for Color Day Cameras	OSD	Electronics
* VIRGINIA Class Submarine Alternative Coating and Surface Preparation Solutions for Air-System Ball Valves	Navy	Metals
HLAW Process Verification and Implementation for Ship Production	Navy	AME / Metals
Non-Destructive Detection of Red Plague in Silver Plated Copper Wire	MDA	Electronics

Enhancing Military Capability

ManTech projects which result in system and sub-system enhancements to improve military performance

Project Title	Service / Agency	Subpanel
* Polymer Gradient Index Lenses for Military Optics	OSD	Electronics

Readiness Improvement

Manufacturing technologies where the primary benefit is readiness

Project Title	Service / Agency	Subpanel
Mainstream Engineering - FLOLS Lenticular Lenses Manufacturing Capability Development & Source Approval	DLA	Electronics
* Advanced Radome Diagnostic System (ARDS)	AF	AME

Supply Chain Improvement

Develop manufacturing technologies, processes, or workforce improvements that enhance efficiency (cost) and effectiveness (quality) of the supply chain

Project Title	Service / Agency	Subpanel
Portable X-ray Detectors for the Dismount Soldiers & Non-Destructive Evaluation (NDE)	OSD	Electronics
Pacer Edge F110 Oil Sump Cover	AF	AME
* Advanced Laser Diode Supply Chain Improvement During COVID	MDA	Electronics
BAE System Improves Circuit Card Assembly Quality & Regains MDA Confidence	MDA	Electronics
Universal AM Process Monitoring for Rapid Part Validation	DLA	Electronics

DEFENSE MANUFACTURING TECHNOLOGY ACHIEVEMENT AWARD WINNERS

The Joint Defense Manufacturing Technology Panel (JDMTP) seeks to recognize and honor those most responsible for outstanding technical accomplishments in achieving the vision of the Department of Defense (DoD) ManTech Program. That vision is to realize:

"A responsive world-class manufacturing capability to affordably and rapidly meet Warfighter needs throughout the defense system life cycle."

To this end, the Defense Manufacturing Technology Achievement Award was established in late 1999.

AWARDEES

2020 - Development of Large Diameter Silicon Carbide Substrates
2020 - Agile Manufacturing Cell with High Energy Buried Arc Welding for Vehicle Structures
2020 - Novel Ultra-Strong Low Cost Film Manufacturing Technology for Superior Warfighter Protection
2020 - Hatchable Cold Spray Technology for Naval Shipyards and Marine Corps Depots
2020 - Integrated Casting Ordering Network (ICON) Portal Enhancement and Supply Chain Development
2019 - 12 µm Pixel High Definition Uncooled LWIR2019
2019 - Maturation of Adv. Mfg. of Low Cost Sustainment
2019 - High Performance, Low Variability AM Parts
2019 - III-V Dual Band Infrared FPAs
2019 - DLA Nuclear Enterprise Support Office NSNs
2018 - Automated Aircraft Inlet Coating
2018 - Organic Light Emitting Diode (OLED) Microdisplays
2018 - F-35 High Fidelity Fastener Measurement
2018 - Lithium-Ion Replacement for TOW MGS Nickel Cadmium Battery
2017 – Tungsten Carbide Penetrator and Assembly Cost Reduction
2017 – Affordable Protection from Objective Threats
2017 – Virginia Class Submarine Retractable Bow Plane System
2017 – 128 Kilobit RAM ROM Microcircuit Emulation
2016 – High Operating Temperature Multi-Band FPA
2016 – Digital Thread for Material Review Board
2016 – Optical Windows – ALON
2015 – F-35 Electro-Optical Targeting System (EOTS) Producibility
2015 – Welding of High Strength Steels
2015 – Manufacturing Technology for High Power Vertical Cavity Surface Emitting Lasers (VCSELS)
2014 – Chip Scale Atomic Clock (CSAC)
2014 – F-35 Canopy Thermoforming Automation
2014 – Low Light Level Sensor
2014 – Large Affordable CdZnTe Substrates (LAS)
2014 – Establishing the Production Capability for Lighter, Higher Energy Soldier Batteries
2013 – Advanced Body Armor
2013 – Plate Edge Preparation Improvements (PEPI)
2013 – Restoration of Aerospace Parts by Cold Spray
2012 – Fastener Insertion Live Link System (FILLS)
2012 – Customer/Supplier Interoperability During Collaborative Design
2012 – 3-D Technical Data Package and Certification
2011 – Use of Digital Radiography for Final Part Acceptance of Aerospace Casting
2011 – Prosthetics & Orthotics Manufacturing Initiative (POMI)
2011 – Automated Fiber Placement of Carbon Fiber Bismaleimide Materials
2010 – High Power, High Energy Density Lithium-Ion Batteries
2010 – Seal Extrusion Development and Demonstration (SEDD)
2010 – Weld Seam Facing and Back Gouging
2009 – F-35 Inlet Duct Robotic Drilling
2009 – Low Cost Manufacturing of Materials for Improved Warfighter Protection
2008 – Laser-Welded Corrugated-Core (LASCOR) Panel Evaluation
2008 – Low Observable Paints for Aircraft
2007 – Lean Battery Initiative
2007 – Low Cost SiC-N Ceramic Tile
2007 – Translational Friction Stir Welding
2006 – Uncooled Focal Plane Array Producibility
2006 – Engine Rotor Life Extension
2005 – Large Aircraft Infrared Countermeasures
2005 – Large Marine Composite-to-Steel Adhesive Joints
2004 – Lean Depot Repair
2004 – Uniform Cannon Tube Reshaping
2003 – Laser Additive Manufacturing
2003 – Laser Shock Peening
2002 – Composites Affordability Initiative
2002 – Apparel Research Network
2001 – Enhanced Manufacturing Processes for Body Armor
2000 – Advanced Optics Manufacturing
2000 – Flexible Manufacturing of Microwave Vacuum Devices
1999 – Advanced Fiber Placement