Joint Defense Manufacturing Technology Panel

DOD MANUFACTURING TECHNOLOGY PROGRAM

2024

The Department of Defense Manufacturing Technology Program

WHAT? The Department of Defense Manufacturing Technology (DoD ManTech) Program was originally created in 1956, and falls under Section 4842 of Title 10, United States Code (USC), 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 constantly respond to world military challenges in a manner that is innovative, agile, robust, resilient, and affordable. The DoD 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 programs and execute its 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 Office administers the DoD ManTech Program by providing central guidance, direction, and support to the components ManTech Programs.

The OSD ManTech Program also manages Manufacturing Education and Workforce Development (M-EWD), the Manufacturing Science & Technology Program (MSTP), and the DoD Manufacturing Innovation Institutes (DoD MIIs). The brochure includes a special insert to provide updates and recognizes over 10 years of the DoD's public-private partnership with its nine DoD MIIs: America Makes (the national additive manufacturing institute), Manufacturing Times Digital (or MxD, digital manufacturing and cybersecurity institute), LIFT (lightweight materials institute), the American Institute for Manufacturing Integrated Photonics (AIM Photonics), NextFlex (the flexible hybrid 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-three manufacturing successes of the DoD Services and Agency ManTech Programs, provides a center article on DoD's Digital Transformation, lists the 2023 nominations for the Defense Manufacturing Technology Achievement Awards, and announces the JDMTP Service Recognition Awards for 2023.

Army Manufacturing Technology Program Overview

The **U.S. Army Manufacturing Technology (ManTech)** program's mission is to support Army readiness and modernization priorities by improving and maturing manufacturing technologies to ensure overmatch and fulfill national security objectives. The Army ManTech Program addresses manufacturing solutions that enable and improve the efficiency and affordability of manufacturing processes to advance the Army's capabilities while reducing life-cycle costs for current and future Army acquisition programs. There are three primary objectives of the program:

- Material development to meet performance requirements
- Improve manufacturability and reduce the cost to programs of record (PoRs)
- Advance the Organic Industrial Base

Critical technology maturation and transition is accomplished by coordinating efforts between the Army Science and Technology (S&T) community, the Program Executive Offices and their supporting program managers, and the defense industrial base through effective, efficient, affordable, and adaptable manufacturing processes. Additionally, the Army, through Army ManTech, actively participates in the Office of the Secretary of Defense's (OSD) DoD ManTech Science & Technology Program for efforts with Defense-wide impacts.

ORGANIZATION

The Army ManTech program supports Army-wide manufacturing requirements with current coordinated efforts across the Assistant Secretary of the Army for Acquisition, Logistics and Technology Program Executive Offices. Participation in the program competitive selection process includes leaders from the U.S. Army Assistant Secretary of the Army for Acquisition, Logistics, and Technology; the U.S. Army Materiel Command; the U.S. Army Futures Command; the U.S. Army Space and Missile Defense Command; U.S. Army Medical Research and Development Command; and the Army Rapid Capabilities and Critical Technologies Office. The Deputy Assistant Secretary of the Army for Research and Technology (DASA(R&T)) provides oversight and management of the Army ManTech program.

INVESTMENT STRATEGY

The Army ManTech process provides a balanced portfolio aligned with S&T, PEO/PM and Department of the Army priorities. Additionally, it enables the Army to maximize technology transition by leveraging both technical and acquisition subject matter expertise for specific weapon systems.

The Army ManTech program focuses investments on specific Army related weapons systems in the following portfolio areas:

- Networks/Command, Control, Communications, and Intelligence (N/C3I) Platforms
- Weapon Systems, including long-range precision fires air missile defense
- Ground Systems, including next generation combat vehicles
- Aviation Systems, including future vertical lift
- Soldier Systems, including Soldier lethality

ARMY SUCCESS STORY

Army ManTech Develops Prototype Digital Additive Manufacturing Supply Chain to Enable Secure Part Sourcing

MANUFACTURING CHALLENGE

AMNOW was created to address a critical technology gap within the digital thread associated with sourcing, producing, and delivering parts for both Air and Ground systems. The AMNOW program was intended to accelerate the dissemination, transition, and use of additive manufacturing (AM) technologies for the Army by delivering a prototype Digital AM Supply Chain (DAMSC) that could securely and economically source needed parts from the U.S. industrial base.

(l) M1 Air Microclimate Vest Manifold. Distributes air from the M1 Tank cooling tank to a soldier's vest to keep them cool

(c, r) Thermostat Housing for the Diesel 8V-71T engine (M109 self-propelled howitzer). Connects the water-cooling system to the radiator to keep the engine from overheating

MANTECH RESPONSE

- Army ManTech developed a fully integrated supply chain by way of a digital thread enabling secure transmission of digital data related to sourcing, producing, and delivering U.S. Army parts
- Demonstrated the capability of buyers to include requirements for in-process time series, post-process, inspection, and test data to be collected and delivered as part of a contract
- Showed that creating a digital additive supply chain is possible and could enable secure data transmission by addressing a critical digital thread connectivity gap related to U.S. Army part development
- Army ManTech investment of $32M

MANTECH IMPACT AND BENEFITS

- 110+ Advanced Process Development Projects (APDP) developed to demonstrate various challenges that AM can resolve, including spares availability, lead time reduction, difficulty sourcing, design enhancement opportunities, difficulty producing, or a combination thereof
- Provided a means to collect data from and disseminate data to suppliers
- Paved the way to transition some Army parts from traditional manufacturing methods to AM
- Improved Army readiness by enabling a library of ready-to-print files for the Warfighter in the field
- Demonstrated bi-directional cybersecure information transfer between government and defense industrial base

Developed and demonstrated a prototype AM digital supply chain system to support Army readiness

PARTICIPANTS

Army ManTech, U.S. Army DEVCOM Aviation & Missile Center, National Center for Defense Manufacturing and Machining (NCDMM), The Barnes Global Advisors, Youngstown Business Incubator, Quotient, Advanced Engineering Solutions, The University of Alabama in Huntsville, Catalyst Connection, StrongKey, T. McGregor & Associates and GCA Coach LLC

ARMY SUCCESS STORY

Army ManTech Matures Machining of Thick Aluminum Armor Plate to Simplify Manufacturing for Key Ground Combat System Platform

MANUFACTURING CHALLENGE

Manufacturing aluminum combat vehicle hull entails the welding of numerous sub-components that are brought together in large fixtures and fabricated into the hull. Sub-component assemblies having numerous welds can be problematic because residual stresses, weld distortion and weld defects require significant re-work and variances, resulting in production delays and higher cost.

Armored Multi-purpose Vehicle (AMPV)

Government-Industry Integrated Product Team (IPT)

MANTECH RESPONSE

- To plan production of the Armored Multi-purpose Vehicle (AMPV), Army ManTech formed a multi-member government and industry integrated product team (IPT) to enable clear communications between the aluminum factory floor workers, vehicle designers, machinists, combat vehicle production fabricators and government and OEM program managers
- Matured the processing of thick 5083 aluminum plate and transitioned the technology to the MIL DTL 46077M aluminum alloy armor plate specification
- Identified 14 problematic sub-component weldments from the AMPV low-rate initial production, and designed and machined analogous single piece parts from thick 5083 armor plate
- Conducted detailed cost model incorporating material, machining, labor, welding, and rework costs to demonstrate the cost benefit of the machined thick plate approach
- Army ManTech investment less than $5M with approximately 30% cost share from industry

MANTECH IMPACT AND BENEFITS

- Extended aluminum alloy armor plate from thickness of 3” up to 10.5” thick
- Reduced part count by 70% for affected assemblies
- Reduced inventory ordering, handling and tracking
- Eliminated 95 welds per hull, reducing required weld inspections and repairs
- Reduced combat vehicle hull manufacturing labor hours by >15%
- Demonstrated increase in hull fabrication throughput by >25%

Cost Model Reflects $50+M in Production Cost Benefits for AMPV System

PARTICIPANTS

Army ManTech, Army Research Laboratory (ARL), U.S. Army DEVCOM Ground Vehicle Systems Center (GVSC), Deputy Assistant Secretary Army (DASA) Plans, Programs and Resources (PPR), PM Mounted Armored Vehicles (PM MAV), Joint Manufacturing Technologies Center (JMTC) Rock Island Arsenal (RIA), Constellium Rolled Products, BAE Systems, JWF, Wagstaff, Corvid Technologies.

ARMY SUCCESS STORY

Army ManTech Improved Manufacturing for 6T Li Ion Batteries to Enable Implementation on Ground Vehicles

MANUFACTURING CHALLENGE

Li-ion batteries have greater energy density, longer cycle life and significantly lighter weight when compared to the currently fielded lead acid ground vehicle (6T) batteries. However, existing manufacturing processes for Li-ion 6T batteries are labor intensive. This leads to inconsistent quality and an inability to meet capacity, a situation which results in high procurement costs, lower reliability, and reduced availability of the batteries.

(l) 6T Lithium Ion battery

(r) Joint Light Tactical Vehicle (JLTV)

MANTECH RESPONSE

- Developed manufacturing processes that incorporate lean manufacturing principles to improve quality and increase battery reliability/availability more than 20%
- Demonstrated high volume manufacturing capability for batteries that are MIL-PRF-32565 (safety and performance military performance specification) compliant
- Close teamwork with Joint partners culminated with Joint Light Tactical Vehicle (JLTV) program receiving complete SG270 Naval Certification, clearing the way for full implementation
- Army ManTech investment of $9M

MANTECH IMPACT AND BENEFITS

- Increased life cycle (3X to 5X) and reduced logistic footprint
- Reduced costs with an anticipated service life of over 1000 cycles
- Improved power in ground vehicles for starting, lighting, and ignition (SLI), and silent watch capabilities
- Return on Investment of 4.6 to 1 with $39.7M cost benefit for Army and $56.8M cost benefit across DoD
- Fully transitioned to the JLTV program and was implemented through a February 2023 production contract

Impact across 20,000+ vehicles through recently awarded multi-billion dollar production contract for the JLTV A2

PARTICIPANTS

Army ManTech, U.S. Army DEVCOM Ground Vehicle Systems Center (GVSC), Program Executive Office for Combat Support and Combat Service Support (PEO CS&CSS), Joint Light Tactical Vehicle (JLTV) Program Office, SAFT America, Navy (NSWC Carderock), Defense Logistics Agency (DLA)

Navy Manufacturing Technology Program Overview

The **U.S. Navy Manufacturing Technology (ManTech)** is an industrial preparedness program focused on affordability improvements for key naval platforms as well as capability acceleration to get capabilities to the Fleet faster. Navy ManTech works closely with the Program Executive Offices (PEOs), Program Offices, key industry partners, and the Navy ManTech Centers of Excellence to identify manufacturing affordability challenges; develop affordable manufacturing technology; and transition that technology to the industry partners for implementation. Once implemented, the developed technology results in substantial affordability improvements — measured as either cost savings or cost avoidance — and strengthens the industrial base.

ORGANIZATION

Navy ManTech executes through seven Centers of Excellence (COEs), which provide a focal point for the development and transfer of new manufacturing processes and equipment in a cooperative environment with industry, academia, and the Naval Research Enterprise.

- Center for Naval Metalworking (CNM)
- Composites Manufacturing Technology Center (CMTC)
- Electronics Manufacturing Center (EMC)
- Electro-Optics Center (EOC)
- Energetics Manufacturing Technology Center (EMTC)
- Institute for Manufacturing and Sustainment Technologies (iMAST)
- Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

INVESTMENT STRATEGY

Navy ManTech will execute an investment strategy in FY24 – FY28 based on the direction of Office of Naval Research (ONR) leadership and determined by total acquisition funding; stage in acquisition cycle; platform cost-reduction goals; cost-reduction potential for manufacturing; and other factors primarily associated with the ability of ManTech to deliver the technology when needed. Over the next five years, Navy ManTech will continue to improve the affordability of Navy platforms critical to the future force, focusing resources on the VIRGINIA Class submarine (VCS), COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class aircraft carrier, FFG 62 Class frigate, and F-35 Lightning II aircraft, as well as select manufacturing technology projects that accelerate the delivery of capabilities to the Navy. The eight capability acceleration thrust areas include Sustainment Technology, Energetics Production Support, Advanced Submarine Technology Fabrication, Future (Major) Acquisition Platform Support, Unmanned / Autonomous Vehicle Production, Directed Energy, Hypersonics Fabrication, and Other ONR Manufacturing Maturation. Navy ManTech will also focus efforts on PEO IWS weapon systems that support the ship platforms in its investment strategy.

Navy ManTech investment in platforms typically ranges from $3M-8M annually and varies from year to year based on many factors, such as funding required for existing projects, past implementation record, cost savings, and potential of planned projects. Strategic planning for Navy ManTech is an ongoing effort. Navy ManTech annually analyzes acquisition scenarios and plans to determine major acquisition programs for potential investment. As the current platforms that ManTech supports mature through their respective acquisition cycles, ManTech's investment targets change. In FY24 – FY28, Navy ManTech will develop enabling manufacturing technology – new processes and equipment – for implementation on Navy weapon system production lines.

NAVY SUCCESS STORY

Navy ManTech Implements Advanced Technology to Automate Complex Plate Shaping to Reduce Manufacturing Costs

MANUFACTURING CHALLENGE

Ingalls Shipbuilding employs traditional forming technologies for complex plate geometries (e.g., press bending and line heating) that are labor intensive and heavily dependent on a specialized workforce and strict process monitoring. Prior to the project, no model-based guidance existed to accurately achieve the final plate design shape in a timely fashion. This project developed an automated plate shaping and geometry verification process that ensures proper alignment of hull plates in accordance with critical design parameters.

(l) Ingalls' current forming process using line heating; (c) Automated plate-shaping system developed by Navy ManTech; (r) Plate formed by Navy ManTech system in approximately 4 hours; the manual process to form the same plate takes nearly 54 hours

MANTECH RESPONSE

- Navy ManTech developed a prototype automated thermal-forming system at the Ingalls Shipbuilding (Ingalls) facility in Pascagoula, MS
- The automated system fully integrated all designed functions into a closed-loop process, including heating-path prediction, robotic induction heating, 3D camera scanning, and programmed quenching
- The system demonstrated performance on three selected production plates, with an improvement in root-mean-square (RMS) accuracy of over 20% for directly comparable plate shapes
- The system demonstrated significant improvement in process time by automatically forming the hard shape in 4 hours compared to approximately 54 hours with the previous manual process
- The prototype system was implemented in 3QFY2023
- Navy ManTech investment of $4.4M

MANTECH IMPACT AND BENEFITS

- Reduced overall processing time for forming complex shaped plates by 93.7%
- Significantly reduced labor, rework, material handling, and crane support resulting in a savings of $1.6M per DDG 51 Class destroyer or $5.9M per ship for all platforms constructed by Ingalls
- Automated plate-shaping system was approved by the technical warrant holders for implementation (forming production plates) in 1QFY2023

Automated plate-shaping system results in estimated 5-year cost savings of $7.9M for the DDG 51 Class destroyer program or $18.5M for all naval platforms constructed by Ingalls

PARTICIPANTS

Office of Naval Research Navy ManTech, Center for Naval Metalworking (CNM), PMS 400, Ingalls Shipbuilding, EWI, Gatekey Engineering, Concurrent Technologies Corporation, and ARC Specialties

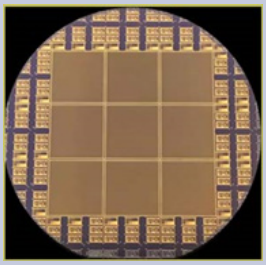
NAVY SUCCESS STORY

Navy ManTech Delivers Critical III-V Infrared Detectors at Reduced Cost for F-35 EODAS

MANUFACTURING CHALLENGE

The Electro-Optical Distributed Aperture System (EODAS) is a multi-sensor system that collects and sends high-resolution, real-time imagery to the pilot's helmet from the infrared sensors mounted around the aircraft, allowing pilots to see the environment around them – day or night. EODAS provides pilots unprecedented situational awareness of the battle space.

- The current baseline etch process meets program requirements; however, it is not compatible with transition to production (rate cannot be sustained and yield needs significant improvement)
- The current hard mask process is complex and can result in pinhole openings that can result in cluster defects
- The current photolithography process can introduce photoresist bubbles and gel slugs that result in the creation of cluster defects
- The current metal deposition process is comprised of photolithography, evaporated metal deposition, and lift-off steps
- The current dicing process is a two-pass recipe with significant front and back-side chip outs



F-35 EODAS III-V Infrared Detector

MANTECH RESPONSE

- This Electro-Optics Center (EOC) project will implement process improvements resulting in a reduction in defects, increased throughput and yield, and improved manufacturability of infrared detectors, leading to significant cost savings
- **Navy ManTech investment of ~$2.4M**; leverages more than $12.0M in Raytheon independent research and development funding and capital investments

11% Yield Improvement
10% Processing Time Reduction

MANTECH IMPACT AND BENEFITS

- An optimized etch process will improve manufacturability, improve yield, and significantly reduce cost
- A new hard mask process will reduce the number of pinhole openings, reduce the potential number of cluster defects, and greatly decrease the overall process complexity, increasing cycle time and further reducing cost
- Implementation of photolithography process improvements using a new coat and develop track tool with advanced capabilities over the existing tool will decrease cycle time and increase product yield
- Implementing an optimized metal contact process will significantly shorten the process flow, eliminating a photolithography and lift-off step, saving both time and reducing cluster defects
- Reduction of both front-side and back-side chip outs with a single-pass process without a blade change will provide cycle time savings, reduce defects, and improve yield
- **This project has begun implementation with further improvements occurring through early 2024, impacting Lots 16 and beyond**

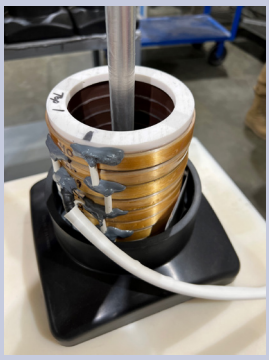
PARTICIPANTS

Office of Naval Research Navy ManTech, F-35 Lightning II Joint Program Office, Electro-Optics Center (EOC), and Raytheon, an RTX Business

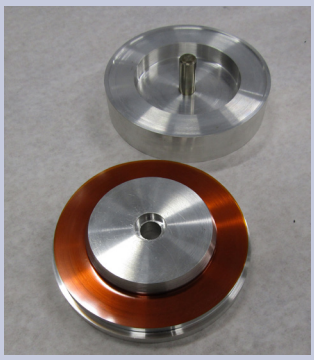
Navy ManTech Modernizes TR-343 Isolation Ring, Saving Navy $23.0M Over Five Years

MANUFACTURING CHALLENGE

Legacy materials and designs used for isolation of the piezoelectric ring stacks in TR-343 transducers rely on materials and processes that are outdated. In order to restore existing transducers and extend their service life, the Navy must rely on materials that have a shrinking commercial base and significant rise in procurement costs. Additionally, the material used is brittle, prone to reduced yield and failure, and not compliant, and the manufacturing process can lead to internal defects that result in in-service failure and ultimately expensive repairs. In order to combat these issues, Navy ManTech investigated alternative materials and manufacturing processes to improve yield and reduce cost while stabilizing procurement.



Use of alternative isolation capability developed by Navy ManTech will lower the procurement cost and improve reliability



The manufacturing process for alternative components developed by Navy ManTech uses novel techniques that enable easier manufacturing

MANTECH RESPONSE

- Navy ManTech investigated alternative materials and manufacturing methods to downselect viable candidate materials / processes for evaluation
- Produced an alternatively manufactured isolation ring that is available at a 90+% cost reduction per part
- Demonstrated the ability of new isolation rings to pass all testing requirements
- **Navy ManTech investment of $279K with $100K cost share from Naval Surface Warfare Center – Crane (NSWC-Crane)**

MANTECH IMPACT AND BENEFITS

- Reduced cost by more than 90% from ~$55 to ~$5 per ring
- Potentially improves transformer reliability, reducing attrition loss and in-service failure
- Developed and validated use of alternatively manufactured isolation rings through engineering evaluations conducted at NSWC-Crane
- Directly impacts TR-343 sonar transducers; research conducted could also benefit other platforms

Improved material procurement and reliability while saving the Navy a potential $23.0M over a five-year window as a result of implementation in 4QFY2023

PARTICIPANTS

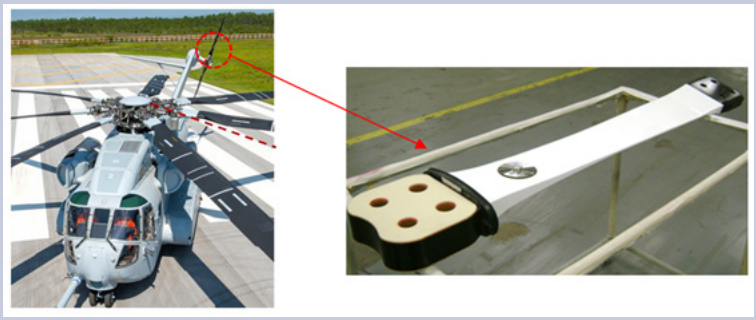
Office of Naval Research Navy ManTech, Institute for Manufacturing and Sustainment Technologies (iMAST), NSWC-Crane, and PMS 401

NAVY SUCCESS STORY

Navy ManTech Develops Robotic Manufacturing Cell to Decrease Inefficiencies in CH-53K Tail Rotor Blade Flexbeams and Reduce Labor Costs by $79.0M

MANUFACTURING CHALLENGE

Historically, CH-53K composite tail rotor blade flexbeams consist of several hundred individual plies that have been costly to manufacture through a predominantly manual lay-up process. Current process inefficiencies include significant touch labor for manual ply lay-up, raw material waste, ply kitting / storage / transfer, and manual vacuum bagging / debulk operations. Navy ManTech developed a multi-module robotic manufacturing automation cell that reduces costs related to labor and material waste, provides greater repeatability and process control, and includes an automated inspection capability.



Finished tail rotor flexbeam for reference (l) and the Navy ManTech-developed flexbeam automation cell (r), which will be implemented at Sikorsky in 1QFY2025

MANTECH RESPONSE

- Navy ManTech demonstrated advanced composite manufacturing technologies by developing an automated flexbeam manufacturing cell capable of ply handling, automated debulk, in-process vision system inspection, and robot integration
- Manufactured, programmed, tested, installed, and validated the flexbeam manufacturing automation production cell
- Installed and deployed for immediate use in the production of components for in-sourcing qualification
- Validated technology and cell robustness through the production of multiple articles throughout the program
- **Navy ManTech investment of $5.3M**

MANTECH IMPACT AND BENEFITS

- Reduced cost-per-flexbeam by ~$26K
- Reduced total CH53-K program cost by ~$79.0M, resulting in return on investment of 5.4:1, spanning 160 production aircraft and more than 2,300 replenishment spares
- Component lay-up touch labor reduced by more than 60% from 132 to 47.5 labor hours
- Throughput and production capacity increased from 4 to 8 flexbeams per month
- Improved process control and repeatability compared to the manual process
- Additional high ply-count critical composite components have been identified as candidates for future application of this integrated composite manufacturing automation approach
- Implementation at Lockheed Martin – Rotary Mission Systems (Sikorsky), Stratford, CT, in 1QFY2025

Improved composite flexbeam manufacturing lay-up efficiency will reduce an estimated $79.0M for all CH-53K helicopters constructed at Sikorsky using a fully automated process

PARTICIPANTS

Office of Naval Research Navy ManTech, Composites Manufacturing Technology Center (CMTC), PMA-261 (CH-53K Program Office), NAVAIR, Accudyne Systems, Inc., Sikorsky Aircraft

Department of the Air Force Manufacturing Technology Program Overview

OVERVIEW

Throughout its rich history, the **Department of the Air Force (DAF) ManTech** program has served a foundational role in maturing critical technologies and modern business practices for the defense industrial base, including numerically controlled machining, organic matrix composites, lean manufacturing, and manufacturing readiness levels. DAF ManTech has also worked closely with Programs of Record such as F-16, B-1, F-22, B-2, F-35, and B-21 to deliver billions of dollars in acquisition and sustainment cost savings and avoidance. Over the last twenty years, the cost of computing power, data storage, and internet bandwidth have all fallen exponentially, dramatically reshaping the manufacturing sector, and DAF ManTech remains at the forefront of the 4th Industrial Revolution (or Industry 4.0), characterized by an infrastructure built on digital manufacturing tools, such as robotics, Industrial Internet of Things (IIoT), and additive manufacturing.

ORGANIZATION

The DAF ManTech program is managed by the Air Force Research Laboratory's Manufacturing and Industrial Technologies Division within the Materials and Manufacturing Directorate. Sources used to build the program include strategic policy documents, DAF Programs of Record, AFRL's technical directorates and the AFRL Transformational Capabilities Office (TCO), industry roadmaps, the Joint Defense Manufacturing Technology Panel (JDMTP), and technical interchange meetings (TIM) with government/industry/academia stakeholders. All DAF ManTech projects are captured in technology roadmaps that are reviewed throughout the year to ensure alignment with our Warfighters. The program is funded with core 6.3 funds and by leveraging resources of other partners, such as the OSD Manufacturing Science & Technology Program, Manufacturing Innovation Institutes (MIIs), and the Industrial Base Assessment program that is executed on behalf of the Secretary of the Air Force for Acquisition. The Division also acts as the Defense Production Act (DPA) Title III Executive Agent Program Office, effectively executing over $1B in DPA funding.

INVESTMENT STRATEGY

Based on both the DoD demand signals and the technology trends driving rapid manufacturing innovations. DAF ManTech uses five technology pillars in its investment strategy. **Advanced Concepts** includes programs that address procurement and sustainment needs of Programs of Record to provide a new capability to the weapons platform or substantial return-on-investment (ROI) in the form of reduced cost and/or increased platform availability. **Hypersonic Strike, Autonomous Collaborative Systems, Space Systems, and Networked C3 Systems** generally include enabling technologies that are more pervasive in nature and therefore impact multiple weapons platforms and are often directed at emerging operational capabilities for which there isn't currently a baseline technology.

The DAF ManTech investment portfolio also includes two crosscutting emphasis areas, Advanced Manufacturing Technologies (AMT) (TRL/MRL 4-7) and Digital Manufacturing Research (TRL/MRL 2-4). These represent pervasive opportunity areas that deliver capabilities across all the technology pillars at reduced cost and timelines in the high mix, low volume aerospace manufacturing environment. DAF ManTech efforts in AMT and Digital Manufacturing Research heavily leverage the Manufacturing Innovation Institutes as well as partnerships with academia and industry to meet Warfighter needs.

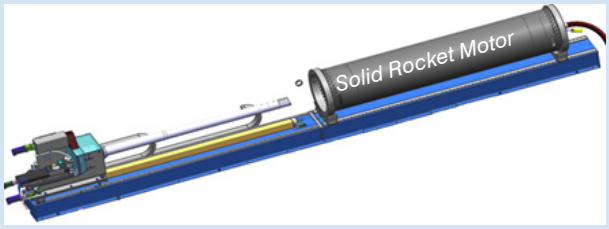
AIR FORCE SUCCESS STORY

DAF ManTech Reduces Costs by Developing Modular Slot Cutter Tool for Wide Range of Solid-State Rocket Motor Sizes

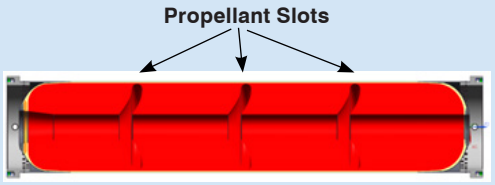
MANUFACTURING CHALLENGE

Historically, solid rocket motor (SRM) booster manufacturing has used tooling and support equipment unique to that specific motor size, which limits any shared use across multiple programs. With a wide range of required booster sizes and performance, the SRM prime contractors must invest in a high amount of tooling and equipment to accommodate each booster design that may have a different length and diameter, as well as a different slot width, diameter, and depth. This leads to significant costs in program capital equipment and larger facilities to support the growing manufacturing foot print.

Slot Cutting Tool



(l) Example of propellant grain slot cutting tool



(r) Slots are cut to provide the necessary strain relief required to operate at the cold temperature extremes typically seen during captive carry conditions

MANTECH RESPONSE

- DAF ManTech developed and fabricated a production ready propellant grain slot cutting tool capable of supporting a wide range of SRM sizes and slot cut designs using a single modular design rather than multiple slot cutters
- In coordination with industry, demonstrated dynamic slot cutting capability through process trials and demonstrations on multiple inert propellant materials
- Conducted a Manufacturing Readiness Assessment (MRA) to validate production readiness
- Developed the necessary qualification test plan for a transition program validation
- DAF ManTech Investment of $1.5M

MANTECH IMPACT AND BENEFITS

- A tool capable of supporting an increase in SRM diameter (40%), length (25%), and weight (150%) over current capability
- A tool capable of cutting an increase in slot width (67%), diameter (50%), and depth (50%) over current capability
- Reduced production change over time to a different SRM design by 200%
- Achieved smaller manufacturing foot print leading to reduced facility size requirements
- Eliminated single point failure and significant schedule risk on a current program
- Cost savings expected on an upcoming hypersonic program's Low-Rate Initial Production (LRIP)

Newly-developed slot cutting tool accommodates wide range of Solid Rocket Motors to reduce overall cost

PARTICIPANTS

Air Force Research Lab, Air Force Life Cycle Management Center EBX Division, ARCTOS, Northrop Grumman

AIR FORCE SUCCESS STORY

DAF ManTech Implements First Mobile Robotic Manipulator for DoD Sustainment Tasks

MANUFACTURING CHALLENGE

Traditional automation solutions in manufacturing aircraft require moving the hardware to a fixed robotic work cell, resulting in hard tooling and fixturing with little agility. As a result, the benefits of automation have been limited to high-volume/low-mix environments with little opportunity to remove operators from dull, dirty, or dangerous production operations.

Robotics being used at Warner Robins Air Logistics Complex (WRALC)

MANTECH RESPONSE

- DAF ManTech demonstrated automation can be cost-effective for low-volume/high-mix/high-variability operations
- Developed onboard sensors that "see" its environment, allowing the system to generate robotic motions in near real-time based on a 3D scan of the asset it is working on
- Accomplished nondestructive X-ray inspection for F-15 inlet ramps
- DAF ManTech investment of $6.5M with $4.5M from WRALC to transition

MANTECH IMPACT AND BENEFITS

- Created unprecedented agility for production operations in both DoD organic and commercial sectors
- Fully automated sanding systems are now on the floor running off-aircraft components at WRALC
- Spawned DoD's first operational mobile manipulator
- System capable of adapting to the intricacies of a particular tail number without laborious use of manual teach pendant programming

Demonstrated value of robotic automation for low-volume, high-mix, high-variability production environments

PARTICIPANTS

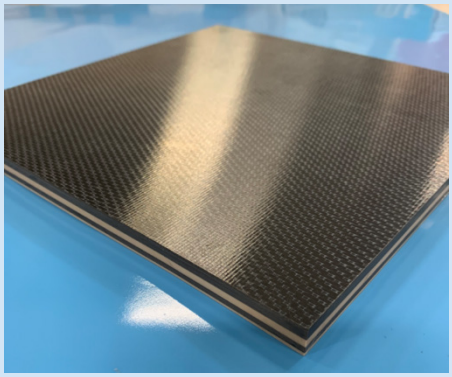
Air Force Research Lab, Warner Robins Air Logistics Complex, National Center for Defense Manufacturing and Machining, Boeing, Southwest Research Institute

AIR FORCE SUCCESS STORY

DAF ManTech Enhances Manufacturing Capability of Low SWaP-C Solution for Radiation Shielding in Space

MANUFACTURING CHALLENGE

When implementing technology in space applications, design decisions often involve making space components smaller, lighter, more powerful, and/or lower in cost. The size, weight, power and cost (SWAP-C) requirements for radiation shielding in space are high, and there are currently significant supply chain limitations in buying radiation hardened components.



Radiation shield for space applications

MANTECH RESPONSE

- A Program of Record (PoR) alerted DAF ManTech about manufacturing enhancements required to take a multilayer, polymer based, radiation shielding design from prototype to a relevant production phase
- Nanosperse Inc applied its expertise in managing uniform distribution of metal particulates suspended in a polymer to achieve the ~600 square inch surface area required to become a solution for a multitude of applications in shielding electronics from particle radiation onboard a spacecraft
- The project successfully advanced the TRL from 4 to 6 and the MRL from 4 to 7
- DAF ManTech investment of $1.3M

MANTECH IMPACT AND BENEFITS

- Increased radiation shield sizes from 64 square inches to ~600 square inches using the same production equipment with enhanced tooling
- Reduced the mass of radiation shields by 50% and reduced thickness by 30% over traditional metallic slabs while demonstrating comparable performance
- Reduced manufacturing costs by 25% by implementing enhancements
- Reduced reliance on metallic slabs that are high cost and difficult to obtain within the supply chain
- Enhanced mission capability by reducing an operational satellite by 18 pounds
- Technology was transitioned to a PoR and provided a total reduction in mass of 18 pounds for a large satellite with a Geosynchronous Equatorial Orbit (GEO) mission

Facilitated SWaP-C polymer-based radiation shielding for use in space applications at lower cost and weight

PARTICIPANTS

Air Force Research Lab, Space Test Program, Nanosperse Inc.

AIR FORCE SUCCESS STORY

DAF ManTech Develops Autonomous "Robotic Blacksmith" that Reduces Lead Times for Metal Parts by 50x

MANUFACTURING CHALLENGE

Bulk metal replacement components at Air Force logistics complexes may require 12-48 month procurement lead times, often for single digit numbers of parts. To address this readiness shortfall, a team led by the Air Force Research Lab (AFRL) developed an autonomous closed-loop robotic cell controlled by an artificially intelligent agent. The system, called AI-FORGE, consists of commercially available hardware and is capable of forming bulk metal into arbitrary geometries using open-die forging without predefined forging paths. This enables a flexible, novel, point-of-need manufacturing process that reduces lead times by up to 50x.

(l) Robotic blacksmith work cell demonstrating continuous autonomous demonstration for multiple hours. Team members present are from Yaskawa Motoman, Ohio State University, AFRL, and WRALC

(r) Metal billet between forge press flat dies being transformed through incremental pressing

MANTECH RESPONSE

- DAF ManTech developed an autonomous robotics forging cell driven by artificial intelligence
- The system developed included a Yaskawa robot for moving the component, an industrial furnace for heating the component, a Zivid camera for determining the current state of the part, and a 16-ton Coal Iron Works Forge Press for deforming the component
- The system, built with COTS hardware but driven by custom built software, is capable of forging bulk metal into arbitrary shapes
- AI-FORGE was demonstrated at the Warner Robins Air Logistics Complex, operating for several hours autonomously
- This equipment was outfitted with custom sensorization and control for tracking and responding to the amount of deformation, temperature, and overall shape change
- DAF ManTech investment of $150K with $500K of funding from the Advanced Robotics for Manufacturing (ARM) Institute and $500K cost share from industry

MANTECH IMPACT AND BENEFITS

- Reduced potential lead times on bulk metal components from 12-48 months to 1-4 weeks
- Delivered novel manufacturing technology to enable custom finishing of additively manufactured parts
- Demonstrated technology in a relevant environment at the Warner Robins Air Logistics Complex
- Secured follow-on funding ($500K from the ARM Institute) to continue maturation and system scale-up

Autonomous robotic forging cell promises up to 50x faster delivery of replacement components at Air Force Air Logistics Complexes

PARTICIPANTS

Air Force Research Lab, Ohio State University, Yaskawa Motoman, and Warner-Robins Air Logistics Complex

Digital Transformation at DoD

Digital engineering is a force multiplier that helps the DoD ManTech Program meet its mission.

DoD defines digital engineering as an integrated digital approach that uses sources of systems data and models across disciplines to support life-cycle activities from concept through disposal of a military system. Benefits include informed decision making through increased transparency, enhanced communication, increased understanding for greater flexibility in design, increased confidence that the capability will perform as expected, and increased efficiency in engineering and acquisition practices. (Reference: 2018 DoD Digital Engineering Strategy, OUSDR&E Systems Engineering).

DoD ManTech's Mission

Reduce the acquisition and supportability costs of defense weapon systems and reduce manufacturing and repair cycle times across the life cycles of such systems

Digital engineering practices may be employed to foster rapid, superior execution of manufacturing enterprises across the life cycle of military systems. The examples below illustrate how DoD uses digital engineering to improve readiness and to modernize how DoD designs, develops, delivers, operates, sustains, and disposes of systems:

NAVY MANTECH DIGITAL SHIPBUILDING EFFORTS

To counter manual, paper-drive inefficiencies and increasing fabrication labor and costs associated with legacy shipbuilding processes, the Navy improved its shipbuilding processes by moving to digital workflows. Newer digital technologies and ship designs have been proven to optimize construction workflows. In addition, increased use of digital thread established by model-based designs and processes, as shown in Figure 1, will enable future improvements in shipbuilding.

Beginning in 2016, shipbuilders at General Dynamics Electric Boat, Newport News Shipbuilding, Ingalls Shipbuilding, and Bath Iron Works partnered to digitally transform shipbuilding processes to reduce major acquisition platform costs. Navy ManTech invested $65.6M to conduct 45 digital engineering projects and achieved cost savings of $13.6M per VIRGINIA Class submarine, $11.2M per CVN 78 aircraft carrier, $8.3M per COLUMBIA Class submarine (CLB), and $31.3M per DDG 51 destroyer.

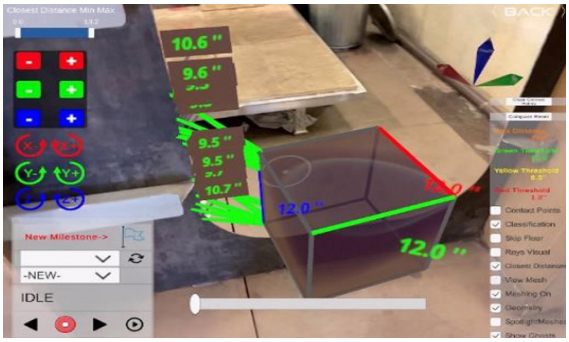


Figure 1. *Virtual Load Out Interference Detection (Project S2899) developed an application that Integrates mixed reality technologies with "as-built" ship conditions and CAD product data to detect interferences in real time assessments of equipment load outs or removals*

ARMY MANTECH DIGITAL ADDITIVE MANUFACTURING SUPPLY CHAIN (AMNOW)

In late 2022, the Army's AMNOW program successfully developed a robust, capable, digital additive manufacturing (AM) supply chain by way of a digital thread that enabled secure transmission of digital data related to sourcing, producing, and delivering AM parts for both Army air and ground systems. (See p. 4)

The AMNOW program accelerated the dissemination, transition, and use of additive manufacturing (AM) technologies for the Army by delivering a prototype Digital AM Supply Chain (DAMSC) that could securely and economically source needed parts, such as the Shadow Jackstand (Figure 2), from the U.S. industrial base.

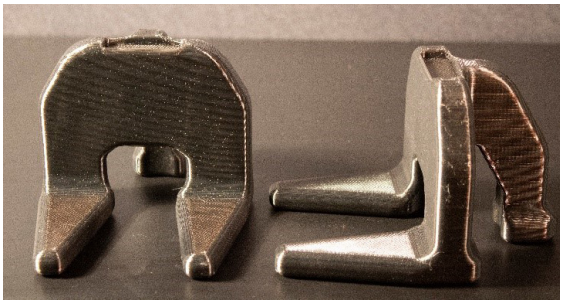


Figure 2. *Shadow Jackstand holds the Army aircraft up and allows a single person to change the tire significantly reducing time required to perform the maintenance task.* *Read more on p. 4.*

THE DEPARTMENT OF THE AIR FORCE MANTECH PROGRAM DIGITAL MANUFACTURING INNOVATIONS

The 4th Industrial Revolution (Industry 4.0) is characterized by an infrastructure built on digital manufacturing tools, such as robotics, Industrial Internet of Things (IIoT), and additive manufacturing.

Based on both the DoD demand signals as well as the technology trends driving rapid manufacturing innovations through Industry 4.0, Department of the Air Force developed five technology pillars: advanced concepts, space systems, hypersonic strike systems, autonomous collaboration systems, and networked C3 systems. (See Figure 3 below).

These pillars are supported by two crosscutting digital opportunity areas: (1) Advanced Manufacturing Technologies (e.g., digital design and AM); and (2) Digital Manufacturing Research (e.g., intelligent robotics). These represent pervasive opportunity areas that deliver capabilities across all AF technology pillars.

For example, DAF ManTech demonstrated the value of robotic automation to reduce costs and timelines associated with low-volume, high-mix, high-variability production environments (see success story on p. 16).

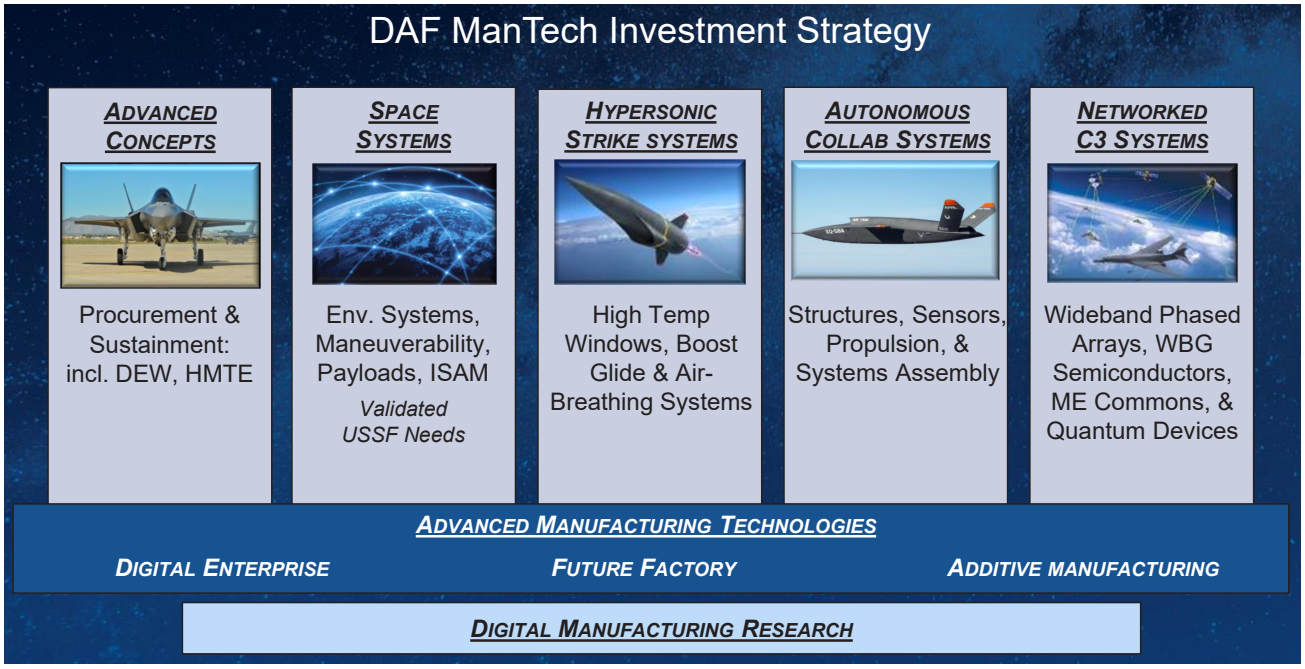


Figure 3. *DAF ManTech Program Digital Manufacturing Innovations*

DEFENSE LOGISTICS AGENCY DIGITAL THREAD EFFORTS

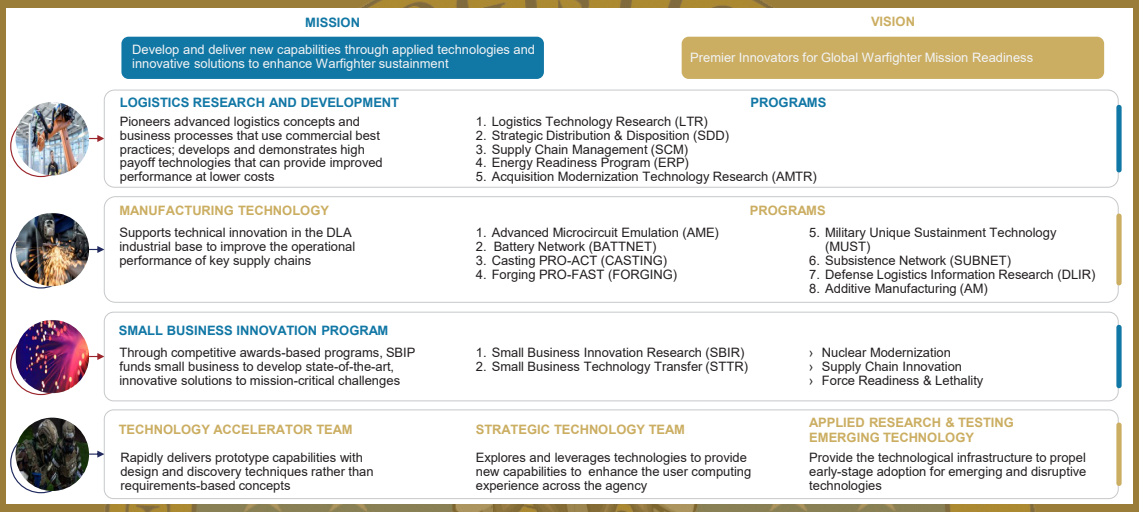
DLA supports DoD digital modernization efforts with the creation of model-based (digital as master) enterprise systems in which DLA, the Military Services, and industry streamline the delivery of accurate requirements, high-quality material, and end-items throughout the supply chain.

For example, DLA ManTech has developed the Digital Sustainment Platform (DSP) that would improve supply chain readiness (see success story on p. 21). This platform supports bi-directional digital data flow among DLA, the suppliers, and the military services for the weapon systems in sustainment.

DLA ManTech worked with Air Force sustainment to develop DSP prototypes to enable collaboration among DLA, suppliers, and military services to track military service directed engineering changes that affect military inventory. DLA also developed a model-based engineering tool to convert stock data of Army Paladin A6 weapons system components from 2D to 3D model-based technical data packages to seamlessly connect DLA, the Military Services, and Small Mid-Size Manufacturers (SMMs).

DLA Manufacturing Technology Program Overview

The **Defense Logistics Agency (DLA) ManTech** program mission is to develop and deliver new capabilities through applied technologies and innovative solutions to enhance warfighter sustainment. Working with its diverse supply chain, the DLA ManTech Program funds the advanced technology development needed to improve manufacturing capability throughout a product's life cycle. As illustrated, DLA's R&D programs deliver responsive, innovative solutions that improve DoD readiness, support current strategies and operations, and anticipate future logistics and manufacturing needs at lower cost and risk.



DLA ManTech developments provide the crucial link between invention and application by maturing, scaling up, and validating advanced manufacturing technology in "real-world" environments. The program goal is to provide a path to low-risk technology implementation by small businesses, defense unique suppliers, and to the military depots and shipyards. By anticipating and addressing production and sustainment problems before they occur, readiness levels increase, and sustainment costs are decreased.

ORGANIZATION

The DLA ManTech Program is aligned under the Office of the Under Secretary of Defense (OUSD) Acquisition and Sustainment, Assistant Secretary for Sustainment, as the nation's combat logistics support agency. Within DLA's Information Operations (J6), DLA R&D (J68) improves Warfighter support by addressing military needs, internal business processes, and industrial base manufacturing challenges. DLA ManTech works with the Military Engineering Support Activities to conduct annual strategic assessments to identify, and fund needed efforts to meet Warfighter needs.

INVESTMENT STRATEGY

The DLA ManTech program uses two lines of effort (LOE) to guide its investments. The first DLA R&D LOE 1, Industrial Base and Aging Weapon System Support, ensures a viable and responsive defense industrial base; addresses obsolescence using trusted manufacturing sources of qualified microcircuits to sustain legacy DoD weapon systems; and introduces advanced manufacturing concepts into the DoD supply chain, such as AM replacement parts.

The 2nd DLA R&D LOE 2, 3D Technical Data Modernization/ Model Based Enterprise Technologies, transforms data into 3D machine usable formats to support DoD's digital modernization efforts for significantly improved readiness. MBE systems enable DLA, the military services and industry to specify accurate requirements and deliver high-quality material/end-items throughout the supply chain.

The DLA ManTech program portfolio areas are:

(1) Advanced Microcircuit Emulation
(2) Battery Network
(3) Castings/Forgings
(4) Military Unique Sustainment Technology (MUST)
(5) Subsistence Network
(6) Defense Logistics Information Research, and
(7) Additive Manufacturing

DLA ManTech Demonstrates Powerful, Lightweight, Conductive Polymer Bipolar Military Batteries

MANUFACTURING CHALLENGE

Traditional lead-acid battery technology is a logistics burden, involves complex manufacturing, and is limited in energy and cycle life. This project established a unique bipolar lead-acid technology design for increased power, energy, cycle life, and lighter weight. The 88-pound 6T battery is used in virtually every armored and automotive military system and other applications (185,000 requisitions in FY 2022).

(l) Abrams Tank

(r) Joint Light Tactical Vehicle

MANTECH RESPONSE

- Designed, assembled and tested Bipolar 2V cells and 6V modules with normal Applied Glass Materials (AGM) and Lead Oxide pastes
- Developed advanced production techniques for high volume assembly
- Confirmed prototype production procedures at Univ. of Sheffield for future U.S. and U.K. plants
- Provided Bipolar 12V 6T batteries for U.S. Army Ground Vehicle Systems Center (GVSC) testing and qualification
- DLA ManTech investment of $1.988M

MANTECH IMPACT AND BENEFITS

- Lighter weight (37% decrease), long lasting, inexpensive, robust, and corrosion-resistant lead-acid battery alternatives
- The Bipolar 6T battery meets or exceeds the MIL-PRF-32143C requirements
- Improves vibration resistance, higher charge rate, and increases shelf life
- Expands advanced manufacturing techniques for lead-acid batteries (bipolar design, conductive polymer extrusion, cold spray and electroplating)

Provides low-cost, rapid manufacturing for higher performance lead-acid batteries

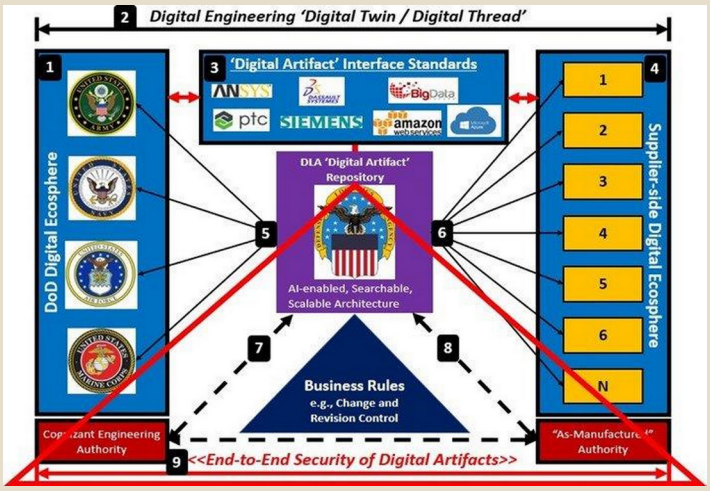
PARTICIPANTS

DLA ManTech (BATTNET Program), Ultimate Battery Company, University of Sheffield (UK), US Army Ground Vehicle System Center (GVSC)

DLA ManTech Develops Digital Sustainment Platform (DSP) to Enable Collaboration with the Military Services and Industry Partners

MANUFACTURING CHALLENGE

The Department of Defense (DoD) supply chain is multifaceted, complex, and subject to stringent regulations. Currently, DLA's IT infrastructure is not set up to procure items with digital models, hence it is not possible to build a Digital Thread/Digital Twin (DT/DT). DLA's newly developed Digital Sustainment Platform (DSP) (figure below) enables DLA to seamlessly connect the digital technical data received from the military services to the supplier side 'as manufactured" data digitally. Building a DT/DT in the sustainment phase offers DoD a significant gain in quality and efficiency by providing the right information to the right place at the right time.



DLA Digital Sustainment Platform

MANTECH RESPONSE

- Developed a new DSP to support bi-directional digital data flow between the suppliers and the military services for the weapons systems in sustainment
- Worked with Air Force sustainment to develop DSP prototypes to allow collaboration among DLA, suppliers, and the military services to track military service directed engineering changes that affect inventory
- Worked with Army Paladin Program Management Office (PMO) to develop 2D-3D conversions
- Transitioned DSP capabilities to DLA J62 in FY23

DSP Enables the DoD Model-Based Sustainment Enterprise

MANTECH IMPACT AND BENEFITS

- DSP allows the military services, DLA, and industry partners to engage on a real-time basis to make design changes with full traceability
- DSP enhances the security and resiliency of the DLA supply chain by extending NIST 800-171 / Cybersecurity Maturity Model Certification (CMMC) compliant tools / services to supply chain partners
- DSP enables a framework so small mid-size manufacturers (SMMs) can easily adopt digital manufacturing, automation, and Industry 4.0
- DSP provides DoD a seamless web-enabled bi-directional exchange of advanced manufacturing digital artifacts for CONUS / OCONUS operations

PARTICIPANTS

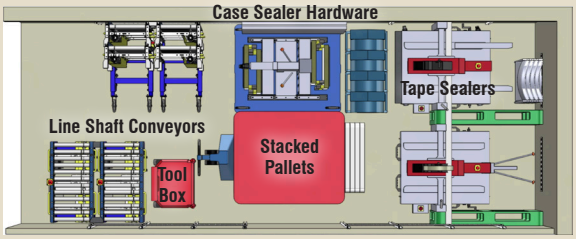
DLA ManTech (J3, J6, J7), OSD, Military Services DLA, Land and Maritime (L&M), DLA Aviation, RGBSI Aerospace and Defense, LLC and defense suppliers

DLA ManTech Creates Rapidly Deployable Unitized Group Ration Kitting Platform

MANUFACTURING CHALLENGE

The Unitized Group Ration – Heat and Serve (UGR-HS) and UGR E (Express) – is vital in sustaining military personnel during worldwide operations. It is designed to maximize the use of commercial items and simplify the process of providing high quality and safe food in field environments. These UGRs are comprised of three boxes and organized as two menus of 50 items each on one tier of a pallet. One tier provides 100 meals and one pallet (four tiers) provides 400 meals. To meet emerging operational surge requirements, the UGR Kitting Platform provides a critical defense capability that enables UGR kitting, that is the packing of food items into modules, at different CONUS or OCONUS locations.

(l) Unitized Group Ration Kitting Platform able to be rapidly deployed



(c) Deployable UGR Platform Layout

(r) UGR Modules

MANTECH RESPONSE

- Under the DLA Research and Development Small Business Innovation Research (R&D SBIR), TurnAround Factor created a deployable and scalable solution to UGR kitting
- Developed the operational, maintenance, deployment, and packing manuals for the UGR platform
- Demonstrated operational functionality and viability of the Deployable Unitized Group Ration (DUGR) at DLA Distribution in New Cumberland, PA
- DLA ManTech investment of $1.6M

MANTECH IMPACT AND BENEFITS

- Designed to largely reflect the processes used today at the only fixed facility in Tracy, CA
- Deployed 2x20' International Organization for Standardization (ISO) shipping containers and produced up to 12,000 UGR modules in the first 30 days
- Employs targeted automation, process improvements, and mitigates surge capability gap for critical defense activity
- Deployable capability can be used for exercises and military humanitarian assistance & disaster relief efforts

Successfully demonstrated the deployable UGR platform capability to supplement emerging operational surge requirements

PARTICIPANTS

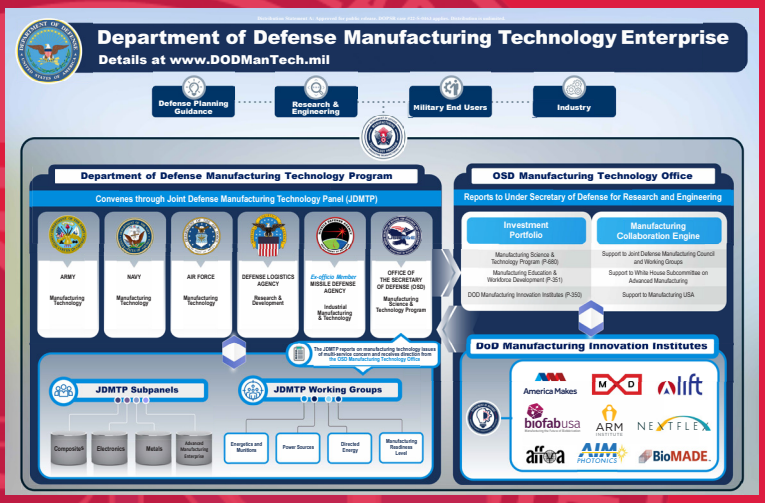
DLA ManTech, TurnAround Factor, DLA Troop Support Subsistence, DLA Distribution, and DLA J3

Manufacturing Science and Technology Program Overview

The **OSD ManTech's Manufacturing Science and Technology Program (MSTP)** focuses on cross-cutting defense manufacturing needs – those that are beyond the ability of a single service to address. The program stimulates the early development of manufacturing processes and enterprise business practices concurrent with science and technology (S&T) development to achieve the largest cost-effective impact and to facilitate the developments enabling capabilities to our warfighters. The program focuses heavily on satisfying the manufacturing technology needs for the DoD's critical technology areas including: trusted artificial intelligence and autonomy, biotechnology, integrated network systems-of-systems, directed energy, microelectronics, quantum science, hypersonics, space technology, renewable energy generation and storage, advanced computing and software, human-machine interfaces, future generation wireless technology (FutureG), advanced materials, and integrated sensing and cyber.

ORGANIZATION

The MSTP is located under the Assistant Secretary of Defense for Science and Technology with the Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)). The program office has three main organizational components: MSTP, the DoD Manufacturing Innovation Institutes (MIIs), and Manufacturing Education and Workforce Development (M-EWD).



INVESTMENT STRATEGY

The MSTP focuses its research and development investment portfolio on cross-cutting defense manufacturing needs using a set of identified joint, defense-critical, and sometimes high-risk manufacturing technology areas. JDMTP helps identify the defense manufacturing technology gaps and assists MSTP in determining potential joint investment opportunities. MSTP then assesses these opportunities against R&E critical technology areas and then issues a call for project proposals that must feature a Governmental office lead. Project tenets must include:

- DoD Enterprise-wide issues
- Joint service applicability
- Enhanced manufacturability and producibility of a process or component
- Risk beyond reasonable and normal industry and program office
- Defense-essential or defense-unique requirement

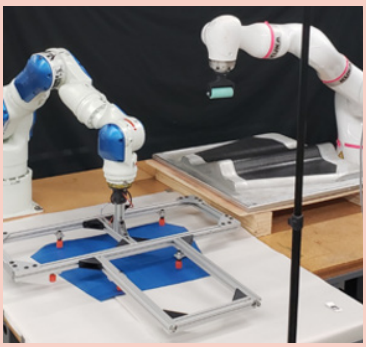
Technology transition and joint-service or multi-system application are key factors in selecting MSTP projects. All potential MSTP projects are required to have a clear technology transition plan and target along with endorsement from the potential project team's program office. Funding is typically a combination of MSTP investment, component ManTech program investments, program office or transition office investments, and industry investment cost share. Additionally, technical experts are recruited from the DoD Services or Agencies to serve as government program managers and are responsible to support technical execution, conduct financial management, and ultimately transition the technology to fielded systems.

The MSTP investment portfolio is broken down into 4 categories: Advanced Electronics and Optics, Advanced Materials and Manufacturing, Enterprise and Emerging Processes, and Advanced Energetics Manufacturing.

MSTP Ensures Domestic Supply of Carbon-Carbon Composites for Hypersonic Applications

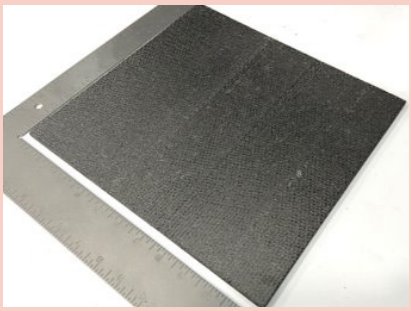
MANUFACTURING CHALLENGE

Carbon to Carbon (C/C) materials are a critical component for high-speed systems and high-temperature environments. These advanced materials have higher strength, lighter weight, higher efficiency, and can handle more extreme temperatures. Recognizing the importance of these materials, the Office of the Under Secretary of Defense for Research and Engineering created MOC3HA – the Manufacturing of Carbon-to-Carbon Composites for Hypersonic Applications program. The goal of this program is to improve automation, increase yields to expand onshore manufacturing capability, accelerate process flow, and improve advanced material supply stability.



(l) Robotic layup of C/C composite

(c) 3D printing of C/C Composite



(r) C/C Composite plate

MANTECH RESPONSE

- The OSD ManTech MOC3HA program worked with legacy manufacturers and multiple emerging producers to establish a stronger, broader onshore supply base for C/C components to meet DoD weapon and flight system requirements
- MOC3HA contributed to workforce development with several new personnel trained in composite production, high temperature manufacturing, and materials modeling for high temperature production
- MOC3HA ensured a ready supply of C/C composite components for defense applications
- Increased U.S. production volume at reduced time and cost by bringing in new suppliers to the industrial base

MANTECH IMPACT AND BENEFITS

- Conducted 31 separate projects with >35 commercial collaborators who made >70 unique C/C articles that were tested to demonstrate good thermal and mechanical performance
- Enabled rapid production at reduced cost, for example, by demonstrating automated robotic layup with 25% materials reduction while achieving 100% of thermophysical performance
- Accelerated prepreg processing with enhanced material consistency implemented at a Tier 1 manufacturer
- Used automated processing and predictive tools to obtain 30% cost savings over incumbent production methods

Rapidly matures and integrates manufacturing innovations to accelerate the onshore production of carbon/carbon composites for hypersonics in extreme environments

PARTICIPANTS

OSD MSTP and U.S. Advanced Materials Manufacturers

MSTP and Navy Improve Personnel Safety in Energetics Manufacturing

MANUFACTURING CHALLENGE

Infrared countermeasure devices are comprised of hazardous material that is sensitive to impact, friction, and electrostatics while mixing and is unstable and prone to cause accidents to personnel during production. Production automation using robots reduces personnel exposure and improves their safety in handling the hazardous materials required.

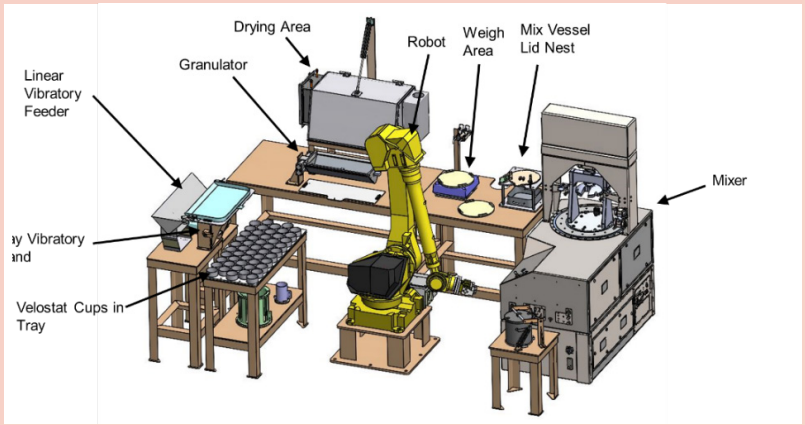


Figure 1. *Energetic mixing manufacturing cell*

MANTECH RESPONSE

- OSD worked with the Navy ManTech to develop a mixing process with the Resodyn OmniRAM mixer to replace the legacy cowls mixer to meet product and performance specifications in Phase 1
- Phase 2 developed and finalized the design of an automation system for material handling and cleaning
- Combined investment of $3.3M from MSTP and Navy ManTech

MANTECH IMPACT AND BENEFITS

- Improved safety of production personnel by automating the process to reduce their exposure to the hazardous environment
- Reduced cost of infrared countermeasures
- Reduced negative environmental impact by using less hazardous solvents
- Reduced costs and increased production capacity to meet projected demands
- New automation system is applicable to all energetic manufacturing and can be tailored or scaled to specific processes

Modernized energetics manufacturing process reduces personnel exposure to hazardous environments to drastically reduce risk to personnel

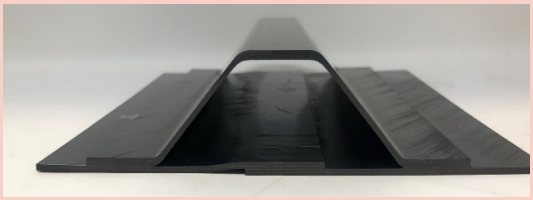
PARTICIPANTS

OSD MSTP, Navy ManTech, Kilgore Flares Company, Franklin Engineering

MSTP and Navy ManTech Lower Cost and Increase Production of Thermoplastic Composite Welded Assemblies

MANUFACTURING CHALLENGE

Structural composite assemblies require adhesive bonding or mechanical fastening to join the individual components. This requires extensive and costly preparation of the components for assembly, either through surface preparation and bonding or hole machining and fastener installation. The "future of joining" components may be revolutionized and costs reduced by using thermoplastic composite welded assemblies in which the components can be re-melted (due to the chemical nature of the thermoplastic matrix), which provides "welding" of components as a means of joining.



(l) Toray TC1320 (UD CF/PEKK); 16 ply thickness laminates; Quasi-isotropic layup (45 degree outer surface plies)

(c) Stamped, formed ridge

(r) Full Width Induction Welding- Overlap joint and stiffener rib joint shown

MANTECH RESPONSE

- OSD ManTech and Navy ManTech leveraged a thermoplastic induction welding effort to reduce the cost of an induction welding process for assembly of structures with significant curvatures, such as aircraft fuselage chines and leading and trailing edges (like on the MQ-25A and Low Cost Attritable Aircraft Platform)
- Focused on inductive heat on joining surfaces so welded assemblies can be fabricated without negatively impacting the integrity of the base components
- Demonstrated that inductive welding is a fast, automated process that does not require a cure cycle, as needed in traditional adhesive bonding
- MSTP investment of $2M with $2.2M cost share from other government agencies

MANTECH IMPACT AND BENEFITS

- Reduced weight by 10% through elimination of fasteners and adhesives
- Reduced production cost by 30% – component fabrication, freezer storage, reduction in consumables (bagging), and a more robust fabrication process
- Improved production rate by 20% due to continuous compression molding, stamp forming and induction welding that are geared towards automation, which reduces touch labor
- Simplified supply chain with a reduction in the number of components, parts required for assembly, and coordination for varying production rates
- Developed and demonstrated a U.S. Domestic capability for induction welding of thermoplastic composite assemblies

Thermoplastic composite welded assemblies provide a cost-effective and sustainable alternative to traditional metal and thermoset composite assemblies.

PARTICIPANTS

OSD MSTP, Navy ManTech – The Composites Manufacturing Technology Center, The University of South Carolina, The Boeing Company, PMA 268 Unmanned Carrier Aviation Program

MSTP Collaborates with Industry Partners Advancing Domestic Manufacturing Readiness of Hypersonics

MANUFACTURING CHALLENGE

Hypersonic systems fly within the atmosphere for significant portions of their flight at or above 5 times the speed of sound, or approximately 3700 miles per hour, dramatically shortening the timeline to strike a target and increase accuracy. MISTP is working alongside its industry partners to investigate the industrial base limitations and challenges associated with the manufacture of hypersonic systems, a critical asset to strengthen the Nation's technological superiority.

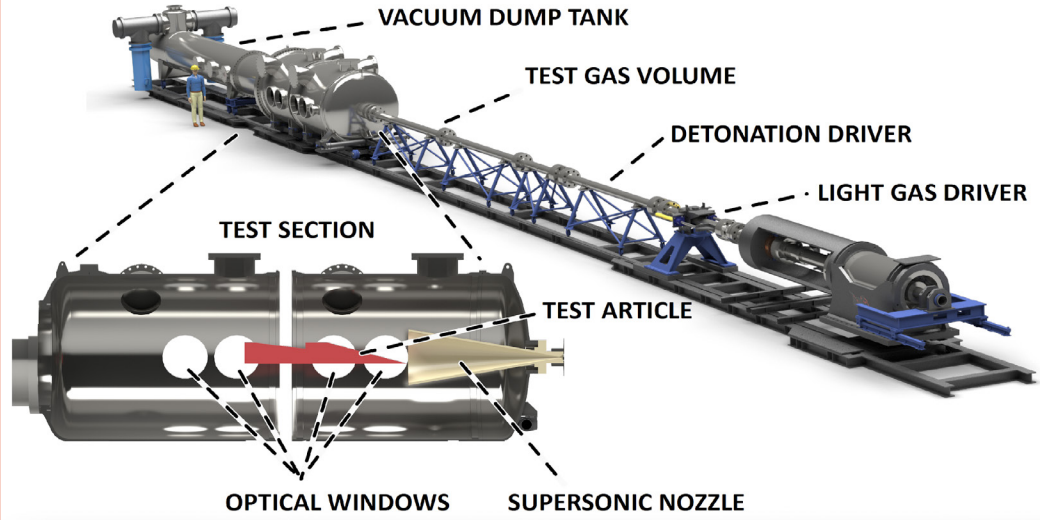


Figure 1. *HYPULSE hypersonic flow tunnel enables a simulated flight environments of Mach numbers from 2 to 40 with test durations between approximately 10 ms - 0.5 ms, respectively*

MANTECH RESPONSE

- OSD ManTech is collaborating with industry at the Purdue Applied Research Institute, Hypersonics Advanced Manufacturing Technology Center (HAMTC) to advance domestic manufacturing readiness in support of hypersonic missile development
- Developed the flow and design optimization of multi-material systems for hypersonics
- Demonstrated that successful application of hypersonic support systems and additive manufacturing of high temperature metals leads to shorter manufacturing lead times, mass customization, and development of complex shapes and high temperature materials

MANTECH IMPACT AND BENEFITS

OSD MSTP in close partnership with members of the defense industrial base developed transition plans to enable technology transfer and testing capabilities to the HAMTC partners

Developed advanced testing capabilities to make significant advancements in additive manufacturing, design and integration of Components, and vertical supply chain

PARTICIPANTS

OSD MSTP, Purdue University, GE Additive, GE Edison Works, Dynetics, Aerojet Rocketdyne, Lockheed Martin, Innoveering, Molyworks Materials, CompuTherm, Boeing, HyPerComp

OSD ManTech Office and the Manufacturing Science & Technology Program: The Power to Connect and Drive Transition

The Office of the Secretary of Defense Manufacturing Technology (OSD ManTech) Program seeks to further the national security of the United States by furthering advanced manufacturing technologies and processes through joint, interagency, and public-private collaborations.

The OSD ManTech Program is responsible for:

- Supporting the Office of the Secretary of Defense for Research and Engineering OUSD(R&E) Critical Technology areas
- Managing the Manufacturing Science and Technology Program (MSTP)
- Administering the DOD Manufacturing Technology Program
- Furthering the DOD's Manufacturing Education and Workforce Development activities
- Collaborating with other federal agencies on advanced manufacturing in the United States
- Overseeing the federal government's partnership with the DOD Manufacturing Innovation Institutes

Along with providing manufacturing policy and direction for the DoD ManTech Program and serving as a Principal on the Joint Defense Manufacturing Technology Panel (JDMTP), the OSD ManTech Office also oversees the MSTP investment portfolio. MSTP is a research and development investment portfolio focused on a set of identified joint, defense-critical, and sometimes high-risk manufacturing technology areas.

The following section highlights four projects that were funded by MSTP in FY23. These projects address manufacturing challenges common across the Services and develop technology solutions, where joint investments in manpower and in funding may be combined or leveraged.

In each one of the success stories, three or more Military Service or Defense Agencies were involved in developing the manufacturing technology. These projects align with both OUSD(R&E) modernization priorities and the Service and Agency manufacturing technology focused investment areas.

By leveraging Service and Agency ManTech investment and expanding opportunities for implementation, DoD ManTech effective impacts improvements for the warfighter!

Joint Investment in Free Space Optics Meets DoD Requirements and Reduces Cost

MANUFACTURING CHALLENGE

Free space optical communication uses light propagating in free space to wirelessly transmit data for telecommunications or computer networking. The fast-steering mirrors and optoelectronics sensors for these communication systems are very costly. New vendors were needed to provide affordable mirrors and sensors on schedule to support the Tactical Line-of-site Optical Communications Network (TALON) and Electrically Articulated Grenade Launcher (EAGLS) communication systems.

(l) Fast Steering Mirror assembly that is used in the Navy TALON free space optic communication system

(c) Packaged Optoelectronic sensor used for sensing laser data in TALON free space optic communication system

(r) The TALON Transceiver is a crucial component of the TALON system, enabling high-speed data transmission over FSO links. With a data transfer rate of up to 800 mbps, it ensures efficient connectivity for mission-critical operations

MANTECH RESPONSE

- MSTP and the Navy ManTech funded the effort to make an investment in optoelectronic sensors to improve their performance and yield and provide needed components for the U.S. Marine Corps EAGL program of record
- Successfully improved the "as-received" optical subassembly design, while maximizing performance
- Generated a Navy-owned design and technical data package for a fast steering mirror (FSM) subsystem that is used in tactical free space optic assemblies
- Worked with vendor to prototype and validate a fabrication run of a new FSM supplier

MANTECH IMPACT AND BENEFITS

- Reduced the cost of optoelectronic detectors by increasing yields after packaging
- Improved uniformity of delivered packaged design, thus improving uniformity of FSO links between 1km and 56km ranges
- Obtained new optoelectronics vendors that can now meet Department of Defense requirements
- Reduced the cost of the FSM sub-assembly in support of the U.S. Marine Corps EAGL program of record
- Government owned technical data package ensures a robust supply chain for future FMS acquisition

Through joint efforts of MSTP and Navy, two new vendors are able to meet the cost and schedule requirements for emerging Navy and Marine Corps Free Space Optic communication systems

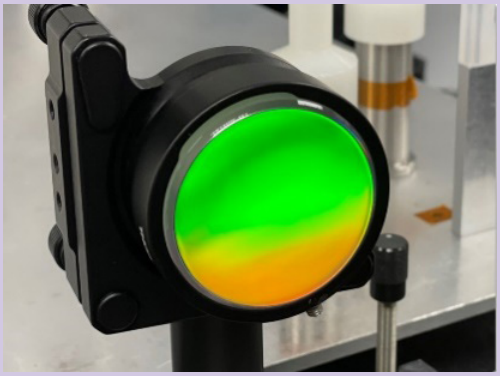
PARTICIPANTS

OSD MSTP, Office of Navy Research, Office of the Secretary of Defense – Strategic Capabilities Office, Marine Corps Systems EAGL, GPD Optoelectronics, Optogration, Optics in Motion, L3Harris

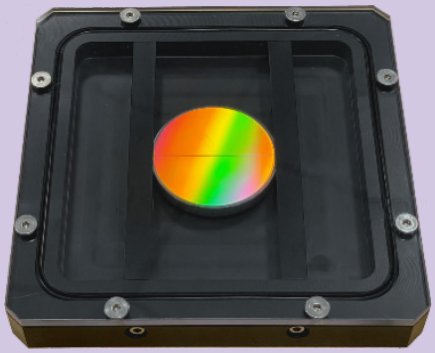
Joint Effort Stands Up Industrial Manufacturing Capability for Multi-Layer Dielectric Gratings for High Energy Lasers

MANUFACTURING CHALLENGE

Multi-layer dielectric (MLD) gratings are a critical component of High Energy Laser (HEL) weapon systems that utilize Spectral Beam Combining technology. This component combines several low power lasers into the high-power beam needed to engage targets. Currently, MLD gratings that meet performance requirements are only fabricated at a Department of Energy national laboratory; previously no commercial vendor existed to meet the performance requirements.



(l) MLD Grating mounted during evaluation



(r) MLD Grating ready for shipment

MANTECH RESPONSE

- The Army Directed Energy Manufacturing & Industrial Base project partnered with Plymouth Grating Laboratories to create a roadmap to commercialized grating production
- Viable substrates were evaluated together with thin-film coatings to establish performance comparisons to identify optimal combinations
- Developed new, innovative Grating manufacturing processes to improve yield and batch size (throughput)
- Coordinated with Navy ManTech to leverage ongoing effort with Penn State Electro-Optics Center (EOC) to provide testing on substrate/coating combinations

MANTECH IMPACT AND BENEFITS

- Improved diffracted wavefront yield of baseline components from 67% to 90%
- Increased first pass yield for grating etching process from 33% to $\geq$50%
- Increased Etching batch size by 100%
- Obtained cost savings as a result of increased first pass yield and batch size

Established baseline work for standing up commercialized industrial source of critical component for SBC HEL systems across all DoD services/agencies

PARTICIPANTS

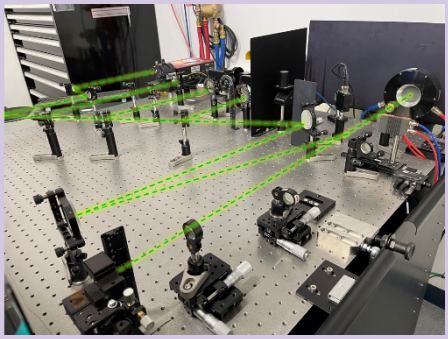
OSD MSTP, Army RCCTO (Rapid Capabilities and Critical Technologies Office), SMDC (Space and Missile Defense Command), PGL (Plymouth Gratings Laboratories), Navy ManTech, Penn State Electro-Optical Center.

MSTP and Army Automate Fiber Laser Alignment and Testing Process to Reduce Test Time by 90%

MANUFACTURING CHALLENGE

Each High Energy laser (HEL) system requires large numbers of fiber laser amplifiers. Amplifier testing required manual alignment and calibration of the amplifier test bench for each laser amplifier produced, requiring highly skilled engineers and a great deal of time to align the lasers to the test equipment, operate the lasers, and test the lasers against a long list of requirements. This process imposed a significant delay in product throughput.

(l) Fiber Laser Amplifier for High Energy Laser



(r) Automated Test Bench

MANTECH RESPONSE

- In coordination with industry partner, Coherent, the Army Directed Energy Manufacturing & Industrial Base project developed and fielded automation hardware and routines to achieve free-space fiber coupling of amplifiers to test bench diagnostic equipment
- Coherent integrated automation into existing test software for seamless operation resulting in a de-skilling of the test process
- MSTP investment enabled development and integration of the software and associated automation into a single prototype test stand and developed the associated production processes to support automated capability
- Army ManTech is investing additional resources to implement updated technology into all applicable test stands, thereby replicating the impact across total production capability

MANTECH IMPACT AND BENEFITS

- Reduced testing process touch labor from 100 minutes to 4 minutes (96%)
- Increased amplifier testing throughput by 400%
- Obtained reduction in component cost due to de-skilled labor cost and production time savings

Increased throughput of directed energy specific fiber amplifiers to support DoD development, production and fielding of HEL Systems

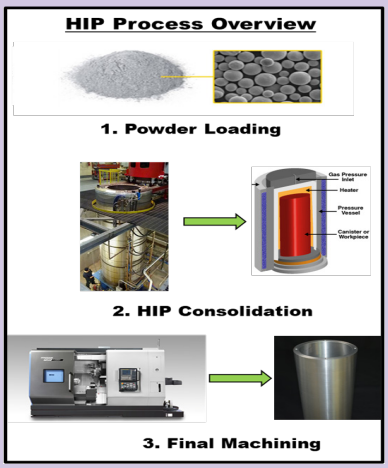
PARTICIPANTS

OSD MSTP, Army Rapid Capabilities and Critical Technologies Office, Space and Missile Defense Command, Coherent Advanced Defense Systems, Navy ManTech, Penn State Electro-Optical Center.

ManTech Modernization Efforts Optimize Reactive Material Munitions Manufacturing

MANUFACTURING CHALLENGE

Current manufacturing technology for conventional warhead materials cannot be applied to high density reactive material (HDRM), a new class of warhead materials that provides significant performance enhancements. New methods of automation were needed to optimize the manufacturing of these reactive materials and to ensure the safe handling of combustible metal powders while preserving the chemical and mechanical properties of the reactive materials that leads to the warhead's enhanced performance.



(l) Overview of the manufacturing process to make advanced reactive materials

(r) BAM ALMO warhead prototypes developed under the BAM Navy FNC, the target transition opportunity for this ManTech project

MANTECH RESPONSE

- MSTP conducted an evaluation with the Army on two reactive material manufacturing processes: low Powder Metallurgy/ Hot Isostatic Processing (PM/HIP), medium (cold spray) and high field assisted sintering Technology (FAST) to determine the optimum manufacturing process
- PM/HIP was downselected and automation was implemented to streamline production and to reduce process time and labor costs of mixing energetics compounds for increased performance
- Demonstrated scalability of the PM/HIP technology and its application to multiple weapon systems and types to include the Navy's BAM ALaMO warhead prototypes
- Demonstrated a Manufacturing Readiness Level improvement from 4 to 7

MANTECH IMPACT AND BENEFITS

- Increased production Capacity for BAM warhead from 10/ month to 200/month
- Lowered unit cost for BAM Warhead from $5000/warhead to $1000/warhead

New HDRM was optimized with automation to reduce touch labor, ensure the safe handling of combustible metal powders, and preserve their chemical and mechanical properties allowing enhanced performance

PARTICIPANTS

OSD MSTP, Army Research Lab, Navy ManTech, MATSYS, Inc.