The future of our nation's defense depends on our ability to consistently respond to military challenges in a manner that is innovative, agile, robust, resilient, and secure. The DoD Manufacturing Technology (ManTech) Program meets these challenges with its focus on affordable, risk-mitigated manufacturing development and sustainment of defense systems.

This brochure highlights success stories of the manufacturing projects of the OSD, Army, Navy, Air Force, Defense Logistics Agency (DLA), and the Missile Defense Agency (MDA) programs. Collectively, these components make up the congressionally-chartered Joint Defense Manufacturing Technology Panel (JDMTP).

In the JDMTP’s role of identifying and integrating requirements, they continue to transition defense manufacturing technologies through partnerships across the DoD, other agencies, industry, and academia. The folios of the brochure illustrate the ongoing benefit of how DoD ManTech strengthens manufacturing technology and the industrial base. JDMTP also leverages other activities such as DARPA, Title III, and the Small Business Innovation Research program through its joint planning methodology.

Of note, this year’s center article addresses how DoD ManTech jointly coordinates its component program activities through the JDMTP. The DoD ManTech strategic plan provides the program’s operational context and is the essential centerpiece to meet the inexorable challenges of the future.

Finally, an update is provided on the activities of the DoD-led Manufacturing Innovation Institutes working to increase domestic manufacturing competitiveness. DoD ManTech is making significant investments in the institutes that cover industries in 33 states, transcending state and federal and defense/commercial industrial base boundaries to ensure the defense manufacturing base can address future technological needs.

We are pleased to present you with this year’s DoD ManTech brochure – a testimony to the successes of joint collaboration that fuels the Department’s innovation engine to ensure our nation continually strengthens its competitive edge on the battlefield.

Ms. A. Adele Ratcliff
Director
Manufacturing Technology
ODASD (MIBP)

John D. Russell, D.Sc.
Chairman, JDMTP
Technical Director, Manufacturing and Industrial Technologies Division
Air Force Research Laboratory
A responsive world-class manufacturing capability to affordably and rapidly meet Warfighter needs throughout the defense system life cycle.

FOCUS

An important focus of ManTech is on the processes and enabling production capabilities that reduce the acquisition and sustainment cost of weapon systems and provide direct benefit to the Warfighter. Measures of effectiveness include improved mission capability, improved readiness, and reduced total ownership costs. Timely transition of the technology consistent with acquisition and operational requirements is essential.

STRATEGY

The DoD Strategic Plan prepared by the Office of the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Policy (MIBP), in close collaboration with the Joint Defense Manufacturing Technology Panel (JDMTP), contains four strategic thrusts:

• Thrust 1: A responsive and balanced manufacturing technology investment portfolio to meet DoD requirements
• Thrust 2: Active support for a highly connected and collaborative defense manufacturing enterprise
• Thrust 3: Active support for a strong institutional focus on manufacturability and manufacturing process maturity
• Thrust 4: Active support for a healthy, sufficient, and effective defense manufacturing infrastructure and workforce

The ManTech Program Strategy supports the broader defense industrial base to deliver maximum value to the Warfighter and the nation. The strategy is executed by the Component ManTech programs within the Army, Navy, Air Force, Defense Logistics Agency (DLA), Office of the Secretary of Defense (OSD) (e.g., Defense-Wide Manufacturing Science and Technology (DMS&T)) and Missile Defense Agency (MDA). The complete DoD ManTech Program Strategic Plan can be downloaded at www.dodmantech.com.

This brochure highlights fourteen ManTech Program successes of the Component ManTech programs and DMS&T. The center two pages of this brochure focus on how JDMTP is examining strategic priorities today to better address challenges in the Future.

Finally, updates are provided on the activities of the five current DoD-led Manufacturing Innovation Institutes (MIIs), namely America Makes, the Lightweight Innovations for Tomorrow (LIFT) Institute, the Digital Manufacturing and Design Innovation Institute (DMDII), the American Institute for Manufacturing Integrated Photonics (AIM Photonics) and NextFlex, the Flexible Electronics Manufacturing Innovation Institute (FHE-MII).
Innovative Manufacturing Technologies Enable Reliable
Missile Defense against Evolving Threats

The Challenge:
The Missile Defense Agency (MDA) develops, produces, and fields an integrated, layered ballistic missile
defense system. The Agency continues to develop cutting edge designs to counter evolving missile threats.
These designs demand innovative manufacturing technologies to deliver the most reliable missile defense
capability at the lowest cost to the Warfighter. These technologies, in domains that include optics, propulsion,
micro-electronics, and guidance, will ensure the delivery of the next generation of MDA missiles, sensors,
and ground systems.

Manufacturing Innovation Emphasis:

- Leverage the Small Business Innovation Research program to develop basic technologies in
  components and key enablers for current and future systems
- Employ the Rapid Innovation Fund to mature technologies and readiness levels
- Support program office and supplier initiatives to implement innovative technologies and approaches
  that improve production line efficiency and modularity
- Capitalize on Title III funding to augment Agency and Program investments in manufacturing innovations
- Collaborate with other Services and Agencies to identify common manufacturing technology initiatives

Impact:

- Ensure overall system reliability through repeatable processes and higher quality components
- Mature manufacturing technologies to ensure availability to support future program success
- Improve production cycle time, product yield, and cost through innovative manufacturing processes

Support the Warfighter and the Nation with reliable, effective missile defense systems
**Air Force ManTech Transitions Improved Sealant Methods to F-35 Production**

**The Challenge:**
There are approximately 20,000 fasteners located in the fuel areas of the F-35 Lightning II Joint Strike Fighter that must be “wet installed” using a qualified aerospace sealant to keep fuel in and seal moisture out. Sealant is currently hand-applied to fastening elements such as nut-plates, Eddie bolts and collars and is time consuming and labor intensive. The variability of sealant application between technicians due to the difficulty of hand application often leads to voids or use of excessive sealant.

**ManTech Response:**
- Air Force funded a Small Business Innovation Research (SBIR) effort to improve and automate the current aircraft sealing methods
- Systems & Materials Research Corporation (SMRC) developed their Gemini Kaps™ under the Air Force SBIR program to aid technicians with backside fastener sealing
- Air Force ManTech led in the transition of this SBIR to provide optimized sealing methods as the F-35 moves into full rate production
- Gemini Kaps™ are designed to ensure the right amount of sealant is applied every time minimizing application time and sealant weight while consistently delivering a high quality identical “twin” seal from fastener-to-fastener
- Air Force (AF) SBIR funding of $1.6M

**Impact:**
- Sealant volume and weight reduced by 50% (0.8 g per fastener) for Eddie collars and 27% (0.7 g per fastener) for each enclosed dome
- Sealant application time reduction of greater than 10% when comparing Gemini Kaps with traditional sealing methods using Semco® sealant dispense guns
- Gemini Kaps will allow the F-35 weights group to log a known weight for each of their fastener seals that is in line with the F-35’s weight savings initiatives
- Gemini Kaps being implemented at Lockheed Martin Aerospace (LMA) Marietta as part of a plan to roll out implementation across other F-35 sites

**Aircraft weight savings of 10 – 40 pounds per F-35**

**PARTICIPANTS**
Air Force ManTech, AF SBIR, Systems & Materials Research Corporation (SMRC), Lockheed, Northrop Grumman Corporation
Navy ManTech Reduces Cable Certification Costs with Integrated Link Test System

The Challenge:
The manual certification process for testing the cables on the VIRGINIA Class Submarine (VCS) requires 36,000 hours per hull. Pin-by-pin measurement of thousands of electrical and fiber optic links is both time-consuming and error-prone. Associated with the manual certification process is risk of hook-up errors and data transcription errors. Uncertainties and omissions in each data record must be corrected before final data submission and approval.

ManTech Response:
- The Navy ManTech Electro-Optics Center project team worked with shipbuilders to identify link test requirements and documented a list of 534 requirements for an automated Integrated Link Test System (ILTS).
- The prototype ILTS was designed and fabricated as a modular system:
  - Includes electrical (300 pins), RF, and fiber optic test modules
  - Instructions and results are displayed on the test unit for the operator
- Compliance with each of the requirements was verified
- August 2014 – system demonstration at Huntington Ingalls Newport News Shipyard
- Spring 2015 – ILTS optimization for the VCS platform was complete
- Navy ManTech Investment of $2.0M

Impact:
- The Shipyard database holds link identification, acceptance criteria, and test results
- Decreased cable test time by 25%
- Portable test units are easily carried through bulkheads and hatches
- Automated test method eliminates manual data transcription errors
- ILTS is commercially available for other platforms, shipyards, and maintenance facilities through DIT-MCO International

Estimated cost savings of $450K per VCS hull

PARTICIPANTS
ONR Navy ManTech, Penn State Electro-Optics Center, Huntington Ingalls Newport News Shipbuilding, DIT-MCO International, General Dynamics Land Systems, VCS Program Office
ManTech Demonstrates Large Affordable Substrates for Focal Plane Arrays

The Challenge:
Current and future Army Infrared Focal Plane Arrays (IR FPAs) that use Mercury Cadmium Telluride (HgCdTe) detectors are expensive, in large part due to the small size of the underlying Cadmium Zinc Telluride (CdZnTe) substrate.

ManTech Response:
• This joint DMS&T/Army ManTech program improved the single crystal volume of boule growth
• Enabled a greater yield of large substrates which significantly reduced their cost
• Developed a modified vertical growth technique, where the furnace is stationary and the gradient motion is achieved by ramping the multi-zone furnace temperature profile
• Demonstrated an improved polishing process which resulted in a factor of 3 total defect reduction
• Army ManTech and DMS&T investment was $7.9M

Impact:
• Increased single crystal boule yield from 30% to 90%
• Increased boule diameter from 92mm to 125 mm
• Produced the largest ever CdZnTe substrates (8×8 cm2)
• Assured sources of high quality, large area, CdZnTe substrates
• Transition to Army Combat Vehicle Armament Systems Technology (CVAST) (FY14); Air Force Multi-Spectral Targeting System (FY14); MDA Standard Missile (SM3 IIB) Program (FY12); Army LRAS3 (FY13); Army PM Ground Sensors Next Gen FLIR B-Kit EMD Program (FY14); Army Abrams Modernization Program (FY15); Air Force Space Based Infrared System (SBIRS) Program / High Stare Program (FY15); Army PEO Aviation: Apache (FY15)
• Cost avoidance of $150.6M with a Return On Investment (ROI) of 10.6:1

Strengthened the focal plane array supply chain
Navy ManTech Reduces Cost of VIRGINIA Class Submarine with Robotic Welding

The Challenge:
Structural welding of components including assemblies, small foundations, tank internals, bulkhead structures, main propulsion foundations, and inserts are a major contributor to construction costs of the VIRGINIA Class Submarine (VCS). Preliminary assessments identified opportunities to improve the accuracy of weld preparations, component assembly and fit-up, and welding processes and equipment.

ManTech Response:
- The U.S. Navy and General Dynamics Electric Boat (GDEB) have a joint initiative to continue to reduce the construction cost of the VIRGINIA class submarine (VCS)
- Major fabricated structural assemblies have been broken down by product structure and defined as either “part family” (PF), “interim product” (IP), or “major product” (MA) assemblies
- Identified PFIP assemblies for robotic welding and developed functional specifications
- Used offline programming (OLP) to develop welding processes for PFIP assemblies
- Identified alternative methods/equipment, selected prototypes and conducted evaluations
- Developed roadmap and validated business case to implement robotic manufacturing at GDEB
- Documented the qualification process for robotic welding systems and robotic welding personnel
- Roboticallly welded, and successfully nondestructively tested, several first article assemblies
- Navy ManTech Investment of $2.1M

Impact:
- Reduced welding man-hours by more than 50%
- Enabled discrete planning of welding small assemblies within existing planning systems
- Increased first time quality of welds and assemblies
- Electric Boat has made a formal request to the Navy for approval to use robotic welding for VCS structural components

Estimated cost savings of $1.2M per VCS hull
DLA ManTech Helps Develop Stretch Roll Forming of Complex Extrusions

The Challenge:
Modern commercial and military airframes use complex parts produced from extrusions of many differing shapes and sizes. The current process for developing these parts requires a different die for each part. In the case of a small batch size, particularly for maintenance, too much time is spent in setup/retooling and this large footprint is detrimental to onsite part production.

ManTech Response:
• Defense Logistics Agency’s (DLA) Small Business Innovation Research (SBIR) program identified and developed Stretch Roll Forming (SRF) that uses universal dies to eliminate specialized tooling
• DLA ManTech working with SBIR to implement SRF that enables a portable means to produce extrusions of parts at maintenance depots and on aircraft carriers
• This program successfully demonstrated Stretch Roll Forming, as an agile, portable, green, “dieless” Computer Numerical Control (CNC) process for forming part extrusions
• DLA SBIR investment of $760K

Impact:
• Reduced cost and lead time to extrude commercial & defense aircraft/vehicle components
• Improved process with fewer steps, reduced setup and retooling time, better part quality, and less waste material
• Portable clean/green process with a small footprint that provides just-in-time and one-off spares
• Improved strength, increased fatigue life, and reduced weight of replacement parts
• Supports “Complex of the Future” goals of “100% Parts Availability”, “improved capability of local manufacturing” as well as “rapid low-rate reverse engineering and manufacturing capability”

Potential savings of $20M/year in production and maintenance costs

PARTICIPANTS
DLA ManTech, DLA SBIR, Fairmount Technologies, Spirit AeroSystems, Cessna Aircraft Company, and The Center for Innovation and Enterprise Engagement at Wichita State University
Army ManTech Demonstrates Extended Gun Barrel Life

The Challenge:
Due to environmental hazards, the Office of the Under Secretary of Defense for Acquisition and Logistics challenged the Army to eliminate hexavalent chrome in weapon systems that use this material for wear and erosion resistance such as for gun barrels. There is a chromium substitute material consisting of tantalum-tungsten (Ta-10W) that may be used to replace the hexavalent chrome, but it is extremely difficult to machine using traditional manufacturing processes.

ManTech Response:
- Army ManTech refined the current bonding process of Ta-10W in weapons systems to obtain higher and more reliable yields
- Developed tools and machining processes to efficiently hone and rifle Ta-10W lined barrels
- Utilized novel alternate rifling methods to include waterjet and electro-chemical machining to rifle 25mm and rifle M2 .50 caliber barrels to demonstrate Manufacturing Readiness Level (MRL) 6 capable process
- Army ManTech investment was $14.3M with $.5M in leveraged Army SBIR program funding

Impact:
- Achieved 4x improved barrel life (14,019 rounds) compared to traditional chrome-clad barrel (3,500 rounds) for M242 25mm barrel used on Bradley Fighting Vehicle
- Potential for extending M2 .50 Cal Machine Gun barrel life from current (10,000 rounds) to 30,000 rounds
- Enabled weapon systems to fire higher lethality ammunition by increasing operating temperature from 1800°C to 3000°C therefore, extending barrel service life, increasing readiness, and reducing sustainment costs throughout a systems life cycle
- Cost benefit of $62M projected if implemented with minimum 3x barrel life extension

Transitions to Project Manager, Soldier Weapons in FY16
DoD ManTech Improves Safety by Automating Process for Slurry Dipping of Pyrophoric Decoys

The Challenge:
Catastrophic events in the manufacture of countermeasure flares have injured and/or killed operators, destroyed manufacturing facilities, and cost tens of millions of dollars in litigation and disrupted flare deliveries. Slurry dipping is the process of an operator manually dipping up to 1,000 flares per day in a slurry of high energetic material to coat the flare and create a contiguous ignition path. Automated processes reduce the danger to the operator due to the volatility of the energetic material, and its inability to be extinguished once ignited.

ManTech Response:
• DMS&T and AF ManTech partnered to automate the slurry dipping process and to replace manual methods to monitor, manage and replenish the slurry level in the dipping pots
• Combined material process knowledge of the flare manufacturer with application experience of automation industry experts to design, build and validate a robotic dipping sub-system
• Developed a slurry management sub-system which was tested first in a lab for mechanical robustness using inert materials before being installed at the Esterline production facility
• Successful testing evaluations and system training will lead to the use of live energetic materials
• System design has Class I Division I safety certification, robot, end-of-arm grippers, vision cameras, control software, and human machine interface
• DMS&T investment of $3.0M

Impact:
• Enhances safety by minimizing human exposure to hazardous materials
• Helps ensure uninterrupted flare deliveries
• Reduced repetitive operation injuries

Improves safety of personnel in hazardous environments

PARTICIPANTS
Defense-wide Manufacturing Science & Technology Program, AF ManTech, Variation Reduction Solutions, Inc. (VRSI), AeRobotix, Safety Management Services, Esterline Defense Technologies
AF ManTech Continues Work on Automated Sanding to Reduce Cycle Time, Cost, and Worker Health Issues

The Challenge:
Manual sanding of aircraft coatings is tedious, time consuming, and requires multiple personnel and occasional rework in order to produce the surface finishes required. Automated sanding addresses these problems by developing automated, precision, robotic processes. The effort also addresses safety, environmental, and ergonomic problems that occur when workers sand the numerous coatings that are built up on aircraft surfaces.

ManTech Response:
- The Air Force Research Laboratory Materials Directorate (AFRL/RX) leads a high profile SBIR Technology Transition Plan (STTP) program to reduce the aircraft production and sustainment burden for aircraft coatings
- AFRL Manufacturing and Industrial Technologies Division (AFRL/RXME) developed the automated sanding technology and conducted manufacturing readiness assessments
- Robotic sanding technology demonstrated in a relative production environment (i.e., using production robots and realistic mockups of aircraft surfaces to a Manufacturing Readiness Level of 7)
- AFRL/RXME is now leading the successful transfer of SBIR technology to original equipment manufacturer (OEM) production and depot sustainment facilities
- AFRL/RX SBIR funding of $2.176M and AF ManTech investment of $0.750M

Impact:
- Enables greater availability of aircraft by reducing cycle time
- Meets demanding engineering tolerances of surface finish required for aircraft sanding
- Eliminates safety and environmental concerns of confined spaces and dust inhalation

Enables lower cost, shorter cycle time, and safer production
DoD ManTech Applies Electro-Optical Targeting System (EOTS) Producibility for the F-35

The Challenge:
The F-35 Electro-Optical Targeting System (EOTS) is a high-performance, lightweight, multi-functional system for precision air-to-air and air-to-surface targeting. EOTS provides high-resolution imagery, automatic tracking, infrared-search-and-track, laser designation with range finding, and laser spot tracking. Investments in yield and automated manufacturing technologies were required in order to meet F-35 Program cost and production rate targets.

ManTech Response:
- A joint DMS&T and AFRL ManTech project was conducted through the Navy ManTech Center of Excellence for Electro-Optics (Penn State Electro-Optics Center) to automate manufacturing and improve yield of the F-35 EOTS sensing component (Integrated Dewar Cooler Assembly (IDCA))
- Leveraged advances in the commercial semiconductor industry (automation of production, handling, and testing) to improve quality, increase capacity, and reduce costs of IDCA manufacturing
- Process improvements were form-fit-function interchangeable, with rolling implementation occurring as each production change was qualified, approved, and cut into production
- Manufacturing improvements were implemented with direct application to on-going and future delivery lots, beginning with Low Rate Initial Production (LRIP) 6, and with full realization of benefits by LRIP 8
- DMS&T and AF ManTech investments totaled $4.62M.

Impact:
- Improved the reliability of the F-35 EOTS IDCA production line by advancing the manufacturing readiness level (MRL) from 4 to 8
- Reduced cost, cycle time, and scrap which led to improved producibility, throughput, and yield to meet F-35 production rates and cost

Projected savings of $117M for F-35 Joint Program
The Joint Defense Manufacturing Technology Panel (JDMTP) is recognized as the focal point for subject matter expertise in manufacturing technology initiatives within the Department of Defense (DoD). In accordance with statutory requirements (Title 10, Section 2521, United States Code), JDMTP has developed joint strategies for the program, conducted joint planning and coordination, and facilitated outreach and collaboration.

ManTech Strategic Plan Implementation

The DoD ManTech strategic plan identifies joint activities conducted by the JDMTP and outlines the manufacturing technology priorities and the component program activities that individually build investment strategies according to their unique needs. On a broader view, the plan provides the strategic context which the DoD ManTech program operates and provides for the flexibility to adjust to emerging priorities. For example, Manufacturing Innovation Institutes (MIIs) in broad partnership with industry have become a key investment strategy to advance U.S. manufacturing innovation and strengthen domestic competitiveness of the U.S. manufacturing base. The strategic plan is in the process of being updated. The DoD ManTech Strategic Plan is available to download from www.dodmantech.com.

Joint Planning and Coordination

As part of implementation of the strategic plan, the JDMTP provides a forum for its principal members to coordinate ManTech investments from the Army, Navy, Air Force, Defense Logistics Agency (DLA), OSD and the Missile Defense Agency (MDA). Extending out to a 2 year planning cycle (FY+2), joint planning identifies common manufacturing issues, avoids duplication of investments, and informs, among others, OSD’s Defense-Wide Manufacturing Science and Technology (DMS&T) program strategic investment areas. This planning directly feeds Service and agency ManTech planning processes and establishes a basis for resourcing common manufacturing challenges and innovations. Projects selected for funding by the ManTech programs are then coordinated with their peers on the Panel and with direct input from the four JDMTP Subpanels consisting of Metals, Composites, Electronics, and Advanced Manufacturing Enterprise.

The JDMTP Subpanels consist of government members from each ManTech program as well as representatives from other Federal Government agencies and industry. The subpanels who meet regularly to review projects within their technology portfolio, identify opportunities for collaboration, and provide input to the JDMTP Principals on opportunities for future investment, known as joint technology pursuit areas. Subpanel portfolio reviews bring major value to the DoD ManTech portfolio as it generates “good news” stories and opportunities for future joint planning. The portfolio reviews also identify nominees for the annual Defense Manufacturing Technology Achievement Award.

DoD ManTech shares an expansive vision with the broader defense industrial base – that is, to maintain a responsive, world-class manufacturing capability. Through its joint planning and coordination, the JDMTP is a vital tool in this process.

“Manufacturing Dominance underpins technical dominance. Manufacturing must be a core competency of our Defense industrial base. History tells us that whoever possesses manufacturing innovation holds a competitive advantage.”

_statement by Andre Gudger, DoD Director of MIBP_
JDMTP Outreach and Collaboration

DoD ManTech provides a crucial link between technology invention and industrial application. To do this, the ManTech community coordinates with many stakeholders to identify production issues early on and to provide timely solutions to reduce risk and improve system affordability.

The JDMTP serves as a key focal point in strengthening manufacturing capability and innovation by informing and supporting the Manufacturing Innovation Institutes (MIIs). DMS&T investment in the institutes has grown dramatically in the past year with the addition of two institutes during FY15 and the announcement of two more institutes that will be funded during FY16. These institutes transcend 33 states bringing over $800M in matched cost share from industry, state and local governments and academia. The MIIs participate in the JDMTP Subpanel Portfolio Reviews, work with JDMTP to plan the Defense Manufacturing Conference (DMC) and assist the DoD ManTech program with strategic planning. For example, America Makes is roadmapping additive manufacturing technologies for the Army, Navy, Air Force and DLA to assure that investments are synergistic, leveraged and coordinated not only within the DoD but across the industrial base.

The JDMTP routinely collaborates with other stakeholders, including the Defense Advanced Research Projects Agency (DARPA), the Service Science and Technology (S&T) and Acquisition Staffs, other DoD communities such as the Manufacturing and Materials Processing (M&MP) Community of Interest (Col), Engineered Resilient Systems (ERS), and the Systems Engineering community. JDMTP also collaborates with agencies such as the Department of Energy (DoE), the Department of Commerce National Institute of Standards and Technology (NIST), the National Aeronautics and Space Administration (NASA), and with industry representative organizations such as National Center for Advanced Technologies (NCAT), Aerospace Industries Association (AIA), and many others. The DoD ManTech program also leverages Service and Agency S&T and Small Business Innovation Research (SBIR) programs to transition those technologies aligned with the ManTech vision.

As part of outreach to the wider materials and manufacturing community, the JDMTP has strengthened its linkages to the S&T community by participating in the annual Materials and Manufacturing Process (M&MP) Communities of Interest (Col) joint planning workshop. The results of the M&MP included manufacturing technology input to the M&MP roadmaps and stronger linkages with design manufacturing in ICME (Integrated Computational Materials Engineering).

The JDMTP also coordinates with Industry and Academia through engagements at conferences and symposia. The JDMTP is an active member of the NDIA Manufacturing Division, participates heavily in the annual Defense Manufacturing Conference, and presented its vision and activities at SAMPE 2015 (Society for the Advancement of Material and Process Engineering).

Overall, the DoD ManTech Program helps enable affordable solutions to Warfighters by addressing producibility, total ownership costs, cycle-time and responsiveness of the defense industrial base. This directly supports the President’s National Security Strategy to strengthen our national defense, put our economy to work and lead in science and technology and innovation.

“Our U.S. industrial base serves at least two major national security objectives: It is the engine that drives our economy and it equips our soldiers, sailors and airmen… So it’s critically important that we maintain our technological advantage within the U.S. industrial base, and these institutes help us maintain that competitiveness in important technology areas…”

Statement by Andre Gudger, DoD Director of MIBP in “DoD News”, October 2014
Army ManTech Improves Sustainment of Weapon Systems with Advanced Nanocomposite Coatings

The Challenge:
Advanced nanocomposite coatings have shown promise of reducing weapon system sustainment costs. However, a demonstrated plasma assisted chemical vapor deposition (PACVD) nanocomposite coating process was limited to a “lab” environment, and manufacturing process improvements were needed to apply the new coatings to a variety of process configurations and components.

ManTech Response:
• The Army ManTech demonstrated a coating system on aviation and missile components to improve optics durability, decrease component wear, reduce friction and prevent corrosion
• Demonstrated automated part handling, flexible fixtureing and improved controls
• Enabled 500X more durability than anodizing process and 10X improvement in surface hardness using SP3EC™ nanocrystalline diamond/amorphous carbon coatings
• Army ManTech investment was $9.4M

Impact:
• Reduced friction and increased wear performance from 70% to 200%
• Delivered approximately 800 Navy P-8 Brake Actuator Components
• Delivered over 300 Advanced Threat Infrared Countermeasures optical windows for CH-47
• Potential implementation on 1000’s of windows for Reaper Unmanned Air Vehicle (UAV), Hellfire (Joint Attack Munitions System PM), Joint Strike Fighter and 1000’s of mechanical components to include M24 gun mounts for CH-47, Navy H-53 and Marine V-22s
• Unit cost benefit of $5K for optics and corrosion prone parts with total estimated cost benefit of $42M

Return-on-investment of over 5:1 for aviation system components

PARTICIPANTS
Army ManTech, RDECOM Aviation and Missile Research, Development and Engineering Center (AMRDEC), United Protective Technologies
Navy ManTech Sonar Dome Manufacturing Improvements Implemented on DDG 51

The Challenge:
The Aegis Destroyer (DDG 51 class) sonar dome has a complex geometry and is challenging to construct. Customized fabrication tools, fixtures, and automation / mechanization could reduce the time, labor, and rework associated with fabricating and assembling the sonar dome at Ingalls Shipbuilding (Ingalls).

ManTech Response:
• A Navy ManTech Integrated Project Team (IPT) assessed the sonar dome fabrication process, developed concepts, and down-selected the concepts for prototyping
• The IPT enhanced / integrated commercial-off-the-shelf material removal technologies and developed prototype tools
• Conducted field trials of tools for sonar dome fabrication processes with Ingalls craftsmen and operations supervisors
• Conducted metrology system field scanning trials on four sonar dome focus areas on DDG 117 and 119
• Navy ManTech Investment of $2.1M

Impact:
• Ingalls implemented two material removal tools earlier than anticipated for DDG 117 and 119
• Advanced metrology improves the dimensional accuracy of complex subassemblies, reducing the need for additional labor hours to address fit-up issues
• Reduced labor to fit and assemble DDG sonar dome components by 30% and structures across other DDG process areas by 20%
• Application to Amphibious Assault Ship (LHA), Amphibious Transport Dock (LPD) and National Security Cutter (NSC) hulls under construction at Ingalls will reduce labor hours by approximately 10%

Estimated cost savings of $15M over five years

PARTICIPANTS
ONR Navy ManTech, Navy Metalworking Center, Ingalls Shipbuilding, Forming and Metrology Industry Partners, Naval Surface Warfare Center Carderock, DDG 51 Class Program Office
DoD ManTech Transitions Larger, More Durable Optical Windows (ALON) at Lower Cost

The Challenge:
There is a growing DoD need for very large monolithic transparent ceramic windows (up to 36” x 36”) for reconnaissance applications and transparent armor. ALON® Optical Ceramics offer a larger, more durable monolithic transparent ceramic for these IR windows, however they have a unique combination of properties and producibility that require manufacturing under higher temperature and pressure levels.

ManTech Response:
- A joint DMS&T ManTech project was conducted with Air Force ManTech, the Defense Production Act (DPA) Title III Program, and Naval Air Systems Command (NAVAIR) to scale up ALON windows from the baseline size of 15” x 27” to 36” x 36” x 0.5” by the end of the program
- Improved manufacturability for ALON transparent armor that is half the thickness and weight of conventional glass laminates; 2X lighter and >10X more durable than Cleartran; 40% improvement in low light situational awareness; and 250% better in ballistic protection
- Modified existing processing equipment (at a fraction of the cost of new equipment) to be able to manufacture at increased temperature and pressure levels required for ALON
- Evaluated lower cost forming techniques to determine the best method for scaling up to large plates
- Developed repeatable and reliable processes for forming, heat treating, densifying and polishing large ALON windows
- DMS&T investment was $4.3M with additional funding provided by the DPA Title III Program, Air Force ManTech, and NAVAIR

Impact:
- Reduced the price for large windows 6-fold since the inception of the program
- Increased the size of reconnaissance windows and transparent armor windows by 30%
- Increased throughput capacity by >100% for ALON® Optical Ceramics
- Transitioned ALON into Navy program requiring an initial window size of 19” x 36”
- Transitioned the next generation window for the Navy program to 21” x 23”, with seven windows delivered to date

Projected cost savings through 2021 is $26.5M, resulting in a 6:1 ROI
DLA ManTech Develops Process to Reduce Downtime and Total Cost for Bearing Refurbishing and Obsolete Part Production

The Challenge:
The Department of Defense recognized the criticality of the bearing supply chain used in support of our nation’s defense. DFARS 252.225-7016 requires that all defense-related purchases of ball and roller bearings and/or components, shall be wholly manufactured in the United States, its outlying areas or Canada. However, the manufacturing costs for these bearings is high.

ManTech Response:
• DLA’s Small Business Innovation Research (SBIR) program identified and developed an advanced bearing remanufacturing process for critical and high cost bearings
• The Eccentric Positioning System (EPS) is being leveraged by DLA ManTech and provides an alternative method of remanufacturing bearings at lower cost while meeting all required tolerances and specifications
• EPS-patented robotics technology features programmable raceway shaping, requires no special tooling, and enables flexible manufacturing in which the operator just changes the program and quickly sets up for different bearing types
• The programs established a remanufacturing line with a smaller footprint to enable manufacturers to improve production capacity with existing facilities or achieve equivalent production from smaller facilities
• DLA SBIR investment of $1.3M

Impact:
• Developed a viable domestic remanufacturing solution, which contributes to Warfighter readiness, reduced costs and improved productivity
• Reduces the time required to grind aerospace bearing steels by 30%
• Reduces cost of goods (COG) by 10%
• Reduces “dead” time in the grinding cycle with its high acceleration and high-speed motion capability
• Reduces energy use by 15-25% by eliminating the need for a hydraulic power unit

Bearing remanufacturing saves 50-80% over the cost of new bearings
President Obama has stated his intent to maintain the United States’ edge in innovation and expand American manufacturing. In 2012, he initiated the National Network for Manufacturing Innovation (NNMI), a public-private initiative composed of innovative manufacturing institutes across the United States. The goal of the NNMI is to help the U.S. manufacturing industry become a competitive force worldwide, and inspire investment in new manufacturing technologies.

In August 2012, the Defense-Wide Manufacturing Science and Technology (DMS&T) program in partnership with Army, Air Force, DOE, NSF, and NASA, established the first pilot Institute, America Makes to address additive manufacturing. Since then, four more DoD-led pilot institutes were added: In early 2014, the Digital Manufacturing and Design Innovation Institute (DMDII) and Lightweight Innovations for Tomorrow (LIFT) were established. New institutes established in 2015 are the American Institute for Manufacturing Integrated Photonics (AIM Photonics) and NextFlex, the Flexible Electronics Manufacturing Innovation Institute (FHE-MII).

Go to www.manufacturing.gov for more information on NNMI. A summary of the activities of the five existing DoD-led manufacturing institutes is found on the following pages.

**America Makes** is the National Additive Manufacturing Innovation Institute located in Youngstown, OH. In year 3 of operations, America Makes ramped up its core activities and continued to grow to over 145 members, including over 33 large businesses, 45 small businesses, 39 universities and community colleges, 16 non-profit organizations and 9 government partners. America Makes also launched a pilot Satellite Center at the University of Texas El Paso, extending the institute’s presence to a new region and expanding its in-house capabilities.

America Makes has completed three project calls, awarding 31 projects with $22M of public funding. The average project team has 5.5 members that include several levels in the supply chain and a built-in path for technology transition. The first wave of projects is completed. The industry-led technology roadmap not only guides institute investments, it also influences industry members to realign their internal research & development resources with the roadmap, further leveraging the investments of all participants.

America Makes is also conducting R&D projects that are directed by the DoD services, government agencies, members, and outside organizations. The Air Force, DARPA, NIST, and NASA have asked America Makes and its members to perform 12 agency-driven projects funded at over $25M.

For more information, please go to www.AmericaMakes.us or contact the DoD lead, Dr. Jennifer Fielding at jennifer.fielding@us.af.mil.
The **Lightweight Innovations for Tomorrow (LIFT)** (formerly Lightweight & Modern Metals Manufacturing Innovation (LM3I)) Institute was established in February 2014 to advance our national metals manufacturing industry. The institute brings together the U.S. Department of Defense (DoD), State Governments, leading manufacturers, professional societies & organizations, universities, and other research partners. LIFT’s highly linked and leveraged network is facilitating technology transfer into supply chain companies and empowering the lightweight metals workforce.

LIFT’s primary objectives are to accelerate the development and application of innovative lightweight metal production and component manufacturing technologies to benefit the US transportation, aerospace and defense market sectors. LIFT benefits extend beyond the commercial market to DoD activities to support the Navy, Army, and Air Force weapons systems to improve the Warfighters’ capabilities through reduced fuel consumption and cost, improved transportability, speed, and ground troop mobility.

The LIFT Institute headquarters opened its doors on January 15, 2015 in the historic Corktown section of Detroit, MI. LIFT joins a larger effort with local industry to impact jobs and facilitate the revitalization of the city. LIFT is led by the American Lightweight Materials Manufacturing Innovation Institute (ALMMII).

The LIFT team consists of 81 member organizations working together to improve U.S. manufacturing competitiveness through the introduction of lightweight metal products and components while improving affordability and facilitating the transition of these new technologies to the industrial base. Among the LIFT organizations working together are 27 small businesses, of which 11 are start-up companies, and 17 leading universities.

LIFT membership has selected 31 topics from two project ideations sessions. Technology thrust areas are Melt processing, Powder processing, Thermo-Mechanical Processing, Coatings, Joining/Assembly, and Agile tooling. In addition, LIFT has launched 6 Workforce/Education initiatives within its 5-state region, ranging from STEM education to skilled trades supporting a national credentialing program.

For more information, please go to [http://lift.technology/](http://lift.technology/) or contact the DoD lead, Johnnie DeLoach at johnnie.deloach@navy.mil.
The Digital Manufacturing and Design Innovation Institute (DMDII) was established in February 2014. The Institute is a unique public-private partnership acting as a world-class, first-of-its-kind manufacturing applied research and development lab. Based in Chicago and in collaboration with UI LABS, the Institute has the capabilities, innovative spirit and collaborative expertise to transform American manufacturing.

DMDII focuses on enterprise-wide utilization of the digital thread, enabling highly integrated design and manufacturing of complex products in order to reduce time and cost, as well as accelerate the pace of new products coming to market. Processes developed within DMDII that create an open and collaborative environment will help retain supply chain knowledge and improve capabilities to produce low volume, complex systems.

DMDII has 136 members consisting of 84 companies; 52 universities, states and non-profits; spanning across 31 states. Since its inception, the Institute has acquired key operational staff, developed a technical roadmap and strategic plan, and circulated a membership agreement for signature.

DMDII will leverage over $55 million in research to be awarded by the end of 2015, and has already kicked off five projects in the following areas:

- Completing the Model-Based Definition (DMDII-15-11)
- Technologies Enabling Supply Chain Visibility (DMDII-15-12)
- Cyber Security for Intelligent Machines (DMDII-15-13)
- Agile Manufacturing to Compensate for Production Variability (DMDII-15-15)

For more information, please go to [http://dmdii.org/](http://dmdii.org/) or contact the DoD lead, Dr. Greg Harris at gregory.a.harris81.civ@mail.mil.
AIM Photonics was established in July 2015 and is led by the Research Foundation for the State University of New York on behalf of the SUNY Polytechnic Institute. The Institute will focus on developing a U.S. based end-to-end integrated photonics ecosystem, including domestic foundry access, integrated design tools, automated packaging, assembly and test, and workforce development.

The Institute brings government, industry and academia together to organize a currently fragmented domestic capability in integrated photonics to better position the U.S. globally. AIM will develop and demonstrate innovative manufacturing technologies for:

- Ultra-high-speed transmission of signals for the internet and telecommunications
- New high-performance information-processing systems and computing
- Compact sensor applications enabling dramatic medical advances
- Multi-sensor applications including urban navigation, free space optical communications and quantum information sciences
- Other diverse military applications including electronic warfare, analog RF sensing, communications, and chemical/biological detection

AIM Photonics is in the process of converting nearly 100 letters of commitment and support into membership. These commitments include 56 from industry, 26 universities plus dozens of community colleges, and 15 trade associations and research labs. The Institute has an initial five year budget that includes $110M (federal funding). The Institute is also busy preparing a slate of pilot projects that are scheduled to launch in early 2016.

For more information, please go to www.aimphotonics.com or contact the DoD lead, Neil Supola at neil.d.supola.civ@mail.mil.
NextFlex, America’s Flexible Hybrid Electronics Manufacturing Innovation Institute, was announced on August 28, 2015 by Secretary of Defense Ashton Carter. The consortium is led by FlexTech Alliance located in San Jose, CA and had more than 162 companies, universities, and non-profits contributing to the proposal. The Institute will receive $75M in OSD DMS&T funding over five years, matched with more than $90 million from industry, academia, and local governments. In total, the institute will receive $171 million to invest in strengthening U.S. manufacturing.

Flexible hybrid electronics (FHE) is an innovative manufacturing industry segment at the intersection of the electronics industry and the high-precision printing industry creating the next-generation of sensor platforms that conform, stretch or have reduced weight for novel commercial and important Department of Defense (DoD) applications. These FHE manufacturing processes will integrate ultra-thin silicon IC’s with sensors and power components, adapting and innovating processes using conductive and active inks and pastes on flexible, stretchable substrates. Flexible hybrid electronic technologies enabled through innovative FHE manufacturing will preserve the full operation of traditional electronic circuits in flexible, conformal, and stretchable architectures. These highly functional devices can be attached to curved, irregular and often stretched objects and humans.

NextFlex released their membership agreement and first project call in November 2015. The institute is strongly supported by its Government Working Group that consists of nearly 50 members from 17 different DoD and other Federal Government organizations. NextFlex is establishing a headquarters and hub facility for FHE manufacturing process integration in San Jose, CA to support pilot-scale demonstrations and process integration from its nodes (Centers of Excellence) that develop the manufacturing processes and materials. The headquarters facility is expected to be open in early 2016.

If interested in learning more about participation in NextFlex, please contact the Executive Director, Dr. Malcolm Thompson, via email at malcolm.thompson@flextech.org.

For more information on the program, please go to http://www.nextflex.us or contact the DoD Program Manager, Dr. Eric Forsythe at eric.w.forsythe.civ@mail.mil or the Chief Technology Officer, Dr. Ben Leever at benjamin.leever@us.af.mil.
DoD ManTech Innovation Timeline

1950s
DoD ManTech developed the original numerically controlled machine tool and the associated programming language (APT) to advance military aircraft manufacturing – now used globally in countless manufacturing applications.

1960s
The DoD ManTech program developed the technology that became the foundation for the current microelectronics industry.

1970s
DoD ManTech developed processes for the production of the forerunners of precision laser guided missiles and munitions.

1980s
DoD ManTech developed a process for reverse engineering thousands of obsolete microcircuits that support weapon systems still in service – use and mission benefits continue to expand today.

1990s
DoD ManTech program developed magneto-rheological finishing for advanced military optics. The process is now also used by all manufacturers of photolithographic optics.

2000s
DoD ManTech:
- Provided revolutionary electronics such as Micro Electro-Mechanical Systems (MEMS) for field artillery systems and Focal Plane Arrays (FPAs) for sensor systems
- Enabled manufacturing of interceptor body armor currently used by our forces
- Manufactured next generation of enhanced combat helmets to replace 30-year old technology
- Developed automated processes for lighter, durable and more comfortable composite prosthetics
- Provided improved combat rations with high quality, safer, and surge-capable production
- Implemented higher power, longer duration batteries across weapon systems
- Applied model-based manufacturing and CAD in aeronautical and maritime construction for greater affordability

2010 and beyond

The Defense Manufacturing Technology Achievement Award (DMTAA) is awarded to ManTech teams who demonstrate outstanding performance in executing and delivering ManTech solutions for DoD. This year, 15 teams were nominated for their work on the projects listed below. The Joint Defense Manufacturing Technology Panel would like to recognize these teams for their hard work and congratulates the winners of this year’s DMTAA, to be announced at the Defense Manufacturing Conference.

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Service</th>
<th>Subpanel</th>
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</thead>
<tbody>
<tr>
<td>* F-35 Electro-Optical Targeting System (EOTS) Producibility</td>
<td>DMS&amp;T, Navy &amp; AF</td>
<td>Electronics</td>
</tr>
<tr>
<td>NDI of Electron Beam Additive Manufactured (EBAM) Titanium Structural Components</td>
<td>DMS&amp;T &amp; AF</td>
<td>Chairman</td>
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<tr>
<td>* Advanced Ceramic Manufacturing &amp; Machining Process Development</td>
<td>Army</td>
<td>Composites</td>
</tr>
<tr>
<td>Slurry Dip Automation</td>
<td>DMS&amp;T &amp; AF</td>
<td>Metals</td>
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<tr>
<td>Net-Centric Model Based Enterprise (MBE) Data to Support Integrated Weapon System Life Cycle</td>
<td>Army</td>
<td>AME</td>
</tr>
<tr>
<td>Weapons and Stores Elevator Doors Manufacturing Cost Reduction</td>
<td>Navy</td>
<td>Metals</td>
</tr>
<tr>
<td>* Navy Standard Pressure Actuated Watertight Door</td>
<td>Navy</td>
<td>Metals</td>
</tr>
<tr>
<td>Cold Spray Repair and Rebuild Technology</td>
<td>DMS&amp;T</td>
<td>Metals</td>
</tr>
<tr>
<td>Armor Protection from Objective Threats</td>
<td>Army</td>
<td>Metals</td>
</tr>
<tr>
<td>* Welding of High Strength Steels</td>
<td>DLA</td>
<td>Metals</td>
</tr>
<tr>
<td>VLS-LCRS Updates for Production Readiness</td>
<td>Navy</td>
<td>Metals</td>
</tr>
<tr>
<td>CVN Reality Capture</td>
<td>Navy</td>
<td>AME</td>
</tr>
<tr>
<td>* Manufacturing Technology Improvements to the Conformable Wearable Battery (CWB) System</td>
<td>Army</td>
<td>Electronics</td>
</tr>
<tr>
<td>Robotic Welding for VCS Interim Products</td>
<td>Navy</td>
<td>AME</td>
</tr>
<tr>
<td>* Manufacturing Technology for High Power Vertical Cavity Surface Emitting Lasers (VCSELs)</td>
<td>DMS&amp;T &amp; AF</td>
<td>Electronics</td>
</tr>
</tbody>
</table>

* Finalist
Defense Manufacturing Technology Achievement Award

The Joint Defense Manufacturing Technology Panel (JDMTP) seeks to recognize and honor those individuals 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 the Fall of 1999.

AWARDEES

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 – 3D 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 Productability
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
“Manufacturing Technology is key to innovation in defense products. It’s part of the genesis of the things that we equip our Warfighters with to give them technical superiority on all battlefields at all times.”

Frank Kendall
Undersecretary of the Defense

For Further Information
www.dodmantech.com