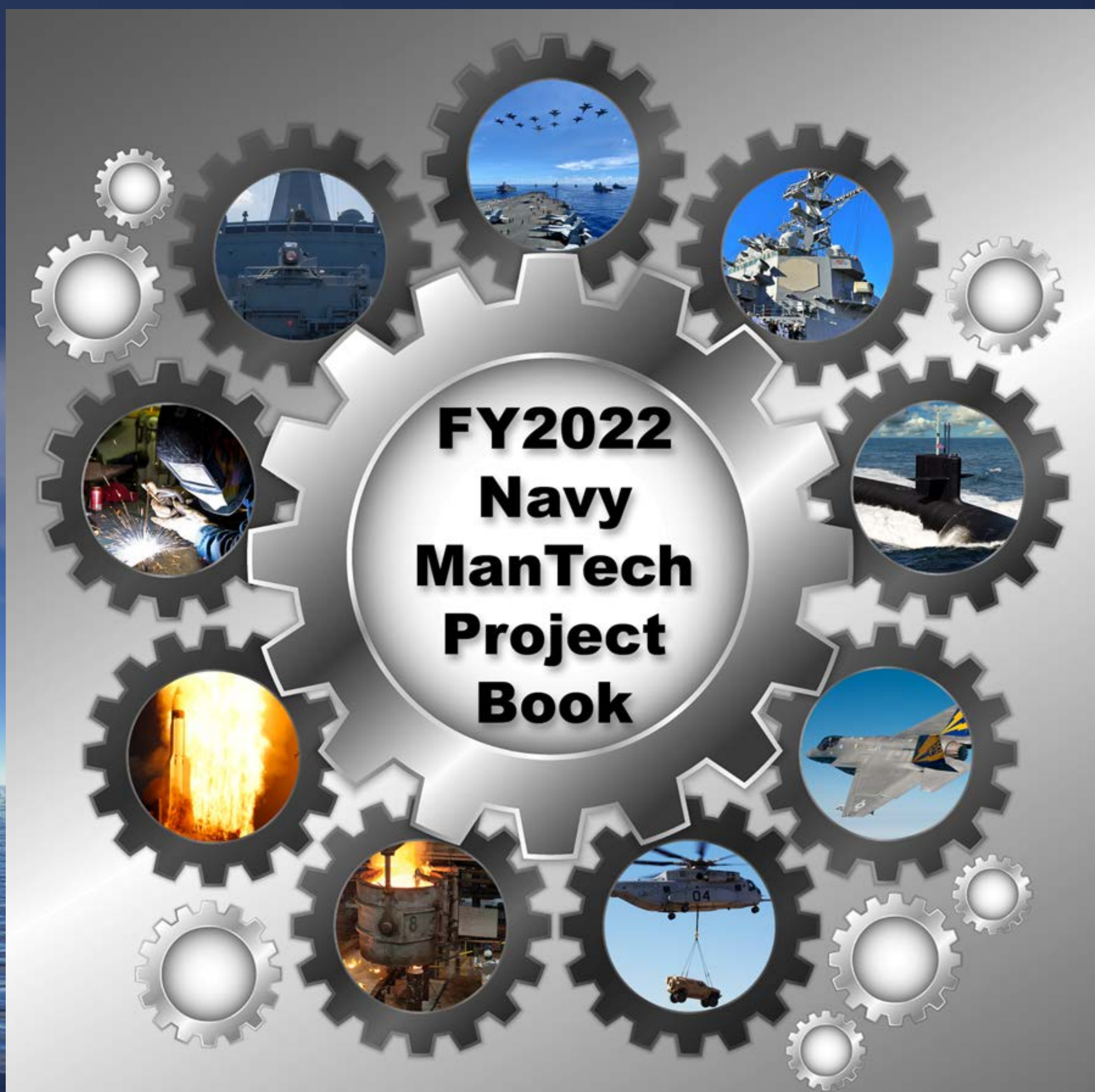
Office of Naval Research
Science & Technology

NAVY MANTECH

Transitioning advanced manufacturing technology and accelerating capabilities for an affordable fleet



DCN# 0543-545-23

Clockwise from top-center:

1. Warships Steam in Formation While E/A-18G Growlers, FA-18E Super Hornets and an E-2D Hawkeye From Carrier Air Wing (CVW) 5 Fly Over. *(U.S. Navy Photo by Lt. Lauren Chatmas/Released)*

2. USS Porter (DDG 78) Returns to Norfolk, Virginia, on October 9, 2022, After Spending Several Years Homeported in Rota, Spain. Members of the Crew Can Be Seen Standing by, Anxiously Awaiting Liberty Call to Be Re-United With Their Families. *(Photo Courtesy of Dr. Angel Diaz / Allegient Defense, Inc.)*

3. VIRGINIA Class Attack Submarine USS Delaware (SSN 791) Conducts Bravo Sea Trials in the Atlantic Ocean. *(U.S. Navy Photo Courtesy of Huntington Ingalls Industries by Ashley Cowan/Released)*

4. The Carrier Variant of the F-35 Lightning II Flies for the First Time With External Weapons. *(U.S. Navy Photo Courtesy Lockheed Martin/Released)*

5. CH-53K King Stallion Lifts a Joint Light Tactical Vehicle at Naval Air Station, Patuxent River, Maryland. *(U.S. Marine Corps Photo/Released)*

6. Molten Steel Readied for USS John F. Kennedy (CVN 79) at Huntington Ingalls Industries – Newport News Shipbuilding. *(Photo Courtesy Huntington Ingalls Industries/Released)*

7. A Standard Missile-3 is Launched From the Guided Missile Cruiser USS Lake Erie (CG 70), During a Joint Missile Defense Agency / U.S. Navy Ballistic Missile Flight Test. *(U.S. Navy Photo by Lt. Chris Bishop Deputy/Released)*

8. Hull Maintenance Technician 3rd Class Jesse Belfi Strikes a Welding Rod to Mend the Hinge of a Quick-Acting Watertight Door Handle Aboard the Amphibious Assault Ship USS Bonhomme Richard (LHD 6). *(U.S. Navy Photo by Mass Communication Specialist 3rd Class Amanda S. Kitchner/Released)*

9. Amphibious Transport Dock USS Portland (LPD 27) Transits the Gulf of Aden, December 13, With a Solid State Laser – Technology Maturation Laser Weapon System Demonstrator Mark 2 MOD 0 on Board. The Office of Naval Research Selected *Portland* to Host the Laser Weapon Technology. *(U.S. Marine Corps Photo by Lance Cpl. Patrick Katz/Released)*

Contents

FY2022 Navy ManTech Project Book: This edition of the Navy ManTech Project Book provides brief write-ups for most of the Navy ManTech projects active in FY2022. The projects are organized by platforms and highlight Navy ManTech's cost-savings investment strategy, with its concentration on accelerating capabilities and transitioning affordable manufacturing technology for the key platforms and to the fleet. Please contact the points of contact listed in the project summary for additional information on any Navy ManTech project.

Projects by Platform:

Index:

There have been many changes to the ManTech Program since the last publication of the ManTech Project Book. We have welcomed new faces to the ManTech community as well as said fond farewells to others. In particular, we have welcomed Dr. Jeffrey Farren as our new Navy ManTech Metals Program Officer. What has not changed, however, is ManTech's commitment to its mission: transitioning affordable technologies and accelerating capabilities to the fleet. I am especially excited about our renewed focus on maintenance and sustainment and our new efforts to advance high energy laser (HEL) / directed energy technology.

FY2022 brings continued emphasis on the two key components of the ManTech investment strategy: major acquisition platform affordability and capability acceleration to get capabilities to the fleet faster.

ManTech will continue to play a significant role in providing cost-savings to the VIRGINIA Class submarine (VCS), COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class aircraft carrier, F-35 Lightning II aircraft and now the FFG 62 Class frigate to help these platforms meet their affordability goals. ManTech highlights include optimizing processes for the F-35 Lightning II electro-optical targeting system that will save the F-35 Lightning II program $224.0M, evaluating ceramic coatings for submarine ball valves that will provide total life-cycle savings of approximately $125.4M for VCS and further savings for CLB, facilitating open architecture radar designs based on common commercial components used as modular building blocks that will save $40.0M for the Next Generation Surface Search Radar and improving shipbuilding shaped-plate fabrication and verification processes to automatically form steel into complex 3D shapes, significantly minimizing lead-time and costly downstream rework for implementation on DDG 51 Class destroyers as well as other surface ships.

ManTech's capability acceleration efforts will continue to support the Chief of Naval Operations' direction to get capabilities to the fleet faster. Our seven primary thrust areas include swarm / unmanned / autonomous vehicle production, HEL weapon systems / directed energy, advanced submarine fabrication technology, fleet sustainment technology, energetics production improvement, hypersonics fabrication and manufacturing acceleration of other ONR activities. For more information about ManTech's HEL efforts and our work with the other services under the Joint Defense Manufacturing Technology Panel to develop a comprehensive HEL manufacturing technology roadmap, read pages 18-19.

I am excited about Navy ManTech's future and our ability to help major Navy platforms meet their affordability goals for acquisition, maintenance and sustainment. I look forward to working with all of you as we continue to improve manufacturing technologies and provide great benefit to the Navy and the Department of Defense.

Neil A. Graf
Manufacturing Technology Program Lead
ONR Navy ManTech Program

Navy ManTech Overview

The Navy Manufacturing Technology (ManTech) Program responds to the needs of the Navy for the production and repair of platforms, systems and equipment. It helps reduce acquisition and total ownership costs by developing, maturing and transitioning key manufacturing technologies and processes. Investments are focused on those that have the most benefit to the warfighter.

The Navy ManTech Program is managed by Code 33, Sea Warfare and Weapons Department, of the Office of Naval Research (ONR).

Since FY2007, the Navy ManTech Program has been focused on affordability improvements for key acquisition platforms. In addition, Navy ManTech has recently supported efforts to accelerate the delivery of capabilities to the fleet.

Navy ManTech works with defense contractors, the Naval Research Enterprise, Navy acquisition Program Offices and academia to develop improved processes and equipment. ManTech promotes timely implementation to strengthen the defense industrial base. With their expertise in specific technology areas, the Navy ManTech Centers of Excellence (COEs) play a key role in the definition and execution of the program. Together with the Navy ManTech Program Office, representatives of our Navy customers and our industry partners, the COEs function as a team to define projects that address the needs of the Navy in time to make a difference. As an example, extensive interaction and cooperation among the Navy ManTech Program Office, COEs, General Dynamics Electric Boat, Huntington Ingalls Industries – Newport News Shipbuilding, Program Executive Office (PEO) Submarines and the PMS 450 Program Office have resulted in a focused ManTech initiative for VCS.

To date, technology from 68 of the portfolio's projects have been implemented, or are in the process of being implemented, resulting in real acquisition cost-savings of approximately $44.9M per hull, verified by our industrial partners and PMS 450.

The directors of the ManTech programs of the Army, Navy, Air Force, Defense Logistics Agency, Missile Defense Agency and Office of the Secretary of Defense (OSD) coordinate their programs through the auspices of the congressionally chartered Joint Defense Manufacturing Technology Panel (JDMTP) with ex-officio representation from agencies such as the Department of Commerce and the Department of Energy. The JDMTP is organized to identify and integrate requirements, conduct joint program planning and develop joint strategies. Although the JDMTP has a shared strategic vision, technical projects and initiatives are selected, executed and managed separately through each service or agency ManTech program.

Navy ManTech Objectives

The overall objective of the Navy ManTech Program is to improve the affordability and readiness of Department of the Navy systems by engaging in manufacturing initiatives that address the entire weapon system life-cycle and that enable the timely transition of technology to industry to support the fleet. More specifically, Department of Defense (DoD) Directive 4200.15 states that ManTech investments shall:

1. Aid in the economical and timely acquisition and sustainment of weapon systems and components.
2. Ensure that advanced manufacturing processes, techniques and equipment are available for reducing DoD materiel acquisition, maintenance and repair costs.
3. Advance the maturity of manufacturing processes to bridge the gap from research and development advances to full-scale production.
4. Promote capital investment and industrial innovation in new plants and equipment by reducing the cost and risk of advancing and applying new and improved manufacturing technology.
5. Ensure that manufacturing technologies used to produce DoD materiel are consistent with safety and environmental considerations and energy conservation objectives.
6. Provide for the dissemination of program results throughout the industrial base.
7. Sustain and enhance the skills and capabilities of the manufacturing workforce and promote high levels of worker education and training.
8. Meet other national defense needs with investments directed toward areas of greatest need and potential benefit.

Navy ManTech Investment Strategy

The Navy ManTech investment strategy concentrates ManTech resources on reducing both the acquisition and life-cycle costs of key Navy acquisition programs. ManTech transitions manufacturing technology which, when implemented, results in a cost reduction or cost avoidance. Platforms for investment are 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. ManTech investments are currently focused on affordability improvements for the VIRGINIA Class submarine (VCS), COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class aircraft carrier, F-35 Lightning II aircraft and FFG 62 Class frigate.

Navy ManTech also supports select manufacturing technology projects that accelerate the delivery of capabilities to the Navy. Our seven primary thrust areas include swarm / unmanned / autonomous vehicle production, HEL weapon system / directed energy, advanced submarine fabrication technology, fleet sustainment technology, energetics production improvement, hypersonics fabrication and manufacturing acceleration of other ONR activities.

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 ManTech supports mature through their respective acquisition cycles, ManTech's investment targets change.

Although different in focus, scope and size, ManTech's affordability initiatives function similarly. For each, ManTech has established an integrated project team (IPT) with representatives from Navy ManTech, the platform Program Office, and representative industry. The IPT meets regularly to coordinate and review the portfolio and to ensure that projects are completed in time to meet the platform's window of opportunity for implementation.

Individual Navy ManTech projects are developed in conjunction with industry and the acquisition Program Manager (PM). With their expertise in specific manufacturing areas, the Navy ManTech COEs play a key role in project definition. Planning for transition prior to the initiation of projects is critical for the implementation of technology on the factory floor and eventually into the fleet.

To clarify communication between program participants, Navy ManTech has established definitions for "transition" and "implementation." For Navy ManTech purposes:

- **Transition** denotes that point at which the ManTech project is completed, and the technology meets customer (Program Office / industry) criteria and goals for implementation and is available for use at industrial / naval organic facilities.

Navy ManTech Investment Strategy

- **Implementation** denotes the actual use of the ManTech results on the factory floor. (The resources for implementation are typically provided by entities other than ManTech including the Program Office and/or industry).

Agreements are reached on the degree of participation of the PEO / PM in support of the projects. The goal is for each PEO / PM to contribute resources to enable successful completion and implementation of the ManTech projects. Resources supplied may include financial support or cost share for the ManTech project itself or funding of Navy laboratory personnel to provide test, evaluation, certification and/or other services. In addition, each PEO / PM is expected to provide personnel with technical expertise and/or management experience to assist the ManTech Program Office in project oversight. This support affords assurance that the weapon system PM is truly committed to the successful outcome of the ManTech project. In addition, this close working relationship between the parties provides ManTech with a long-term view of implementation.

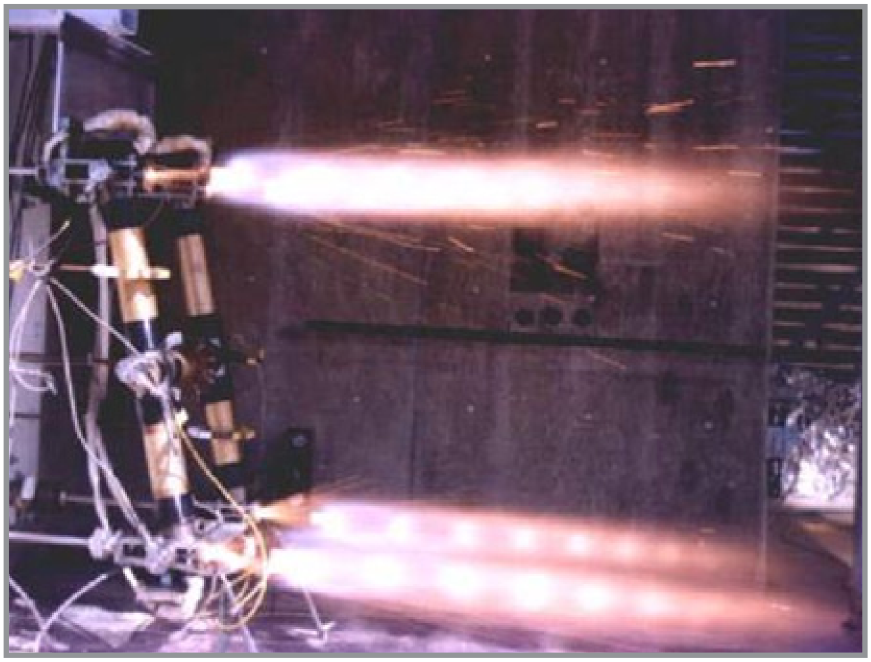
On a per-project basis, Technology Transition Plans (TTPs) document roles, responsibilities and required resources needed to achieve transition and implementation. TTPs highlight the path from the technology development that ManTech performs to implementation on the factory floor. TTPs are signed by Navy ManTech, the relevant COE Director, a management representative of the industrial facility where implementation will occur, the Program Office, and, if appropriate, the Technical Warrant Holder. To assess progress, ManTech tracks the status of TTPs and conducts an annual assessment of transition and implementation.

In FY2012, Navy ManTech formalized its focus on implementation and risks to implementation by instituting an implementation risk assessment management process to assess potential future projects (those in the planning stages) as well as ongoing projects. For ongoing projects, risks are discussed during scheduled program reviews to ensure ManTech is on the same page as acquisition and industry stakeholders. For projects in the planning phases, the goal is to recognize risks to implementation upfront and, by doing so, prioritize the funding of projects that have the greatest probability of implementing and have a real impact on affordability.

Semi-annual affordability assessments identify projected cost reduction / avoidance per project. These assessments, which are verified by industry and the relevant Program Offices, provide critical information to ensure that ManTech can continue to meet both its affordability goals as well as those of the platform and are essential to ManTech's success. While a large majority of annual ManTech Program resources are invested in accordance with the affordability investment strategy, Navy ManTech does support smaller efforts in Energetics and Repair Technology (RepTech).

Energetics: ManTech projects that support energetics develop and transition process technologies for the synthesis of new or improved energetic materials, improved manufacture of propellants and explosives and improved handling and loading of energetic materials into systems and components. Projects develop solutions to ensure the availability of safe, affordable and quality energetics products in support of Program Executive Offices, such as Integrated Warfare Systems (PEO IWS / IWS3C) and Conventional Strike Weapons (PEO (W) / PMA-201). More information on the Energetics Manufacturing Technology Center (EMTC) can be found on Page 13.

RepTech: While the major emphasis of Navy ManTech is on support of new production, ManTech also addresses repair, overhaul and sustainment functions that emphasize remanufacturing processes and advancing technology. The RepTech Program focuses on fielded weapon systems and provides the process and equipment technology needed for repair and sustainment. Requirements for RepTech projects are driven by Navy depots, shipyards, Marine Corps Logistics Bases, intermediate maintenance activities and contractor facilities responsible for overhaul and maintenance of fleet assets. In general, RepTech projects are usually shorter in duration and are funded at lower levels than standard ManTech projects. The RepTech Program is managed by the Institute for Manufacturing and Sustainment Technologies (iMAST). More information on iMAST can be found on Page 13.



Development of Energetics Manufacturing for Primary Explosives.
(Courtesy of EMTC.)

Innovative Cold Spray Repair Technology for Ships.
(Courtesy of iMAST.)

Navy ManTech Execution

Navy ManTech projects are executed through the Navy ManTech Centers of Excellence (COEs). The COEs were established as focal points for the development and transition of new manufacturing processes and equipment in a cooperative environment with industry, academia and the Naval Research Enterprise.

The COEs:

- Execute projects and manage project teams
- Serve as a corporate expertise in technological areas
- Collaborate with acquisition Program Offices / industry to identify and resolve manufacturing issues
- Develop and demonstrate manufacturing technology solutions for identified Navy requirements
- Provide consulting services to naval industrial activities and industry
- Facilitate transfer of developed technologies

Descriptions of ManTech's seven COEs are presented on the following pages.

EMC | ELECTRONICS MANUFACTURING CENTER

EOC | ELECTRO-OPTICS CENTER

IMAST
INSTITUTE FOR MANUFACTURING AND SUSTAINMENT TECHNOLOGIES

EMTC

CNM
CENTER FOR NAVAL METALWORKING

CMTC
Composites Manufacturing Technology Center

NSAM
NAVAL SHIPBUILDING AND ADVANCED MANUFACTURING CENTER OF EXCELLENCE

Navy ManTech Execution

Center for Naval Metalworking (CNM)

Established in 2016, CNM develops and deploys innovative metalworking and related manufacturing technologies to reduce the cost and time to build and repair key U.S. Navy ships and weapon platforms, while also collaborating with other relevant manufacturing industries. CNM utilizes a proven approach that blends a virtual center model with in-house technical expertise to ensure that project teams are comprised of the best providers from industry to identify, develop, select and execute "metals-centric" projects that support the Navy ManTech Program objectives and transition to industry.

CNM is managed by Advanced Technology International (ATI) in Summerville, SC. CNM conducts projects that focus on metals and advanced metallic materials, metal-based composites, metal materials manufacturing processes (e.g., additive manufacturing) and joining techniques, coupled with process design control and advanced metrology and inspection technologies.
CNM web site: www.navalmetalworking.org

Composites Manufacturing Technology Center (CMTC)

Established in 2000, CMTC is a virtual center that develops improved manufacturing processes for composite-based components and facilitates technology transfer to resolve manufacturing and repair issues identified and prioritized by the Navy's Program Executive Offices, Navy platform Program Offices, other Department of Defense (DoD) services and industry. Operated by Advanced Technology International (ATI) in Summerville, SC, CMTC forms teams of prime contractors, composites industry suppliers and universities to address Navy composites manufacturing technology needs and has strong in-depth knowledge and experience in composites manufacturing technology for all DoD weapon systems. As part of CMTC's organizational structure, all laboratories, facilities and project labor resources are provided by project teams. This structure results in cost benefit to the Navy, with maximum funding going to project execution.

CMTC's current portfolio includes composites manufacturing projects active or in development for the VIRGINIA Class submarine (VCS), COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class aircraft carrier, FFG 62 Class frigate, F-35 Lightning II aircraft, MQ-25 and the CH-53K heavy lift helicopter (portfolio ramping down).
CMTC web site: www.cmtc.ati.org

Navigy ManTech Execution

Electronics Manufacturing Center (EMC)

EMC | ELECTRONICS MANUFACTURING CENTER

Established in 2021, EMC is the ONR electronics COE located within the Penn State Applied Research Laboratory (ARL) in Freeport, PA. The core mission and function of the EMC are to identify, develop and facilitate the transition of electronics manufacturing technologies to reduce the cost and time to deploy electrical and electronic (digital and analog) systems as well as the supporting power storage and distribution infrastructure to naval ships, aircraft, submarines and unmanned systems. EMC personnel and technical contributors are experienced in most facets of electronics manufacturing and include experts from ARL, Pennsylvania State University and collaborators in the electronics manufacturing industry. The EMC facility has multiple laboratories dedicated to technology research and development, offices and meeting rooms and spaces to perform Department of Defense (DoD) classified work.
EMC web site: www.arl.psu.edu/emc/ (under construction)

Electro-Optics Center (EOC)

EOC | ELECTRO-OPTICS CENTER

Established in 1999, EOC operates within ARL at Penn State University and has served as Navy ManTech's COE for electro-optics. EOC's mission is to transition new electro-optics technologies and applications to Navy-selected focus platforms, through strong technical interactions with DoD and its industrial base, demonstrating acquisition cost and/or life-cycle cost-savings and accelerating capabilities to the warfighter. EOC generally focuses its projects in one of three technical areas: manufacturing of electro-optics, manufacturing using electro-optics and electro-optics manufacturing systems.

EOC is comprised primarily of former industry and DoD personnel and maintains technical competencies in laser systems, imaging sensors and systems, fiber optics and photonics and electro-optics manufacturing technology. Located in Freeport, PA, EOC collaborates with electro-optics companies throughout the United States. EOC also supports important DoD technology thrusts and programs of national interest, such as the design, analysis and testing of advanced laser weapon systems. As a University Affiliated Research Center, Penn State's ARL supports national security, economic competitiveness and quality of life through education, scientific discovery, technology demonstration and transition to application.
EOC web site: www.eoc.psu.edu

Navy ManTech Execution

Energetics Manufacturing Technology Center (EMTC)

Established in 1994 by ONR, EMTC is Navy-operated and located at the Naval Sea Systems Command's Naval Surface Warfare Center – Indian Head Division (NSWC-IHD), in Indian Head, MD. NSWC-IHD serves as the focal point for EMTC and, as a renowned leader in energetics, provides a full spectrum of capabilities, including energetics research, development, modeling and simulation, engineering, manufacturing technology, production, test and evaluation and fleet / operations support. EMTC develops solutions to manufacturing problems unique to military system / subsystem acquisition and production requirements and the energetics industry. EMTC has a full understanding of the inherent dangers of energetics and the need for special processes, equipment, facilities, environmental considerations and safety precautions required for manufacturing.

EMTC does not own or operate any facilities or equipment but is essentially a virtual enterprise that involves government, industry and academia in identifying requirements and executing projects. EMTC identifies weapon system and manufacturing-based needs, develops and demonstrates the required manufacturing process technology solutions and transitions successful results that ultimately benefit the warfighter.
EMTC web site: go.usa.gov/xMBqg

Institute for Manufacturing and Sustainment Technologies (iMAST)

Established in 1995, iMAST executes and oversees the Navy ManTech mission at the Pennsylvania State University's Applied Research Laboratory, one of seven U.S. Navy University Affiliated Research Centers. Located in State College, PA, iMAST addresses challenges related to Navy and Marine Corps weapon system platforms in the following technical areas: materials processing, laser processing, advanced composites, manufacturing systems, repair and sustainment and complex systems monitoring. iMAST supports the Navy and Marine Corps systems commands, as well as PEOs and Navy laboratories.

iMAST also manages the Repair Technology (RepTech) program and applies new and emerging technologies to improve the capabilities of Navy depots, shipyards, Marine Corps Logistics Bases and lower-level maintenance activities throughout the fleet. RepTech cooperates and communicates with Navy COEs, the joint depot community, Department of Defense industrial activities, industry, PEOs and university laboratories to improve sustainability, reliability and system availability.
iMAST web site: https://www.arl.psu.edu/imast

Navy ManTech Execution

Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

Established in 2003, the NSAM Center and its predecessor, the Center for Naval Shipbuilding Technology, have been operated by Advanced Technology International (ATI) in Summerville, SC. The NSAM Center develops advanced manufacturing technologies and deploys them in U.S. industrial facilities to improve manufacturing processes and ultimately reduce the cost and time required to build and repair Navy weapon platforms. The NSAM Center works closely with the Navy's acquisition community and the defense industry to address manufacturing technology issues that negatively impact efficiency, with respect to both cost and cycle time. Projects improve construction and repair processes, such as optimizing production practices, increasing the use of robotic manufacturing methods, investigating modular / packaged units, improving accuracy control, eliminating inefficiencies in material usage and using advanced manufacturing tools and technologies.

The NSAM Center focuses on technologies that improve the affordability of current Navy acquisition programs. New projects will investigate using modern planning systems, automated fabrication technologies, supply chain improvements, streamlined unit / module flow to and within storage and construction areas, wireless data management applications, using 3D models to support production and developing improved scheduling systems for new, aggressive build strategies.
NSAM web site: https://www.NSAMCenter.org

Induction Heating and Straightening for Ship Panels Will Reduce Rework.
(Courtesy of NSAM.)

CVN 79 Underwater Hull in Dry Dock.
(*Courtesy of Huntington Ingalls Industries – Newport News Shipbuilding.)*

CVN 79 Lower Bow Positioned in Dry Dock.
(*Courtesy of Huntington Ingalls Industries – Newport News Shipbuilding.)*

Navy ManTech Technology Transfer

As previously indicated, the emphasis of the Navy ManTech Program is on transition of manufacturing technology that will result in tangible benefits for the fleet. To achieve transition, it is imperative that the manufacturing advances be widely disseminated to the industrial base for implementation. To foster that dissemination, Navy ManTech provides the following:

Program Web site

The Navy ManTech Program web site can be accessed at **https://www.nre.navy.mil/work-with-us/navy-mantech**. The web site is a central source to access general information about program activities and participation, developments and events and key points of contact. The site also offers links to the annual Navy ManTech Project Book, program success stories, as well as other publications.

Defense Manufacturing Conference

The annual **Defense Manufacturing Conference (DMC)** is a forum for presenting and discussing initiatives aimed at addressing Department of Defense (DoD) manufacturing technology and related sustainment and readiness needs. The conference includes briefings on current and planned programs, funding, DoD initiatives and seminars relating to the various technology thrusts currently being pursued.

ShipTech

The biennial event is a forum to exchange information on the manufacturing technology developments generated by Navy ManTech through its COEs, as well as the related initiatives conducted by the National Shipbuilding Research Program, industry and academia. **ShipTech's** objective is to reduce acquisition and total ownership costs of naval ships, accelerate the delivery of capabilities to the warfighter and enhance the competitiveness of the U.S. shipbuilding industry.

Project Book

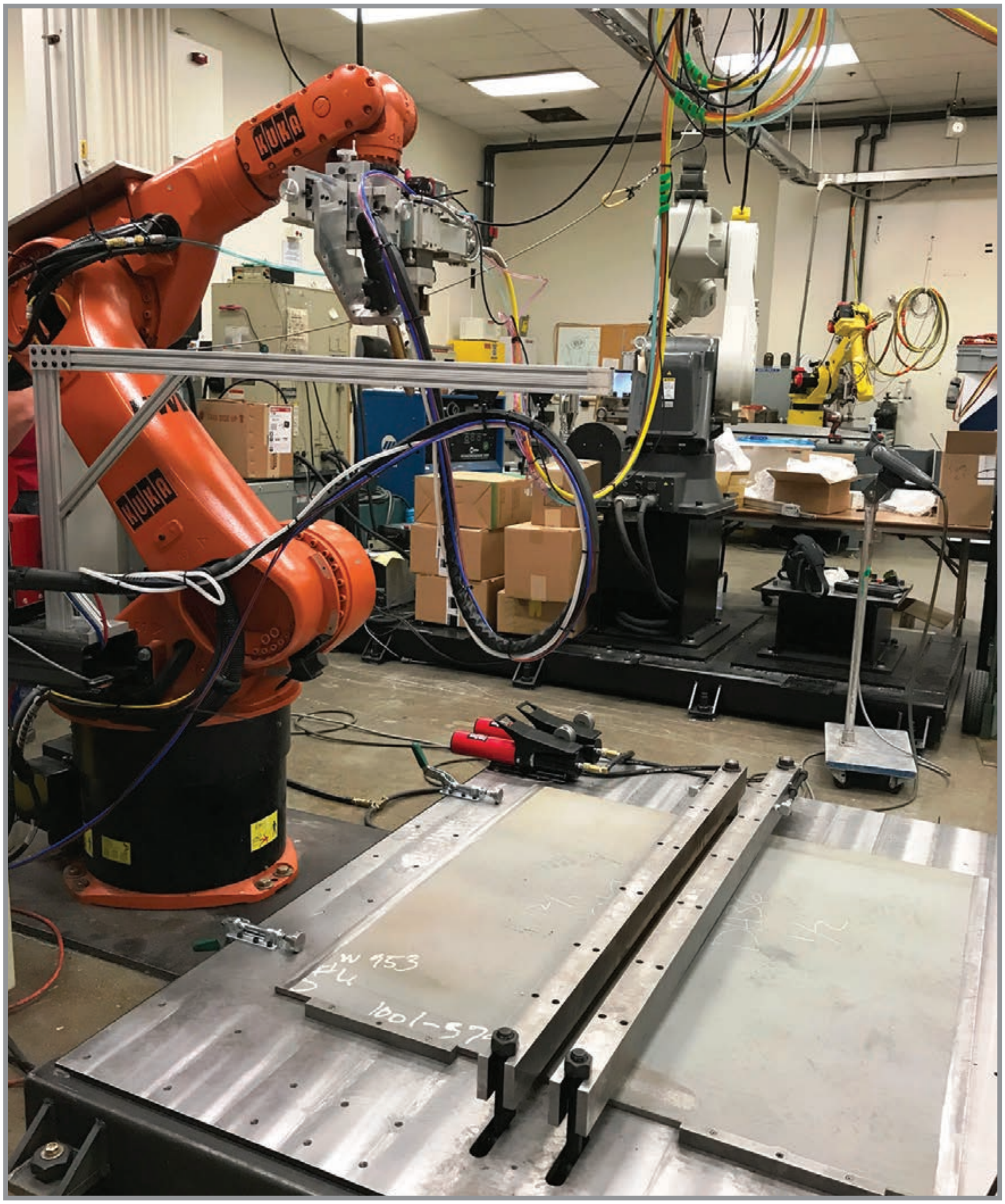
The **Navy ManTech Project Book**, which is published annually, provides a snapshot of the Navy ManTech projects active during the previous fiscal year. Points of contact for each project are provided to facilitate technology transfer.

Centers of Excellence

The **Navy COEs** are focal points for specific manufacturing technology areas. The charter for each COE requires it to act as a consultant to both the Navy and industry, and to facilitate the transfer of technology throughout the industrial base.

Navy ManTech Technology Transfer

The Navy urges government activities, industry and academia to participate in its ManTech Program as participants, advisors, consultants and, most importantly, as beneficiaries. Development and implementation of new and improved technologies is achieved only through a concerted effort by everyone connected with the design, manufacture and repair and sustainment of naval weapon systems.



Increasing Productivity and Reducing Distortion by Employing Hybrid Laser Arc Welding. (*Courtesy of Huntington Ingalls Industries – Ingalls Shipbuilding / NSAM.)*

A Joint Approach to Identifying Manufac

Within the next several years, all branches of the Department of Defense (DoD) are planning to deploy Directed Energy Weapon (DEW) systems. One type of DEW emphasized by the Navy is the high energy laser (HEL) weapon system. Many of the technologies that comprise HEL weapon systems are unique to these systems, and prototypes and demonstrators were built by subject matter experts within the government and industry, including the Navy ManTech Electro-Optics Center (EOC) operated by the Penn State Applied Research Laboratory. In addition, many of the manufacturing processes necessary to realize these components are currently immature and/or the capacity of industry to manufacture these items in relevant quantities is limited.

ManTech representatives from Navy, Army, Air Force and the Missile Defense Agency as well as the Office of the Under Secretary of Defense (OUSD) for Research & Engineering and the laser weapon system science and technology community of interest recognized the need for coordinated manufacturing technology investment. They joined forces under the Joint Defense Manufacturing Technology Panel's Directed Energy Working Group (DEWG), which addresses HEL and high power microwaves and has prioritized HEL systems, to develop a comprehensive manufacturing technology roadmap that will guide future investments and ensure that directed energy capability will be available for our warfighters. The goal of the roadmap is to illustrate where gaps exist and recommend investments in order to ensure the industrial base is capable of producing weapon systems in the timeframe necessary.

A modern HEL weapon system is complicated, so the team tackled the effort by establishing a system engineering decomposition with common nomenclature. This decomposition of the major components, subcomponents and subsystems that comprise a HEL weapon system led the team to identify common needs and leverage existing work across

turing Gaps for HEL Weapon Systems

the services in laser source components, optics and pointing subsystems. The coordination within the DEWG led to immediate investments in the industrial base in laser source components, optics and pointing subsystems. One example is that Navy ManTech has new investments in optical coatings and beam directors sponsored by OUSD to benefit HEL applications for all service needs.

The chief benefit of the directed energy roadmap is an improvement in warfighter readiness for missions that are best addressed using laser weapon solutions. The manufacturing technology roadmap allows for the initiation of manufacturing technology aspects related to laser weapon systems fabrication in conjunction with ongoing science and technology work. This concurrent approach will accelerate delivery of directed energy capability to the warfighter compared to a more traditional approach where manufacturing technology is considered later in the development process and protracts delivery due to a more serial process. Navy ManTech projects have already shown cost-reduction and throughput improvements for several key laser weapon components.

Secondary cost-avoidance benefits are also possible due to the cross-service coordination of laser weapon ManTech efforts among DoD services. Specifically, identification of component and subsystem technologies common to all laser weapon systems avoids unnecessary duplication of efforts and maximizes the efficiency of the investment. For example, investments in mirror fabrication explore different approaches. Further acquisition and life-cycle savings are possible through this joint roadmap effort by producing these common elements in larger quantities and harmonizing maintenance efforts. The capability acceleration and technological advancements made between Navy ManTech Centers of Excellence and all branches of the military in 2021 and 2022 will lead the way for the HEL weapon systems of tomorrow, benefitting the entire DoD well into the future.

Navy ManTech – Affordability Improvements for Key Naval Platforms: VIRGINIA Class Submarine (VCS), F-35 Lightning II Aircraft, COLUMBIA Class Submarine (CLB), CVN 78 Class Aircraft Carrier, DDG 51 Class Destroyer and FFG 62 Class Frigate. *(Courtesy of PEO (Subs), PEO (JSF), PEO (Columbia), PEO (Aircraft Carriers), PEO (Ships) and ES3DStudios.)*

CVN 78 Class / Aircraft Carriers Projects

CVN 78 Class / Aircraft Carriers.
(U.S. Navy image.)

Deploying Induction Heating to Straighten Deck and Bulkhead Panels to Reduce Rework

PERIOD OF PERFORMANCE:
June 2016 to May 2022

PLATFORM:
CVN Class / Aircraft Carriers

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

POINT OF CONTACT:
Marty Ryan
(864) 646-4512
marty.ryan@ati.org

STAKEHOLDER:
PMS 379

TOTAL MANTECH INVESTMENT:
$2,946,000

S2664 — Induction Straightening for CVN

Objective

Construction for current CVN 78 Class aircraft carriers employs flame-straightening to straighten deck and bulkhead panels within required tolerances. Although effective, the process is time-consuming and allows for variability in application. It requires numerous application zones across the full area of the panel and often necessitates multiple treatments. Phase I of this Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project determined the technical acceptability testing and executed a test plan to develop induction-straightening parameters that do not adversely affect high-strength low-alloy (HSLA) 65 material properties. Phase II determined the effectiveness of the developed induction-heating parameters to straighten a representative mock-up of a ship structure.

Payoff

Huntington Ingalls Industries – Newport News Shipbuilding (NNS) projects an estimated savings of $8.5M per CVN hull.

Implementation

NNS anticipates implementation in the third quarter of FY2024.

Leveraging Air Vehicle Technology to Inspect Tanks and Surfaces Will Reduce Time While Increasing Accuracy and Safety

S2788 — Tank Inspection Using Drones

Objective

Inspections of over 700 new tanks and enclosed areas on the CVN 78 Class aircraft carrier are currently performed manually. Manual inspections, both internal and external, are time-consuming, generate opportunities for human error and create safety concerns as personnel use ladders, scaffolding or boom lifts to inspect areas for defects. This Electro-Optics Center (EOC) project has developed and tested a prototype unmanned aerial vehicle (UAV) inspection system to inspect tanks and surfaces with UAVs, thereby reducing inspection time, while increasing accuracy and safety.

In the first phase, Huntington Ingalls Industries – Newport News Shipbuilding (NNS) led the evaluation and enumeration of all inspection processes, both internal and external, from which UAV inspection requirements and specifications were derived. The goal was to identify the inspections that would yield the most benefit from UAV inspection and supply the requirements for performance and payload capabilities to support subsequent phases. In the second phase, EOC led the evaluation of UAV platforms, examining commercial off-the-shelf (COTS) hardware and software offerings and examining the design space for custom prototype options. While no COTS system was available, EOC was able to develop a custom prototype to fulfill many of the requirements. In the final phase, the shipyard and EOC worked cooperatively to test the prototype system in mock-ups representing actual environments in order to validate the UAV inspection processes.

Payoff

The primary focus of the project was to reduce labor costs and improve safety for the inspection of tanks and surfaces on the CVN 78 Class aircraft carrier. Estimated savings were evaluated throughout the project as part of the benefits analysis, and custom prototypes have been demonstrated in representative mock-ups in order to demonstrate the UAV inspection processes. For the initial business case, which was focused predominantly on CVN 80, savings were estimated at approximately $4.0M, if fully implemented. The savings result from an estimated 50 percent reduction in labor and rework using UAVs for remote inspection of internal and external spaces. Long-term benefits of this project will be applicable well beyond new hull construction for CVN 80. As part of the project team, Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) also evaluated this technology for potential use on DDG 51 platforms and identified estimated cost-savings, if the technology were to be fully implemented. Other applications may include new inspections of enclosed areas, voids, tanks and external structures for Landing Helicopter Assault, Landing Platform / Dock and U.S. Coast Guard's National Security Cutter platforms, as well as overhaul inspections of all platforms. Finally, additional benefits include reduced occupational, health and safety risks for personnel; reduced human error when transcribing inspection data for analysis and recordkeeping; as well as the transition to digital inspection processes to reduce analysis time and maintain permanent inspection records for the life of the ship.

Implementation

NNS developed an implementation plan that identifies transition requirements and articulates a transition strategy with methods for tracking successful implementation. The implementation plan also identifies remaining technology gaps that the custom prototype must fulfill before NNS / Ingalls can transition the developed technology. A follow-on project would be needed to close the documented technology gaps, as well as identify a commercialization partner that could manufacture the UAV. The UAV opportunity space has much to offer and the rapidly-evolving UAV inspection system market will continue to be monitored. Lessons learned from this project were substantial and have already been leveraged on concurrent ManTech projects, positioning ManTech and industry to adopt this high-return technology in the near future.

PERIOD OF PERFORMANCE:
April 2019 to July 2022

PLATFORM:
CVN Class / Aircraft Carriers

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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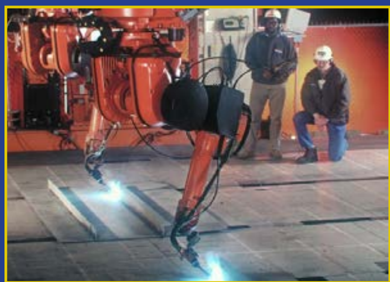
STAKEHOLDER:
PMS 378

TOTAL MANTECH INVESTMENT:
$1,950,000

Using Robotic Mechanized Gas Metal Arc Welding to Increase Panel Line Productivity



PERIOD OF PERFORMANCE:
April 2019 to December 2022

PLATFORM:
CVN 78 Class / Aircraft Carriers

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

POINT OF CONTACT:
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STAKEHOLDER:
PMS 378

TOTAL MANTECH INVESTMENT:
$1,700,000

S2794 — Adopting GMAW for Robotic Panel Line Fillet Welding Operations

Objective

The Department of Defense (Navy) budget continues to strain to meet new goals for fleet size and increased acquisition activity. An acquisition cost goal set by the Navy has been to reduce the construction costs for CVN 78 Class aircraft carriers. A major portion of the strategy to achieve this goal is through the use of technology insertion to reduce fabrication costs.

This Center for Naval Metalworking (CNM) project determined the advantages of converting legacy equipment from a robotic flux-core arc-welding mechanized (R-FCAW-ME) process to a robotic gas-metal arc-welding mechanized (R-GMAW-ME) process. The project team compared the current baseline welds to the welds fabricated with the R-GMAW-ME process.

Lincoln Electric is providing additional technical insight and feedback to stand up the R-GMAW-ME system. After Lincoln has proven out the technology and stood up the solution, the project will transition to the shipyard for testing in a representative environment. Once Huntington Ingalls Industries – Newport News Shipbuilding (NNS) completes shipyard evaluation activities and the process achieves successful results with project expectations, NNS will develop positive supporting documentation to implement the R-GMAW-ME process using capital funding.

Payoff

If the project achieves its threshold labor reduction goal, NNS anticipates an estimated CVN five-year savings of $3.8M beginning the third quarter of FY2024.

Implementation

Upon acceptance of both the technology and associated business case by the acquisition program office, the results will transition to the NNS facility. NNS anticipates implementation in the first quarter of FY2025.

The Primary Thermal Management Solution for SEWIP Block 3

S2801 — SEWIP Block 3 Enhanced Thermal Management

Objective

The Electronics Manufacturing Productivity Facility (EMPF) developed innovative, affordable manufacturing processes to increase the Surface Electronic Warfare Improvement Program (SEWIP) Block 3 – Low Band (LB) Transmit (TX) subsystem cold-plate performance to remove detrimental heat from the arrays of high-power amplifiers during intended electronic warfare (EW) LB TX operations. Prototype cold plates were fabricated to demonstrate the manufacturability of the present design and the performance capability.

The project goals were to improve the manufacturability of the LB TX cold plate to enable peak performance of the current design, and to determine if the design can meet the required operational capacity.

The objectives were to validate the present cold plate design by evaluating the present design-manufacturing process, developing proper screening and mitigation processes, and to increase thermal management performance of the current cold plate to allow the LB TX subsystem to run at full operational capacity.

Payoff

Expected benefits to the Navy are effective, consistent and predictable cold plate designs; improved capacity performance that meets design requirements; and a maintainable production cost point for full rate production procurements and future cost-reduction activities.

Implementation

Acceptance of the updated manufacturing processes that addressed the root cause effects by the integrated project team was the first milestone in the implementation process. It resulted in the approval of the Manufacturing Screening and Mitigation Processes document. In addition, production plates of an alternate material (foil) were tested and successfully met performance quality as alternate production plates. At the end of this project, as documented in the Technology Transition Plan, the program office committed to support the Engineering Change Proposal (ECP) to ensure the implementation of the manufacturing instructions / drawings needed to mitigate the identified issues in support of future low-rate initial production. This is currently in the queue to be implemented at the next opportunity to do so.

PERIOD OF PERFORMANCE:
June 2019 to November 2021

PLATFORM:
CVN Class / DDG 51 Class

CENTER OF EXCELLENCE:
Electronics Manufacturing Productivity Facility (EMPF)

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STAKEHOLDER:
PEO IWS2

TOTAL MANTECH INVESTMENT:
$5,190,000

Shroud and Tundish for the Reduction of Ceramic Oxide Defects

PERIOD OF PERFORMANCE:
August 2019 to August 2022

PLATFORM:
CVN Class / Aircraft Carriers

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDER:
PMS 379

TOTAL MANTECH INVESTMENT:
$2,016,000

S2807 — NNS Foundry Casting Improvements

Objective

In manufacturing, castings are often used to alleviate fabrication costs by delivering raw material parts with near-net or end-use geometry. This enables manufacturers to minimize or eliminate machining operations to reduce costs. While this process is highly appealing to shipbuilders, the metal caster must ensure that the end product meets the U.S. Navy's high technical requirements. This, along with the low volume in shipbuilding, makes obtaining a commercial supplier difficult. As the Navy attempts to increase vessel acquisition while reducing costs, the Huntington Ingalls Industries – Newport News Shipbuilding (NNS) Foundry is proactively reviewing issues that affect product schedule and cost. Internal investigations found a majority of defects in high yield (HY) 80 steel castings associated with ceramic oxides in cast parts are located on the surface or slightly sub-surface.

The objectives of this Center for Naval Metalworking (CNM) project were two-fold. The first was to develop a shroud and tundish design to reduce air entrainment and ceroxide defects in HY80 cast parts manufactured at the NNS Foundry. The second was to improve modeling software capabilities to increase forecasting accuracy for casting defect areas. This will facilitate better casting design and first-time quality. The project primarily affects cast parts for the fabrication of CVN 78 Class aircraft carriers. Successful design will transfer across castings for all Navy platforms.

Payoff

Based on the results of the acceptance testing, there was an unsatisfactory business case. The payoff came in the form of increased knowledge surrounding the shrouded pouring and computational modeling of HY80 steels. Further trials are needed to increase modeling accuracy and casting performance.

Implementation

Based on the results of testing, NNS will not be implementing the solution due to unsatisfactory results. Future projects would need to be completed to further advance the shrouded pouring technology for the NNS Foundry needs.

Laser Ablation to Improve NNS Preconstruction Primer Removal Operations

S2823 — Laser Ablation of PCP from HSLA Steel

Objective

In aircraft carrier (CVN) construction, preconstruction primer (PCP) must be removed prior to welding. Typically, needle guns, handheld or walk-behind grinders and/or abrasive blast equipment are used. These are often laborious, dangerous and detrimental to the substrates and/or produce excessive waste materials. At the Huntington Ingalls Industries – Newport News Shipbuilding (NNS) Steel Production Facility (SPF), a substantial percentage of CVN steel-fabrication labor is consumed in PCP removal. This process inherently results in an unacceptable number of personnel injuries per year, some surface erosion of the steel substrate and cleanup and disposal costs for blast media.

Laser-ablation technology can reduce the detriments that are tied to current practices. Numerous civilian industries are implementing laser ablation, as supported by many studies showing its potential. Challenges for implementation (including technical, procedural, training, safety, environmental and financial) may be overcome by appropriately identifying and carefully addressing them on an as-needed basis.

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project was to qualify and implement laser-ablation technology for the semi- or fully-automated removal of PCP from high-strength low-alloy steel (HSLA) within the NNS SPF that are supporting the more rapid construction schedules of CVN 80 and CVN 81.

Payoff

The preliminary business case, based on pre-project figures provided by NNS, shows a labor reduction in excess of 20,000 hours for the first year of full laser-ablation implementation for automated PCP removal. Following full implementation of laser ablation at NNS, the five-year return on investment is expected to be approximately 2.4:1. This figure does not include quantified savings in material costs (e.g., abrasives) or cost avoidances related to injuries experienced using current PCP removal methods. In the last phase of this project, NNS will provide an updated business case.

Implementation

Early estimates for implementation costs are nearly $3.0M, which include procurement of capital equipment; development of standard operating procedures and safety protocols / training; and equipment installation, debugging and training. NNS anticipates the need for three to five laser-ablation systems in the SPF and will begin transition with its final business case. The strategy for implementation has a timeline beginning in FY2023.

PERIOD OF PERFORMANCE:
February 2019 to September 2022

PLATFORM:
CVN 78 Class / Aircraft Carriers

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDER:
PMS 378

TOTAL MANTECH INVESTMENT:
$1,450,000

Automating Radiation Control

PERIOD OF PERFORMANCE:
March 2020 to January 2022

PLATFORM:
CVN Class / Aircraft Carriers

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDER:
PEO Carriers

TOTAL MANTECH INVESTMENT:
$244,000

S2865 — Digital Exposure Record Card and Electronic Personal Dosimeter Self-Issue

Objective

There is a major labor shortfall of Radiological Control Technicians (RCTs). These technicians control nuclear work for shipyards and other nuclear facilities, including providing access to High Radiation Areas (HRA). As part of their responsibilities for controlling access to HRAs, RCTs provide qualified radiation workers with an electronic pocket dosimeter (EPD). This can be a laborious and time-consuming task, especially when there is a backlog of personnel seeking access to an HRA. In addition to the labor burden for RCTs, there is an administrative burden to radiation workers and dosimetry-monitoring personnel in the form of paper exposure record cards (ERC). The ERC is used by radiation workers to manually track their exposure after exiting an HRA, which is a time-consuming and error-prone process. Also, attaching ERCs to Thermoluminescent Dosimeters, reading the data when they are returned and collecting data to share externally represent a significant burden on the radiation exposure-monitoring program.

Radiation work requires over 5,000 hours per year for administrative tasks related to ERC management, tracking and reporting, as well as nearly 3,500 additional hours for manning HRAs to conduct radiation monitoring and reporting in accordance with legacy manual processes. In a digital world, processing ERCs could be automated and would require little human oversight.

In order to remain competitive through the 21st century, Huntington Ingalls Industries – Newport News Shipbuilding (NNS) and other shipyards must replace outdated processes with cutting-edge technology or automation to lift the burden that a shrinking workforce brings. This project aims to re-engineer EPD request, self-issue and data processes.

Payoff

NNS anticipates that this project will digitize the management of personnel exposure by eliminating the paper ERCs and allowing radiation workers to self-issue electronic personal dosimetry. Implementation of new technologies / products developed under this project is estimated to result in annual savings of $1.1M for CVN construction at NNS, creating a five-year return on investment of 8.1:1.

Implementation

Implementation began in the fourth quarter of FY2021. NNS fully implemented the solution in a production environment in the first quarter of FY2022 on the CVN platform.

Newport News Seeks to Improve Weapons Elevator Manufacturing to Increase Efficiency and Throughput

S2894 — Advanced Weapons Elevator – Modular Hatch Assembly

Objective

Huntington Ingalls Industries – Newport News Shipbuilding (NNS) has been constructing Ford Class aircraft carriers for more than 10 years. Advanced weapons elevators (AWEs) are essential components of these carriers. These elevators are used to carry munitions and other mission critical items from deep within the carrier to the upper decks. The total build time for the elevators is five to six years with 130 milestones for building, outfitting, grooming and testing. Each Ford Class aircraft carrier has 11 AWEs.

This project seeks to develop a method for building AWE doors and hatches modularly to reduce alignment issues and schedule delays. Building large modules in a shipboard environment presents many manufacturing challenges, including environmental factors and space constraints. Manufacturing the elevator modules in a shop environment, versus onboard the ship, will typically reduce labor costs by a factor of eight to one. Included in the deliverables for this project is a new process for manufacturing AWE modules, improved fixturing and jigs, a new manufacturing cell concept and new build plans.

This effort will be accomplished in three phases over a 39-month period. Phase I will consist of requirements definition and concept summary. Phase II will perform design and engineering activities. Finally, Phase III will encompass construction and testing activities.

Payoff

By moving the build of the AWE modules to an earlier stage of construction, the initial estimate for cost-savings is $10.1M per CVN, which equates to a return on investment of 1.5:1.

Implementation

The results of this project will be implemented partially on CVN 80 and CVN 81. Preliminary plans indicate that full implementation of the equipment and methods will occur within 18 months of project completion.

PERIOD OF PERFORMANCE:
August 2022 to October 2025

PLATFORM:
CVN Class / Aircraft Carriers

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDER:
PEO Carriers

TOTAL MANTECH INVESTMENT:
$4,700,000

Integrate Automated Schedule Optimization and Machine Learning into Shipyard AI

PERIOD OF PERFORMANCE:
December 2021 to December 2023

PLATFORMS:
CVN, VCS, CLB, DDG

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDERS:
PMS 450, PMS 378, PMS 397, PEO Ships

TOTAL MANTECH INVESTMENT:
$2,800,000

S2959 — Machine Learning and Schedule Optimization

Objective

The objective of this Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project is to integrate automated schedule optimization and machine learning (ML) into shipyard artificial intelligence (AI) and use these data sets to support more robust construction schedules with closer centers (shorter overall time spans for blocks of vessels), enhanced communication with internal supply chain management departments and a better consideration of efficiency and safety concerns. The technology developed by this project will not be limited to a single yard but could be deployed with the underlying shipyard AI software to other locations supporting Navy vessel production.

Long lead time items on vendor-supplied components have always played a critical role in vessel production and schedule adherence. Any effort to optimize schedule and production must include links that will inform both internal and external supply chains of construction need-by dates (CND) and, alternately, allow supply chain to inform production planning of changes in availability dates. The ability for production planning and supply chain to rapidly inform each other of CNDs, availability dates and subsequent changes will significantly reduce risk to schedule compliance.

A final major objective of this project is for the project results to become a standard capability in support of CVN Class aircraft carriers, VIRGINIA Class submarines (VCS), COLUMBIA Class submarines (CLB), DDG Class destroyers, LHA, LPD and NSC programs. Successful operation of the feature should be designed for the typical shipyard planner. Bringing AI and ML into everyday use by shipyard personnel will be a major accomplishment for Huntington Ingalls Industries – Newport News Shipbuilding (NNS), Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls), NAVSEA and the Navy ManTech Program.

Payoff

This project has multiple avenues for return on investment resulting from cost reductions for activities associated with planning and scheduling, long-term storage, transportation and unit work. The combined five-year savings across all impacted Navy platforms is projected to be $18.2M for an overall return on investment of 5.0:1.

Implementation

Deployment of the solution will occur at both NNS and Ingalls shipyards after initial acceptance tests are complete and affected stakeholders are engaged to ensure the solution satisfies documented needs and expectations. Implementation is anticipated in the fourth quarter of FY2024.

DDG 51 Class Destroyer Projects

DDG 51 Class Destroyer.
(U.S. Navy image.)

Improved Automation and Technology to Optimize Plate Shaping

PERIOD OF PERFORMANCE:
September 2018 to August 2022

PLATFORMS:
DDG 51, LHA, LPD, NSC

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDERS:
PMS 400D, PMS 377, PMS 317

TOTAL MANTECH INVESTMENT:
$4,194,000

S2753 — Shaped Plate Automation and Verification

Objective

Legacy processes utilized by Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) in the fabrication of 2D and 3D hull plates have been identified for improvements. The current multifaceted process requires skilled labor and strict process monitoring to ensure proper alignment of individual hull plates during downstream hull construction stages. Irregularity and inconsistency in construction material inject variability into the hull construction process, requiring mitigation to ensure each hull is within critical design parameters. Additionally, manual execution of plate shaping, geometry verification sequences and alignment during stiffener attachment frequently result in increased rework requirements. Commercial off-the-shelf solutions capable of automating or semi-automating these complex sequences are not readily available.

Through the Shaped Plate Automation and Verification project, which was managed by the Center for Naval Metalworking (CNM), Ingalls developed an automated system and process capable of forming shell plates and verifying the geometries of as-built plates in accordance with design data. Mechanical testing and macroscopic evaluations were performed to determine the impact of the new process on material properties. Additionally, tooling and fixtures were developed to set, align and fabricate shell plates and shell plate assemblies. This allows for quick and accurate checks to monitor the as-built geometry to determine the adherence to tight process tolerances.

Payoff

Ingalls anticipates this effort will enable significant reductions in labor, rework, material handling, crane support and increased throughput. Following implementation in the third quarter of FY2023, the anticipated benefits of this CNM project are expected to result in five-year savings of $7.6M for the DDG 51 Class destroyer and an additional $13.7M across all other ship platforms constructed by Ingalls (LHA, LPD and NSC).

Implementation

The project results will be implemented at Ingalls' Pascagoula, MS, facility across the DDG, LHA, LPD and NSC platforms. Implementation is anticipated to occur in the third quarter of FY2023.

Ingalls Shipbuilding Develops Improved Fabrication Processes to Increase Quality and Efficiency

S2781 — Work Cell Development

Objective

Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) fabricates and assembles a variety of repetitive parts, such as louvers, covers, strainer plates, tanks, filters, vents, lifting lugs, custom bolts and lifting lug repairs. The legacy processes have a significant amount of manual operations performed at workstations in various shop locations. Many of these processes are not automated and require highly skilled labor to efficiently execute.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project developed manufacturing solutions in the Machine Shop, IPD Shop and other support shops focused on improving process efficiency and tooling for production of repetitive and labor-intensive products. The development of manufacturing work cells that automated and/or mechanized various processes, by incorporating lean manufacturing principles and advanced tooling and fixtures, reduced labor, improved quality and increased throughput. Development of improved fabrication processes in these areas also resulted in increased quality.

The project was executed in two phases. Phase I baselined the current processes for fabricating labor-intensive parts and compiled part family data, including size, quantity, manufacturing process, labor hours and rework. Process maps were developed to document current processes for target parts and part families. Time studies were performed and industrial engineering data was gathered to perform cost analysis and document the quality of the target processes. Work cell requirements were developed to identify engineering and operations constraints, processes, tolerances, etc. Phase II performed the design and engineering of the prototypes and produced the prototypes by fabricating and/or modifying commercial off-the-shelf equipment.

Payoff

Implementation of the automated / semi-automated processes and the tools developed under this project is estimated to result in annual savings of $972.0K and five-year savings of $4.9M across all U.S. Navy and U.S. Coast Guard platforms constructed at Ingalls.

Implementation

Ingalls deployed the solution in its target environment after initial acceptance tests were completed and engaged affected individuals, groups and organizations to ensure the solution satisfied documented needs and expectations. Implementation into a production environment began in the third quarter of FY2021 on DDG 128, LHA 8, LPD 30 and NCS 11.

PERIOD OF PERFORMANCE:
September 2018 to November 2021

PLATFORMS:
DDG 51, LHA, LPD, NSC

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
$1,284,000

BIW Creating Toolsets to Improve Manufacturing, Planning, Construction and Testing Activities

PERIOD OF PERFORMANCE:
May 2019 to January 2023

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
$1,815,000

S2802 — Advanced Diagram Development and Management

Objective

The DDG 51 Class destroyer was initiated in the late 1970s, with the first DDG 51 procured in 1985. It is one of the longest-running shipbuilding programs in Navy history, and the DDG 51 Class, in terms of number of hulls, is one of the Navy's largest classes of ships since World War II. General Dynamics Bath Iron Works (BIW) sees cost-savings potential in how it designs, plans and installs nearly 320 miles of electrical cable on each DDG 51 through the development of "intelligent" 2D electrical drawing products, where drawing components are attributed and include engineering, design and planning details within the component's description.

Currently, electrical diagram development and maintenance for DDG 51 are mostly done manually through the use of AutoCAD 2D drawings. The 2D diagrams are not linked to the 3D designs, which often create misalignments and prolong maintenance activities. This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project will introduce more advanced diagram development and management through the use of "intelligent" 2D electrical drawing products. The objective of the Advanced Diagram Development and Management project is to create toolsets that can consistently process data and present data in the formats required – in this case, functional diagrams. Using tools to accomplish this goal, BIW will be able to create diagrams in a consistent manner with data that is verified, directly managed and consistently used by other users throughout the organization and it will become routine when identifying what the data represents, its relevance to products that are delivered and its impact to diagrams and other downstream products.

Payoff

This project will reduce labor hours to create / maintain diagrams, reduce / eliminate rework attributed to errors and improve first-time quality of diagrams. BIW estimates the use of "intelligent" 2D drawings can save as much as $924.0K per DDG 51 hull. This creates five-year savings of $5.5M and a return on investment of 1.5:1.

Implementation

BIW will deploy the solution at its Bath, ME, facility during FY2023. Data migration, tool deployment and interface deployment will be done throughout the organization. Training will be conducted for users, and tools will start to generate the functional products required for delivery.

Advancing Targetless Photogrammetry for High-Accuracy Inspection

S2828 — Automated Metrology for Structural Assembly

Objective

The objective of this Electro-Optics Center (EOC) project was to develop an automated targetless photogrammetry system for use during structural assembly of DDG 51 Class destroyers that conducts in-process accuracy checks. The system was designed with the needs of the shipbuilding industry at the forefront to accommodate the specific manufacturing hurdles that exist, including inverted builds and the joining of large structural assemblies into a single unit. The solution is minimally targeted or targetless to reduce labor and human error and includes automated software scripting that conducts comparative measurements of as-built conditions against the computer-aided-design (CAD) model. The project also demonstrated a trade-friendly automated solution that rapidly generates a visual and numerical output to display deviations of the as-built condition against the model with minimal user interaction.

Payoff

This project will greatly improve the shipbuilding process by reducing costs and increasing manufacturing throughput. Additionally, this new metrology technique will provide more accurate surveys at a faster rate, leading to a reduction in rework, less risk of operator error and greater accuracy control.

General Dynamics Bath Iron Works (BIW) estimates total savings of $1.6M per hull, which generates a five-year return on investment of 2.1:1.

The project realized significant cost-savings in labor hours and provided near real-time (on-demand) measurements of products to the ship fitters. By avoiding rework in the present construction stage, errors can be identified upstream prior to products being shipped downstream.

Implementation

The system developed by this project was demonstrated at BIW during the final task of the project and tested on DDG 51 structural assemblies. Successful demonstration triggered the transition of the technology to BIW. Implementation of the developed technology into the shipbuilding process at BIW is anticipated in the second quarter of FY2023. Implementation will require a capital investment from BIW, and this investment is supported through its internal CapEX. Justification for implementation of the metrology system was illustrated through the return on investment generated by the project. Following successful demonstration at BIW, this technology will have application at other similar facilities, expanding the impact of the system beyond BIW.

PERIOD OF PERFORMANCE:
February 2020 to September 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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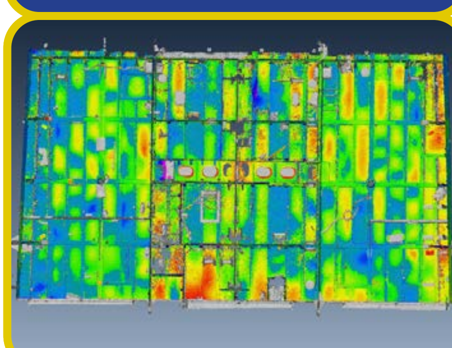
STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
$3,431,000



BIW Creates Better Methods to Detect and Eliminate Early Construction Measurement Uncertainties

PERIOD OF PERFORMANCE:
December 2019 to October 2021

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
$736,000

S2844 — Digital Accuracy Control Management Control System

Objective

General Dynamics Bath Iron Works (BIW) seeks cost-savings in how it manages accuracy control (AC). At BIW, the AC plan largely relies on paper check sheets, manual data entry, manual transcription and analysis of measured points and lacks integration with modern measurement techniques, such as laser scanners. The challenge is to optimally utilize the data being collected by both shipfitters and surveyors to detect errors immediately, prevent errors from propagating downstream into later phases of construction where they are often more costly to correct, and, when possible, prevent errors from even occurring.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project developed a centralized AC management system. It transformed manual, paper-driven AC check and documentation processes into a fully digital environment. The Digital Accuracy Control Management System (DACMS) contains AC points crucial to fabrication and assembly, as well as their corresponding value within configured design documentation. DACMS analyzes survey and measurement data regarding in / out-of-tolerance and delivers this information to AC engineers, who, in turn, dispose this analysis within DACMS and deliver it back to the originator on the shop floor / deckplates, while interfacing with enterprise planning for timeliness. The system manages and maintains AC data configuration.

Payoff

This project will reduce labor hours for AC surveyors and engineers by 50 percent, and reduce unit erection rework by six percent. DACMS has a user metrics dashboard for the AC engineering, planning and production floor. BIW estimates cost-savings of $1.5M per DDG 51 hull. This creates five-year savings of $9.0M and a return on investment of 5.6:1.

Implementation

Penn State University Applied Research Laboratory led development of the DACMS which transitions to BIW for implementation. Implementation of DACMS is the first step in a larger AC digital thread strategy at BIW. It will also serve as the framework for additional innovation in AC over the next five years, and include integration with automated metrology and improved manufacturing methods throughout BIW's panel line and assembly, with further data analytics tools to offer root cause and predictive dispositioning. BIW anticipates implementation and benefits will first be realized by DDG 136, which is scheduled to begin fabrication in the first quarter of FY2023.

Automation to Optimize Hull Access Hole Cutting and Welding

S2855 — Automated Hull Access Welding and Cutting Applications

Objective

All Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) programs require manual cutting and welding of temporary accesses (cut-out holes) along the exterior of the ship's hull to allow for blasting, painting and ventilation. These manual efforts require the access areas to be dimensionally defined on site and cut and the material removed to open a temporary manhole. This manual labor is intensive and requires a highly skilled workforce to cut, remove and weld to re-install the access cut-out plate. Even with such skilled workers, the working environment lends itself to various scenarios that promote poor cut quality and weld inconsistency. These scenarios, in turn, have direct impact on the ability of the operator to produce first-time quality welds to close-out the access, as validated by ultrasonic non-destructive evaluation. Significant rework is performed by re-welding and repeated inspections to achieve acceptable quality requirements. This redundancy has impact upon productivity, schedule and cost for ship fabrication.

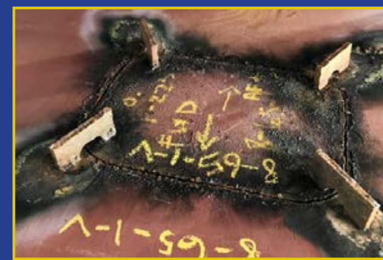
The objective of this Center for Naval Metalworking (CNM) project is to improve the productivity and increase the first-time quality acceptance for hull access cut-out processing by developing an automated or semi-automated solution. Market research was performed to help leverage solutions, including new commercial off-the-shelf technology, as well as other industrial users who work with similar processes amenable for shipyard use. Automated processes can produce consistent quality at generally higher speeds and for greater "duty cycles" than manual or semi-automatic processes. Thus, implementation will reduce rework by providing better first-time quality. This will aid in reducing the overall build time for the areas in which this project will be implemented.

Payoff

Ingalls anticipates this effort will enable significant reductions in labor, rework and material handling, as well as an increase in throughput. Implementation of the automated / semi-automated processes for welding applications developed under this CNM project is estimated to result in savings of $452.0K per DDG hull or $1.1M for the combined platforms of DDG, LHA, LPD and NSC. This results in potential five-year savings of $2.3M for DDG or $5.8M for Ingalls' combined platforms.

Implementation

The project results will be implemented at Ingalls' Pascagoula, MS, facility across the DDG, LHA, LPD and NSC platforms. Implementation is anticipated to occur in the first quarter of FY2024.



PERIOD OF PERFORMANCE:
December 2020 to December 2022

PLATFORMS:
DDG 51, LHA, LPD, NSC

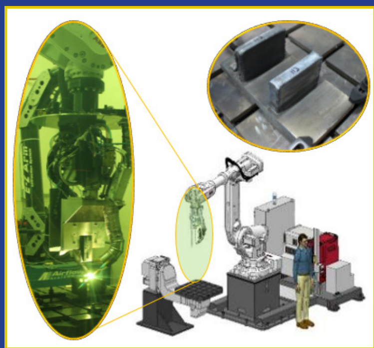
CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

POINT OF CONTACT:
Mark Snider
(843) 760-3239
mark.snider@ati.org

STAKEHOLDER:
PMS 400

TOTAL MANTECH INVESTMENT:
$1,205,000

Innovative Way to Build Traditionally Cast Parts



PERIOD OF PERFORMANCE:
July 2020 to October 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

POINT OF CONTACT:
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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
$1,319,000

Q2863 — Large Format Directed Energy Deposition Additive Manufacturing (DEDAM) for Shipyard Components

Objective

Large castings are a significant problem for shipbuilding. They often arrive out of tolerance from the designed dimensions and are filled with unacceptable levels of porosity. Additionally, the castings exhibit porosity and defects at edges, which lead to stress cracking at the shell during welding. Subsequently, lengthy secondary manufacturing steps are typically required to either build up or cut away at the component until acceptable dimensional tolerance and quality are achieved. This non-value-added rework adds additional time to the build schedule and has the potential to create significant delays to the build cycle.

This Center for Naval Metalworking (CNM) effort evaluated the large-format, directed-energy deposition additive manufacturing (DEDAM) process, generated test data to assist in creating Navy guidance documents for the use of DEDAM, and assessed the potential benefit as a replacement for large castings in alloys relevant to the U.S. Navy and U.S. shipbuilding industry. One of the primary elements that was addressed included pre- and post-heat capability. The effort demonstrated capability and defined limitations of large-format DEDAM and established performance data for alloys suitable for replacement of conventional casting materials. The results advanced DEDAM technology toward effectively addressing the long lead times, poor quality and dimensional tolerance issues U.S. shipbuilders encounter in fabricating large castings. This project would have reduced the labor hours associated with construction of the DDG 51 Class destroyer.

Payoff

At this time, the CNM project does not have a payoff, and a follow-on effort is no longer anticipated.

Implementation

Currently, this effort is not anticipated to be implemented at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) due to the lack of infrastructure at the shipyard. CNM is pursuing opportunities with the submarine community to determine the usefulness of findings from this effort. The project team determined DEDAM for high-strength steels demonstrates promising results and will be beneficial in reducing the lead times and porosity issues associated with traditionally cast parts.

Transforming the Current Process of Deep Hole Drilling

S2869 — Deep Hole Drilling

Objective

Alignment of precision Grade A shock machinery components requires very close tolerances and installation of long fasteners. Additionally, due to the size (diameter / depth) of the holes, they are drilled multiple times to adhere to the required final size. Clearance for the current portable drilling equipment and length of drill bits prevent the use of a standard set-up. The use of current assets is inefficient and the equipment is outdated. The drills currently available are not maintenance-friendly. If the tool breaks, it is sent to a clean environment for full disassembly and repair, rather than allowing a mechanic to repair the drill at the job site. Although there have been previous efforts by Huntington Ingalls Industries – Newport News Shipbuilding (NNS) to address this issue, no commercial off-the-shelf drills are robust, compact or maintenance-friendly enough to replace current drilling tools.

The Center for Naval Metalworking (CNM), NNS and General Dynamics Bath Iron Works (BIW) are developing a solution that will result in a robust, compact and maintenance-friendly deep-hole drill. The project team will develop a prototype that can be used in confined-space, deep-hole drilling to fill an unmet need in shipbuilding. This project performed a rigorous vendor downselection process to partner with Hougen Manufacturing to produce a prototype compact annular cutter with a magnetic base that is designed to have increased bit life that can handle alignment of Grade A shock machinery components. The project will continue with the design, testing and implementation plan for a new drill. It will establish a new process for deep-hole drilling, resulting in improved first-time quality, tool reliability and reduced drill time. NNS and BIW will communicate and collect feedback from end-users to ensure that the final product addresses production needs.

Payoff

By reducing the amount of labor hours and drill set-up time, NNS estimates this CNM effort may result in five-year savings of $2.5M for CVN Class aircraft carriers (new construction and overhaul), and BIW estimates this effort may result in five-year savings of $1.9M for DDG 51 Class destroyers. The combined five-year return on investment for the project is 3.4:1.

Implementation

Tool quality and performance will be evaluated through user acceptance testing. Upon successful and timely completion of the Deep-Hole Drilling project and acceptance of both the technology and associated business case by the acquisition program offices, the results will transition to NNS and BIW facilities. NNS and BIW anticipate implementation in the second quarter of FY2024. Target hull numbers for the beginning of implementation are CVN 80 and DDG 132.

PERIOD OF PERFORMANCE:
June 2020 to November 2022

PLATFORMS:
CVN, DDG 51

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDERS:
PMS 379, PMS 400

TOTAL MANTECH INVESTMENT:
$868,200

Reducing Ship Construction Costs Associated with Installation of Temporary Attachments

PERIOD OF PERFORMANCE:
February 2020 to July 2021

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

POINT OF CONTACT:
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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
$452,700

S2873 — Structural Fit-Up Applications

Objective

Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) assessed there was opportunity for the Structural Fit-Up Applications project to reduce cost associated with temporary attachments via technology insertion, process modification and/or elimination of need.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center effort focused on defining functional, operational, health and safety requirements, as well as identifying temporary attachments to downselect. Ingalls identified 43 temporary-attachment use cases and created a use case matrix spreadsheet detailing weight / holding strength estimate, length of time needed to hold, location, number of instances or prevalence per unit, tack-weld or fully welded, number of tack welds per item, materials being joined, environmental exposure, department, functional family and safety potential for each use case. The 43 use cases created a total of 476 instances, as each use case can be performed more than once in a unit. Then, project team members placed them into functional families, and use cases for each family were downselected.

Ingalls researched existing technologies and products with potential to improve each of these use cases. Based on information the project team received from bid packages, Ingalls downselected to two companies with adhesive, mechanical and magnetic solutions to pilot test.

Ingalls worked with the downselected vendors to pilot their products in a shipyard representative environment. Time studies were conducted during pilot testing to validate savings

Payoff

Once implemented, this technology could potentially produce estimated five-year savings of $2.0M for DDG 5l, $3.0M for LPD and $1.3M for LHA, with respective DDG 51 five-year return on investment of 1.7:1 and a combined five-year return on investment of 7.2:1.

Implementation

Upon acceptance of both technology and associated business case by the acquisition program office, the results will transition into use at Ingalls. Ingalls anticipates implementation in the first quarter of FY2023.

Asset Scheduling and Tracking to Improve the Shipyard Production Planning Process

S2875 — Critical Asset Management

Objective

DDG 51 construction strategies involve multiple stages of construction. As parts are assembled into increasingly complex products, the types of jigs, fixtures, equipment and services needed to move and arrange the physical products also become more complex. The current method for tracking and managing assets is largely manual and time intensive and can result in less-than-ideal planning of critical assets leading to production inefficiencies.

In this project, the Institute for Manufacturing and Sustainment Technologies (iMAST) developed a tool that interfaces with the shipyard's current capacity planning tools and provides an efficient means to digitally track and plan critical assets to support the DDG 51 structural unit assembly plan. The software has the added capability of asset maintenance planning incorporated into the overall resource schedules. This will result in savings for planning, operations and maintenance areas. Additionally, this software has an asset tracking function integrated into it.

Payoff

The Critical Asset Management (CAM) tool will allow the current manual asset tracking and management process to become more automated, reducing the overall time required. The CAM tool is expected to reduce:

- Senior planner's asset management function
- Critical asset search time
- Unplanned unit fixturing
- Handling events per asset
- Resource rebuilding costs
- Asset maintenance costs

Average savings of $660.0K per year are anticipated; total savings of $3.3M are estimated. The five-year return on investment is 2.1:1.

Implementation

The resulting CAM software was transitioned to General Dynamics Bath Iron Works (BIW) upon completion of the CAM project and acceptance of the technology and associated business case by the stakeholders (PMS 400D). BIW deployment of this capability was requested, resourced and scheduled. Documentation of the process and user training occurred during the third quarter of FY2022, followed by initial user introduction. The CAM software was engaged to fully support DDG 130 in the fourth quarter of FY2022.

PERIOD OF PERFORMANCE:
December 2019 to March 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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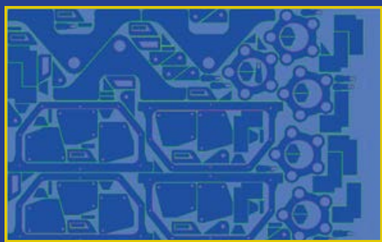
cxl300@arl.psu.edu

STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
$783,000

Streamlining Processes for Pipes, Plates and Shapes



PERIOD OF PERFORMANCE:
August 2020 to September 2022

PLATFORMS:
DDG 51, LHA, LPD, NSC

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
$1,800,000

S2886 — Dynamic Rules-Based Material Process

Objective

The current manufacturing process for nesting plates, cutting plates and cutting pipe at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) results in excessive material waste. Additionally, internal administrative constraints limit the fluid nature of production (e.g., nesting that addresses just-in-time schedule requirements across contracts, hulls, units, material types / sizes). This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project investigated how to make these processes more efficient.

This project created a rules-based process for effective consumption of whole material while reducing overall scrap. A dynamic nesting solution was evaluated with the goal of eliminating risk associated with cross-nesting (nesting across multiple bills, hulls or contracts) while decreasing material handling cost. A formal rules-based program was established that addressed the handling of excess material. These approaches add versatility to the processes and minimize manual nesting, touch cost and material waste. Additionally, the project addressed physical marking for material allocation (cost collection), tracking and locating.

This project also examined whether the opportunity exists to connect results automatically, via a digital solution with other ManTech projects to leverage existing technology like the S2160 VIRGINIA Class Submarine Material Management and S2107 Nested Material Manufacturing Technology Improvement projects.

Payoff

Once implemented, Ingalls anticipates this project will create a reduction in plate and pipe material waste, as well as a reduction in engineering labor hours associated with touch labor, material handling and nesting process. Implementation of new technologies / products developed under this project is estimated to result in annual savings of $1.3M across all platforms constructed at Ingalls, creating a combined five-year return on investment of 4.7:1.

Implementation

Ingalls will implement the solution in a production environment beginning in the fourth quarter of FY2023 on multiple ship platforms, including in the construction of LHA 9, LPD 33, DDG 137 and NSC 12.

Ensuring Data Accuracy and Reliability at Bath Iron Works

M2888 — Manufacturing Support Tools MRR

Objective

General Dynamics Bath Iron Works (BIW) manufacturing processes rely on accurate and reliable data to complete tasks below cost and on schedule. Current processes include unnecessary redundancies, multiple stages of checks and substantial manual effort to ensure the data provided to mechanics is correct and deliverables are accurate and meet requirements. These processes offer a significant opportunity to reduce manual efforts and expedite services and deliverables, while improving first-time quality.

The primary objective of this Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project is to institute functional tools and integrated data management to best support manufacturing to expedite tasks, verify status and validate results. Three primary focus areas exist to modify and enhance the processes and approaches used today:

- Create central data repositories and migrate data that are used by several tools, ensuring data accuracy and reliability across multiple applications.
- Create a tool suite that is extensible, such that it can be adapted to integrate with other types of tools and applications. This would include all interfacing tools, user interfaces and data management tools needed to enable functionality.
- Create toolsets that improve processes, add automation and improve data accessibility in order to support internal and external customer requirements.

The primary focus areas described above are related to test and activation activities. However, other manufacturing needs have been identified, such as the ability to create readiness reports, manage lock out / tag out activities and verification and management of specific design details and installation instructions that facilitate planning, scheduling, construction and testing activities.

Payoff

The Manufacturing Support Tools project will produce estimated savings of $725.0K per year. This will create a five-year saving of $3.6M and a return on investment of 3.2:1. This will be achieved by reducing labor costs and avoiding rework associated with poor access to data.

Implementation

Implementation began in the fourth quarter of FY2022. As such, it will become widely available for use as an integrated tool starting with DDG 127. However, due to the spiral strategy for deployment (including training), it is likely there will be significant tool use before this timeframe.

PERIOD OF PERFORMANCE:
September 2020 to February 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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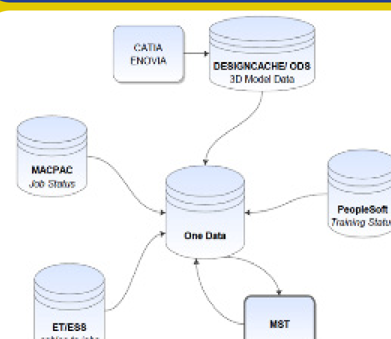
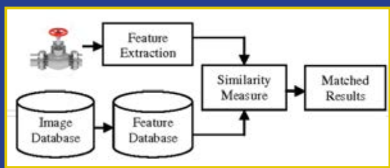
marty.ryan@ati.org

STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
$683,900



Content-Based Search Will Optimize Parts Lookup



PERIOD OF PERFORMANCE:
August 2020 to December 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

POINT OF CONTACT:
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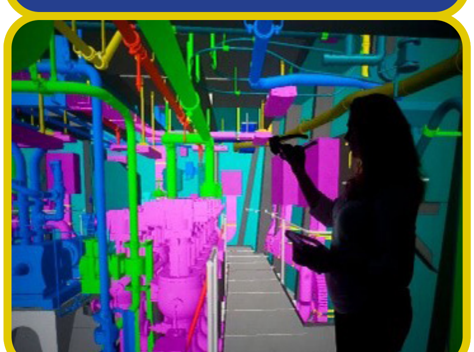
STAKEHOLDER:
PMS 400D4

TOTAL MANTECH INVESTMENT:
$1,200,000



S2889 — Visual Search Engine

Objective

A surface combatant such as the DDG 51 Class destroyer is built from hundreds of thousands of parts, each of which is selected by Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) engineering, sourced and purchased by Ingalls supply chain and installed by Ingalls operations in accordance with ship design requirements. Engineers must perform extensive research to identify and select required parts meeting ship design specifications. During this identification and selection phase, engineers unknowingly identify and select parts believed to be new to the ship's design when, in fact, the parts have already been used in other areas of the ship or on other vessels that have been built. The primary objective of this project is to reduce the time it takes to research, identify and select parts and to reduce the number of parts duplicated each year, thereby reducing the engineering, supply chain and associated labor with respect to new part creation.

The Visual Search Engine project, managed by the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center, has investigated the employment of new technologies enabling component searches across all libraries and databases used in the design process for parts that have appropriate or similar fit, form and function. The anticipated solution space is expected to utilize content-based image retrieval (CBIR), also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR). CBIR is the application of computer vision techniques to image retrieval problems. To accomplish this, Ingalls will index parts catalogs using "visual fingerprinting" (e.g., the attachment of image data to components in text-based libraries). Engineers and supply chain technicians will only need to provide a shape input to the search engine to locate parts of similar shapes, fits, forms and functions. "Content-based" means that the search analyzes the contents of the image rather than the metadata, such as keywords, tags or descriptions associated with the image, which is the "long pole in the tent" with respect to performing parts searches in Ingalls' parts libraries. The term "content" in this context might refer to colors, shapes, textures or other information that can be derived from the image itself. CBIR is desirable because searches that rely purely on metadata are dependent on annotation quality and completeness, and often are very time-consuming to complete.

Payoff

This project is expected to result in savings of approximately $2.6M annually across all platforms. Five-year savings of $7.6M are anticipated which includes $3.3M on DDG 51.

Implementation

The Visual Search Engine technology is expected to be implemented at Ingalls during the fourth quarter of FY2023.

Transforming the Methods to Construct Ingalls' Inner Bottom Assemblies

S2890 — Inner Bottom Transformation

Objective

Hundreds of structural support assemblies are used throughout a typical Navy ship. These are often large and complex structures, such as support tanks and stairwells, and many other common ship structures that require stiffening. The support assemblies are typically a lattice-grid box, sometimes called "egg crates" or "box girders," which consist of a matrix of longitudinal and transverse members that run perpendicular to one another creating a grid framework.

The objective of this Center for Naval Metalworking (CNM) project is to transform the requirements and processes for construction of U.S. Navy surface ship inner bottom assemblies at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls). Two major construction processes are being evaluated for improvement. The first improvement involves the elimination of reinforcing rings around openings inside the inner-bottom structure. The second improvement involves defining a slotted construction process for the grid framework of the assemblies. Technically, proving unreinforced openings and slotted construction meet the performance requirements will facilitate a change in construction requirements. If successful, this will lead directly to major construction process changes and enable future robotic process applications.

This effort will be accomplished in two phases: Phase I will downselect vendors and develop test plans, and Phase II will execute the testing and analyze the results.

Payoff

By eliminating the handling, fitting and welding of reinforcing ring parts and implementing a new slotted construction method, the initial estimate for cost-savings is $5.7M for DDG and $15.4M across all platforms built at Ingalls over five years.

Implementation

The results of this project will be implemented across all ship classes at Ingalls. Training for inner bottom opening-reinforcement construction processes, inner bottom slotted-construction processes and other project recommendations is included in the transition plan. The new construction parameters will be implemented on in-process construction, including DDG 131, LPD 30 and future LHA ships not yet awarded. A schedule for implementation across ship classes and specific applications will be based on the project execution timeline. Process implementation will be phased into production.

PERIOD OF PERFORMANCE:
December 2021 to May 2024

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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Mark Snider
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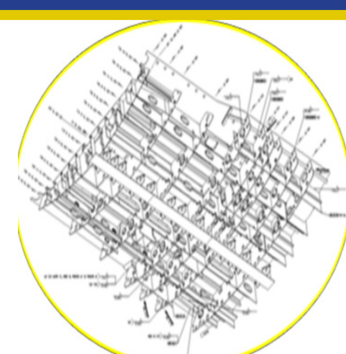
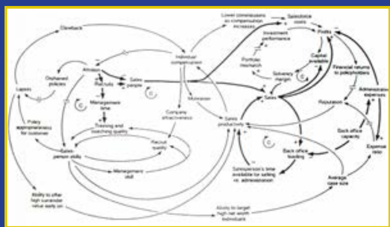
STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
$3,000,000



Dynamic Simulation Capability Brought In-House, Yard-Wide



PERIOD OF PERFORMANCE:
January 2021 to October 2023

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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Marty Ryan
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STAKEHOLDER:
PMS 400D4

TOTAL MANTECH INVESTMENT:
$2,500,000

S2891 — Shipyard-Wide Simulation Platform

Objective

Since the 1980s, yard-wide dynamic simulation modeling has proven highly effective in dealing with complex manufacturing issues, as demonstrated in system dynamics applications on numerous naval shipbuilding and other defense-industry programs. However, these models were built and owned or controlled by outside consultants with deep simulation expertise and could not be operated or employed continuously by naval shipbuilders themselves. This project will change that by adapting software proven in other industries to deliver and test a whole-yard simulator that naval shipbuilders can operate in-house, without system dynamics expertise. This analysis capability will reveal new ways of increasing manufacturing performance and help to ensure the success of improvement initiatives, as seen in increased delivery rates and reduced labor costs.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project adapted existing system dynamics technology and software for naval shipbuilding and created a Yard-Wide Simulation Platform (YWSP) to guide strategic decision-making at General Dynamics Bath Iron Works (BIW). BIW utilized 4Sight Solutions to adapt existing system dynamics model content and simulation software to reflect the shipyard's current programs, capabilities and conditions. The ability to incorporate the impacts of future programs was also be added to the simulator. Auto-calibration functions were added to the system to permit periodic updates to the model. Going forward, BIW will operate and maintain this asset in-house. The basis of the model and the software associated with managing the simulator in-house will be able to be adapted to other naval shipyards.

Payoff

This project is expected to result in combined five-year savings of approximately $29.0M and an increase in five-year cumulative manufacturing throughput and deliveries of 0.6 equivalent DDGs.

Implementation

The YWSP technology is anticipated to initiate implementation activities at the BIW Bath, ME, facility in the first quarter of FY2024 and achieve full availability by the third quarter of FY2024.

Revolutionizing Temporary Attachment Removal

S2892 — Cold-Cutting Steel

Objective

When building steel ships, it is a common practice to employ "hot work" methods for cutting steel. This is true not only to fabricate the ship components, such as plate and shape products, but also to remove temporary attachments or other welded components that may need to be relocated later in the construction cycle. Hot work methods often employ the use of handheld burning torches and arc gouging equipment, which are prone to imprecision. Imprecise cuts can result in wasting lifting pads by cutting too much material and cause rework due to damage on finished areas of the hull. Currently, there are no commercial off-the-shelf options for a safe, handheld "cold-cutting" device to remove large lifting pads.

This Center for Naval Metalworking (CNM) project developed a safe, cold-cutting device capable of removing lifting pads with a precise cut line. General Dynamics Bath Iron Works (BIW) and CNM have finished Phase I, which included baselining, developing a use case and vendor downselection to partner with an exciting new technology for the shipbuilding industry – diamond wire pull saws. CNM and BIW have partnered with Claxton Engineering to develop and adapt its current offering to make precise cuts along the ship hull. Phase II provided the shipyards with a viable alternative to removing lifting pads without damaging the hull integrity, resulting in a safer process that extends the life of lifting pads. By utilizing a "cold" work method, BIW will reduce the need for rework, caused by late-stage construction damage from the hot work cutting process damaging the paint and sensitive components on the interior of the hull, resulting in accelerated ship construction.

Payoff

By eliminating the use of hot work and manual cutting from the lifting pad removal process and replacing with a "cold" cutting approach, BIW estimates five-year savings of $3.4M and a reduction of approximately 1,500 labor hours for DDG 51 Class destroyers.

Implementation

Full implementation is planned for the first quarter of the FY2024. The implementation hull numbers will begin with DDG 132. The results will be implemented primarily in the Outfitting Halls and Land Level Transfer Facility. BIW anticipates initial implementation in the fourth quarter of FY2023.

PERIOD OF PERFORMANCE:
September 2020 to January 2023

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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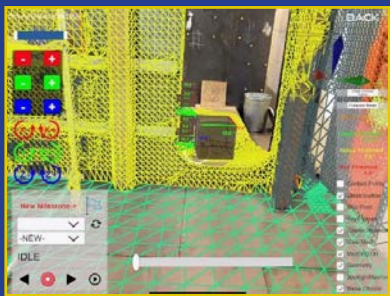
STAKEHOLDER:
PMS 400

TOTAL MANTECH INVESTMENT:
$748,000

Detecting Interferences with Virtual Reality



PERIOD OF PERFORMANCE:
January 2021 to March 2023

PLATFORMS:
DDG, CLB, VCS Submarines

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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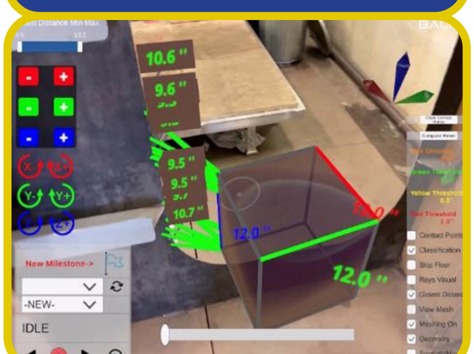
STAKEHOLDERS:
PMS 400D4, PMS 397, PMS 450D

TOTAL MANTECH INVESTMENT:
$1,100,000



S2899 — Virtual Load Out Interference Detection

Objective

During the shipbuilding process, there are numerous planned and unplanned "load outs" entailing the installation or removal of Customer Furnished Equipment (CFE), Government Furnished Equipment (GFE) and fabricated subsystems during some of the later stages of construction. In many cases, load outs involve the rip-out of surrounding structure, grating and other potential interfering objects in the way of load out activities. Planned load outs take place at a specific stage of construction. They follow a pre-determined path and approach for rigging and landing the component, so that potential interferences between the component and any objects within that path are already known. Ideally, the designed travel path for each component correctly identifies possible interferences ahead of time, and only those objects are removed. However, the differences in as-built configurations of the ship often cause additional interferences within the load out or removal path that were unaccounted for in the design. Unplanned load outs and removals entail movement of major equipment unforeseen in the build plan or out-of-sequence according to the plan. These can include removal of defective equipment or delayed deliveries. If equipment has no requirement for removal and maintenance, then no removal route is built into the design. Both planned and unplanned load outs require a travel path to be determined and all interferences identified.

The Virtual Load Out Interference Detection project, managed by the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center, will develop an augmented-reality (AR) application that will be used to identify interferences in the load out path in real time, on the deck plates prior to the load out process. The application will utilize a virtual object based on CAD models or a 3D scan that corresponds to the shape of the equipment. At General Dynamics Bath Iron Works (BIW), the mechanic using the application will move the virtual object through the load out path to identify and verify interferences to minimize unnecessary rip out. General Dynamics Electric Boat (GDEB) would use this tool to allow the riggers to be able to walk a component out of the ship directly. There would be no need to run the time-consuming simulations because the trades will be able to load the component into the AR session and see the interferences directly related to the as-built conditions of the ship.

Payoff

This project is expected to result in savings of approximately $155.0K per VIRGINIA Class submarine, approximately $186.0K per COLUMBIA Class submarine and approximately $268.0K per DDG 51 Class destroyer for combined five-year savings of $3.6M.

Implementation

The Virtual Load Out Interference Detection technology is expected to be implemented at both BIW and GDEB facilities during the second quarter of FY2024.

Robotic Foundation for Welding Structural Joints

S2904 — Multi-Function Shipbuilding Robot

Objective

The current weld process to manufacture vertical and horizontal erection joints requires scaffolding and suspending craftsmen to initially prepare weld joints, perform the weld and inspect the welded joint seam. This process is time-consuming and requires multiple departments and resources to support production and erection.

Current mechanized welding processes utilize a track welding system. The tracks have standard lengths and require multiple sets of magnets to secure the tracks in place. Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) also requires the use of temporary tabs to be welded from the track to the unit as an additional safety measure. Installing this track for a single welding seam becomes cumbersome, and all of the tasks require the use of either scaffolding or boom lifts, increasing manufacturing costs.

This Center for Naval Metalworking (CNM) project will take advantage of the recent emergence of several technologies and develop a foundation for the implementation of automated robotic procedures for the surface preparation, welding, interpass cleaning and inspection, and final inspection required for vertical and horizontal erection joints. The overall multi-function shipbuilding robot will be developed using a phase-based approach. Phase I establishes the requirements for each of the desired processes and researches the available technologies on which the system foundation can be based. Phase II focuses on implementing the automated robotic welding processes and utilizing the foundation of a trackless portable robot. A follow-on project will be developed to expand the functionality of the base robotic system. Phase III will focus on developing the capability for surface preparation by the robot to automatically perform welding preparation and interpass cleaning. Phase IV will add the capability of in-process and final inspection to the overall multi-function robot capability. Ultimately, the final system will provide an implementable, automated multiple-function robot solution that minimizes scaffolding needs and decreases the required craft labor to support the welding of erection joints.

Payoff

Ingalls anticipates this effort will reduce the labor hours and resources required to erect scaffolding and track welding set up and decrease the labor hours needed to weld erection joints by 50 percent. Implementation of the multi-function shipbuilding robot is estimated to result in savings of $668.0K per DDG hull or approximately $3.0M for the combined platforms of DDG, LHA, LPD and NSC. This results in potential five-year savings of $3.3M for DDG or $5.8M for Ingalls' combined platforms.

Implementation

The project results will be implemented at Ingalls' Pascagoula, MS, facility across the DDG, LHA, LPD and NSC platforms. Implementation is anticipated to occur in the second quarter of FY2024.

PERIOD OF PERFORMANCE:
April 2021 to April 2023

PLATFORMS:
DDG, LHA, LPD, NSC

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
$1,004,000

Accelerating the Impact of Sustainment Technologies in Private Shipyards

PERIOD OF PERFORMANCE:
June 2021 to February 2022

PLATFORM:
DDG 51

CENTERS OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
$291,000

S2918-A-B — Sustainment Technology Insertion Assessment

Objective

Technology development and insertion is a key enabler to improve the efficiency and effectiveness of many existing shipyard production processes. The goal of this project was to evaluate key repair technologies previously proven to improve repair processes at public Navy repair shipyards and to identify the feasibility and requirements for transition of the technologies into production within a private naval repair environment.

The Sustainment Technology Insertion Assessment project, executed by the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center and Institute for Manufacturing and Sustainment Technologies (iMAST), investigated the integration of 3D laser-scanning and cold spray technologies and processes for use in Navy platform repair at the Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) shipyard in Pascagoula, MS.

This feasibility assessment was accomplished in seven months. The project team began by reviewing previous efforts led by Penn State Applied Research Lab in the areas of 3D laser scanning and cold spray. Ingalls hosted a shipyard tour with the integrated project team (IPT) to brainstorm potential use cases.

A potential 3D laser-scanning vendor, FARO, traveled to Ingalls and completed a demonstration of its latest hardware and software capabilities and provided cost estimates. A process improvement discussion was also held pertaining to best practices and scanner settings to obtain faster scanning times.

The IPT traveled to Puget Sound Naval Shipyard and met with the Planning Yard Innovation (PYI) team to discuss 3D laser scanning. Benchmarking was performed on hardware and software. Common issues were identified pertaining to data transmission, data storage and scanning electrical cable tags. The PYI also shared its current process of "snipping" scan pictures and inserting them into ship alteration drawings.

The IPT also traveled to Norfolk Naval Shipyard to evaluate the MARS cold-spray unit. MARS is a multifunctional automated repair system that is portable and can blast an area prior to cold spray application. The team compiled all the data and information collected to produce a comprehensive feasibility report for each technology. For 3D laser scanning, a positive business case was identified for investing in the latest technology to reduce ship check labor costs. For cold spray, potential use cases were identified in the areas of structural plate corrosion repair, plate cracking, machined surfaces and metallic component failure.

Payoff

This project identified a potential 25 percent labor reduction in ship check costs. Additional benefits from the project include documented technical, economic and operational assessments to include lessons learned and best practices for future insertions.

Implementation

The primary purpose of this project was to explore the feasibility of transitioning technologies developed in a public shipyard environment into a private shipyard environment.

FFG 62 Class Frigate Projects

Rendering of the FFG 62 Frigate.
(NAVSUP Weapon Systems Support image.)

Improving Ship Module Weight and Center-of-Gravity Accuracy Using Automated Parts and Completion-State Tracking

PERIOD OF PERFORMANCE:
August 2021 to July 2023

PLATFORM:
FFG 62

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDER:
PMS 515

TOTAL INVESTMENT:
$999,000

S2957 — Automated Product and Asset Tracking for FFG 62

Objective

The current process for calculating weight and center-of-gravity (CG) for modules throughout the stages of construction (SOC) is simply adding a 30 percent outfitting factor to the steel weight. This current process results in inefficiencies and potential safety issues. Additionally, there are inefficiencies associated with the current process for managing the location and usage information for the critical lifting assets.

The purpose of this Institute for Manufacturing and Sustainment Technologies (iMAST) project is to develop and implement an automated tracking and information-management capability for individual outfitting components and critical mobile-lifting assets that will integrate with existing processes and information-management software. The first exit criteria for this project is to accurately determine the weight and CG for each major outfitting component and provide that information to the master design database. The second exit criteria is to develop a technology solution for automated asset tracking that can be implemented for each major outfitting component within the modules during each SOC and for each building.

Payoff

Due to the uncertainty of the weight and CG, a significant amount of extra time is required to prepare and conduct lift procedures, which adds safety risk. The ability to reduce the unexpected downtime due to re-planning crane lifts will reduce the costs associated with production delays. Specifically, this project will develop technology that provides automated calculation of weight estimates, offers earlier outfitting due to more precise weight and CG information, provides automated updates to ProModel, improves crane reliability and avoids rental crane costs and lift re-planning. The anticipated savings are in excess of twice the ManTech investment after five years.

Implementation

The implementation path for this project focuses on the development of a prototype technology solution for one module section, one grand module section, the major outfitting components and one building for a critical SOC. Approval for the implementation, upon successful demonstration by iMAST, rests with Fincantieri Marinette Marine with expected implementation at the Marinette facility in the first quarter of FY2023.

VCS / CLB Submarines Projects

VIRGINIA Class (VCS) Submarine.
(U.S. Navy image.)

Ready-to-Install, Plug and Play Composites Accelerate Navy Manufacturing

PERIOD OF PERFORMANCE:
March 2017 to August 2022

PLATFORM:
VCS Submarines

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

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STAKEHOLDER:
PMS 450

TOTAL MANTECH INVESTMENT:
$3,750,000

S2677 — Plug and Play Composites

Objective

External submarine hull components often require significant labor hours to apply supplemental materials to meet performance and functional requirements of the platform. In many cases, several different materials are employed, which require additional labor, costs and manufacturing time. This Composites Manufacturing Technology Center (CMTC) project developed manufacturing processes for and successfully demonstrated fabrication of a multi-functional plug and play composite part (a single part with all functional attributes of the original multi-material system). This part can arrive from the vendor ready for shipboard installation rather than the shipyard perform those additional operations. This technology balanced the performance of multiple materials, structural and non-structural, to enable the final manufactured part to meet the requirements without the need for supplemental materials.

Payoff

Successfully designed and manufactured plug and play composite components offer numerous benefits. The principal benefit involves the reduction of labor by eliminating the need to install supplemental materials for structural components post-fabrication. Receiving a ready-to-install component from the vendor also provides the following benefits:

- Reduced labor costs and scheduled installation time.
- Reduced repair and replacement of the supplemental materials due to damage and loss during routine installation.
- Increased opportunities to replace metal components with composite structures to enhance the material system, thus reducing life-cycle costs through the avoidance of corrosion.
- Reduced exposure to environmental contamination during shipping and storage of multiple materials prior to installation.

Combined acquisition and life-cycle savings are estimated to be approximately $5.0M for VIRGINIA Class submarines (VCS). Integrating different materials into the lamination process fully opens the design space to the submarine community. The plug and play project successfully demonstrates the manufacturing capability to assemble different materials, and while the assembly has some traditional appearance in material placement, it can be tailored to provide targeted responses to meet requirements of specific applications.

Implementation

Additional applications are being investigated for implementation of multi-functional plug and play composites on the VCS submarine. Potential applications include non-pressure hull access covers / hatches, control surfaces and external fairings.

Converting a Paper-Based Weld Process to an Improved Digital Process

S2703 — Electronic Weld Record System

Objective

Welding processes at Huntington Ingalls Industries – Newport News Shipbuilding (NNS) require over 25 different forms, including non-destructive testing (NDT). Each of these forms is manually completed and signed by hand. Information recorded on the forms must be captured and retained to meet internal procedures and/or government requirements. This process leads to hand-written errors; difficulty interpreting hand-written data; missing data fields; misplaced records; and difficult, time-consuming tracking, reviewing and certification of records for accuracy / completeness, which impact NAVSEA audits and system testing.

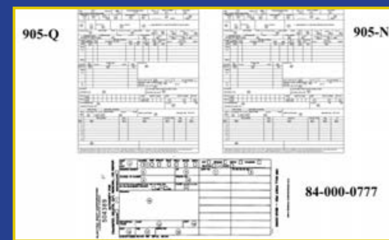
The purpose of this Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project for the VIRGINIA Class submarine (VCS) was to develop an electronic weld record system to eliminate paper records and replace them with an electronic system. The electronic system is web-based and accessible by all users (e.g., welders, auditors, managers, Supervisor of Shipbuilding [SUPSHIP], fitters and inspectors) through the NNS network using a desktop, mobile device (e.g., tablet)or kiosk. The first phase mapped out the current and future state processes, defined the technical requirements and developed an electronic prototype. The electronic prototype example helped determine the welding, NDT, inspection and IT software / hardware requirements. The applicable process and program owners, users, SUPSHIP and NAVSEA reviewed the requirements to ensure all issues and technical input were being considered and met. Phase II focused on system development, which included coding, testing, evaluating, verifying and validating that the software works as determined to meet the end customer / business requirements and stakeholder demonstration of the developed system.

Payoff

An efficient electronic weld record process will result in a reduction of cost and time. Once implemented, this technology will save approximately $3.0M per year (based on 10 VCS in-process hulls per year) and approximately $15.1M over five years.

Implementation

NNS plans to start implementation of Electronic Weld Record (EWR) application during the second quarter of FY2023 with a digital solution that can eliminate and replace three VCS and CLB pipe welding and NDT forms. The EWR prototype can be used on the COLUMBIA Class platform with little-to-no modifications and expanded to the CVN 78 aircraft carrier through a separate, internal effort by NNS.



PERIOD OF PERFORMANCE:
November 2016 to December 2021

PLATFORM:
VCS Submarines

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDER:
PMS 450

TOTAL MANTECH INVESTMENT:
$1,100,000

Predictive Facilities Maintenance and Capacity / Production Planning Systems to Reduce Costs and Meet Manufacturing Schedules

PERIOD OF PERFORMANCE:
May 2017 to October 2021

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDERS:
PMS 450, PMS 397

TOTAL MANTECH INVESTMENT:
$1,050,000

S2750 — Diagnostic and Predictive Monitoring for Facilities Equipment

Objective

Unscheduled equipment maintenance has a profound effect on the manufacturing costs and shipbuilding schedules for both VIRGINIA and COLUMBIA Class submarines. There are inherent delays and additional costs associated with the reactive maintenance approach that is widely used in industry. The objective of this project was to implement a predictive-maintenance (PdM) capability for General Dynamics Electric Boat (GDEB) facilities to improve process efficiencies and decrease infrastructure maintenance costs. In addition, while many capacity and planning tools can organize the production schedule around maintenance events, most cannot quickly re-plan for unexpected equipment failure. This project also explored the integration of failure-prediction information into GDEB's production planning and scheduling systems to reduce the impact of downtime due to unplanned equipment failure.

This project began with a reliability-centered, maintenance-based degrader analysis to determine the critical pieces of equipment (26 and 48 critical pieces at Groton and Quonset Point, respectively), based on their dominant failure modes and ease of implementation. Focusing on this equipment, the total number of measurement locations for selected sensor types, including vibration, temperature and lubrication oil monitors, was determined. This led to the return on investment assessment of commercially available sensor technologies for each equipment application to determine the optimum solution for GDEB.

Payoff

This Institute for Manufacturing and Sustainment Technologies (iMAST) project identified, evaluated and implemented equipment health monitoring systems to more accurately predict failure of critical equipment identified by GDEB. The predictive capability supported improved critical equipment uptime that has a positive effect on planning and scheduling. GDEB estimates annual savings of $1.3M per year and five-year estimated savings of $6.7M, which equate to a 2.3:1 return on investment.

The results of this project provided labor and material cost avoidances associated with reducing the number of reactive and preventative maintenance tasks, which reduced the time for diagnosing equipment failure, decreased maintenance actions and lost production due to unscheduled maintenance. This project also identified the added benefit of having remote interrogation of critical manufacturing assets that could not be monitored manually due to physical access challenges or safety constraints. As a result, another iMAST project was initiated — S2963 Predictive Maintenance II – Industrial Internet of Things — to investigate these assets.

Implementation

The project began implementation in August 2021 to enable a predictive-maintenance capability for both the Groton and Quonset Point facilities. Included in the technology implementation was the development of new maintenance practices and procedures, software tools and hands-on training for GDEB.

Robotics and Automation Will Improve Installation of Submarine Hull Inserts

S2751 — Automated Welding of Hull Inserts for VIRGINIA and COLUMBIA Class Submarines

Objective

The legacy process to install hull inserts in submarine pressure hulls is an intricate sequence of events consisting of multiple manual operations, including cutting, beveling, grinding and welding processes. The process requires extensive labor in excess of 45,000 hours per hull, and installing hull inserts significantly increases the manufacturing span time for the initial outfitting phase. Weld quality is dependent on tribal knowledge and individual skill level, thus additional rework is often required. Because this process is entirely manual, a robotic installation solution would improve weld quality and has the potential to reduce the labor required for submarine build schedules. These welds are much more complex than linear welds in a fixed-welding position. Welding parameters must change multiple times as the weld torch moves along the curvature of the hull through various welding positions. Cutting and beveling holes in the hull require constant varying of the bevel angle on the hull and the insert to keep the weld joint's angle consistent, as the hull curvature changes around the circumference of the weld. Because of the complexities of each individual process, there are no readily available commercial off-the-shelf technologies capable of performing all of the integral steps associated with this complex process.

The objective of this Center for Naval Metalworking (CNM) project is to develop robotic cutting and welding prototypes to demonstrate the hull-insert and hull-penetration process on VIRGINIA and COLUMBIA Class submarines (VCS and CLB, respectively). The project team will develop a hull-insert and hull-penetration process by leveraging previous robotic and automated technologies currently implemented at General Dynamics Electric Boat (GDEB). The solution, achieved robotically, will be capable of cutting and beveling the pressure hull for placement of the insert and penetration and will weld the insert or penetration into the pressure hull. This project investigates the use of large industrial welding and cutting robotic systems in conjunction with collaborative robots for smaller inserts and penetrations.

Payoff

Through automation and weld quality improvements, an estimated 20 percent reduction in cutting, fitting and welding labor is forecast as a result of this CNM project. Through increased efficiencies enabled by the technology, GDEB anticipates savings of approximately $1.9M per VCS and CLB hull for combined five-year savings of $24.4M across all programs.

Implementation

Based on the results of testing, GDEB will generate the data needed for process qualification packages to submit to NAVSEA, finalize the business case analyses and create shipyard implementation plans. The transition event for this project is GDEB's performance demonstration activities. Once those activities have been successfully completed, the process will have been verified to meet the expectations of the project teams and stakeholders and will be ready for implementation efforts at GDEB. Implementation is anticipated in the second quarter of FY2025.

Implementation is expected to utilize a phased approach, in which the most beneficial opportunities will be assigned a higher priority and implemented first in the production of VCS, VIRGINIA Payload Module (VPM) and CLB. The schedule for implementation activities is dependent on the project results.

PERIOD OF PERFORMANCE:
May 2018 to September 2023

PLATFORMS:
VCS, VPM, CLB Submarines

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDERS:
PMS 450, PMS 397

TOTAL MANTECH INVESTMENT:
$2,372,000

Producing Savings Through Portable Welding Technology

PERIOD OF PERFORMANCE:
March 2019 to January 2023

PLATFORMS:
VCS, VPM, CLB Submarines

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDERS:
PMS 450, PMS 397

TOTAL MANTECH INVESTMENT:
$2,385,000

S2754 — Portable Welding Robot for VIRGINIA and COLUMBIA Class Submarines

Objective

Fabrication of major assemblies is a highly labor-intensive, manual process that is both physically demanding and highly complicated. Major assemblies are manufactured in permanent fixtures and are unable to be moved. As a result, welders are required to move over and around assemblies to complete difficult welds.

The Portable Welding Robot project will develop and implement a portable welding robot to aid in the construction of major assemblies of VIRGINIA and COLUMBIA Class submarines (VCS and CLB, respectively). Portable robotic technologies exist for commercial applications, however, the technology has not been tested and proven for submarine construction. This Center for Naval Metalworking (CNM) project will improve major assembly welding for VCS and CLB by creating a portable robotic solution that increases weld quality and reduces the welding labor requirements.

Insertion of a portable robotic welding process is expected to increase productivity, decrease manufacturing costs and potentially decrease major assembly manufacturing span time. A portable robotic welding system that can be quickly deployed and programmed to weld major assemblies will greatly expand the use of robotic welding in shipbuilding.

Payoff

This CNM project is expected to provide an estimated savings of $568.0K per VCS hull, $756.0K per VCS hull with VIRGINIA Payload Module (VPM) and $1.2M per CLB hull for five-year savings of $10.4M.

Implementation

The solution technology is expected to be implemented at General Dynamic – Electric Boat's Quonset Point, RI, facility during the second quarter of FY2024.

Improved Metrology Process through the Integration of Automated Scripting

S2805 — JMAF Metrology Automation

Objective

Huntington Ingalls Industries – Newport News Shipbuilding (NNS) is assembling submarine pressure hull sections in a new manufacturing facility containing large caisson-style fixtures. These fixtures present challenges for traditional contact metrology, but offer opportunities for non-contact metrology. When constructing submarine pressure hulls, assuring that the hull stays within tolerance is a very difficult task due to the large sizes and movement of the metal while hot work is performed. Completing metrology work throughout the build process is crucial to accurately forming and shaping the hull. Within metrology, there are several distinct processes: planning, surveying, analysis and reporting. This project aims to automate the metrology workflow required to survey, analyze and report on portions of this process. Automating the metrology workflow will speed up repetitive tasks and automate the complex data processing, analysis and reporting operations.

The objectives of this Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project were to reduce cycle time for dimensional inspection, provide real-time data to the entire value stream and make dimensional survey results more accessible. Successfully accomplishing these objectives allow for multi-skilled trades personnel to gather metrology data with limited metrology technician support and allow for more in-process accuracy control checks. The project has completed all technical activities, including surveying, analysis and reporting of major evolutions in the Joint Manufacturing Assembly Facility (JMAF). These technologies have enabled the waterfront trades to perform metrology work with limited technician support.

Payoff

By reducing the labor hours associated with planning, surveying and reporting, the NNS project team has seen a reduction in non-value-added work. Through increased efficiencies and quality improvements enabled by the technology, NNS calculated five-year savings of $3.1M and a five-year project return on investment of 1.0:1.

Implementation

Based on the results of testing, NNS has generated the data needed for internal process verification and validation, submitted a finalized business case analysis and created shipyard implementation plans. The transition event for this project was completed when NNS performed a demonstration of the system. At this time, the process has been verified and meets the expectations of the project teams and stakeholders and implementation activities have started at NNS. Full implementation is anticipated to be complete by the second quarter of FY2023.

Implementation is expected to utilize a phased approach, where the most beneficial opportunities will be assigned a higher priority and implemented first. The results of this ManTech project may be implemented in the production of VCS and CLB. However, the schedule for implementation activities is dependent on the project results.

PERIOD OF PERFORMANCE:
August 2019 to February 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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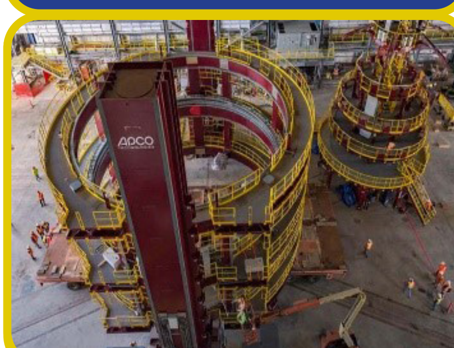
STAKEHOLDERS:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
$944,000



Increasing Efficiency of Steel Processing through Robotic Advancements

PERIOD OF PERFORMANCE:
July 2020 to September 2023

PLATFORMS:
VCS, VPM, CLB Submarines

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDERS:
PMS 450, PMS 397

TOTAL MANTECH INVESTMENT:
$1,198,000

S2812 — Robotic Beveling and Tapering Cell

Objective

General Dynamics Electric Boat (GDEB) currently uses labor-intensive operations and processes to bevel and taper structural steel. This includes hull plating and fabricating hull frames. Plate beveling and tapering is a manual process dependent on annotated paper sketches, manual burning equipment and tribal knowledge of various steel behaviors. Currently, beveled and tapered plate parts are manually laid out and then beveled and tapered by using manually operated torches or grinding equipment.

GDEB has researched various methods of cutting to improve the current manual methods with a focus on combining cutting and beveling into one process. Submerged plasma cutting allows for key thin structural components to be cut and beveled in one process while maintaining flatness, showing no signs of heat distortion and reducing processing time. There are various methods of height sensing that can be used for submerged plasma cutting, including a voltage-based and a mechanical method. Currently, the team is investigating the optimal method of height sensing to provide the best bevel profile.

The objective of this Center for Naval Metalworking (CNM) project is to utilize state-of-the-art bevel and tapering equipment to increase throughput in steel processing for the VIRGINIA Class submarine (VCS), the VIRGINIA Payload Module (VPM) and the COLUMBIA Class submarine (CLB). Project results could enable automation of steel plate beveling and tapering processes, improving accuracy and reducing labor / time costs. This system has the potential to significantly reduce the amount of time spent manually burning and grinding the taper (i.e., scarf), reduce the amount of quality control required and reduce rework that is typical of this difficult beveling procedure. Moreover, the new technology could produce more accurate part-to-part fit-ups, which will reduce downstream fitting, grinding and welding costs.

Payoff

This CNM project is expected to provide estimated savings of $760.0K per VCS hull, $1.0M per VPM and $974.0M per CLB hull for combined five-year savings of $12.5M across all platforms. The five-year return on investment for this project is 2.9:1.

Implementation

Upon successful and timely completion of the Robotic Beveling and Tapering Cell ManTech project and acceptance of the technology and associated business case by the acquisition Program Offices, the results will transition to the GDEB facility. GDEB anticipates implementation in the first quarter of FY2024.

Automating Surface Treatments on Tank Interiors

S2817 — Automated Interior Scanning, Blasting and Painting

Objective

General Dynamics Electric Boat (GDEB) and General Dynamics Bath Iron Works (BIW) are faced with several issues when it comes to blasting and painting the interiors of tanks. Access to these areas is highly limited and requires substantial personal protective equipment to ensure safety in confined spaces. Additionally, there is a substantial amount of labor required during the process due to the complex shapes of the tanks and lack of visibility in the confined blasting environment.

The goal of this Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project is to develop and demonstrate a robotic system to scan, blast and paint a complex surface similar to that of the interior of the tank. The system will aid in reducing cycle time for the process and labor hours required to complete the entire evolution. In addition, the proposed system will create more uniform quality while maintaining safety.

This project includes two demonstrations. One small-scale demonstration will be done at a robotic integrator's facility based on specifications provided by the integrated project team (IPT). A large-scale demonstration will be conducted on a mockup fabricated by the vendor at the Quonset Point facility, with input from BIW.

Payoff

Once implemented, GDEB and BIW anticipate that this project will reduce the hours needed to perform blasting and painting interior tank surfaces by 50 percent. Implementation of new technologies / products developed under this project at BIW is estimated to result in five-year savings of $2.4M for DDG 51. Implementation at GDEB is estimated to save $5.7M for the combined VIRGINA Class submarine (VCS), VIRGINA Payload Module (VPM) and COLUMBIA Class submarine (CLB) platforms.

Implementation

GDEB and BIW will implement the solution in a production environment beginning in the fourth quarter of FY2024 on multiple ship platforms, including construction of DDG 51, VCS, VPM and CLB.

PERIOD OF PERFORMANCE:
March 2020 to August 2023

PLATFORMS:
VCS / CLB Submarines, VPM, DDG 51

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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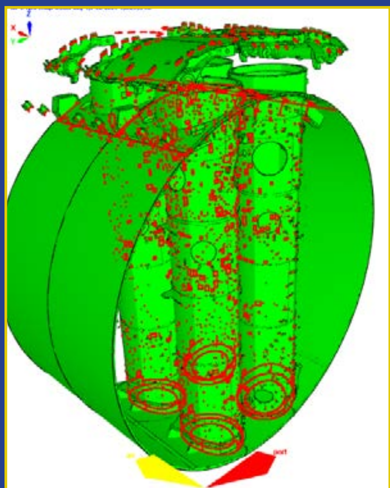
STAKEHOLDERS:
PMS 397, PMS 400D, PMS 450

TOTAL MANTECH INVESTMENT:
$1,570,000

Electric Boat Enables More Comprehensive View of the World of Work in Shipbuilding



PERIOD OF PERFORMANCE:
November 2019 to September 2021

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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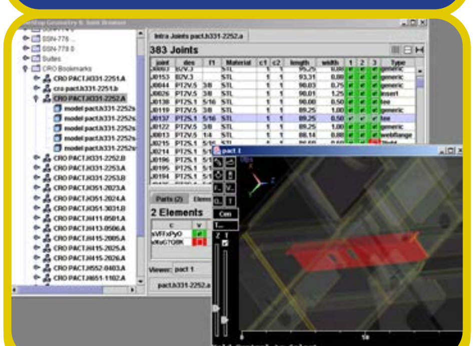
STAKEHOLDERS:
PMS 450D, PMS 397

TOTAL MANTECH INVESTMENT:
$645,000



S2824 — Envision for the Model-Based Enterprise

Objective

The Envision for the Model-Based Enterprise project, which was managed by the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center, developed a user-friendly software tool capable of providing accurate information to the General Dynamics Electric Boat (GDEB) Planning, Operations and Process Improvement departments. This software utilizes attributes from NX data to provide a central location to easily query and extract key data from computer-aided-design drawings. The development plan followed an incremental and iterative approach in which tools were built first to address simple shapes and welds and then progressed to address more complex geometries, such as curved shapes and cut-outs. The Envision software tool enabled an efficient use of resources by providing key components of a drawing to employees at vital times within the planning and manufacturing process. This tool also provided sufficient attribute information to determine primary and secondary forming work centers of steel processing. This allowed GDEB's planning staff to identify the work center required for the forming operation and provided information at the work-order level necessary to forecast workload over time by steel processing assets.

Currently GDEB operations create high-level build plans. Afterward, Quonset Point (QP) Industrial Engineering examines each level of assembly for individual drawings or design models and re-engineers the manufacturing plans. The benefits of this step include defining product lanes that optimize the use of the facility, identifying welds that can be mechanized and rendering build instruction graphics for the trades. Most of the work during this stage entails manual research and labor-intensive development of assembly plan graphics. As a result, a significant amount of time is spent planning 140,000+ structural welds per hull. In addition, these manual efforts can cause quality issues resulting from human error.

Payoff

This project is expected to result in a reduced cost to develop weld joint estimates, reduce secondary operations hours and create a planning tool to pull work forward. These benefits combine for total savings of $3.9M for the VIRGINIA Class and COLUMBIA Class submarines, with a return on investment of 4.3:1.

Implementation

The technology from the Envision for the Model-Based Enterprise project was implemented at the GDEB facility upon receipt of approval from the GDEB Director of Construction Readiness. Implementation initiated in the second quarter of FY2022, with full implementation occurring in the first quarter of FY2023.

Electric Boat Uses GTAW to Increase Productivity

S2831 — Semi-Automatic GTAW Welding Process

Objective

The VIRGINIA Class submarine (VCS) manufacturing process currently includes labor-intensive manual gas tungsten arc welding (GTAW) operations and processes for cladding, welding pipe, welding tanks with difficult-to-weld alloys and some structural welds. Manual GTAW is very slow, particularly for large-diameter circumferential welds. Additionally, it requires a high level of skill, due to the dexterity required in using both hands independently (i.e., one hand to move the welding arc along the joint and the other to feed the filler metal).

This Center for Naval Metalworking (CNM) project uses semi-automatic GTAW equipment to increase throughput for pipe welding, cladding and other applications to meet the demands of the VIRGINIA Payload Module (VPM) and COLUMBIA Class submarine (CLB). This project assessed and selected a semi-automatic GTAW welding system by EWM TIG Speed. This system is being used to evaluate various shipyard applications, including tank welds, cladding inside of tanks and pipe welding, as well as other applications.

The capabilities of welding equipment have advanced enough to enable replacing manual GTAW with semi-automatic GTAW, thus eliminating production delays by producing welds of consistently higher quality. The semi-automatic GTAW process is more productive than conventional (manual) GTAW and produces higher quality welds with the potential for fewer defects, such as lack of fusion. As a result, the new process will improve precision, reduce labor costs and improve schedule performance.

Phase I included defining requirements and developing welding parameters. Phase II includes creating and executing a test plan to determine the acceptability of the semi-automatic GTAW process in the shipyard environment.

Payoff

Semi-automatic GTAW will enable better quality welds at higher deposition rates compared to manual GTAW. It has the potential to be two-to-five times faster than manual GTAW and requires less skilled welders. General Dynamics Electric Boat (GDEB) projects that this effort will result in estimated five-year savings of $684.0K for VCS, $8.0M for VPM and $2.4M for CLB. This equates to total five-year cost-savings of $11.1M and a return on investment of 2.9:1.

Implementation

Upon successful and timely completion of the Semi-Automatic GTAW Welding Process ManTech project and acceptance of the technology and associated business case by the acquisition Program Offices, the results will transition to the GDEB facility. GDEB anticipates implementation in the fourth quarter of FY2023.

PERIOD OF PERFORMANCE:
June 2020 to February 2023

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

POINT OF CONTACT:
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STAKEHOLDERS:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
$2,100,000

Improving the Valve Cladding Process for COLUMBIA and VIRGINIA Payload Module

PERIOD OF PERFORMANCE:
February 2020 to July 2023

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDERS:
PMS 450, PMS 397

TOTAL MANTECH INVESTMENT:
$2,470,000

S2832 — Robotic Valve Cladding Cell

Objective

The Robotic Valve Cladding Cell project is investigating opportunities with General Dynamics Electric Boat (GDEB) to develop a prototype to demonstrate proof-of-concept robotic capabilities to improve production quality and throughput for candidate valve-cladding processes. The innovative robotic system could greatly improve the efficiency and flow of the production of valves. Having a system capable of greater efficiency and greater versatility will support the coming demand of critical schedules. Legacy cladding processes have long setup times, are labor-intensive and require a large footprint of shop space. To meet ship requirements for sufficient clad thickness, a component must be precisely located for welding. Multiple fixtures, optical tool checks and manual adjustments are needed for each component configuration. With the start of VIRGINIA Payload Module (VPM) and COLUMBIA Class submarine (CLB) construction, GDEB must produce almost double the amount of cladded valves to meet ship production needs.

This two-phased Naval Shipbuilding and Advanced Manufacturing (NSAM) Center effort will develop a prototype to demonstrate proof-of-concept robotic cladding capabilities that improve production quality and increase throughput. GDEB has defined the desired system functionality and developed the system requirements and functional specifications. The project team is working with equipment integrators to modify existing robotic cladding systems to specific GDEB applications and demonstrate the desired functionality of a prototype system at the selected robot integrator facility. The team will compare legacy cladding processes to the cladding processes demonstrated with the prototype system, ultimately leading to procurement and implementation, if successful.

Payoff

This technology, once implemented, is estimated to provide VCS and CLB combined five-year savings of $12.5M.

Implementation

The results will transition to the GDEB facility following successful and timely completion of the Robotic Valve Cladding Cell project and acceptance of both the technology and associated business case by the acquisition Program Offices. GDEB anticipates implementation in the third quarter of FY2023.

Develop a Robotic Process to Automatically Locate / Fit / Tack Studs on a Critical Component

S2833 — Robotic Fit / Heavy Studs

Objective

Currently, General Dynamics Electric Boat (GDEB) fits and welds heavy studs to the outside of the hull for external features and components. GDEB Operations identified that the installation of these studs consists of multiple manual operations that are both time-consuming and require a high skill level. The manual legacy process impacts schedule and cost on critical path installation of heavy studs required for submarine applications on the VIRGINIA (VCS), VIRGINIA Payload Module (VPM) and COLUMBIA (CLB) Class submarines.

The desired rise in VCS production rate, ongoing VPM construction and upcoming CLB construction will require an increase in production volume for GDEB Quonset Point and Groton facilities. If this higher production volume is not addressed, there is a risk the increased work will cause future delays in the overall shipbuilding schedule. With the successful implementation of the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center Robotic Welding of Heavy Studs project and the automation of the legacy manual processes, a significant decrease in labor hours per installation can be realized.

The major challenge is automatically locating and welding heavy studs that require tight tolerances with respect to location, orientation and fillet weld leg size. Some of the studs require the stud to be beveled before it is welded to the hull. Manual arc welding of the studs is conducive to over-welding and requires rework to remove excess weld reinforcement so the mating component can seat properly.

Payoff

GDEB recognizes the importance of implementing a robot system to locate and weld heavy studs to the exterior of the hull. Robotic stud welding has the potential to reduce the build schedule by decreasing the time it takes to locate and weld the studs, which will, in turn, minimize machining and rework. A robotic process would automatically locate / fit / tack the studs and produce an acceptable first-time quality weld profile on a critical component. The purpose of this robotic system is to reduce cost, reduce span time, increase robotic applications at GDEB and provide a solution for GTAW welding of heavy studs that currently does not exist at GDEB. The goal is to reduce evolution span time from 120 days to a target of 70 days.

This technology, once implemented, is projected to provide VCS and CLB combined five-year savings of $9.0M.

Implementation

With an August 2020 start and a project duration of 42 months followed by a 12-month implementation period, implementation is expected in the second quarter of FY2025.

PERIOD OF PERFORMANCE:
August 2020 to February 2024

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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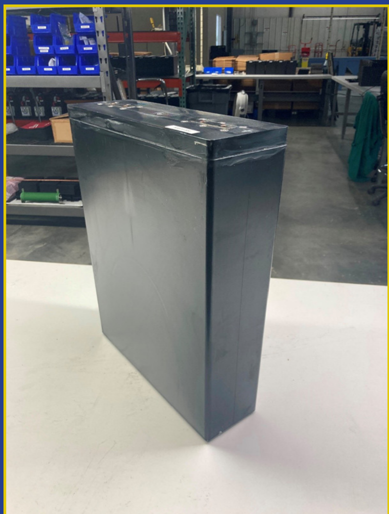
STAKEHOLDERS:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
$2,650,000

Addressing Increased Energy Storage Needs in Large Marine Platforms



PERIOD OF PERFORMANCE:
April 2020 to April 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Electronics Manufacturing Productivity Facility (EMPF)

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STAKEHOLDERS:
SEA 073, SEA 05Z, PMS 392, PMS 450, PMS 397, NSWC-Crane

TOTAL MANTECH INVESTMENT:
$4,166,000

S2836 — Nickel-Zinc Energy Storage Module for Large Platforms

Objective

Due to increased reliance on electronics in large marine platforms, future mission needs will be impacted by limitations of existing valve regulated lead acid (VRLA) battery technology. VRLA technologies have reached their natural energy density limits and additional energy would require increasing the number of battery cells. Thus, battery compartment space will need to be increased for VRLA battery technologies. The challenge is that large space dedicated to the main storage battery (MSB) on large marine platforms, such as submarines, cannot be expanded. Nickel-Zinc (Ni-Zn) battery technology will allow large platforms to meet future mission requirements within the existing space allocation, without suffering electrical load restrictions. This Electronics Manufacturing Productivity Facility (EMPF) project scaled up existing Ni-Zn battery cell size to provide a significant increase in energy storage density of the MSB on large marine platforms. This increased MSB energy capacity will expand platform capability, while avoiding safety issues associated with other energy-dense battery technologies, such as lithium-ion.

Payoff

The benefits of this project are multifold:

- Performance: Significant increase in energy storage for large platforms with significant power delivery upgrade
- Capabilities: Increased available energy directly impacts naval warfighting capabilities, the majority of which are electronics based
- Weight: 25 percent lower weight per unit volume compared to VRLA technology, thereby increasing weight allocation available for critical mission systems
- Modularity: Readily scalable to respective energy requirements of multiple large platforms
- Safety: Fully compatible with safety requirements of large manned marine platforms

The most important benefit of this project was the ability to meet power demand (and therefore meet mission requirements) without the major platform modifications and excessive costs that would be required to accommodate additional VRLA battery cells within large marine platforms. Hence, Ni-Zn technology will provide significant cost avoidance while additionally offering high reliability, safety and reduced size and weight while delivering more power (SWaP) vs. VRLA technology.

Implementation

Due to the compelling need for the expanded power capability offered by this project, multiple Navy stakeholders are actively supporting Ni-Zn transition to the fleet. PMS 392 and PMS 450 have signaled their support for the project in a Memorandum of Agreement executed in September 2020 (Ser SUB 073/0057), with both PMS 392 and PMS 450 indicated as expected Ni-Zn transition partners. The ManTech project produced prototype cells and a technical data package in FY2022. Extensive battery life-cycle testing and platform qualification during FY2023 and FY2024 are in progress. This effort will be followed by two years of accelerated cycle life and high temperature testing. Full battery cell development and production-ready design will occur in parallel with accelerated cycle life testing (FY2024 through FY2026). First article and formal qualification testing will then be conducted on the production-ready design (FY2027 through FY2028).

MSB system development will also be necessary to accommodate the enhanced Ni-Zn cells. This includes evaluation of potential architecture solutions resulting in a final selection followed by detailed MSB system design, including new battery trays and electrical wiring design during FY2023 and through FY2025. Integration and validation of the Ni-Zn cells with an updated battery monitoring system (BMS) will occur in FY2026 with final system testing in FY2027 and through FY2028.

Automated Plate Panel Line for Submarine Bulkhead Assemblies

S2856 — Bulkhead Fabrication Cell

Objective

General Dynamics Electric Boat (GDEB) manufactures plate panels for bulkheads and other structures for the VIRGINIA Class submarine (VCS) with a process that consists of multiple manual operations. The trades manually prepare individual plate edges for welding, lay the plates on large I-beams to align and fixture the plates and block tack the plates together. After the fitting process is complete, preheat is applied and the first side welding is accomplished with submerged arc welding (SAW). The plates are then flipped and back gouged, and the second side is welded. The bulkhead is then moved to Steel Processing for final marking and cutting. A cutting system is used to mark the location of attaching members and any necessary additional internal holes are added.

The manufacturing of plate panels for VCS currently requires extensive labor, manufacturing space and span time. The two-ships-per-year schedule, starting with VCS Block V hulls, will increase the production rate to 12 bulkhead panels per year. The COLUMBIA Class submarine (CLB) will add more than six bulkhead panels per year to the current production rate. Because this process is completely manual, an automated, panel-line-style solution will improve weld quality, reduce cost and shave weeks off the build schedule. This, in turn, will reduce the manufacturing footprint required by more than 50 percent. The objective of this Center for Naval Metalworking (CNM) project is to develop a panel-line-style system to manufacture VCS and CLB plate panels for bulkheads.

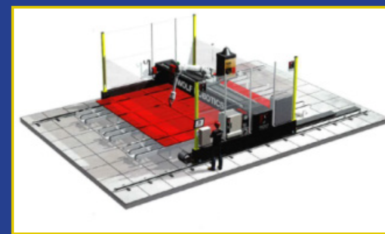
Payoff

This project established an integrated panel line to manufacture plate panels for VCS and CLB submarines. The implementation of this vision represented the first-of-its-kind automated plate panel line for major submarine structural assemblies. GDEB anticipates savings of $1.1M per VCS hull, $1.6M per VCS hull with VIRGINIA Payload Module (VPM) and $2.3M per CLB hull, for combined five-year savings of $21.7M across all programs.

Implementation

Based on project test results, GDEB is finalizing the business case analyses and creating shipyard implementation plans. The transition event for this project is GDEB's successful completion of the performance demonstration activities, after which the process will be verified to meet the expectations of the project team and stakeholders, and will be ready to begin the implementation process at GDEB.

Implementation is anticipated in the fourth quarter of FY2025 and will be a phased approach, in which the most beneficial opportunities will be prioritized and implemented first. The results of this ManTech project may be implemented in the production of VPM, VCS and CLB. The schedule for implementation activities is dependent on project results.



PERIOD OF PERFORMANCE:
June 2020 to November 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDERS:
PMS 450CB, PMS 397

TOTAL MANTECH INVESTMENT:
$1,770,000

Advancement of Temporary Fitting Attachment Technology

PERIOD OF PERFORMANCE:
July 2020 to May 2023

PLATFORMS:
VCS, VPM, CLB Submarines

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDERS:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
$750,000

S2870 — Development of Fitting Aid Tools

Objective

General Dynamics Electric Boat (GDEB) currently uses labor-intensive operations and processes to fit steel components (e.g., egg crates, stiffeners and panels) when creating assemblies. This is a highly manual process that requires the fabrication of temporary fitting attachments, which are welded to the assembly for fit-up and then cut and ground off once fit-up is complete.

The objective of this Center for Naval Metalworking (CNM) project is to eliminate or minimize the need to fabricate, weld, cut and grind these numerous temporary fitting attachments. Other commercial industries currently use temporary and reusable fitting aids for a variety of manufacturing applications. Discussions with a few vendors have indicated that such existing technologies could be modified for submarine applications. This project will verify the tools can be modified for unique submarine applications and are robust enough to handle the work required for submarine construction.

This project will utilize state-of-the-art fitting aids to increase throughput in the fabrication of steel components to meet the demands of the submarine platforms currently fabricated at GDEB. This project will research and validate commercial off-the-shelf fitting aids as well as design, prototype and evaluate custom fitting aids to produce accurate submarine components using Navy-required plate materials.

Payoff

GDEB expects the results of this project will reduce the labor hours required in the fabrication process, improving accuracy and reducing labor / time costs. This CNM project is expected to provide estimated savings of $349.0K per VIRGINIA Class submarine (VCS) hull, $465.0K per VCS with Virginia Payload Module, and $734.0K per COLUMBIA Class submarine (CLB) hull for estimated combined five-year savings of $6.4M across all platforms.

Implementation

Upon successful and timely completion of the CNM project, the results will be implemented at the GDEB facility. GDEB anticipates implementation in the third quarter of FY2024.

Common Datums and Inspection Tools Overcome Inconsistencies

S2874 — Digital Common Layout and Inspection Process

Objective

Many of the components and assemblies that are manufactured at Huntington Ingalls Industries – Newport News Shipbuilding (NNS) are currently inspected using manual methods. In this manufacturing state, efforts are often duplicated as multiple stakeholders perform independent inspections and variations in inspection methods present false-positive or -negative findings, which create production delays. These variations are in part due to the time-intensive process to ensure the part is level, which becomes increasingly difficult when inspecting large parts. Even though common datums and inspection standards exist, slightly different interpretations of the standards and complex geometries often create different results and add non-value-added rework to the process.

The objective of this Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project is to develop common reference datum targets on components based on the analysis of survey data of key features. The monument systems allow technicians to tie an instrument back into the digital datum coordinate system by resurveying these monuments – with a laser tracker, photogrammetry or other metrology tool – and performing a transformation analysis. This capability means that any technician can obtain a monument, tie into the component and perform dimensional surveys or layoffs. This capability persists through a build schedule and can be independent of component relocation.

Payoff

By reducing the labor hours associated with rework and providing timely and efficient dimensional process control data, the NNS project team anticipates a reduction in non-value-added work. Through increased efficiencies and quality improvements enabled by the technology, NNS anticipates five-year savings of $3.3M and a five-year return on investment of 1.2:1.

Implementation

Based on the results of testing, NNS will generate the data needed for internal process verification and validation, finalize the business case analysis and create shipyard implementation plans. The transition event for this project is NNS' performance demonstration activities. Once those activities have been successfully completed, the process will have been verified to meet the expectations of the project teams and stakeholders and will be ready for implementation at NNS. Implementation is anticipated to occur in the third quarter of FY2024.

Implementation is expected to utilize a phased approach, where the most beneficial opportunities will be assigned a higher priority and implemented first. The results of this ManTech project may be implemented in the production of CVN, VCS and CLB. However, the schedule for implementation activities depends on the project results.

PERIOD OF PERFORMANCE:
May 2020 to September 2023

PLATFORMS:
VCS, CLB, CVN

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDERS:
PMS 378, PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
$899,000

Ship Construction 'Planning' with Artificial Intelligence Technologies

PERIOD OF PERFORMANCE:
June 2020 to June 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDERS:
PMS 397, PMS 450C

TOTAL MANTECH INVESTMENT:
$967,000

S2877 — Artificial Intelligence for Planning

Objective

A current challenge at General Dynamics Electric Boat (GDEB) is the planning of a ship's construction, which is a complex and costly task. The ship's build schedule spans years and entails millions of labor hours. Although there have been advancements in planning methodologies, the basic planning toolset has not changed in the last 50 years. Typically, the construction for the lead ship of a class is substantially more costly than follow-on ships. Much of this cost is due to the limitations of current planning tools. Currently, there is no way to fully exploit lessons of past planning efforts. The idea behind this project is to use artificial intelligence (AI), based on historical VIRGINIA Class submarine (VCS) data, to arrive at an optimized plan prior to the construction of the lead COLUMBIA Class submarine (CLB) ship. It is envisioned that follow-on CLB ships and VCS will also benefit from AI for Planning implementations.

The AI for Planning project, managed by the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center, has provided an AI-based planning tool to supplement GDEB's current multilevel planning approach. In the current multilevel planning approach, the highest level (Master Assembly Plan) defines the major modules. The second-level planning scenario entails high-level activities. The third level consists of work orders scheduled in a Material Requirements Planning (MRP) system. The AI for Planning system has introduced a fourth level, which is model-based parametric planning. This means that MRP work activities will be associated with the build product model, enabling the definition of planning parameters that are computed from the model. AI for Planning computes planning improvements based on objective cost functions for work duration and for cost, with an emphasis on structural assembly and welding. Follow-on CLB and VCS ships will benefit due to improved work execution and incremental learning, resulting from accurate cost and duration estimates. In addition, the project has included customizations of the Aurora AI software that improve outsource opportunities, out-of-sequence assemblies and simulations of the variability of durations.

Payoff

This project is expected to result in savings of approximately $228.0K per VIRGINIA Payload Module (VPM) and approximately $403.0K per COLUMBIA Class submarine for a combined five-year savings of $3.1M.

Implementation

The AI for Planning technology is expected to be implemented at GDEB's Quonset Point, RI, facility during the first quarter of FY2023.

Reducing Lead Exposure While Improving Efficiency

S2882 — Improved Lead Caulking Installation Process

Objective

General Dynamics Electric Boat's (GDEB's) current process for lead caulking is time-consuming and labor-intensive. The trades manually locate lead bars / strips into lead bays and use machinery similar to a jackhammer to pound the lead into place, eliminating voids and securing lead sheets within the bay. The intensity of this machinery is identified as a long-term safety concern. The tool exhibits extreme vibrational force, which is hazardous as it is absorbed through the operator's body, causing injury.

The lead-caulking process is a tedious, physically demanding and unique process that needs to be modernized to support the VIRGINIA Payload Module (VPM) and COLUMBIA Class submarine (CLB) programs. This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project will improve the lead-caulking installation process for VPM and CLB by developing an improved installation tool that removes or minimizes the lead installer's exposure to lead and physically intense, time-consuming work.

Payoff

Once implemented, GDEB anticipates this project will improve the efficiency of lead-caulking processes and worker safety. Implementation of new technologies / products developed under this project is expected to result in estimated savings of $467.0K per VIRGINIA Class submarine (VCS), $607.0K per VPM and $982.0K per CLB hulls for estimated five-year savings of $8.4M. The solution technology is expected to be implemented at GDEB's facility in late FY2023.

Implementation

GDEB will implement the solution in a production environment beginning in the fourth quarter of FY2023 on multiple ship platforms, including in the construction of VCS, VPM and CLB.

PERIOD OF PERFORMANCE:
February 2021 to February 2023

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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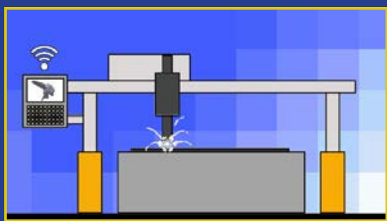
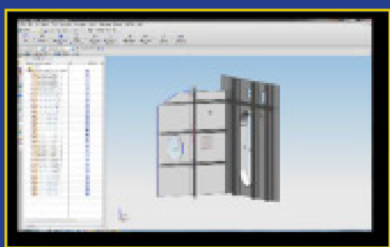
STAKEHOLDERS:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
$1,530,000

End-to-End Process Using Intelligent Data Reduces Time, Effort and Cost





PERIOD OF PERFORMANCE:
January 2021 to December 2022

PLATFORMS:
VCS, CLB, CVN

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDERS:
PMS 378, PMS 397, PMS 450CB

TOTAL MANTECH INVESTMENT:
$1,500,000

S2903 — Model to Manufacturing

Objective

Huntington Ingalls Industries – Newport News Shipbuilding (NNS) is developing increasingly intelligent 3D computer models for its products in support of design activities. However, it is not able to adequately leverage these models downstream to support component and assembly manufacturing. During the design phase of a product, models are created in computer-aided design (CAD) software that aids significantly in the development of design products, including traditional drawings (most common). Unfortunately, the usefulness of the 3D model often ends in design as the 3D model does not persist to downstream stakeholders and often lacks the detail necessary for manufacturing. This poses a significant problem, as manufacturing equipment is becoming increasingly intelligent and is driven more by computer programs than traditional manual operations.

The Model to Manufacturing project, managed by the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center, will establish an end-to-end process where data flows seamlessly from the design agent, or technical authority, to the build authority, including manufacturing entities (internal and external), without losing any of its intelligence or integrity. Stated differently, the authoritative source model will be connected and persevere (maintain its integrity) to each downstream stakeholder, including both external suppliers who may need different neutral formats (ex: STEP, JT, etc.) and internal manufacturers.

Establishing an end-to-end process that includes configuration management of manufacturing by-products reduces the duplication of effort, saves time, reduces cost and improves first-time quality not just locally (in a shop), but also between businesses and suppliers. Manufacturing groups can use a pre-produced product as the baseline for their manufacturing work, utilizing basic attributes such as size, shape, form, material type, etc. This information, coupled with manufacturing details, can then be associated with the technical authority design model (authoritative source) and fed to the appropriate machines. Any engineering or design changes are captured by the system, and new features and details will automatically become available to the manufacturing team, greatly improving the overall configuration management of a given component.

Payoff

This project is expected to result in five-year savings of approximately $5.1M.

Implementation

The Model to Manufacturing technology is expected to be implemented at NNS during the fourth quarter of FY2024.

Pipecrawler to Repair Internal Weld Defects

S2911 — Robotic Blending of Large Diameter Internal Piping

Objective

Final installation of large diameter shipboard pipe assemblies presents a scenario known as "closure joints," where welding technicians complete the last weld assemblies in a pipe system. Weld joints completed before closure preserve a degree of access to the interior diameter (ID) of the pipe, allowing shipbuilders to perform rework, if warranted by inspection, on the ID of pipe joints. By contrast, closure joints eliminate the usual access. If rework is required, the lack of access results in numerous delays and additional labor costs to complete the joint within acceptable quality standards. The combination of material type, application, closure joint scenario and quality requirements make this situation unique to submarine construction at General Dynamics Electric Boat (GDEB).

The objective of this Center for Naval Metalworking (CNM) project is to utilize robotic and video technology to provide access to internal pipe locations to perform work typically conducted when access is not available. GDEB seeks to develop a means for a small device to enter small access points, expand to the working pipe diameter, navigate to the intended work location and perform minor blending and grinding operations. A high degree of system cleanliness must be maintained throughout the operation. This solution will provide an alternative to the current practice of removing critical equipment by making smaller access points associated with valves and bosses viable entry points. The solution will also provide a means to enter non-closure joints in the event ID access is still problematic due to configuration or length.

Payoff

GDEB expects that the results of this project will reduce the labor hours required in the repair of weld defects and reduce the overall number of internal piping weld defects. This CNM project is expected to provide estimated savings of $400.0K per VIRGINA Class submarine hull, $493.0K per VIRGINA Payload Module and $789.0K per COLUMBIA Class submarine hull for combined five-year estimated savings of $6.8M across all platforms.

Implementation

Upon successful and timely completion of the CNM project, the results will be implemented at the GDEB facility. GDEB anticipates implementation in the first quarter of FY2025.

PERIOD OF PERFORMANCE:
July 2021 to November 2023

PLATFORMS:
VCS, VPM, CLB Submarines

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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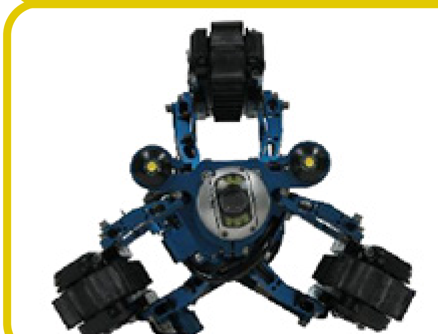
STAKEHOLDERS:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
$1,860,000



Improving Safety and Efficiency in Molten Lead Pouring

PERIOD OF PERFORMANCE:
August 2021 to February 2023

PLATFORMS:
VPM, CLB Submarines

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

POINT OF CONTACT:
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STAKEHOLDERS:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
$528,000

S2915 — Lead Ladle Replacement

Objective

Molten lead is poured in place into numerous structural bays within a nuclear submarine for multiple functionalities. This requires a person to manipulate a ladle, loaded with 50 lbs. of molten lead and traverse the stiffened structure to pour it where needed. Each bay requires 30 to 40 ladles of lead. This is an awkward, tiring and hazardous operation. Approximately 14,500 lbs. per VIRGINIA Class submarine (VCS) and 8,000 lbs. per COLUMBIA Class submarine (CLB) of lead are poured in place. General Dynamics Electric Boat (GDEB) employees first place ingots of lead and then pour molten lead to fill cracks and crevices between the ingots.

The objective of this Center for Naval Metalworking (CNM) project is to find a system that will allow for the continued safe delivery of molten lead across the structure to a designated space without the use of a ladle. This will reduce the time it takes to pour molten lead into the structural bays. An additional benefit is the reduction of injury to personnel by reducing the repetitive motion required to lift, transport and pour the molten lead.

Payoff

If the project achieves its threshold labor reduction goal, GDEB anticipates estimated savings of $168.0K per VIRGINIA Payload Module (VPM) hull and $168.0K savings per CLB hull. This is expected to create total five-year savings of $2.1M.

Implementation

Upon successful and timely completion of the Lead Ladle Replacement ManTech project and acceptance of both the technology and associated business case by the acquisition Program Offices, the results will transition to the GDEB facility. GDEB anticipates implementation in the third quarter of FY2024. The estimated first hull of implementation will be SSN827 for CLB and SSN811 for VCS.

Investigating Drone Operations for Submarine Hull Inspections

S2919 — Drone Photogrammetry

Objective

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project was to outfit a drone with a photogrammetry camera and active gimbal system that can pan and tilt the camera to successfully accomplish approved surveys in tight production surroundings and eliminate the need to operate a vertical boom lift to manually take photographs. The gimbal system needed to be adaptable to existing photogrammetry cameras currently used and approved for handheld photogrammetry.

The drone-and-gimbal system enables the operator to tilt and pan the camera while, at the same time, provides a visual representation of the camera's line of sight. The drone is equipped with collision-prevention technology. A drone operator needs to see and move the alignment of the camera to take photographs, while simultaneously flying the drone. At this time, there is no commercial off-the-shelf (COTS) equipment capable of doing what is required. The project identified an integrator that combined COTS equipment into a drone photogrammetry system. Other constraints considered during this effort included:

- Accuracy required by official circularity surveys
- GSI Inc. Cameras, which required integration into drone platform (considerations included camera weight, drone lift capacity, pan / tilt abilities)
- Drone operation in confined spaces, within buildings and programmed flight paths based on measurement criteria
- Licensing / training requirements for drones
- Flight restrictions for Quonset Point (nearby airport)

Payoff

The main benefits of this project are the reduced labor and construction schedule. The drone photogrammetry creates reduced set-up and break-down times associated with moving sections to the aisle way for JLG boom lift access. A supplemental or secondary benefit is the introduction of drones into manufacturing, overhaul and repair and operational inspection-requirement situations.

Implementation

General Dynamics Electric Boat (GDEB) Quonset Point accuracy control personnel ensured that the required metrics were achieved prior to implementation. An implementation plan was developed during Phase II of the project (based upon research discoveries). The project compared the costs of updated metrology procedures to legacy procedures to determine cost and safety savings. The project covered the steps required for the initial acquisition of the drone photogrammetry platform, as well as life-cycle considerations. The project also included sources for repair parts, in the event the equipment is damaged or needs replacement from normal operation. The plan also outlined all approvals, training and licensing needed to instate the drone capability at GDEB Quonset Point. Implementation is expected in the second quarter of FY2024.

PERIOD OF PERFORMANCE:
March 2021 to December 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDERS:
PMS 450, PMS 397

TOTAL MANTECH INVESTMENT:
$720,000

Invigorating the Additive Manufacturing Supply Base and Shipyards

PERIOD OF PERFORMANCE:
September 2021 to September 2024

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDERS:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
$4,800,000

Q2924 — Modern Shipbuilding Manufacturing to Support VCS and CLB Submarines

Objective

U.S. Navy submarine construction strategies require careful planning of manufacturing schedules and production requirements to meet ship delivery dates and budgetary goals. General Dynamics Electric Boat (GDEB) and its vendor base must be prepared to meet the increased construction demands of two VIRGINIA Class submarine (VCS) hulls and one COLUMBIA Class (CLB) hull per year. To that end, Connecticut Center for Advanced Technologies (CCAT), along with GDEB, has identified a series of manufacturing research and development tasks to invigorate the domestic additive manufacturing (AM) vendor base to prepare for this work. These tasks will support the nation's continued emphasis on the importance of revitalizing manufacturing in America.

The objective of this Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project is to invigorate the AM vendor base to prepare for increased shipbuilding production and sustainment. This includes advancing NSAM Center technology readiness level (TRL) of AM and establishing a framework for GDEB and Connecticut AM vendors to accept AM as a potential manufacturing technique for tools / components, which would then benefit the rest of the AM community.

This project is organized into three main tasks that will be executed in two phases. The first task will focus on creating processes for designing future components with AM as an option and creating databases that will capture information on materials, processes, machines and vendor capabilities for future AM design projects. The second task will identify the business cases where use of advanced manufacturing technologies and processes makes business sense, specifically for non-shipboard components, and will result in the creation and testing of prototype tooling and fixturing. Finally, the third task will focus on advancing the TRL and the manufacturing readiness level from four to five for applying directed-energy deposition (DED) AM for a shipboard component part build or repair.

Payoff

This project is focused on improving readiness of the submarine manufacturing supply base through advancing AM technologies and capabilities, as well as developing a database of relevant suppliers. At this stage, direct benefits of this project, as they apply to cost-savings, are difficult to quantify. However, all aspects of the potential benefits of this project will continue to be investigated and refined throughout the project's life-cycle.

Preliminary anecdotal benefits of the project include a functional AM vendor database, AM design tenets and an improved TRL, all expected to contribute to decreased acquisition costs and more rapid repairs.

Implementation

The implementation plan will be contingent on successful creation of a functioning vendor database, successful design and manufacturing path for AM tooling / fixtures and successful execution of DED build or repair for a shipboard component.

Improving Efficiency and Safety in Lead Bay Packing

S2926 — Improved Lead Bay Packing

Objective

Current classes of U.S. submarines utilize lead to ballast or balance the ship. The current state lead packing process starts with many pallets of painted lead bricks ranging in weight from 34 lbs. to 56 lbs. being delivered to the shop floor; transportation of those bricks using an overhead lift to a hull section; then manual lifting and handling the bricks into place in the hull section. Painted lead bricks are hazardous materials that require handling by specially qualified lead workers. The physical demands upon the individual necessitates increasing the number of qualified leadworkers needed to support lead packing. Qualified lead workers require specialized training and periodic medical surveillance tests and physical exams; must suit-up in cumbersome full-body protective personal equipment (PPE) including respirators; and need to decontaminate at the end of each shift. This adds to the activity's span time with extra tasks for setup, breakdown and clean-up. Inadvertent mishandling of heavy bricks poses both a serious injury hazard, not only to lead packing personnel but also to any non-lead packing personnel working near lead handling. Damaging the painted lead brick surface could result in exposing the work environment to lead.

Specialized training, medical surveillance testing and physical exams reduce the availability of highly skilled trades. Supervision manually collects and reports the weight of lead packed into each bin, which is non-value added and time-consuming. The manual calculations must be checked by Naval Architecture.

This project is expected to decrease cycle time by an estimated 30 percent for lead bay packing processes, and replace manual data logging of weight with an integrated digital weight collection / reporting interface, where possible. It is also expected to minimize human exposure to lead and physically demanding activities (manual lifting and repetitive motion such as bending and twisting). This is an ancillary goal that will not be quantitatively measurable but is an important aspect of this project.

Payoff

Once implemented, General Dynamics Electric Boat (GDEB) anticipates that this project will improve efficiency and safety in the lead bay packing process. Implementation of new technologies / products developed under this project is estimated to result in savings of $454.0K per VIRGINIA Class submarine (VCS) hull and $1.1M per COLUMBIA Class (CLB) hull, creating a combined five-year return on investment of 3.2:1.

Implementation

GDEB will implement the solution in a production environment beginning in the second quarter of FY2026 on multiple ship platforms, including the construction of VCS and CLB.

PERIOD OF PERFORMANCE:
February 2022 to February 2024

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDERS:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
$892,000

Advancing Health Monitoring of Critical Manufacturing Technologies

PERIOD OF PERFORMANCE:
January 2022 to March 2024

PLATFORM:
VCS Submarines

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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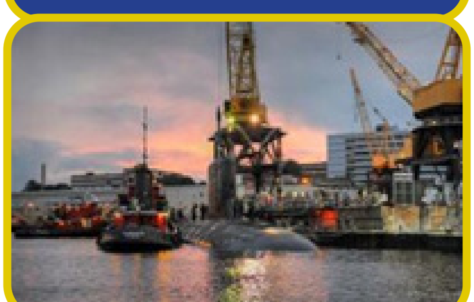
STAKEHOLDERS:
GDEB, PMS 450, PMS 397

TOTAL MANTECH INVESTMENT:
$1,424,000



S2963 — Predictive Maintenance II — IIoT

Objective

General Dynamics Electric Boat (GDEB) has critical path manufacturing assets that have the potential to experience catastrophic failure despite preventative maintenance programs, resulting in unnecessary repair costs, lost production time and rework. Manual health-monitoring systems (HMS) have proven to be very successful, but many assets have accessibility challenges, making access challenging or even hazardous.

Implementing advanced machinery health-monitoring technologies (i.e., those enabled by the Industrial Internet of Things [IIoT]) for inaccessible critical equipment will improve production of U.S. Navy submarines. The Institute for Manufacturing and Sustainment Technologies (iMAST) will use reliability-centered maintenance (RCM) analysis to identify the most suitable critical path components for VIRGINIA Class (VCS) and COLUMBIA Class (CLB) submarine construction for implementing IIoT HMS technologies. The iMAST / GDEB team will prototype an optimum combination of state-of-the-art, turnkey, wireless sensors for critical measurements (pressure, temperature, torque, vibration) on legacy and modern equipment, along with edge devices with programmable logic computers to enable management support for critical path equipment.

Payoff

This project will help mitigate construction downtime due to manufacturing asset failure by circumventing catastrophic failures. Because some assets are essential for submarine manufacturing, avoiding catastrophic failure will also avoid unexpected, extended downtimes and associated costs for full asset repair, lost production time and rework. This project's anticipated savings are in excess of $7.0M.

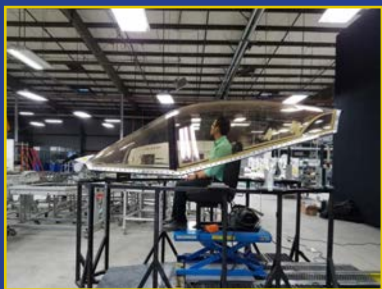
Implementation

Initial implementation will take place during the demonstration of the wireless sensors and edge devices on GDEB production assets. This system demonstration will include a few assets that have the largest potential benefit from an avoided catastrophic failure at the GDEB Groton and Quonset Point facilities. GDEB will then work to expand the use of the IIoT HMS throughout VCS and CLB manufacturing at GDEB. The iMAST team will be conducting a site survey at other yards to identify similar assets to GDEB that would benefit from IIoT HMS technologies to reduce schedule slip and maintain or improve costs. Implementation is anticipated in the fourth quarter of FY2024.

F-35 Lightning II Projects

F-35 Lightning II Aircraft.
(U.S. Navy image.)

Automated Optical Measurement System to Save Millions of Dollars on F-35 Lightning II Transparencies



PERIOD OF PERFORMANCE:
September 2019 to December 2022

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

POINT OF CONTACT:
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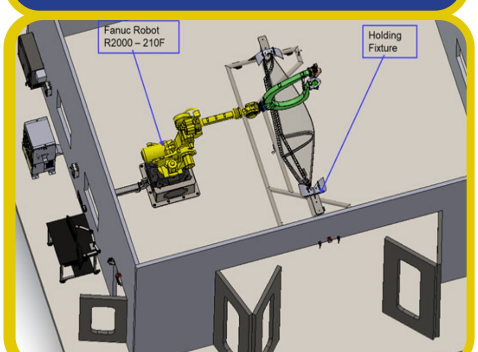
STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$3,100,000



A2765 — F-35 Automated Optical Measurement System

Objective

Inspecting transparencies for optical defects to strict specifications is both time-consuming and prone to error. The Automated Optical Measurement System project will replace manual inspectors with highly specialized optical measurement equipment coupled with advanced analytical algorithms. This Composites Manufacturing Technology Center (CMTC) project had two primary technical goals. The first was to develop and demonstrate equipment and methods that reliably detect and characterize all categories of minor optical defects. This includes the tooling and fixturing required to accurately position the F-35 Lightning II transparency such that inspection is reliable, repeatable and safe. The second technical goal was to develop and demonstrate programming capable of processing and applying accept / reject criteria based on the acceptance criteria in the test plan. The system is required to operate at a confidence level such that GKN Aerospace (GKN), Lockheed Martin Aeronautics (LM-Aero), the F-35 Lightning II Joint Program Office and Defense Contract Management Agency (DCMA) are willing to rely on the inspection cell for part acceptance.

Payoff

By implementing an automated optical measurement system, significant labor hours will be saved by reducing the manual inspections performed by GKN at its facility, as well as source inspections at multiple facilities from DCMA and LM-Aero. GKN anticipates $17.1M in cost-savings over the life of the program. Additional savings are anticipated by reducing downstream source inspection labor for DCMA and LM-Aero. In addition, the cost of quality escapes has not been factored in the projected savings. Factoring in GKN cost-savings alone, the project return on investment is anticipated to be approximately 6.1:1.

Implementation

GKN anticipates working through F-35 Lightning II Program Non-Recurring organizations to fund implementation costs. The implementation effort is anticipated to include purchase and setup of the remainder of the production tooling for the full-scale Automated Optical Measurement System, work instruction updates, gage repeatability and reproducibility and delta first articles. To the extent possible, equipment from the ManTech project will be leveraged to the production program through a transfer to the production contract. Cost-savings from this program will benefit both new F-35 Lightning II deliveries and delivery of spare canopies over the life of the F-35 Lightning II program. Implementation is anticipated to occur in FY2023.

Advanced Mixing Method for Infrared Countermeasures Project to Reduce Solvent Usage and Improve Worker Safety

J2777-A-B — Advanced Mixing Method for Infrared Countermeasures

Objective

The current method for mixing magnesium, Teflon™, Viton™ (MTV)-based infrared countermeasure energetics involves the use of mixing technology that has been in production for many years. These mixing methods, namely the Mix Mueller and Cowles mixing systems, while effective, have seen significant optimization over the years. Further optimization is not anticipated to yield the cost-savings desired by the countermeasure's procurement community. In addition, the current mixing technologies do not accommodate automation. Handling MTV materials is very dangerous and has led to many serious injuries and loss of life. Automation is particularly critical to remove personnel from the hazardous environments.

New mixing technology, Resonant Acoustic Mixing (RAM) by Resodyn, has been introduced to the market, offering significant success in mixing other energetic materials due to improved safety and reduced mixing times, while also lending itself to automation. Naval Surface Warfare Center – Crane (NSWC-Crane) has successfully mixed MTV, and Naval Surface Warfare Center – Indian Head Division (NSWC-IHD) has scaled the mixing of other types of energetic materials.

This joint Composites Manufacturing Technology (CMTC) and Energetics Manufacturing Technology Center (EMTC) project will leverage lessons learned from both NSWC-Crane and NSWC-IHD to develop and demonstrate the ability to scale-up production of MTV utilizing the RAM technology suitable for production operations. Furthermore, Chemring Countermeasures' Kilgore operation will develop the mixing process so it is compatible with both downstream processing requirements and newly developed automation processes. Franklin Engineering will develop the automation system to add constituent materials and transfer mixed material through various stages and bowl clean-up procedures.

Payoff

Of the expected benefits anticipated to be achieved under this project, the most significant payoff will be the removal of personnel from a very hazardous manufacturing process through implementation of automation. Secondary to this is reduced cost as a result of decreased mixing times with the RAM mixer and reduced labor through automation. MTV-based flares are used on nearly every combat aircraft in the Department of Defense inventory. Cost-savings at Chemring Countermeasures' Kilgore facility for ignition composition alone are estimated to be as much as $150.0K per year.

Implementation

The mixing process and automation system developed under this CMTC and EMTC project is anticipated to be capable of small-scale production suitable for ignition composition. This system may be transferred to a contract for production use. Implementation will require capital funding, which is currently being defined. Implementation of the mixing process for ignition composition is expected to begin in late FY2023.

PERIOD OF PERFORMANCE:
May 2020 to August 2023

PLATFORM:
F-35 Lightning II

CENTERS OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)
Energetics Manufacturing Technology Center (EMTC)

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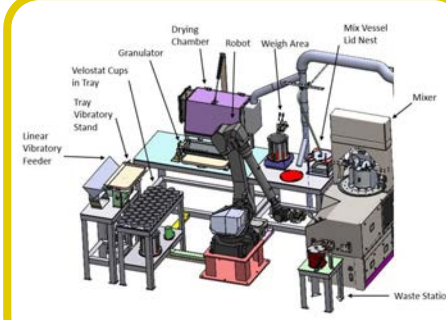
STAKEHOLDERS:
PMA-272J, USN AECM Acquisition Program Office,
Hill AFB, USAF AECM Acquisition Program Office,
F-35 Lightning II Joint Program Office (JPO)

TOTAL INVESTMENT:
$1,300,000 (CMTC)
$ 500,000 (EMTC)
$1,500,000 (OSD Manufacturing Science and Technology Program)



Automated Fillet & Cap Sealing to Save Millions of Dollars and Enable Increased Weight Margin

PERIOD OF PERFORMANCE:
March 2021 to October 2022

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

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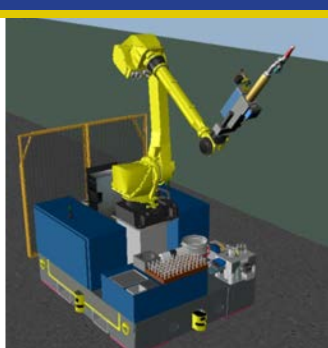
STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$1,650,000



A2818 — Automated Fillet & Cap Seal

Objective

Fillet and cap sealing for F-35 Lightning II is currently a labor-intensive process in which assemblers manually apply sealant to the aircraft using a variety of disposable tips and hand-smooth the material into the final shape. This process is very time-consuming and has multiple application issues, such as material overflow leading to slump, dripping, voids and excessive material usage, which increases cost and aircraft weight. This sealant is utilized on a variety of grooves requiring fillet seals and hardware requiring cap sealing. An automated sealant dispensing system has significant potential to reduce labor costs and increase uniformity of fillet and cap seals, which minimizes aircraft weight. This Composites Manufacturing Technology Center (CMTC) project, which includes Lockheed Martin Aeronautics (LM-Aero) and Encore Automation, implemented a phased approach to develop and demonstrate an automated application system capable of transitioning to production.

Payoff

The benefits of developing an automated solution for fillet and cap seals include a major payoff in process savings alone, with additional potential benefits in material and quality savings. The total cost-savings for the Left / Right F-35 Wings are estimated at more than $7.0M. A follow-on implementation is expected on Center Wing, resulting in total F-35 Lightning II cost-savings of over $13.7M. In addition, reduced variability in total wing weight resulting from automation is anticipated to allow more weight margin for the addition of new potential capabilities for the aircraft.

Implementation

Initial implementation is expected to begin in FY2024 at the chosen LM-Aero facility with a follow-on implementation at an additional LM-Aero facility. Implementation is expected to include procurement of the capital system, performing qualification testing and any necessary changes to procedures, work instructions and drawings.

F-35 Lightning II EOTS Focal Plane Array Batch Manufacturing and Automated Dewar Test Station Process Improvements

A2820 — EOTS Integrated Dewar Cooler Producibility Improvements for F-35

Objective

The Electro-Optical Targeting System (EOTS) is a high-performance, lightweight, multifunctional system for precise air-to-air and air-to-surface targeting. The EOTS focal plane array sensing element and the integrated Dewar cooler had initially suffered from inefficiencies and were unable to meet production quantities at the required cost points when the EOTS multiple-phase producibility effort was initiated. Since the producibility program's inception, significant improvements have been made to meet production quantities at the required cost points. Leveraging the success achieved in the previous phases of the F-35 Lightning II EOTS producibility projects, this Electro-Optics Center (EOC) project continues to execute cost and risk reductions for key EOTS infrared components critical to production quantity delivery and cost targets.

Payoff

The current focal plane array manufacturing process is very labor-intensive and inefficient. Implementing novel processes will allow for a process with 100 percent A-grade die. Insertion of a focal plane array batch manufacturing process will significantly lower manufacturing costs (reduction in focal plane array touch time per unit).

The current EOTS Dewar process line has an in-process image screen test prior to the final weld to verify that all electrical connections are secure and the focal plane array is free of defects. Implementing an automated continuity test station provides the following benefits:

- significant touch time reduction
- significant reduction in cost of rework (approximately 80 percent reduction)
- increased capacity and throughput (approximately twice)
- identifying defects at this point saves approximately three weeks of manufacturing time
- increased test detail and analysis capacity
- reduced test station clean room footprint (50 percent reduction)

Together, these tasks are expected to save over $19.0M for the F-35 Lightning II Program.

Implementation

The F-35 Lightning II EOTS is the transition platform. These producibility improvements are following a rolling implementation process. Processes will be implemented as they are completed, qualified, approved and cut into production prior to the first quarter of FY2023. These manufacturing process-level changes were required to be reviewed and approved by the internal Santa Barbara Focal plane Process Control Review Board. This EOC project implemented multiple industry-approved process changes beginning with Lot 14 in the second quarter of FY2021. This project is of interest to the Air Force Research Laboratory.

PERIOD OF PERFORMANCE:
September 2019 to May 2022

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$1,121,000

Manufacturing and Producibility Improvement for CIAM Assembly for Total Life-Cycle Cost-savings

PERIOD OF PERFORMANCE:
July 2021 to May 2024

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

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STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$1,600,000

A2827-2 — CIAM Manufacturing and Producibility Improvement Phase II

Objective

Rolls-Royce experiences multiple issues with the current rotor tip treatment, known as the CIAM. Each CIAM is complex and consists of 50 individual components. Eleven CIAMs are required per assembly. The complexities of fabrication in a multi-step manufacturing process result in an expensive component with significant nonconformance issues. The current issues and quality drivers are centered on the erosion coating and the adhesive used during the CIAM assembly process, causing a significant amount of rework.

The objective of this Composites Manufacturing Technology Center (CMTC) effort is to execute redesign and manufacturing improvements to the CIAM components. This phase will encompass redesign of components, manufacture of hardware for testing, component-level testing, assembly testing and detailed design approval of a solution ready for production verification and validation testing.

Payoff

The project will deliver a solution into production that reduces the cost of non-quality by minimizing rework hours and scrap rate, decreases weight and reduces part fabrication recurring costs.

This effort is estimated to deliver $13.0K in savings per unit and total life-cycle cost-savings of $19.0M. Included in this value is the production life-cycle labor cost reduction that will be realized through the elimination of erosion coating disbonds and adhesive blowout events, which drive high cost and delivery delays for teardown, rebuild and re-test. Further, the proposed design will eliminate a significant amount of rework by the hardware supplier. This will contribute to the stated cost reduction and aid in cycle time reduction and delivery reliability. The resulting return on investment is 5.8:1.

Implementation

Upon approval of the detailed design and successful completion of Phase II, work is anticipated to commence on the Phase III: Production Implementation project, which includes all engineering labor, test hardware, test activities, material qualification, production process validation and production tooling to achieve production implementation. Phase III is estimated to be implemented in January 2026.

The keys to achieving production implementation are successful system-level strain gage testing of the new hardware, approval of new materials by Rolls-Royce and the establishment of a fixed manufacturing process for the new design hardware.

Polymer Additive Manufacturing to Replace Traditional Manufacturing Methods and Materials for F-35 Lightning II Non-Flight-Critical Parts

A2849 — Carbon Fiber PEKK Additive Manufacturing

Objective

The F-35 Lightning II program continues to work toward successful full-rate-production. As part of that effort, the program is seeking to leverage advanced technologies that will control or reduce costs to the platform while maintaining or improving overall weight and performance of the aircraft. Most F-35 Lightning II components were designed prior to additive manufacturing (AM) technologies being considered a viable method for low-load, non-flight-critical parts. Due to advancements made in AM processes and materials, traditional fabrication methods may no longer be the most cost-effective. This Composites Manufacturing Technology Center (CMTC) project will develop and demonstrate an alternative method to fabricate non-flight-critical parts by building upon previous data to validate HexPEKK® material and demonstrate performance against F-35 Lightning II specifications. New designs for candidate non-flight-critical parts, such as ducts and equipment trays, will be developed, printed and demonstrated through full-scale testing to support a Design Guide, available at the end of this project.

Payoff

The benefit to production, which is based on work currently in progress, is estimated at total cost-savings of over $16.0M for the program. The savings are a result of a reduction in unit cost for individual parts and include the expected conversion and implementation of up to 50 total parts. In addition to the direct impact on the F-35 Lightning II program, data and documentation developed under this project will serve as a springboard for defense industry adoption. This includes future programs, which, in comparison to the F-35 Lightning II, can further realize the benefits by considering AM in the initial design phase.

Implementation

Assuming successful technology maturation during this CMTC project, implementation on aircraft as early as the second quarter of FY2023 is possible for candidate parts developed and tested during the period of performance. Follow-on implementation efforts consist of re-design and approval of additional parts utilizing the Design Guide and Qualification Guide documents developed under the ManTech project.

PERIOD OF PERFORMANCE:
July 2020 to February 2024

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

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STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$3,462,000

Automated In-Process Inspection for Composite Lamination: Consistent Qualification for Consistent Quality Results

PERIOD OF PERFORMANCE:
May 2021 to June 2023

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

POINT OF CONTACT:
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STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$2,000,000

A2853 — Automated In-Process Inspection for Automated Composite Lamination

Objective

The demanding performance requirements of modern composite structures are predicated on tightly controlling the tolerances of the as-built parts. This approach ensures that the as-designed parts are manufactured within established design limits. Defects that cause parts to deviate from the design can come from a wide variety of sources. One of the defining strengths of automated composite layup and forming is that it removes a considerable degree of the variability introduced by manual layup. Although automated layup and forming technologies provide a significantly more robust and repeatable process, automated manufacturing equipment is still susceptible to producing parts that deviate from nominal and violate specification tolerances. To detect, correct and control these deviations, an inspection system is required.

The current industry standard for inspection of composite parts is manual ply-by-ply inspection of the composite layup. This approach has a number of limitations and drawbacks that result in costly rework, excessive material consumption and reduced production rates. An automated in-process inspection system has significant potential to mitigate and eliminate the aforementioned drawbacks of the current industry standard. This Composite Manufacturing Technology Center (CMTC) project, which includes Northrop Grumman and Fives, uses a phased approach to develop and demonstrate an automated in-process inspection system capable of transitioning to production.

Payoff

The benefits of developing an automated solution for composite laminate inspection have a major payoff in process savings. Potential production rate increases, quality savings and reduction in production material waste enable these possible process savings. Specific benefits include a five percent increase in machine uptime and 25 percent first-pass yield improvement on wing skins and nacelle-type structures. Total cost-savings of $5.6M are estimated for F-35 Lightning II nacelle production over 1,232 aircraft. There are additional opportunities on current and future platforms, with larger benefits realized when the technology is applied at program start-up.

Implementation

Upon successful completion of this project, the intent is to pursue the transition of the technology onto automated fiber placement machines used to produce wing skins and nacelles on the F-35 Lightning II program. Qualification of the system will take a minimum of three months beyond the end of this CMTC effort, and orders for inspection systems could be placed as soon as 2023.

Novel Heating Film Paves the Way for In-Situ Composite Layup Processes

A2867 — Heated Debulk Process Improvement

Objective

Lockheed Martin Aeronautics (LM-Aero) has prioritized efforts to achieve full-rate production by focusing on advanced manufacturing technology improvements aimed at reducing F-35 Lightning II costs. A technology of interest is expanding in situ / in-process capabilities for composite fabrication to minimize dependency using traditional oven / autoclave processes. Traditional heated debulk processes require removing the tool and composite lay-up from the lay-up room and transporting to / from the oven. This also involves realignment upon return to the lay-up room before additional plies can be placed. The objective of this Composites Manufacturing Technology Center (CMTC) project was to reduce span time and cost by eliminating the need for ovens / autoclaves during the composite lay-up and debulk process. This was accomplished by leveraging a novel, non-metallic heating film to develop an accurate, reusable in-process heating system for production and demonstration on full-scale candidate parts, which were chosen to allow for development on geometries that would cast the widest net for additional implementation candidates.

A secondary objective of this project was to evaluate the same non-metallic heating film technology for initial feasibility in repair applications.

Payoff

The CMTC project developed a repeatable method to perform in-situ heated debulk in production. By eliminating the need for an oven, labor-savings and span time reductions were realized, resulting in total cost-savings of more than $11.0M for the program.

The technology did prove feasible for repair applications, however, further testing is necessary to optimize the process.

Implementation

Implementation is expected to occur during the second quarter of FY2023 for the prototype controller and heating elements developed and tested for heated debulk in production during this CMTC effort. Follow-on implementation efforts account for improvements to the controller and require the development of heating elements for additional candidate parts that have been identified. Prioritization will occur based on the return on investment of the individual parts.

PERIOD OF PERFORMANCE:
August 2020 to August 2022

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

POINT OF CONTACT:
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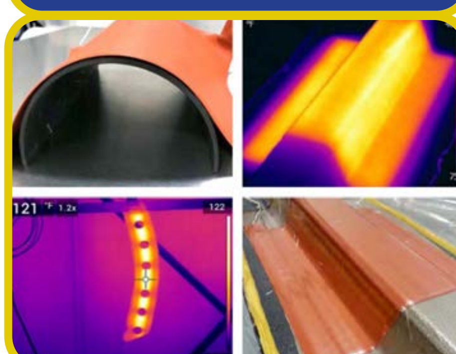
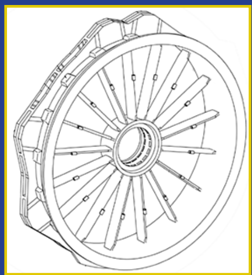
STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$1,705,000



Increased Throughput and Reduced Cost for the F135 Fan Inlet Case



PERIOD OF PERFORMANCE:
November 2021 to January 2023

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

POINT OF CONTACT:
Ryan Frankart
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STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$3,734,000

A2868 — Preform Consolidation for F135 Fan Inlet Case

Objective

As the F-35 Lightning II program continues to work toward full rate production, opportunities to reduce cost and improve throughput are being investigated, including efforts focused on the delivery of the F-135 engine. The F135 Fan Inlet Case is the front-frame for the engine, which includes the front engine mounts and main shaft bearing support, in addition to other components and functions. The complexity of the design for the Fan Inlet Case resulted in a manufacturing method with numerous preforms that must be joined together, creating opportunity for defects at each joint. Defect types include wrinkling, resin-rich pockets and cracking, which lead to significant rework hours and delivery delays. The objective of this Composites Manufacturing Technology Center (CMTC) project is to reduce the preform count and improve joint design of candidate preforms to improve quality, reduce labor and improve rate. Performers on this project are GKN Aerospace and Pratt & Whitney.

Payoff

Five-year savings are currently estimated to be greater than $8.0M, with a cost reduction of at least $5.0K per unit. The cost reduction will be achieved through reduced labor, improved cycle time, reduced rework and Materials Review Board. In total, these items will improve current delivery estimates as the F-35 Lightning II program accelerates overall production.

Implementation

Upon successful completion of this project, there will be sufficient justification to incorporate the validated changes into the production definition, which requires completion of quality system requirements and program approvals via a Class 1 Engineering Change. This change is scheduled to be completed in the first quarter of FY2024 with cut-in, on-engine deliveries beginning in the second quarter of FY2024.

F-35 Lightning II EOTS Wafer Photolithography and In-Situ Etch and Passivation Process Improvements

A2883 — F-35 EOTS Wafer & Focal Plane Array Producibility Improvements

Objective

The Electro-Optical Targeting System (EOTS) is a high-performance, lightweight, multifunctional system for precise air-to-air and air-to-surface targeting. The EOTS focal plane array sensing element and the integrated Dewar cooler had initially suffered from inefficiencies and were unable to meet production quantities at the required cost points when the EOTS multiple-phase producibility effort was initiated. Since the producibility program's inception, significant improvements have been made to meet production quantities at the required cost points. Leveraging the success achieved in the previous phases of the F-35 Lightning II EOTS Producibility projects, this Electro-Optics Center (EOC) project continues to execute cost and risk reductions for the EOTS infrared detector critical to the continued production quantity delivery and cost-reduction goals.

Payoff

The current niobium nitride (nBn) wafer-fabrication process requires multiple photolithography steps. Implementing process improvements and streamlining the detector wafer-fabrication process will eliminate several current manufacturing challenges. Insertion of wafer photolithography process improvements will significantly lower touch labor time and cycle time per unit, reduce rework and improve yield.

The current methods for depositing wafer and focal plane array passivation films are not ideal. Implementing process improvements will reduce or eliminate defects and trim the number of process steps. Insertion of in-situ etch and passivation process improvements will improve the yield, performance and reliability of the focal plane array as well as provide touch time per unit cost-savings.

Together, these tasks are expected to save approximately $5.0M for the F-35 Lightning II Program.

Implementation

The F-35 Lightning II EOTS is the transition platform. These producibility improvements are following a rolling implementation process. Processes will be implemented as they are completed, qualified, approved and cut into production prior to completion of this project. These manufacturing process-level changes are required to be reviewed and approved by the internal Santa Barbara Focal plane Process Control Review Board. This EOC project has implemented multiple industry-approved process changes beginning with Lot 15 in the second quarter of FY2022. This project is of interest to the Air Force Research Laboratory.

PERIOD OF PERFORMANCE:
September 2020 to January 2023

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$1,059,000

Assessing Hole Rifling on the F-35 Lightning II Production Line

PERIOD OF PERFORMANCE:
September 2021 to July 2023

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$936,000

A2893 — Rifled Hole Assessment

Objective

To achieve full rate production (FRP) and cost reduction of the F-35 Lightning II, Lockheed Martin Aeronautics (LM-Aero) is focusing its efforts on implementing various advanced manufacturing technology improvements over the next five years. One technology of interest is a handheld fastener-hole measurement device to improve measurement, inspection and characterization of F-35 Lightning II fastener holes. Current F-35 Lightning II production inspectors do not have an adequate device to allow users to accurately inspect and measure defects inside fastener holes to determine acceptability.

The objective of this Center for Naval Metalworking (CNM) project is to develop and implement a handheld measurement device and inspection process that will eliminate existing inaccurate and costly inspection processes to characterize hole features, enable inspectors to quickly assess metallic and composite hole features on aircraft, and accurately measure hole features. This project also will reduce costly rework by means of accurate, repeatable data, so that not only are "acceptable" readings quickly defined, but the necessary amount of rework is quickly agreed upon and completed by collecting 360-degree hole surface data for external systems. Completion of this effort will result in a handheld measurement system capable of accurately and reliably measuring the entire internal surface of metallic and composite fastener holes with a tolerance threshold of 0.001" and objective of 0.0001".

Payoff

By enabling inspectors to quickly and accurately assess metallic and composite fastener hole features on aircraft, the proposed solution aims to reduce labor hours in the wing, final assembly and sustainment inspection processes by a combined 26.7 hours per aircraft. This will yield five-year savings of $3.1M.

Implementation

Based on the results of testing, LM-Aero will generate the data needed for internal LM-Aero process verification and validation, finalize the business case analyses and create production floor implementation plans. The transition event for this project is LM-Aero's performance demonstration activities. Once those activities have been successfully completed, the process will have been verified to meet the expectations of the project team and stakeholders and will be ready for implementation at LM-Aero. Implementation is anticipated in the fourth quarter of FY2023.

Implementation is expected to utilize a phased approach, where the most beneficial opportunities will be assigned a higher priority and implemented first. The results of this ManTech project are expected be implemented in the production of F-35 Lightning II.

Abradable Coating Improvement for Production and Sustainment Cost Benefits

A2908 — Lift Fan Stage 2 Fan Case – Abradable Coating Improvement

Objective

The current manufacturing process of the Fan Case Abradable Coating is leaving voids that require extensive rework. The abradable coating is in the attrition liner. As production is increasing, excessive rework on parts is affecting cost and delivery. Voids are inherent with the current material and application method. The manual process to apply the material is time-sensitive, susceptible to voids and increases manufacturing variation between parts. Because the liner material has a short pot life and high viscosity, the application must be prompt. This reduces the opportunity to work the material manually or by other means for the purpose of reducing or minimizing voids. The reworked, filled voids could potentially fall out, impacting tip clearances and aerodynamic performance.

The objective of this Composites Manufacturing Technology Center (CMTC) project is to deliver improvements to the current manufacturing process that reduce the size and distribution of voids remaining in cured attrition liner material and eliminate rework to fill voids exposed after machining the abradable material. Target improvement opportunities include the automated mixing program, the attrition material pot-life and cure characteristics, attrition material-application methods and alternate attrition liner fabrication / installation methods using the same material system currently defined. These areas will be investigated to improve the quality, cost and delivery of the fan case.

Payoff

Rolls-Royce uses a total life-cycle cost business case to quantify the overall impact the project will have on production and sustainment costs. The significant impact this project can have on production and sustainment (maintenance, repair and overhaul) makes this the most reasonable approach to assess the overall benefits. Rolls-Royce will realize cost-savings greater than $3.8M over the remaining life of the program.

Implementation

Any process or material changes will be subject to validation testing. The intent is to use specimen testing to demonstrate that any changes produce material properties the same or better than the existing solution. The validation plan includes manufacturing trials to confirm process repeatability, validation of new abradable coating using a fan case, Technology Readiness Level 6: cyclic mechanical testing, and testing of requisite duration / conditions to confirm acceptable material properties / system performance, which is required for production release. Finally, post-test inspections will be conducted to assess damage, durability, etc.

Implementation of the revised manufacturing process is projected for the first quarter of FY2024. The estimated duration for implementation is nine months for validation / verification activities and updates to the final assembly drawings.

PERIOD OF PERFORMANCE:
May 2021 to April 2023

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

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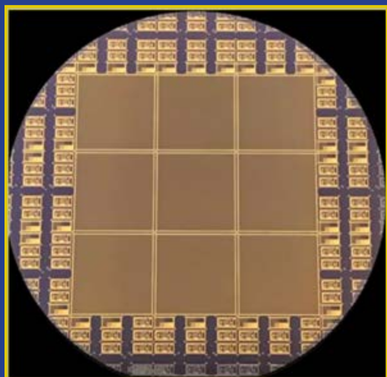
STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$800,000

Etching and Hard Mask Improvements Lead to Higher Rate Production of F-35 EODAS



PERIOD OF PERFORMANCE:
September 2021 to March 2024

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

POINT OF CONTACT:
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STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$2,377,000

A2925 — III – V Detector Process Improvement

Objective

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 battlespace. 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.

Payoff

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). Implementing an optimized etch process will improve manufacturability, strengthen yield and significantly reduce cost.

The current hard mask process is complex and can cause pinhole openings resulting in cluster defects. Implementing a new hard mask process will reduce or eliminate the number of pinhole openings, reduce the potential number of cluster defects (improve yield), greatly decrease the overall process complexity and increase cycle time to further reduce cost.

The current photolithography process can introduce photoresist bubbles and gel slugs that create cluster defects. Improving the photolithography process by using a new coat and developing a track tool with advanced capabilities over the existing tool will decrease cycle time and increase product yield.

The current metal deposition process is composed of photolithography, evaporated metal deposition and lift-off steps. Implementing an optimized metal contact process will significantly shorten the process flow, thus eliminating a photolithography and lift-off step and saving time and reducing cluster defects.

The current dicing process employs a two-pass recipe. Optimizing both front-side and back-side chip outs with a single-pass process without a blade change will save cycle time and reduce defects and corresponding yield improvement.

Together, these tasks will potentially increase infrared detector yields up to 18 percent for Lots 16-19 of the F-35 Lightning II Program.

Implementation

The F-35 Lightning II EODAS is the transition platform. These producibility improvements will follow a rolling implementation process. Processes will be implemented as they are completed, qualified, approved and cut into production prior to completion of this project. These manufacturing process-level changes are required to be reviewed and approved by the internal Raytheon Technical Review Board. This EOC project will implement multiple industry-approved process changes beginning as early as the second quarter of FY2023, impacting Lots 16 - 19.

Manufacturing Technologies and Inspection Techniques for Boot Disbond Process Improvement

A2947 — Boot Disbond Improvement

Objective

As the F-35 Lightning II Production Program continues to grow, Lockheed Martin Aeronautics (LM-Aero) is focusing efforts on achieving the ramp to full rate production. Part of these efforts focuses on implementing various advanced manufacturing technologies and process improvements aiming at reducing F-35 Lightning II costs. A specific manufacturing challenge for the F-35 Lightning II program is the occurrence of disbonds and voids on Outer Mold Line (OML) bonded materials known as boots. Boots are a coating type material bonded to F-35 Lightning II doors and panels that require a complex, labor-intensive manual operation for application.

The objective of this Composites Manufacturing Technology Center (CMTC) effort is to address two of the high drivers for boot disbonds and liquid epoxy process improvements. The team is developing two manufacturing technologies to address these drivers. The two selected technologies being developed include liquid epoxy mix on demand and vacuum bagging tools.

LM-Aero is also collaborating with Pennsylvania State University's Applied Research Lab to develop an inspection system capable of identifying and quantifying boot disbonds. The team is reviewing shearography and thermography systems as part of this effort.

Payoff

For this effort, the LM-Aero team will develop the following technologies for complex boots to provide boot disbond improvements: boot disbond inspection system, liquid epoxy mix on-demand system and custom-molded boot vacuum bagging tools.

The successful development of these proposed technologies has the potential to provide $9.7M in production savings for the program. For this effort, these cost-savings are achieved with the reduction in hours per unit (HPU) and scrap, repair and rework (SRR). LM-Aero assumes a SRR reduction of 50 percent as a result of the technologies developed with this effort and a HPU reduction of 80 percent as a result of the mix-on-demand system development with this effort.

Implementation

Following completion of the effort, LM-Aero will recommend manufacturing and inspection technologies to be implemented within the F-35 Lightning II production line to reduce boot disbonds and to provide improved liquid epoxy mixing and boot inspection.

LM-Aero will seek both F-35 Lightning II Affordability and Program Non-Recurring funding for implementation, if required. Each fiscal year, all projects are evaluated based on progress at established technology gates and/or Kaizen Events to ensure the project meets requirements such as benefit to the program, return on investment and savings. If this effort does not require Affordability funding for implementation, then other LM-Aero internal investments (e.g., Internal R&D, Capital, Contract funds) will be used to support implementation outside the scope of Affordability.

Implementation is expected to occur in the fourth quarter of FY2023 and is anticipated to include identification of necessary qualification testing and changes to procedures, work instructions and drawings.

PERIOD OF PERFORMANCE:
August 2021 to February 2023

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

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STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$1,400,000

Substrate Thinning and Rapid Thermal Annealing Streamline F-35 EOTS Wafer Processing

PERIOD OF PERFORMANCE:
October 2021 to October 2023

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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STAKEHOLDER:
F-35 Lightning II Joint Program Office (JPO)

TOTAL MANTECH INVESTMENT:
$1,052,000

A2950 — EOTS FPA Advanced Processing Techniques

Objective

The EOTS is a high-performance, lightweight, multifunctional system for precise air-to-air and air-to-surface targeting. Production of the EOTS focal plane array sensing element and the integrated Dewar cooler had initially suffered from inefficiencies and were unable to meet production quantities at the required cost points when the EOTS multiple-phase producibility effort was initiated. Since the producibility program's inception, significant improvements have been made to meet production quantities at the required cost points. Leveraging the success achieved in the previous phases of the F-35 Lightning II Electro-Optical Targeting System (EOTS) producibility projects, this Electro-Optics Center (EOC) project continues to execute cost and risk reductions for the EOTS infrared detector critical to the continued production-quantity delivery and cost-reduction goals.

Payoff

The current automated optical inspection (AOI) tools are used for defect tracking, and final die grading is performed manually by operators. Implementing artificial intelligence capabilities for the AOI system will significantly reduce operator touch time and inspection time.

The current processes for read-out integrated circuit wafer grinding, thinning for detector wafers and metrology measurement / data collection are not optimized for processing time and yield. Implementing new substrate-thinning processes will reduce touch time and cycle time as well as improve yield.

The current anneal process is outdated, the in-house equipment is no longer supported by the vendor, and the existing equipment has a large footprint in the cleanroom. Implementing a new rapid thermal annealer system will save on process time, touch time and cleanroom space.

Together, these tasks are expected to save approximately $2.9M for the F-35 Lightning II Program.

Implementation

The F-35 Lightning II EOTS is the transition platform.

These producibility improvements will follow a rolling implementation process. Processes will be implemented as they are completed, qualified, approved and cut into production prior to completion of this project. These manufacturing process-level changes are required to be reviewed and approved by the internal Santa Barbara Focal Plane Process Control Review Board. This EOC project will implement multiple industry-approved process changes in beginning with Lot 15 as early as the second quarter of FY2022. This project is of interest to the Air Force Research Laboratory.

CH-53K Projects

CH-53K Heavy Lift Helicopter.
(U.S. Navy image.)

Development of Automated Flexbeam Manufacturing Cell Decreases Inefficiencies

PERIOD OF PERFORMANCE:
November 2019 to December 2022

PLATFORM:
CH-53K

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

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STAKEHOLDER:
PMA-261

TOTAL MANTECH INVESTMENT:
$5,250,000

A2739 — CH-53K Flexbeam Automation

Objective

Existing CH-53K tail rotor blade flexbeams are expensive to manufacture and are predominately built using a manual lay-up process. Each flexbeam consists of several hundred individual plies that are stacked by hand. Current process inefficiencies include significant labor for manual debulking, raw material waste, ply kitting / interim kit storage and transfer and manual layup.

The purpose of this Composites Manufacturing Technology Center project was to develop, build and validate a fully automated manufacturing cell to cut, laminate and debulk the plies necessary to layup a complete flexbeam.

Payoff

The anticipated labor cost-savings of an automated fabrication approach for the tail rotor flexbeam, as opposed to the current hand layup process, are approximately $78.3M over 155 aircraft and 2,352 spares.

Implementation

Contingent upon successful installation and validation of the flexbeam manufacturing cell, Sikorsky and the CH-53K program will productionize this process. This is expected to include limited fatigue testing, teardown and first article inspection. Automated production is targeted for insertion as early as the second quarter of FY2023.

Sikorsky will work with PMA-261 through the Project Cost and Affordability Tracker (PCAT) process to secure the funding required to develop the full-scale, production-ready, automated flexbeam manufacturing cell that was proposed in the project plan. Follow-on funding for the validation testing noted above will also be coordinated with PMA-261 through the PCAT process as well.

In addition, Sikorsky will work internally to ensure adequate facilities are planned and funded appropriately to productionize the automated flexbeam manufacturing cell. Items to be considered will include, but are not limited to, clean-room availability and ensuring that suitable facility requirements are met, and proper utilities are in place for the manufacturing cell.

Upon successful demonstration of the technology and verification of the business case, Sikorsky will submit the project into its normal approval cycles required for typical technology insertion on CH-53K.

Depot-Enabling Capability for Damage Inspection

A2841 — Large-Area Fuselage Inspection for CH-53K

Objective

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project was to identify, test and transition visual inspection technologies that are capable of detecting barely visible damage in integrated composite fuselage structures , beginning with the CH-53K. The candidate inspection technologies were assessed for both automated use and the ability to be deployed in the field. Inspection technologies that can accommodate exterior fuselage components and geometries while detecting required surface and sub-surface damage to the integrated composite structures were evaluated against NAVAIR requirements and Fleet Readiness Center East's (FRCE's) planned inspection capabilities and preferences. Based on the ability of the technologies to meet the prescribed detection needs, the team downselected to a manageable suite of technologies or a single inspection technology that can enable a 50 percent time reduction over current manual inspection methods.

Payoff

This project provided an enabling capability that the NAVAIR depot at Havelock, North Carolina, (FRCE) did not have – specifically, the ability to rapidly and accurately conduct the required induction inspection of the CH-53K fuselage. A preliminary cost benefit analysis showed that up to 95 percent savings in inspection time can be realized (from 19 minutes to just under a minute with new inspection methods). Based on the surface area to be inspected per full aircraft and average off-aircraft lots, cost-savings are projected to be between $89.0K and $34.0K, respectively, based on labor savings alone. This time reduction results in representative five-year cost-savings of over $18.5M. This conservative estimate does not include cost-savings related to finding composite damage that might not otherwise be found or flight crews that may be grounded due to extended maintenance induction times. Implementation of an automated inspection system can further improve the cost-savings as digital data logging is realized and the ability to review previously damaged areas on individual aircraft is enabled. The inspection system may also be used for the V-22 and F-35 aircraft and component inspection.

Implementation

Requirements for implementation include technical, financial, procedural, training and safety aspects. Preliminary implementation efforts supported by PMA-261 are planned to begin in late FY2023 and full implementation (i.e., equipment construction, installation, testing and demonstration at FRCE) will be complete in FY2024. Training associated with the automated system was funded by PMA-261. Use of the inspection technologies and application to the CH-53K was conducted as hands-on training with FRCE personnel prior to completion of the project. Inspection equipment-specific safety procedures, which govern policy, enclosures, personal protective equipment etc., was also drafted and reviewed by NAVAIR and other cognizant authorities prior to completion of the project. iMAST, with support from PMA-261 and FRCE, developed the business case required for full implementation and justification to proceed with this enabling inspection capability.

PERIOD OF PERFORMANCE:
June 2019 to September 2022

PLATFORM:
CH-53K

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDER:
PMA-261

TOTAL MANTECH INVESTMENT:
$1,050,000

Energetics Projects

A RIM-161 Standard Missile (SM-3) is Launched from the Aegis Cruiser USS Lake Erie.
(U.S. Navy image.)

RAM Technology Provides Safer and Cheaper Manufacturing of Energetic Materials

A2575 — Energetics Production Utilizing Resonant Acoustic Mixing (RAM)

Objective

A Resonant Acoustic Mixer (RAM) uses a novel mixing technology developed for the U.S. Army under a Small Business Innovation Research project that was patented in 2007. There have been subsequent laboratory-scale investigations of the technology at various labs throughout the Navy and Department of Defense (DoD). In the RAM, mixing is achieved by acoustical energy input to the material rather than mechanical mixing by moving blades. This means that, unlike current mixing, there are no moving parts in contact with the explosive material, which provides a significant safety advantage. Existing methods have the potential for friction initiation of energetic material if the blades and the bowl become off-set and make contact, or if foreign material enters the mixer and becomes lodged between the blades and bowl. This failure mechanism has resulted in past explosive incidents. Replacing mechanical mixing of energetics with resonant acoustic mixing would eliminate this safety hazard. The objective of the project was to develop and demonstrate a small munitions production process utilizing RAM-5 to mix the explosive fill.

Payoff

RAM technology offers a number of benefits as compared to current energetics mixing processes. Polymer-bonded explosive (PBXN-110), the explosive fill of the Mk 152 warhead, is currently manufactured using planetary vertical mixers. RAM offers a number of benefits over vertical mixing.

As mentioned above, RAM provides a significant safety advantage over vertical mixing and mixes much more quickly than conventional mixers. In addition, evaluation of the labor required for the proposed production process shows a cost reduction that, at current production levels, results in annual savings of $1.0M to Mk 152 production, providing a 2.5-year return on investment. Additional savings would be achieved when the newly proven technology is used for other existing programs and new work. RAM also offers reduced footprint, new capabilities and the potential to produce materials not easily processed using current mixing methods. Materials with higher viscosities and shorter pot lifes (solidification times) can be made.

Implementation

This Energetics Manufacturing Technology Center (EMTC) project resulted in a fully operational RAM production facility at the Naval Surface Warfare Center – Indian Head Division (NSWC-IHD), as well as a qualified RAM production process for the Mk 152 warhead to meet PMA-242 requirements. Direct transition to full production is anticipated following successful first article testing in FY2023.

Techniques and processes developed will support RAM programs elsewhere. Multiple Department of Defense contractors have already expressed interest in partnering with NSWC-IHD and utilizing the newly purchased RAM-5. Implementation is targeted for 2.75-inch insensitive munitions warheads, such as the Mk 152 and Mk 146. PMA-242 has signed a Technology Transition Plan to look at utilizing the RAM technology for full-scale manufacture.

PERIOD OF PERFORMANCE:
July 2014 to December 2022

PLATFORM:
Energetics / Mk 152

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology Center (EMTC)

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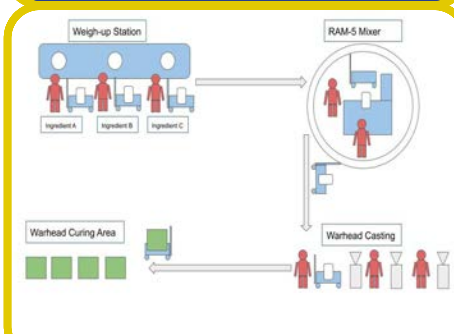
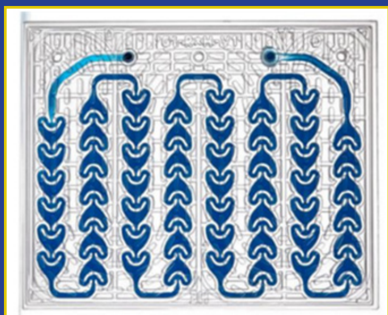
STAKEHOLDER:
PMA-242

TOTAL MANTECH INVESTMENT:
$2,590,000



AFR Technology Provides Safer and Cheaper Manufacturing of Energetic Materials



PERIOD OF PERFORMANCE:
October 2016 to December 2023

PLATFORM:
Energetics / Navy Gun-Launched Systems

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology Center (EMTC)

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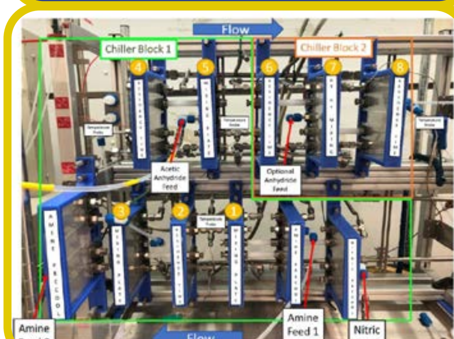
STAKEHOLDER:
PEO IWS 3C

TOTAL MANTECH INVESTMENT:
$3,920,000



S2719 — Advanced Flow Reactor Energetics Manufacture

Objective

N-alkyl-N-(2-nitroxyethyl) nitramines (NENAs) have been demonstrated to be effective energetic plasticizers in gun propellants while reducing sensitivity to unplanned stimuli relative to nitroglycerin. The use of NENAs in gun-propelling charges has increased the demand for NENA materials, thus, sustainable manufacture of NENA blends requires investment to demonstrate and document a safe, economical method. A fully continuous process is envisioned as the solution.

The scope of this Energetics Manufacturing Technology Center (EMTC) project is to adapt the existing batch co-nitration chemistry to a continuous Advanced Flow Reactor (AFR). The co-nitration synthesis of methyl / ethyl NENA is planned as the design criteria for the AFR. Methyl / Ethyl NENA is produced via separate methyl and ethyl batch syntheses, followed by physical blending to create the 58 percent methyl / 42 percent ethyl ratio. Co-nitration of the two components provides improvements by reducing the number of reactions and has been demonstrated at the laboratory scale. It is expected this method will extend in application to other NENAs as well, including butyl NENA.

Payoff

Continuous nitration via AFR offers a number of benefits compared to batch NENA processes. Batch synthesis utilizes multiple reactors to complete the two-step synthesis, as well as flow-on wash and separations. Through consolidation, a continuous process will provide improvements in the following areas.

Improved Safety – The actual amount of material participating in the nitration reaction at any given time is reduced from the multi-gallon batch reactor size to grams at the continuous flow reactor size. Due to the small quantity undergoing the synthesis reaction, there is a much higher contact surface area with the temperature control plates for a given reaction volume, resulting in better heat transfer and reaction temperature control, as well as prevention of runaway reactions.

Improved Product Quality – Reaction kinetics are more stable with consistent reaction temperatures and heat transfer. Once the continuous flow reaction has reached a steady state, material produced will have consistent quality from start to finish.

Reduced Footprint – Production rates for an AFR unit with an anticipated footprint of 24 square feet will be comparable to production rates utilizing standard batch reactors that would occupy a footprint of 2,490 square feet, including associated chillers and temperature control units, which equates to a 100-times reduction in plant footprint.

Implementation

The successful completion of this project will result in a fully operational NENA production facility at Naval Surface Warfare Center – Indian Head Division (NSWC-IHD) capable of producing metric tons of material annually, as well as a demonstrated methyl / ethyl NENA and butyl NENA production capability that meet existing reference quality requirements.

Developing a Domestic Source of Critical Antioxidant DNPD

A2720 — Development of DNPD Manufacturing Process

Objective

N,N'-di-2-naphthyl-p-phenylenediamine (DNPD) is a component of the antioxidant package used in air-to-air missile propellants, including the AIM-120 Advanced Medium Range Air-to-Air Missile. DNPD is the primary antioxidant in this propellant, working to maximize propellant shelf life by inhibiting oxidation of the binder network. A continental United States (CONUS) source of DNPD has not existed since its U.S. manufacturer discontinued the product. Production of propellant using DNPD has proceeded with outside the continental United States (OCONUS)-sourced material since then.

The objective of this Energetics Manufacturing Technology Center (EMTC) project was to develop and scale up a cost-effective method for synthesis and purification of DNPD that meets customer material specification HS 6-0089A. A further objective was to establish a reliable, CONUS-based source for DNPD of consistent quality and availability for propellant production. If such a source were established, DNPD may become the antioxidant of choice for next-generation propellants owing to its combination of performance, price and availability.

Payoff

This project has established a production capability for DNPD at Naval Surface Warfare Center – Indian Head Division (NSWC-IHD), ensuring a stable supply of the material for propellant manufacturing. The quality of material produced meets or exceeds customer (i.e., propellant manufacturer) requirements and performance parity with the current OCONUS material source is being determined through qualification testing.

Implementation

The development of the DNPD manufacturing process was performed between FY2017 and FY2021 at NSWC-IHD. Scientific and patent literature research were followed by laboratory experimentation to determine a viable synthesis route, after which the process was scaled up to the appropriate size to demonstrate a further scalable manufacturing process. Throughout development, NSWC-IHD worked with the customer to verify that the DNPD was of acceptable quality.

A lot of DNPD was produced at NSWC-IHD and sent to the customer in early FY2022 for use in propellant mixes for qualification testing and aging studies. Unaged propellant tests will be completed in the first quarter of FY2023, and the aging studies will be completed in the third quarter of FY2023. The process development and scale up were documented and published in an internal NSWC-IHD technical report.

PERIOD OF PERFORMANCE:
October 2016 to December 2022

PLATFORM:
Energetics / AMRAAM Missile (AIM-120)

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology Center (EMTC)

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STAKEHOLDER:
PMA-259

TOTAL MANTECH INVESTMENT:
$2,027,000

Enabling Advanced Propellant Manufacturing

PERIOD OF PERFORMANCE:
October 2017 to December 2022

PLATFORM:
Energetics / M91 Impulse Cartridge utilized on the AV-8, F-5, F-16, and T-38

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology Center (EMTC)

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STAKEHOLDER:
PMA-201

TOTAL MANTECH INVESTMENT:
$2,050,000

A2774 — Additive Manufacturing for Propellants

Objective

The objective of this Energetics Manufacturing Technology Center (EMTC) effort was to enable the advanced manufacture of U.S. Navy / U.S. Marine Corps critical, solid propellant grains for use in cartridge actuated devices (CADs) and propulsion systems. Additive manufacturing (AM) is an advanced manufacturing technology that has the potential to produce lower cost propellant grains with little-to-no induced thermal stress / strain during cure. Under this effort, two types of AM technology were explored for use in propellant manufacturing: material extrusion and vat photo-polymerization. Adaptation of these AM technologies for energetics will enable both composite and single- and double-base forms of propellants to be manufactured using advanced techniques.

Payoff

AM has become an attractive technology for low-volume production of specialized parts for as-needed applications. AM has flat cost per part vs. production volume curves and would be far less sensitive to changes in product demand. While the year-to-year demand for the manufacture of new CADs containing HES-5808 is difficult to project, an advanced manufacturing technique like AM will provide increased sustainability and lower costs. Additionally, the implementation of an AM process will likely eliminate "cracking" commonly found during traditional grain manufacturing and would enable consistent CAD performance due to the potential for higher precision printed grains.

Implementation

The initial focus was on transitioning AM-produced HES-5808 grains into the M91 Impulse Cartridge utilized on the AV-8, F-15, F-16 and T-38 aero-platforms. Upon completion of this project, the final formulation and technical information will be submitted to the CAD technical agent to determine energetic material qualification requirements and testing. Following this, Naval Ordnance Safety and Security Activity approval will be sought to use the AM-produced grain in the end-item application and validated by a design verification test (DVT). A critical design review (CDR) will analyze the results of the DVT prior to beginning the device qualification process. After the CDR, service release testing (SRT) will be conducted. SRT results will be reviewed to ensure all technical requirements are met and, if found acceptable, a Type III service release will be issued to allow manufacturing of the M91 with the AM grain. In order to achieve implementation of the AM-produced HES-5808 grain, the JPO technical agent Naval Surface Warfare Center – Indian Head Division (NSWC-IHD) will conduct the AM HES-5808 and M91 Impulse Cartridge qualification. These activities are currently projected to complete by the end of FY2026.

RAM Enhances Manufacturing of Delay and Ignition Composition

A2775 — Tungsten and T-10 Delay Composition via RAM

Objective

Pyrotechnic delay compositions are carefully engineered energetic materials that function to burn at a specific, known and consistent rate. The delay compositions are pressed into a delay column, which is the primary component of delay cartridge actuated devices (CADs) that are critical components of U.S. Navy aircrew escape systems. Delay cartridges allow for and provide timing between various sequencing of system components to ensure that all the functions of the aircrew escape system have sufficient time to occur and that the timing of events is correct for a safe, successful emergency egress event.

There are three main delay compositions used in CADs for escape systems and ejection seats: tungsten, T-10 and Z-1. This project focuses on tungsten and T-10 specifically due to the following considerations related to safety, manufacturing challenges and production demand.

The most important consideration with respect to this investigation of the feasibility of manufacturing tungsten and T-10 delays via RAM is personnel safety. All three CAD / propellant actuated devices (PAD) delay compositions are manufactured through an attended mixing process due to the current lack of capability to support remote mixing. Implementing a RAM manufacturing process would eliminate the use of attended mixing for CAD / PAD delay compositions and would benefit all three of the delay compositions and the associated end-items and platforms.

Payoff

This Energetics Manufacturing Technology Center (EMTC) project will achieve the following: improved delay composition manufacturing capability, updated mixing technology (safety advancement – remote mixing), improved mixing controls, reduced processing equipment footprint and a better product due to time, cost and quality improvements.

This project also has the potential to be the first Naval Surface Warfare Center – Indian Head Division (NSWC-IHD)-manufactured application to use RAM-manufactured material in human-rated devices, with the goal of using RAM technology to manufacture all CAD / PAD delay compositions and secondary ignition compositions.

Implementation

Completion of a successful first article test in a cartridge application is required prior to full-scale production use of the RAM-manufactured delay compositions. This project will enable the production of tungsten and T-10 delay compositions with various burn times and ignition compositions to meet production needs starting in FY2023. These compositions are used to manufacture delay cartridges that are components of aircrew escape systems on F/A-18, T-34C and AV-8 aircraft. First article testing will be completed in FY2024.

PERIOD OF PERFORMANCE:
October 2017 to September 2023

PLATFORM:
Energetics / Aircrew Escape Systems
F/A-18, T-34C and AV-8

CENTER OF EXCELLENCE:
Energetics Manufacturing
Technology Center (EMTC)

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STAKEHOLDER:
PMA-201

TOTAL MANTECH INVESTMENT:
$1,039,000

Development of a Source of HNS for the Production of HNS

PERIOD OF PERFORMANCE:
November 2018 to December 2022

PLATFORM:
Energetics / CAD / PAD Devices

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology Center (EMTC)

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STAKEHOLDER:
PMA-201

TOTAL MANTECH INVESTMENT:
$864,000

A2776 — Development of HNS Manufacturing Process

Objective

Many of the currently fielded air- and surface-launched Navy missile programs were initially developed 20-30 years ago. As such, these programs may experience material-related issues including material obsolescence, discontinued products, inconsistent quality or characteristics of material from manufacturers and diminished manufacturing sources.

These issues make it necessary for alternate materials and/or sources to be identified to perform the same or similar function as the material being replaced. In some instances, a modification of a formulation may be necessary in order to allow systems to continue to be manufactured without interruption. Any formulation modifications would need to be evaluated in advance so that the necessary changes can be made without program interruption.

The established process for the production of hexanitrostilbene (HNS) is the classic one-step Shipp procedure. The Shipp process typically produces a crude yield of 30-55 percent that requires further purification and results in even lower overall yield. A two-step process for small-scale synthesis of HNS is also reported. The first step is the synthesis of the intermediate hexanitrobibenzyl (HNBB) and the second step is the oxidation of HNBB to HNS. The objective of this work is to optimize the two-step process in such a way that a large-scale synthesis of HNS becomes feasible and cost effective. This will provide the Navy and the Department of Defense with a reliable CONUS source of HNS.

Payoff

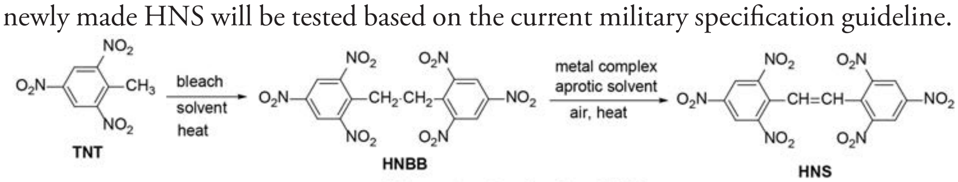
Successful production at Naval Surface Warfare Center – Indian Head Division (NSWC-IHD) will provide a readily available, cost-effective and reliable, CONUS source of HNS.

Implementation

The successful results of this Energetics Manufacturing Technology Center (EMTC) project will be used to provide large quantities of HNS-I and HNS-II. These quantities will be used to prove out the material utility in final (type) qualification studies for existing as well as future applications.

A two-step synthesis of HNS, in milligram scale, was studied at NSWC-IHD, Chemical Development and Manufacturing Branch. Each step was optimized for high yield, safety and ease of production. The data was used to carry out experiments in larger-multigram scale.

The process will move to the pilot plant in the coming months. Meanwhile, the newly made HNS will be tested based on the current military specification guideline.



A Two-step Synthesis of HNS

Continuous Acoustic Chemical Reactor Enables Flexible Support for Energetics Production

S2778 — Resonant Acoustic Continuous Microreactor (RACMR)

Objective

The objective of this Energetics Manufacturing Technology Center (EMTC) initiative was to develop and build a prototype Resonant Acoustic Continuous Microreactor (RACMR) for the nitration, oxidation and hydrolysis of energetic materials and their precursors. There are many advantages associated with the continuous production of chemical compounds. Continuous flow chemistry exhibits much better heat and mass transfer, smaller footprint and enhanced safety due to significantly smaller quantities of potentially hazardous chemicals at a given time. However, for reactions wherein solids are precipitated or deposited during the course of the reaction, clogging is an inherent problem. RACMR technology can provide a solution to this phenomenon and allow effective continuous production of slurries without clogging the reactor.

The material 2,6-diaminopyrazine-1-oxide (DAPO) was synthesized to demonstrate this capability. DAPO is the immediate precursor to the energetic compound 2,6 diamino-3,5-dinitropyrazine-1-oxide (LLM-105) and is currently produced via a batch process with low yields. To improve the cost, availability and quality consistency of DAPO, a continuous chemical reaction process that is capable of handling solids within the reaction pathway was desired. This chemical reaction process and the associated equipment are advantageous to other chemical syntheses, such as nitrations, oxidations and hydrolysis reactions for energetic compounds.

Payoff

LLM-105 was evaluated as a high-energy, low-sensitivity, secondary explosive material to replace varied percentages of Research Department eXplosive (RDX) and High Melting eXplosive (HMX) in propellant formulations. It is also applicable to the development of high-performance, low-sensitivity, mortar-propelling charges used by the U.S. Marine Corps. Development of a continuous chemical reaction process to manufacture DAPO will ensure a reliable and lower-cost supply of LLM-105.

Implementation

The successful completion of this project resulted in a fully operational continuous resonant acoustic chemical reactor prototype for the Naval Surface Warfare Center – Indian Head Division (NSWC-IHD) that is capable of continuously manufacturing energetic materials and their precursors whose synthesis involves the problematic precipitation of solids during the reaction. This was demonstrated at Resodyn by producing DAPO at kilogram throughput in high yield and purity with significant improvements over the existing batch process. While the RACMR was developed to produce DAPO as part of this initiative, it can also be adapted to produce other energetic materials and their precursors as well. Production of DAPO at NSWC-IHD is anticipated to begin in the third quarter of FY2025.

PERIOD OF PERFORMANCE:
September 2018 to July 2022

PLATFORM:
Energetics / Low-sensitivity mortar propelling charges used by USMC

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology Center (EMTC)

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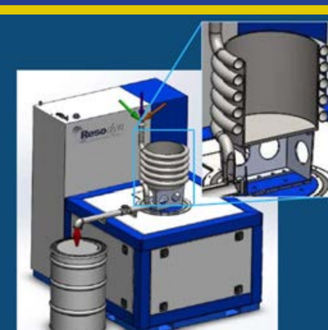
STAKEHOLDER:
MARCORSYSCOM

TOTAL MANTECH INVESTMENT:
$1,451,000



Development of the Next Generation of Demolition Explosive

PERIOD OF PERFORMANCE:
June 2020 to December 2022

PLATFORM:
Energetics / Composition C-4

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology Center (EMTC)

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STAKEHOLDERS:
PEO USC, PMS 408

TOTAL MANTECH INVESTMENT:
$1,047,000

S2900 — Fastpack Demolition Explosive (FPEX)

Objective

The U.S. Army and U.S. Marine Corps have documented operational deficiencies of M112 C-4 Demolition Block (DODIC M023), the most widely used plastic explosive demolition charge, related to the hardness and brittleness in cold weather environments, which affects every aspect of explosive ordnance and disposal (EOD) operations, as well as pliability issues, which leads to the restriction of the use of C-4 for demolition operations. The Joint Service Explosive Ordnance Disposal (JSEOD) Notional Concept 17-004, "Advanced Explosive Ordnance Disposal Energetics," documents the need to update the field of disposal energetics with a new demolition energetic that overcomes C-4 (MIL-C-45010) operational limitations and allows for low-temperature flexibility and high-temperature stability, matching or exceeding C-4 detonation characteristics, and a green and cost-effective manufacturing process. This Energetics Manufacturing Technology Center (EMTC) effort developed the next generation of malleable energetics, referred to as Fastpack Demolition Explosive (FPEX). FPEX will be an all-weather, moldable, easily compacted demolition explosive that matches or exceeds C-4 explosive performance. The FPEX manufacturing process will use state-of-the-art Resonant Acoustic Mixing (RAM) technology to deliver a one-unit, solvent-free, green and cost-effective manufacturing process.

Payoff

The Composition C-4 manufacturing process was developed in 1948. At the time, cheap labor and lower energy costs and environmental protection standards enabled the use of the multi-step water slurry process. The process produces a large quantity of waste and requires large quantities of energy, including heating and cooling, distilled water, wastewater treatment and solvent recovery systems. The process spans several production plants and requires at least six consecutive labor shifts to complete a batch. FPEX RAM-based manufacturing process decreases processing time from days to minutes, reduces / eliminates processing solvents, eliminates process wastewater, provides a biologically inert binder system that reduces health-related hazards and reduces manufacturing hazards associated with the use of mechanical mixers by performing high-speed mixing through vibration. In addition, this new demolition energetic material will help address the current operational limitations encountered by C-4 under extreme climates. FPEX will enable warfighters to perform demolition tactics, techniques and procedures under all-weather / environmental conditions.

Implementation

The FY2021 effort focused on developing FPEX formulation and the manufacturing process via LabRAM and acquiring the preliminary performance data. In FY2022, the formulation was scaled up to the RAM5 to simulate a small-scale manufacturing process. During the first quarter of FY2023, EOD and demolition operations will be conducted with FPEX and C-4. FPEX will undergo explosive qualification during FY2023-FY2027 as it transitions to the Insensitive Munition Advanced Development (IMAD) Program. FPEX is expected to be available to the end-users between FY2028-FY2029.

Novel Initiating Explosive Provides Warfighter with Safe, Lightweight and Reliable Weapon Systems Initiation

S2920 — Industrialization of Submicron Explosive for Ultra-Low Energy Initiator (µLEEFI)

Objective

The objectives of this Energetics Manufacturing Technology Center (EMTC) project are to demonstrate and qualify a novel initiating explosive for use in ultra-low energy exploding foil initiators (µLEEFI) and then demonstrate and qualify a novel ultra-low energy initiator. The warfighter needs lightweight, safe and reliable initiation systems. This technology is an enabler for future smart weapons when employed in multi-point configurations that facilitate directional, deformable and tailorable effects warheads, as well as inclusion in smaller smart munitions that may currently employ out-of-line devices and hot wire detonators. Future in-line safe initiation systems must consume less energy, volume and weight. This state-of-the-art explosives technology can meet the requirement for smaller, less energy-intensive systems.

The µLEEFI is a qualified in-line initiator (ILI) permitted for use without interruption. Advancements in ILI technology are required to enable much smaller initiation systems with lower energy demands. This project will demonstrate µLEEFI technology enabled by the use of sub-micron CL-20 harvested from industrial grinds of CL-20.

Payoff

Successful completion of this project will provide important benefits to the U.S. Navy in several areas, including improved cycle time, reduced cost and improved reliability.

In addition to the substantial reduction in process steps, handling and material movement, it is highly probable that this project will result in improved reliability by eliminating the current requirement for wetting and drying small particle size CL-20. Finely ground nitramines, including CL-20, typically agglomerate to some degree during drying. Eliminating the need for drying after shipment will result in a more consistent starting material for the mixing process.

The first programs that will receive this technology are unable to achieve reliable firing or consistent lot-to-lot performance using the current µLEEFI. The µLEEFI technology that is leveraging this novel explosive is a multi-threaded enabler that allows increased firing margin, use of smaller and lower cost components, and reduced supply chain risks. At a minimum, it is expected to save approximately $2.0M over the next five years by enabling the use of less expensive components and by guaranteeing a consistent future supply of enhanced explosives. This continental United States (CONUS) source will produce the required enhanced explosives using industrial processes with increased repeatability of quality, decreasing the material cost.

Implementation

After successful demonstration of the reproducible benefits of using the novel explosive in a µLEEFI, Naval Surface Warfare Center – Crane will assess the performance of the parts produced in the EMTC project in the end application. The measures of performance include an acceptable reliability at tactical all fire based on both threshold testing and functional testing after exposure to tactically representative environments. If the device demonstrates reliable performance across those environments, the data will be compiled and submitted to the program manager for review and approval for immediate implementation into the production pipeline.

PERIOD OF PERFORMANCE:
January 2021 to December 2024

PLATFORM:
Energetics / Special Purpose Munitions Initiation System

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology Center (EMTC)

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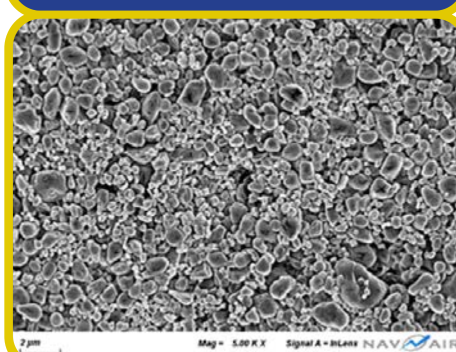
STAKEHOLDER:
NSWC-Crane

TOTAL MANTECH INVESTMENT:
$1,385,000



RepTech Projects

Hull Maintenance Technician 3rd Class Jesse Belfi Strikes a Welding Rod to Mend the Hinge of a Quick-Acting Watertight Door Handle Aboard the USS Bonhomme Richard (LHD 6).
(U.S. Navy image.)

Optimized Ceramic Coating Improves Wear and Prevents Calcareous Deposit

RT2837 — Submarine Large Diameter Ball Valve Improvement

Objective

The coating on large submarine ball valves is failing prematurely, resulting in emergent repairs at significant cost. Causes of increased torque are attributed to swelling of valve seats, loss of lubricity between the surface of the ball valves and seat due to the loss of the green coating, and calcareous deposits from marine growth. Damage to the surface finish of the valve ball coatings requires full restoration.

This Institute for Manufacturing and Sustainment Technologies project is evaluating ceramic coatings with an overcoat for hydraulically actuated valves with high torque output. The project will identify the contributing coating system deficiencies (porosity, density, uniformity, adhesion, microstructure, friction, etc.) and the failure mechanism of the ceramic-coated and Teflon™-coated titanium ball valves and their repair-processing parameters. The ceramic coating-application process, deposition parameters and coating microstructure will be evaluated and optimized, in order to provide the ultimate ceramic coating solution.

Payoff

An improved ceramic-coated ball valve system would eliminate a month-long honing operation and result in significant cost-savings and increased mean-time-between-overhaul, resulting in improved availability, less rework and reduced delays in complex repairs. The coating may also be applied to large and small diameter seawater ball valves further increasing the cost-savings. The total life-cycle cost-savings for the VIRGINIA Class submarine would be approximately $201.1M. Additional cost-savings would be realized with the COLUMBIA Class at a minimum of $58.9M, depending on the number of seawater ball valves. Early testing using an improved ceramic-coated ball valves system indicates potential life of boat reliability.

Implementation

The seminal transition event will be the satisfactory completion of a laboratory validation test of a 12-inch seawater ball valve assembly coated with an effective ceramic coating that improves wear and prevents calcareous deposit. This project will be completed at the end of FY2023 and will be available for implementation in the seawater system's ball valves on new construction submarines and back-fit on operational hulls on an attrition basis.

PERIOD OF PERFORMANCE:
April 2020 to July 2023

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDERS:
PMS 450, PMS 397

TOTAL MANTECH INVESTMENT:
$1,415,000

Improving the Electrical Isolation Capabilities of the TR-343 Transducer Will Improve Performance and Increase Reliability

PERIOD OF PERFORMANCE:
October 2020 to August 2023

PLATFORM:
RepTech

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDER:
PMS 401

TOTAL MANTECH INVESTMENT:
$279,000

RT2910 — TR-343 Isolation Ring Modernization

Objective

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project is to improve the isolation capabilities of the TR-343's piezoelectric acoustic ring stacks by increasing reliability and reducing premature failures. Improving the performance of the ring stack isolation and preventing premature failure will increase on-board reliability, contributing to the broader goal of realizing a 20-year service life. To achieve this objective, the project team is investigating two paths. The first path involves improving the manufacturability of the TR-343's isolation ring by investigating improved materials and processes to replace outdated practices. The second path involves developing an alternative isolation capability by combining the isolation and centering rings into one insulation component without degrading the transducer's acoustic performance.

Payoff

Improving the isolation capabilities of the TR-343 will reduce premature failures and help to extend the service life of the transducer. Financially, this directly correlates with a significant reduction in the annual cost of major overhauls and may improve component acquisition cost. Additionally, development of new processes / materials will increase the manufacturability of existing components, which is a current issue with legacy materials. Also, if a combined isolation / centering ring is successfully developed, it will reduce the parts list for each ring stack and decrease replacement costs by using common materials available from tens of suppliers, instead of sole sources.

Implementation

Prototype evaluation has been successfully completed. Project results began transitioning to Naval Surface Warfare Center – Crane (NSWC-Crane) in the fourth quarter of FY2022 for first article testing. Post-project testing, will includes UNDEX (underwater explosive shock), accelerated life and submerged acoustic testing. After all testing has been completed and validated, NSWC-Crane will submit all required engineering change proposals and begin updating existing TR-343 transducers as they are returned from the fleet for refurbishment starting in approximately the third quarter of FY2023.

Shop Floor Control Integration in a USMC Depot

RT2914 — Shop Floor Control at USMC Albany

Objective

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project was to improve the efficiency of the depot maintenance operations at the Marine Depot Maintenance Command (MDMC) by providing a modern Shop Floor Control (SFC) capability utilizing the new Navy Enterprise Resource Planning (ERP) system and supplementing it with the additional tools necessary to meet shop floor control requirements. A SFC system can transform the way manufacturing products are tracked, controlled and recorded. It provides the manufacturer, or in this case, the MDMC re-manufacturing depot, transparency of production information; lowers downtime; provides flexible production operations; and reduces quality costs with thorough traceability. It accomplishes this via the following functions:

- Quality control management – managing, tracking and assigning inspections, defect and non-conformances, and Statistical Process Control
- Capturing process data in real time
- Functionality for tracking work-in-process, data collection, traceability of components and assemblies
- Real-time work-order assignments
- Routing management of products, subassemblies and defective components
- Production line control overseeing the speed of production and assigning workload as needed
- Real-time analysis and reporting capabilities

MDMC will be the first naval depot with full ERP functionality, including shop floor execution processes in the depot.

Payoff

The main benefit of this project will be the implementation of an SFC system for the U.S. Marine Corps. The benefits and cost-savings have been documented in the open market of up to 50 percent reduction in inventory, management, production and logistics costs. Specifically for Marine Corps MDMC, cost-avoidance will initially be determined in reduced refurbishment cost, as enabled by less labor and more accurate construction schedules. In the long term, the benefit will be direct communication of vehicle information by the Marine Corps MDMC depot of fleet vehicle maintenance records for analysis and improvement.

Implementation

An implementation plan was published during the project based upon research developments. This plan included the Marine Corps ERP integration effort accomplishments and defined the attributes of a supportive SFC system. Responsibility for implementation will be Marine Corps Logistics Command (LOGCOM). A detailed implementation plan was developed for the selected applications that included, but are not limited to, the following:

- Confirmation of LOGCOM sponsorship
- Implementation schedule that matches ERP integration
- Initial development of procedures for integration into Marine Corps operations
- Tracking of cost-savings

PERIOD OF PERFORMANCE:
November 2020 to October 2022

PLATFORMS:
Light Armored Vehicles
Amphibious Assault Vehicles
MRAP Refurbishments

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDER:
USMC LOGCOM

TOTAL MANTECH INVESTMENT:
$800,000

Improving Stripping Operations for Off-Aircraft Parts

PERIOD OF PERFORMANCE:
January 2021 to August 2023

PLATFORM:
T-6 (Air Force and Navy)

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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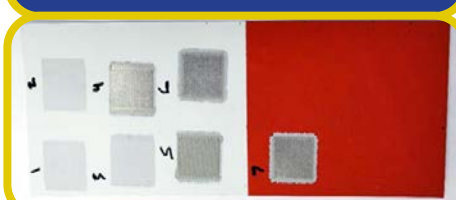
STAKEHOLDER:
FRCSE

TOTAL MANTECH INVESTMENT:
$1,400,000



RT2923 — Laser Ablation for NAVAIR Applications

Objective

Removal of aircraft coatings in Naval Air Systems Commands (NAVAIR) Fleet Readiness Centers (FRCs) is performed using various chemical, manual (hand sanding) and blasting methods. Many of these coatings contain hexavalent chromium (Cr+6) or other hazardous chemicals, which create occupational exposure and hazardous waste-disposal issues and are targeted for elimination by the Department of Defense.

This Institute for Manufacturing and Sustainment Technologies (iMAST) project is identifying and testing various laser-ablation technologies on NAVAIR off-aircraft parts to determine suitability for use in the depot. Top-performing candidate(s), in terms of cost effectiveness and technical feasibility, will be optimized and tested until one process is selected for qualification. iMAST will then qualify and transition a laser-ablation process to remove coatings from the selected Navy asset(s).

Payoff

The business case for this iMAST Repair Technology (RepTech) project is based on sustainment cost avoidance. Aircraft components were selected for laser stripping during Phase I of this project. Information specific to the trainer aircraft parts, such as current repair information, including preparation, stripping and clean-up in current blasting operations, is being gathered. Similar U.S. Air Force-sponsored projects have shown stripping times being reduced from 16 hours (hand sanding) to 45 minutes. Times are expected to be less significant for metallic parts but still substantial with associated significant savings.

Implementation

Implementation in sustainment operations at Fleet Readiness Center Southeast (FRCSE) will be pursued initially for T-6 off-aircraft parts. The NAVAIR fleet support team (FST) has approval authority for Navy T-6 aircraft. The data generated will be provided to the Air Force, ensuring the additional benefit of potential joint service application and wider applications. The project plan includes a secondary objective for process optimization, including different paints on the same or similar substrates. Additionally, chemical conversion coatings and primers (chromated and chrome-free) are being tested with the three top coatings used on Navy and Air Force trainer aircraft, which will provide insight for the removal of other coating strategies involving similar pre-treatments / primers with different top coatings. NAVAIR FRCSE is committed to this project as a way to reduce sustainment costs and improve process flow in maintenance and repair operations at fleet readiness centers in general. Implementation will be funded by Commander Fleet Readiness Centers (COMFRC) / FRCSE.

Improved Repair Process for CVN Components Yields Lower Costs and Faster Repair Times

RT2935 — Cold Spray for CVN Sustainment

Objective

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project was to develop and qualify cold spray repairs for CVN components that will result in lower repair costs, higher quality repairs and reduced repair times.

This project provided repair processes for components that have corrosion, wear or other surface damage using a cold spray-based process. The cold spray process is being used to repair several different components made from different materials that previously had zero or limited reparability using conventional weld build-up. The first component repair selected for development was the rotating coupling covers (RCCs). The traditional weld repair can result in distortion and extensive machining causing delays in the part's return to service and potential condemnation of the part due to distortion. The cold spray process reduces the amount of distortion and machining, which reduces the repair cost and time. Other components were also identified. An efficient and economical repair process greatly reduces operating costs, increases system availability and reduces repair times.

Payoff

The repair and reclamation of the RCCs offers significant savings through reduced repair costs and time. The estimated cost avoidance for the first five years of implementation is $3.0M for a return on investment of 10.1:1.

Implementation

The RCC repair process is being implemented at the NAVSEA pop-up cell in Chesapeake, VA, and at other vendor sites. Norfolk Naval Shipyard also has the capability to perform the repairs. This will be the ManTech program's first successful implementation of cold spray in a private shipyard. Implementation on the RCC and the other components to be selected is expected in the second quarter of FY2023.

PERIOD OF PERFORMANCE:
July 2021 to September 2022

PLATFORM:
CVN 68 Class

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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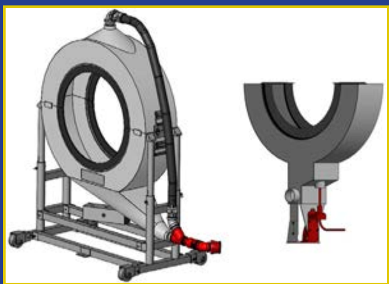
STAKEHOLDER:
PMS 378

TOTAL MANTECH INVESTMENT:
$150,000

Improving GRP Shaft Coating Removal Using Specialized Mechanical Water Blasting Equipment



PERIOD OF PERFORMANCE:
May 2021 to June 2022

PLATFORMS:
VCS, SSBN, SSGN, CVN

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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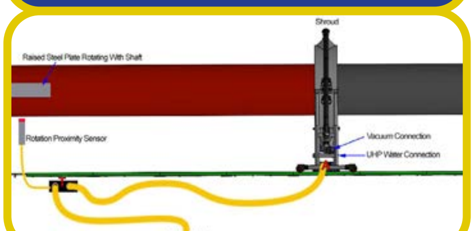
STAKEHOLDER:
NAVSEA 04

TOTAL MANTECH INVESTMENT:
$150,000



RTR2948 — Shaft Blasting with Ultra-High Pressure Water Jets

Objective

Removal of Glass Reinforced Plastic (GRP) shaft coatings must occur at the beginning of the overhaul process. Ultra-high-pressure (UHP) water blasting, which can generate jet pressures between approximately 30,000 pound-force per square inch (psi) and 60,000 psi, has become the preferred method to remove these robust coatings when applied to zero-damage-tolerance parts such as hulls and shafts. The high-pressure, in conjunction with constant motion, prevents damage to the valuable part underneath while fully removing the coating for inspection and eventual replacement.

This project sought to implement water blasting equipment as a time-saving and hazard-reducing stripping process. Previously, workers used manual water blasting (lancing) to remove coatings, but due to hazards, exhaustion, unpredictable production rate and difficulty containing hazardous waste, shipyards began experimenting with mechanized systems to improve production and the work environment.

The goal of this project was to create a purpose-built, minimal version of the mechanized water-blasting tool carrier delivered with the dual-track system previously developed by the Institute for Manufacturing and Sustainment Technologies (iMAST).

Payoff

This iMAST Rapid Response project successfully delivered specifically designed equipment for use in shaft blasting.

Project payoffs include:

- Increased worker safety
- Improved first-time quality of shaft coating removal
- Increased inspection quality before the shaft enters the Shop 31 repair processes
- Reduced Shop 31 production bottleneck by moving the shaft coating-removal process off of lathes
- Known production rate
- Improved hazmat collection

Implementation

In August 2021, an all-public yard training event and demonstration of the system was performed at Puget Sound Naval Shipyard (PSNSY). This event demonstrated the purpose and effectiveness of the single-track shaft blast system. After delivering a stand-alone system and electrical schematics to Portsmouth Naval Shipyard (PSNY), a shaft was identified for a training event held April 13, 2022. During this event, four operators were trained and five linear feet per hour was stripped from the shaft, achieving first-time quality of the shaft surface.

Optimizing Motor Generator Remanufacturing Efficiency

RTR2964 Motor Generator Rewind Optimization

Objective

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) Rapid Response project was to evaluate the current state of motor generator overhaul processes to identify potential areas that could be improved by incorporating new or mature technology in innovative ways. The iMAST project team documented its findings in a report detailing improvements focused on saving labor, improving first-time quality and decreasing workforce repetitive-stress injuries. Additionally, a project plan was developed to refine, test and implement identified solutions in future phases of a follow-on project focused on implementation.

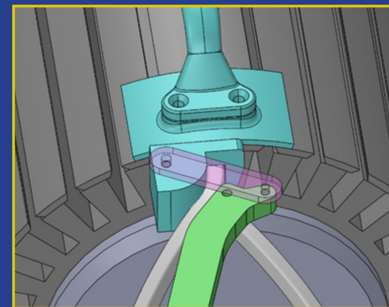
The identified solutions will improve the existing process by reducing the labor burden on Puget Sound Naval Shipyard (PSNS) Shop 51 by streamlining processes and improving tooling. This will lead to reduced labor and injuries to artisans, while improving the quality of the build.

Payoff

The primary benefit of the initial phase is an understanding of the challenges PSNS Shop 51 is experiencing, the motor generator-rebuilding process and the identification of a path to improve the process. If the solutions identified in this phase are implemented, cost and duration of rebuilds will be reduced, and quality and system availability will increase.

Implementation

This initial evaluation resulted in several recommendations for the PSNS Shop 51 personnel and the Technical Warrant Holder. An implementation plan will be developed during Phase I of the follow-on project, based on solutions implemented and tested.



PERIOD OF PERFORMANCE:
February 2022 to July 2022

PLATFORMS:
LOS ANGELES, VCS, OHIO, SEAWOLF Class Submarines, CVN

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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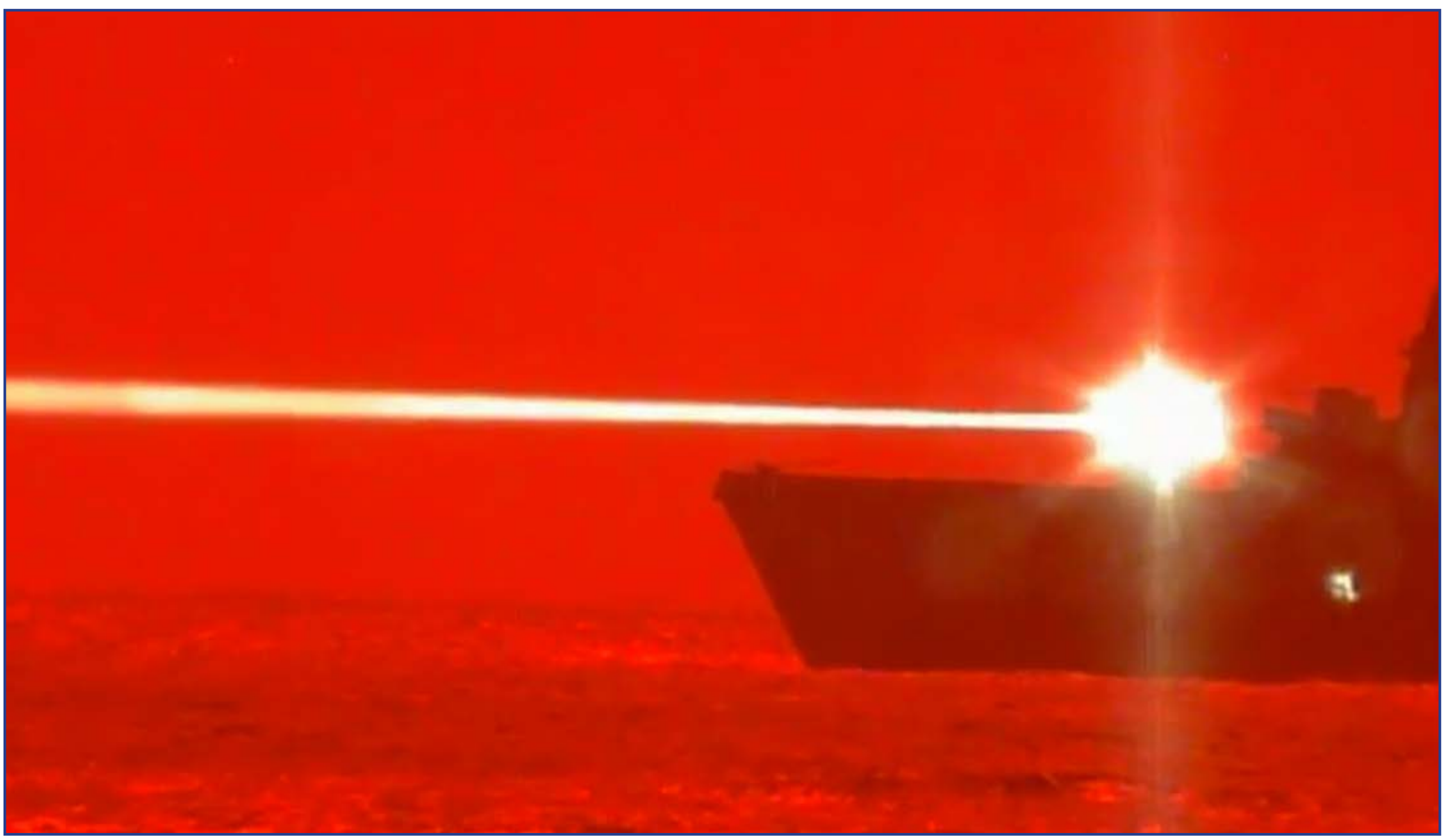
STAKEHOLDER:
PSNS S51

TOTAL MANTECH INVESTMENT:
$68,000

Capability Acceleration Projects



USS Portland (LPD 27) Successfully Disabled an Unmanned Aerial Vehicle with a Solid State Laser. *(U.S. Navy image.)*

Improving Optical Quality and Reducing Cost of High-Quality Spinel Optics

Q2790 — Laser Quality Spinel Optics

Objective

The objective of this Electro-Optics Center (EOC) project was to develop a low-cost powder purification technique that would allow for the production of low-cost, high-optical quality and rugged spinel optics. While small, lab-scale optics have been produced using powder that has been processed through a purification technique, large-scale production of both ultra-high purity powder and laser-quality optics has yet to be achieved. The final objective was to demonstrate the capabilities developed by this project by producing a large diameter optic that met or exceeded the requirements for high energy laser weapons and other system applications.

Payoff

A current limitation of spinel development is the high cost and low availability of commercial ultra-high purity powders. Developing a low-cost, high-volume powder purification technique for commercial low-grade powders would increase the supply chain, reduce the cost for ultra-high purity powder and increase interest in the inclusion of spinel in Navy systems. By advancing the development of a production-scale purification technique and demonstrating its capabilities, all Navy, and Department of Defense systems that would benefit from spinel can then leverage the project's results to take advantage of spinel's advantageous properties, such as middle wavelength infrared capability.

Implementation

The subcontractor CeraNova Corporation has developed a defined process for producing laser-quality spinel optics using the powder purification technique developed by this project. This process can be leveraged for the development of optics and elements, both flat and conformal, for use on Navy systems in need of a rugged alternative material that has increased capability over other materials including fused silica.

PERIOD OF PERFORMANCE:
September 2019 to November 2022

PLATFORM:
HEL weapon systems

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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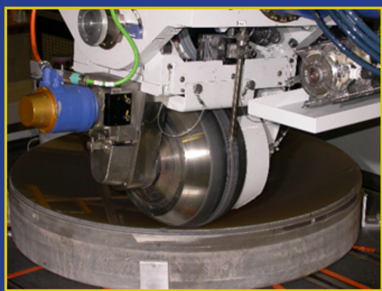
STAKEHOLDER:
TBD

TOTAL INVESTMENT:
$3,100,000

Lowering Cost of Large Optics with High-Rate Production Methods



PERIOD OF PERFORMANCE:
February 2020 to November 2022

PLATFORM:
HEL weapon systems

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

POINT OF CONTACT:
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STAKEHOLDER:
PEO IWS 2.0

TOTAL MANTECH INVESTMENT:
$2,223,000

S2834 — Production of Optics for High Energy Laser Weapons

Objective

Off-axis primary mirrors within high energy laser (HEL) beam directors have historically been produced in single quantities for demonstration systems. As HEL weapon systems move toward becoming Programs of Record for installation onboard ships, such as the DDG 51 Class destroyer, methods to increase production rates of these high-quality optics will be critical to meeting the needs of the Navy for fielding and maintaining HEL weapon systems.

This Electro-Optics Center (EOC) project developed and demonstrated a high-rate production method for 0.5 meter class off-axis, paraboloid primary mirrors, resulting in a lower unit cost while meeting HEL performance requirements. Manufacturing methods to reduce subsurface damage (microscopic fractures within the glass substrate) were developed to reduce the working time required to generate the optical surface. Additionally, advanced metrology methods that employ computer-generated holograms were used to reduce cycle times. This high-rate process was demonstrated in a production environment on uncoated mirrors having appropriate mounting and lightweight features for a HEL beam director. Subcontractor L3Harris collected production data and compared it against a historical baseline, as well as the production metrics established for the project, to demonstrate its support of future production demands for the Navy's High Energy Laser with Integrated Optical-dazzler and Surveillance weapon systems.

Payoff

Savings in both time and cost are expected from reductions in subsurface damage during figure generation and improvements in metrology that minimize processing time during high-cost operations. Traditional optical manufacturing processes for prototype quantities typically require 18 months to produce a 0.5 meter class primary mirror at a cost of over $150.0K. The project developed a high-rate optical manufacturing process that can produce 15-25 uncoated mirrors annually with a cost reduction of 33 percent. Results of the final demonstration supported a production rate of 24 uncoated mirrors annually and a cost reduction of 33 percent.

Implementation

The primary transition platforms for this project are the DDG 51 Class destroyer and FFG 62 Class frigate. Implementation is expected to be a natural transition to an updated best practice for primary mirror manufacturing on the current equipment for these platforms and many others as HEL weapon systems are fielded.

Improved Gold Coating Process for High Energy Laser Applications

S2845 — High Energy Laser Weapon System Gold Coating

Objective

Laser systems require highly reflective surfaces to properly function. There are very few vendors in the United States capable of gold-coating surfaces for the required reflectivity. In addition, the current coating system does not meet performance and reliability requirements due to poor coating adhesion.

This Institute for Manufacturing and Sustainment Technologies (iMAST) project will identify potential gold-coating vendors, define alternative processes, test and evaluate coating system performance and scale the manufacturing process to allow uniform, consistent gold coatings on substrate materials. Once a suitable candidate system is identified, the process will be scaled to meet system and design performance, as well as identify methods to reduce cost and improve affordability.

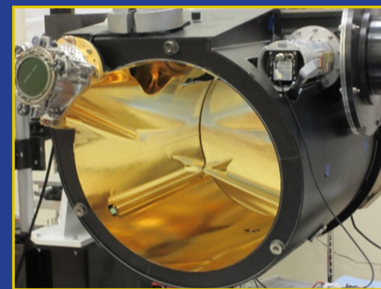
Payoff

The preliminary business case, based on pre-project figures, shows a reduction in acquisition affordability from $250.0K per high energy laser (HEL) beam-expander telescope system to approximately $125.0K. A reduction in life-cycle affordability from a current cost of $250.0K per HELBET system to approximately $125.0K is also expected. Schedule lead time is also expected to be reduced by three months after implementation, which will address high-priority defense / Navy needs.

This project addresses manufacturing technology beyond the normal risk of industry. These components have no commercial equivalent and are strictly for use in HEL weapon systems. The results of this project can also be applied to other HEL system platforms.

Implementation

Implementation on a Navy ship will be pursued depending on the construction schedule. Identification of potential gold coating vendors and/or alternative coating processes is expected in the second quarter of FY2024. iMAST and its partners are committed to this project as a means to reduce acquisition costs and obtain three months in lead time schedule savings. Implementation of this project requires successful coating identification / development by the iMAST project team and qualification and certification approvals by the Program Office technical authorities.



PERIOD OF PERFORMANCE:
January 2020 to July 2023

PLATFORM:
HEL weapon systems

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDERS:
PEO IWS 2DE,
ONR w35 SSL-TM

TOTAL MANTECH INVESTMENT:
$1,448,000

Testing and Process Protocols Improve the Reliability of High Energy Laser Optical Coatings

PERIOD OF PERFORMANCE:
August 2020 to July 2023

PLATFORM:
HEL weapon systems

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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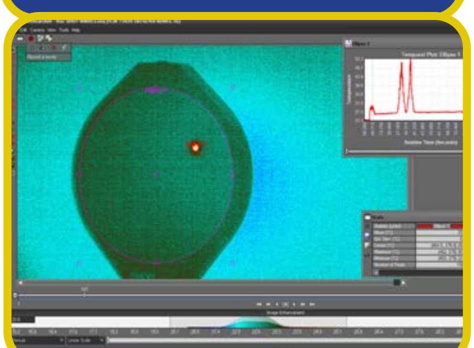
STAKEHOLDER:
PEO IWS 2.0

TOTAL MANTECH INVESTMENT:
$1,395,000



S2884 — High Energy Laser Optical Coating Reliability Improvement

Objective

High-reflectivity optical coatings intended for use in high energy laser (HEL) systems must be highly reflective, have low absorption and possess sufficiently low stress to maintain wave front specification. They must also have low defect densities with small defect sizes to mitigate the potential risk of failure from thermal runaway that can occur when a defect is exposed to high irradiance levels. Optical coating failures in HEL systems can lead to time-consuming and costly replacements that require skilled engineers and technicians. Prior testing has shown that very small defects can induce catastrophic damage when exposed to high-intensity laser light. As HEL weapon systems move toward Programs of Record and are installed onboard ships, such as the DDG 51 Class destroyer and the FFG 62 Class frigate, a higher level of optical coating reliability will be essential. This Electro-Optics Center (EOC) project will improve the reliability of HEL weapon systems optical components by understanding how coating defects impact coating performance, developing coating process improvements to minimize such defects while maintaining or improving optical properties, and resulting in lower life-cycle costs and improved system availability. While this project functions as a risk-reduction effort, it also supports the requirement for higher laser power of future systems.

Payoff

Improved coating reliability will directly translate into improved HEL weapon systems reliability, resulting in increased availability and lower life-cycle costs, primarily from reduced maintenance costs. Successful execution of this capability acceleration project will result in advanced test protocols and advanced metrology methods that ultimately support the production of coatings with improved reliability for HEL weapon systems. The project also seeks to demonstrate HEL coatings from commercial suppliers with higher reliability than currently available for HEL weapon systems to achieve significant life-cycle savings and to avoid lengthy repairs.

Implementation

The primary transition platforms for this project are the DDG 51 Class destroyer and FFG 62 Class frigate. Implementation is expected to be achieved through Department of Defense use of the HEL coating specification and inspection protocols resulting from Phase I of the project. The improvements in the coating process to reduce defects are expected to naturally transition as best practices to meet the HEL coating requirements for the weapon systems.

Demonstrating Alternate Manufacturing Methods and Materials to Reduce Bulkhead Lead Time

S2895 — ORCA XLUUV Bulkhead and Fixed Control Surface Substructure Improvements

Objective

The vast majority of the primary structure bulkheads in the Extra Large Unmanned Undersea Vehicle (XLUUV) are unitized machinings. Long lead times for material procurement, long processing times for bulkhead fabrication and limitations in capacity to fabricate these large items present obstacles to accelerating XLUUV production. Single piece designs constrain fabrication options since there is a limited supply base of companies with the capability to process and machine components this large. In addition, lead times for obtaining the large billets are long. This situation increases the risk of production delays, and the throughput of the limited supply base presents potential bottlenecks in production.

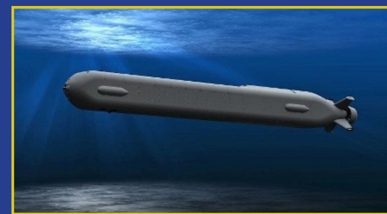
This Center for Naval Metalworking (CNM) project is establishing the technical feasibility and benefits of implementing a new XLUUV bulkhead design that accelerates capability by solving the problems of manufacturing inflexibility, long lead times and high material cost. Boeing and CNM are currently executing Phase I, which includes baselining, concept identification, trade study, concept and process development and sub-scale testing. Phase II consists of prototype design, fabrication and testing.

Payoff

The interim business case, which is based on work currently underway, shows estimated savings up to $800.0K per XLUUV hull and 33 percent reduction in bulkhead lead time. At the conclusion of the project, Boeing will submit a final benefits analysis.

Implementation

The transition event will follow the successful demonstration of the prototype through full-scale testing. Implementation plans will continue to develop in parallel with project execution and Program Office evaluation of future production.



PERIOD OF PERFORMANCE:
September 2021 to September 2023

PLATFORM:
XLUUV

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

POINT OF CONTACT:
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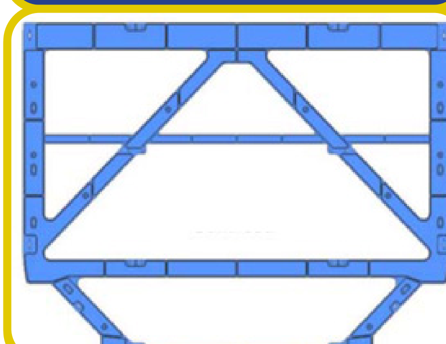
STAKEHOLDER:
PMS 406

TOTAL MANTECH INVESTMENT:
$3,121,000



Navy ManTech Increases MQ-25A Mission Capability

PERIOD OF PERFORMANCE:
June 2022 to June 2024

PLATFORM:
MQ-25A

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

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STAKEHOLDER:
PMA-268

TOTAL MANTECH INVESTMENT:
$3,565,000

A2896 — MQ-25A Lightweight Composite / Hybrid Nozzle

Objective

The unmanned MQ-25 flight vehicle enables extended combat range of deployed F/A-18 Super Hornet, EA-18G Growler and F-35C fighters through its refueling capability, and conveys additional mission-readiness opportunities for tactical aircraft, which were previously encumbered with refueling missions. The current focus is on identifying and maturing manufacturing technologies and design concepts to reduce the MQ-25 airframe weight, enabling additional fuel available for offload to maximize this capability. One key piece of structure identified with significant weight-savings opportunities is the exhaust nozzle. The objective of this Composites Manufacturing Technology Center (CMTC) project is to develop and validate a lightweight exhaust nozzle through investigation and analysis of alternate materials and designs, concluding with a full-scale demonstration using high temperature-capable polymer matrix composite as a drop-in replacement for the baseline nozzle. A manufacturing process will be investigated that produces a hybrid exhaust nozzle composed of metallic and non-metallic materials. The full-scale demonstration will occur on the most complex section to reduce the risk for the remaining design and implementation activities.

Payoff

The primary benefit resulting from a material change and associated redesign of the exhaust nozzle is the airframe weight reduction, allowing for increased mission capability. Additional benefits are the potential for a reduction in lead time, which will be quantified during project execution, and estimated savings of $400.0K per aircraft by elimination of the metallic nozzle.

In addition to the weight savings, the lead time for a nozzle is expected to reduce by 12 months by changing nozzle material and vehicle performance improvement is anticipated by enabling additional system integration.

Implementation

Implementation activities consist of detailed design of the remaining nozzle sections and testing, as well as a detailed drawing release. A material and processing specification will need to be generated and released in advance of fabrication and flight test of an article. It is anticipated that design activity could occur in parallel to this Navy ManTech project to accelerate technology insertion, which is expected to be as early as FY2026.

Recovering Lost Sonar Manufacturing Technology and Insertion of Advanced Materials

S2905 — Advanced Hydrophone Manufacturing and Materials

Objective

The objective of this project was to re-establish lost manufacturing technology for acoustic transducers and develop the manufacturing process for advanced-technology transducer materials to enable improved detection. The U.S. industrial base for Navy transducer manufacturing has significantly shrunk as a result of industry consolidation, foreign buyouts and a focus shift toward high-volume commercial and medical applications. Completion of this Institute for Manufacturing and Sustainment Technologies (iMAST) project yielded a detailed, government-owned, technical data package that supports vendor development over the next several decades. This will ensure a continuous supply base to meet the immediate need for acoustic-threat detection focusing on six-inch spherical transducer applications. Second, this project addressed continued innovation for undersea sensor technology via insertion of textured ceramics in various Navy acoustic systems. Successful completion resulted in modernized material technology and enhanced threat detection.

Payoff

This iMAST capability acceleration project will immediately fill a gap left by decay of the existing ceramic sonar component industry. It created a robust Navy-owned manufacturing process and documented it in explicit detail to facilitate the incorporation of future vendors capable of delivering this unique and critical product to the Navy. In addition, it allows for rapid insertion of new materials into these same critical applications to provide advanced detection capabilities.

Implementation

Implementation was carried out in two phases. Phase I resulted in successful development of forming, densification and machining processes for large ceramic hemispheres. Processes developed by this effort were demonstrated at industrial scale by key commercial partners verifying that processes and procedures were executable within the existing industrial base. Key processes were captured in technical documentation and via invention disclosures to ensure Navy access to all technical details. Phase II yielded two new ceramic compositions designed for Navy sensor systems. Prototype sensor elements were built and tested to verify performance under relevant conditions. Program offices supporting VIRGINIA and COLUMBIA Class submarines have funded or are pursuing funding for transition demonstrations in a variety of sensor systems. Existing ceramic vendors possess greater than 90 percent of the equipment required to execute manufacturing of these advanced components. The outcome of transition in this phase will support a variety of hydrophone and transmit / receive applications.

PERIOD OF PERFORMANCE:
June 2020 to June 2022

PLATFORMS:
LOS ANGELES Class,
VCS Submarines

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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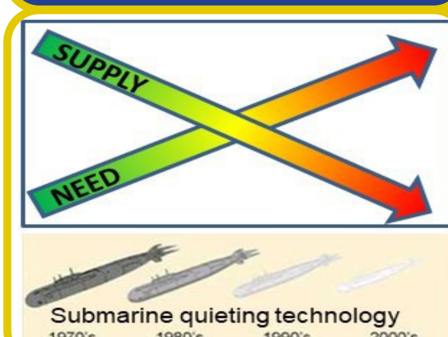
STAKEHOLDER:
PMS 415

TOTAL MANTECH INVESTMENT:
$600,000



Inertial Measurement Unit Navigation-Grade Performance for JDAM in a GPS-Denied Environment

PERIOD OF PERFORMANCE:
June 2021 to July 2022

PLATFORM:
Joint Direct Attack Munition (JDAM)

CENTER OF EXCELLENCE:
Electronics Manufacturing Productivity Facility (EMPF)

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STAKEHOLDER:
PMA-201

TOTAL MANTECH INVESTMENT:
$6,826,000

A2906 — Disc Resonator Gyro (DRG) Inertial Measurement Unit (IMU) for Navigation Grade Performance in GPS-Denied Environments

Objective

The Electronics Manufacturing Productivity Facility (EMPF) addressed GPS-denied navigation by providing a functional Inertial Measurement Unit (IMU) prototype that uses a ruggedized Disc Resonator Gyro DRG that is interfaced with a host navigation system for reliable end-use operation for the Joint Direct Attack Munition (JDAM). This ManTech effort developed a navigation-grade prototype DRG IMU that has better target accuracy and improved drift error performance in a form factor comparable to the existing tactical grade IMU. By integrating newer microelectromechanical systems (MEMS) technology, the project also had applicability beyond JDAM transition to longer flight times.

Payoff

Expected benefits to the Navy included a five-year capability acceleration of the latest MEMS gyroscope technology and increased drift error performance that would have contributed to increased target accuracy. By extension, the project would have also provided improved lethality, decreased collateral damage, expanded applicability to longer flight applications and decreased size, weight and power (SWaP) versus existing IMUs. Other defense platforms and organizations under the Precision Strike Weapons Program Office would also have benefitted from this effort.

Status

This project was terminated with the award of the Electronics Manufacturing Center (EMC). The technology investigated may be reconsidered in the future based on Navy needs.

Low-Cost Atomic Clock Enables High-Volume Position, Navigation and Timing Applications in GPS-Denied Environments

T2907 — Low-Cost Chip Scale Atomic Clock

Objective

The Chip Scale Atomic Clock (CSAC) is a critical technology that provides a trusted and assured timing solution in disrupted and GPS-denied environments. However, the current high cost is limiting widespread deployment of CSAC technology and reducing use to only essential military installations. A significant reduction in the manufactured cost level will enable far-reaching CSAC adoption for warfighters and manned and unmanned platforms, leading to dramatic improvements in mission coordination and effectiveness.

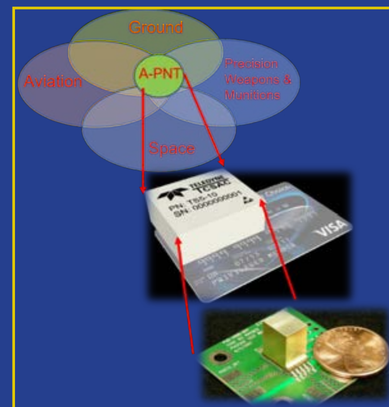
This Electronics Manufacturing Productivity Facility (EMPF) project with Teledyne Scientific Company was part of a larger, four-year Army Research Laboratory (ARL) program that would have lowered CSAC costs through improvements in physics package assembly and testing, lower-cost materials, fabrication and assembly of the thermomechanical isolation system, and refined control electronics.

Payoff

Successful completion of this project would have resulted in a CSAC with microsecond / day accuracy and 1E-11 / day frequency drift, with significantly reduced cost while maintaining performance, reducing power consumption, reducing size and extending the operational temperature range.

Status

This project was terminated with the award of the Electronics Manufacturing Center (EMC). The technology investigated may be reconsidered in the future based on Navy needs.



PERIOD OF PERFORMANCE:
December 2021 to July 2022

PLATFORMS:
Unmanned ground, underwater and aerial vehicles

CENTER OF EXCELLENCE:
Electronics Manufacturing Productivity Facility (EMPF)

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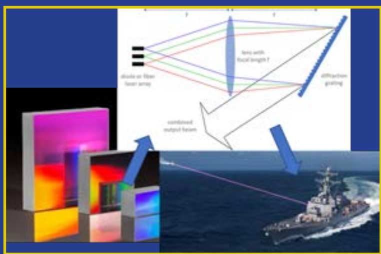
STAKEHOLDER:
Combat Capabilities Development Command (CCDC) Army Research Laboratory (ARL)

TOTAL MANTECH INVESTMENT:
$1,374,000

Metrology Tools and Processes Enable Commercial Grating Supply for High Energy Laser Weapons



PERIOD OF PERFORMANCE:
October 2020 to May 2023

PLATFORM:
HEL weapon systems

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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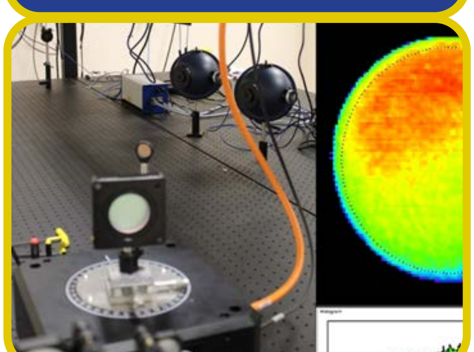
STAKEHOLDER:
PEO IWS 2.0

TOTAL MANTECH INVESTMENT:
$763,000



S2909 — Production of Multilayer Dielectric Gratings for Laser Weapon Systems

Objective

Multilayer dielectric (MLD) diffraction gratings, a key optical element in many current and planned high energy laser (HEL) weapon systems, are currently not available at the required performance level from a verified commercial source. Lawrence Livermore National Laboratory (LLNL) is currently the only source to fabricate MLD gratings for the Department of Defense suitable for spectral beam combining (SBC) HEL weapon systems. MLD gratings must withstand high-laser intensities, provide high diffraction efficiency with minimal scatter over the spectral range of the laser sources and exhibit minimal thermal heating to minimize optical deformation. Performance in all of these areas must be verified with specialized instruments and testing procedures to fully characterize grating performance. This Electro-Optics Center (EOC) project will develop the characterization tools and processes required to assess grating performance and is the first phase in a group of grating projects aimed at developing a commercial grating production capability for HEL weapon systems.

Payoff

Successful execution of this capability acceleration project will result in documented grating characterization processes and measurement instruments to permit independent assessment of commercial gratings against the performance specification. It will then be available to support the development of a common means of specifying a grating at a component level (versus the current approach which is a design specification supporting an overall system performance requirement). Navy, Army and the Office of the Secretary of Defense are supporting follow-on projects that will leverage the use of the instruments developed under this effort and the EOC expertise gained from characterizing the commercial and LLNL gratings. Grating manufacturing requires very technical use of lithography and etching tools to achieve the required performance levels. This project is providing critical characterization data to support development of commercial grating capability and verification of the grating product prior to HEL insertion. With SBC grating procurements expected to grow exponentially for HEL use, a commercial source greatly reduces supply risks. Upon completion of the follow-on projects, a minimum of one commercial source for HEL gratings is expected.

Implementation

The results from this project, including characterization processes, measurement instruments and expertise in characterizing HEL gratings, will be implemented in follow-on HEL gratings manufacturing programs across multiple services. This stringent characterization capability will be essential for the development of commercially supplied MLD gratings, which are needed for future deployment of HEL weapon systems on Navy DDG 51 Class destroyers and FFG 62 Class frigates.

Domestic Demonstration of Thermoplastic Composite Induction Welding Capability

J2917 — Thermoplastic Composite Welded Assemblies

Objective

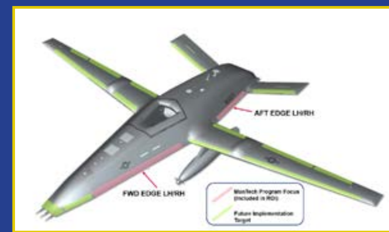
Structural composite assemblies require bonding or mechanical fastening to join individual components. After initial manufacture of the composite components, joining methods require extensive and expensive preparation of the components for assembly, either through surface preparation and bonding or hole machining and fastener installation. Thermoplastic composite components can be adhesively bonded or mechanically fastened to form structural assemblies. The chemical nature of the thermoplastic matrix also enables local re-melting and opportunities to "weld" these components as a means of joining. This Composites Manufacturing Technology Center (CMTC) project aims to build upon previous thermoplastic induction welding efforts to develop an induction welding process for assembly of structures with significant curvatures representative of aircraft fuselage chines and leading and trailing edges, and to demonstrate on MQ-25A representative geometries. The performers on this project are Boeing and the University of South Carolina.

Payoff

Reduced material handling, supply chain simplification and automation of assembly contribute to cost-savings for the platform, which is currently estimated to be $100.0K per MQ-25A. This is conservative and only considers the forward and aft chine assemblies while additional candidates will increase savings. Supplemental to platform savings is the weight-reduction associated with eliminating fasteners, which will also be realized with the implementation of this technology. In addition to the MQ-25 program, the LCAAPS program will be continually evaluated for transition of this technology. The change to thermoplastics will also allow a higher resistance to impact damage resulting in a reduction in maintenance costs.

Implementation

Implementation of the fuselage chine on the MQ-25A requires detailed design, analysis and testing – details of which will be defined during project execution. The results of this CMTC project are currently planned to be implemented in production of MQ-25A aircraft as early as FY2025. Additional fuselage chine structures not targeted in this Navy ManTech project have been identified as additional candidates for conversion.



PERIOD OF PERFORMANCE:
June 2022 to June 2024

PLATFORM:
MQ-25A

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

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STAKEHOLDER:
PMA-268

TOTAL INVESTMENT:
$2,000,000 (OSD ManTech)
$1,450,000 (Navy ManTech)
$ 750,000 (AFRL)

Rapid, Large, Inflatable Structure Deployment for Navy Applications

PERIOD OF PERFORMANCE:
December 2020 to May 2022

PLATFORM:
SUPER SWARM

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDER:
ONR Expeditionary Portfolio

TOTAL INVESTMENT:
$250,000

Z2921 — FLOTSAM

Objective

This Institute for Manufacturing and Sustainment Technologies (iMAST) capability acceleration project developed a process for creating low-cost, easy-to-manufacture, inflatable structures that can be rapidly procured and fielded. These structures support multiple purposes, including as decoys for tactical deception and rapidly assembled structures with complex geometries. The project demonstrated the capability to readily manufacture inflatables and provided multiple scale and full-size prototypes. The iMAST team delivered several FLOTSAM vessels to support Navy exercises.

The primary challenge for decoy manufacturability was balancing design complexity, cost, fabrication technique and ease of deployment with shapes that are appropriately deceptive or perform the desired structural function. Rapid manufacture and deployment of a fleet of attritable, inflatable decoy platforms for mission operations provides the warfighter with a capability and strategic advantage. iMAST has explored dozens of design variants with commensurate manufacturing processes to document the process, design variants and utility afforded by each iteration to support the use of inflatable structures for rapid decoy development and deployment.

Payoff

The key benefit is the development of techniques and processes to easily design, fabricate and deploy inflatable structures allowing warfighters to use uncertainty and deception to gain a tactical advantage against peer adversaries. iMAST developed additional methods for inflatable fabrication at various scales to support ONR-identified exercises with multiple shipsets that have expanded to other more complex shapes to emulate in more domains (including air and ground).

Status

FLOTSAM evaluated and enabled rapid employment of inexpensive inflatable structures for use as decoys in military operations, at reduced cost and increased flexibility in manufacturing and sourcing. The ultimate benefit is increased warfighter performance; enhanced SWARM technologies combining sea, air and land; and effective inflatable and fabric structures for broad military applications.

Contamination Sensing and Monitoring Prevents High Energy Laser Damage

Z2953 — HEL Coating Contamination Mitigation

Objective

High energy laser (HEL) coatings are critical enablers to the success of HEL technology. Some level of optical coating contamination is inevitable in field conditions, and HEL testing of optical coatings has shown a significant reduction in the laser-induced damage threshold (LIDT) when surface contaminants are present. LIDT degradation is dependent on several variables. Imprecise knowledge of contaminant impact on optical coatings can lead to loss of system availability due to unnecessary maintenance or system damage due to contaminant-induced coating failure.

The overarching objective of this Electro-Optics Center (EOC) project was to achieve capability acceleration for HEL weapons. Specifically, the project quantified the LIDT threshold when surface contaminants are present, providing a metric that can be monitored to avoid associated coating failures. Defining contamination thresholds that warrant maintenance cleaning and developing an in situ monitoring system concept to sense contamination levels achieved this objective.

To identify contaminant thresholds requiring maintenance and develop an in situ monitoring system, the project team performed the following steps:

- Selected representative contaminants
- Identified the appropriate contaminant deposition methods for laboratory testing
- Evaluated pristine and contaminated samples before irradiation
- Performed HEL irradiation
- Evaluated coupons post-irradiation
- Determined contaminant factors that affect LIDT
- Evaluated the contamination monitoring system's ability to detect contaminant factors that affect LIDT

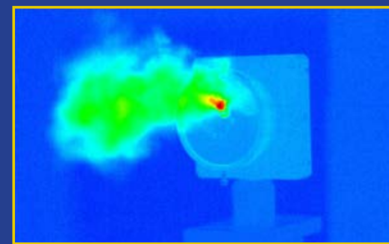
Payoff

The specific benefits of this project include increased system availability from lower coating failure incidences and lower system life-cycle cost due to minimization of unnecessary maintenance and spare optics. If the developed in-situ monitor is utilized in current and future weapon systems, the project will yield cost-savings from optimized maintenance work that extends coating life and cost avoidance associated with catastrophic failures. It is reasonable to expect additional benefits from increased availability of the weapon systems and improved optical performance from a reduction in scattered HEL photons.

Implementation

The project transition point for this effort was the identification of problematic contamination levels and proof of concept for an in-situ optical contamination monitoring system. This project final report captured the results for the transition partners to employ.

Transition pathways are target platforms across services and other beam director manufacturing efforts. Programs that will benefit from this project include all services employing laser weapon systems.



PERIOD OF PERFORMANCE:
August 2021 to September 2022

PLATFORM:
HEL weapon systems

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

POINT OF CONTACT:
Andrew Trageser
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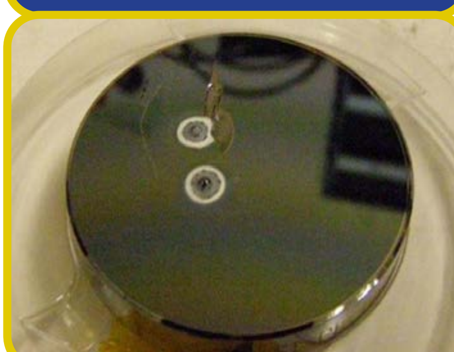
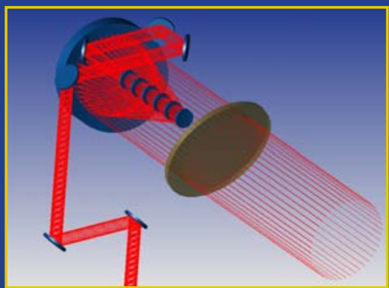
abt1@arl.psu.edu

STAKEHOLDER:
Office of the Secretary of Defense (OSD)

TOTAL INVESTMENT:
$709,000 – OSD Manufacturing Science and Technology Program



Accelerating the Impact of Sustainment Technologies in Private Shipyards



PERIOD OF PERFORMANCE:
August 2021 to September 2022

PLATFORM:
HEL weapon systems

CENTERS OF EXCELLENCE:
Electro-Optics Center (EOC)

POINT OF CONTACT:
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STAKEHOLDER:
Office of the Secretary of Defense (OSD)

TOTAL INVESTMENT:
$535,000 – OSD Manufacturing Science and Technology Program

Z2954 — Manufacturing Challenges for Low Size, Weight and Power Beam Directors

Objective

Many platforms and missions across Department of Defense (DoD) services are unable to employ laser directed energy solutions due to size, weight and power (SWaP) constraints. The laser beam director represents a significant portion of the system's SWaP and is often external to the vehicle envelope. Many practitioners expect to encounter unique manufacturing challenges when building a low SWaP beam director, although there are currently no DoD efforts to explicitly and proactively identify these anticipated manufacturing issues. Immediate exploration of these inherent challenges enables timely introduction of manufacturing solutions in this ManTech capability acceleration thrust area.

This Electro-Optics Center (EOC) project employed an optical manufacturing perspective to identify the manufacturing needs for a significantly lower SWaP beam director of a fixed main aperture size. An optical model quantified the manufacturing needs for components and assemblies. With the reduced optical layout established, opto-mechanical relationships were used to estimate the beam director SWaP parameters, including height, swing radius, weight, inertia, acceleration, power and cost change. The final thrust of the effort identified and prioritized manufacturing improvements to provide SWaP impact with cost, risk and performance trade-offs.

Intended platforms include new and current Navy ships, as well as mobile land vehicles and air vehicles.

Payoff

Capability acceleration is achieved by initiating the manufacturing aspects of these directed energy solutions concurrently with technological development, thereby compressing the delivery schedule of this capability. Another benefit of a low SWaP beam director is the ability to incorporate a directed energy solution on a smaller host platform, thereby broadening the solution space for warfighter missions. Benefits derived directly from the project results include design for manufacture information for the development of a system and investment planning information to assist with manufacturing technology roadmaps.

Implementation

The project transition point for this effort was the identification of manufacturing challenges associated with a highly optimized SWaP beam director with ranked recommendations for how best to resolve these manufacturing challenges to improve beam director SWaP. The project final report details the analysis methods and results. The SWaP estimation tool can be used without the need for specialized training or computing resources. This estimation tool can be shared with transition partners upon request.

Transition pathways are target platforms across services and other beam director manufacturing efforts. Program Offices that will benefit from this project include both Army and Navy.

Efficient Beam Director Manufacturing

S2956 — Beam Director Manufacturing

Objective

Laser weapon systems offer warfighters unique solutions to particular challenges and Navy ManTech capability acceleration thrust areas. The beam-director assembly subsystem in the beam-control system is an essential subassembly of every high energy laser (HEL) weapon system. Navy plans call for increased placement of laser weapon systems on DDG 51 Class destroyers and FFG 62 Class frigates.

Several aspects of beam director manufacturing combine to create a complex manufacturing challenge. The beam director is a precision assembly of many different optical, mechanical and electrical components. The components are large high-value items with substantial lead times, require special handling procedures and originate from several different manufacturers. A poorly planned or poorly executed beam director manufacturing process results in a system with serious performance degradation and inefficiencies that significantly increase system acquisition cost and limit production capacity.

The Navy has made several successful investments to improve the manufacture of beam director optical components. This Electro-Optics Center (EOC) project complements the component investments and addresses the manufacturing challenges of the integrated beam director assembly by defining a process for the interface, build and test of the beam director optical assembly.

Payoff

Capability acceleration is achieved by initiating the manufacturing aspects of these directed energy solutions concurrently with technological development, thereby optimizing the delivery schedule of this capability. The project will yield both manufacturing capacity expansion and cost-savings through a reduction in assembly and test labor for the beam expander and the use of defined processes for improved efficiency. It will also achieve manufacturing efficiency by minimization of tooling, training and process development costs through use of common assembly and test methods for new and existing systems.

Implementation

The project transition point for this effort is a build-and-test process demonstration covering the most complex aspects of the beam director manufacturing process, using a full-size, high-fidelity hardware demonstrator of a beam director optical system. Project transition and implementation partners from the Department of Defense and industry will participate in the demonstration event. The project final report and process documentation package will capture results for the transition partners to employ on new projects. Program Offices that will benefit from this project include both Army and Navy.

PERIOD OF PERFORMANCE:
June 2022 to October 2024

PLATFORM:
HEL weapon systems

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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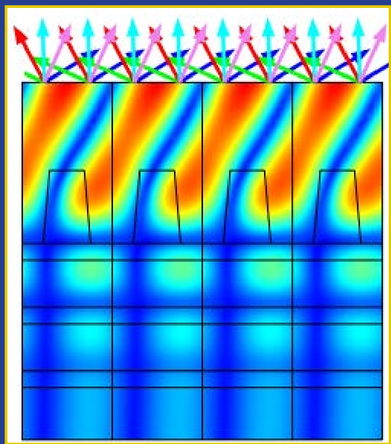
STAKEHOLDER:
PEO IWS 2.0

TOTAL MANTECH INVESTMENT:
$1,822,000

Requirements, Modeling and Verification Testing Enable Commercial Grating Supplier Development for High Energy Laser Weapons



PERIOD OF PERFORMANCE:
September 2021 to December 2022

PLATFORM:
HEL weapon systems

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

POINT OF CONTACT:
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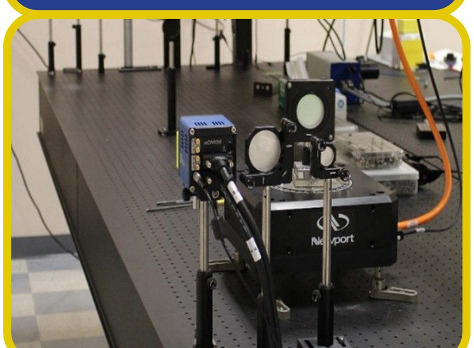
STAKEHOLDERS:
PEO IWS 2.0,
Office of the Secretary of Defense (OSD)

TOTAL INVESTMENT:
$800,000 – OSD Manufacturing Science and Technology Program



Z2962 — Production of Multilayer Dielectric Gratings (Gratings 2)

Objective

This project is part of a group of joint service projects developing a verified commercial production capability for the manufacture of Multi-Layer Diffraction (MLD) gratings for high energy laser (HEL) weapons. The overall objective is to establish a commercial vendor capable of producing MLD gratings of equivalent quality and repeatability as those currently produced by Lawrence Livermore National Laboratory (LLNL). Project objectives exist in four technical effort areas. The requirements effort is developing a common set of performance requirements for HEL gratings in Army and Navy applications. The modeling effort is building a performance simulation model to assess the impact of manufacturing process improvements and forecasting sensitivity in higher power applications. The testing effort is leveraging prior ManTech investments in grating characterization and evaluating methods to provide test feedback on manufacturing process samples from the commercial vendors. This testing drives process improvements over several improvement and test cycles. Finally, subject matter experts familiar with the grating tests and applications are providing support to both Army and Navy commercial vendors.

Payoff

Development of commercial gratings sources alleviates supply risk and promotes affordability across many Department of Defense platforms employing directed energy. Successful execution of this capability acceleration project will result in documented grating requirements and an assessment of the commercial grating product, ultimately providing verification of a commercial source if the requirements are achieved. While this project, funded by the Office of the Secretary of Defense (OSD), does not achieve financial returns on its own, it does enable returns for the group of projects developing the commercial sources through valuable fundamental specification development, data verification and technical support to reduce development risks.

Implementation

The project deliverables capture results in requirements definition, testing and modeling for the transition partners to employ. The requirements verification matrix includes values and the test methods used for the measurement. This information, along with test results and modeling tools obtained from the execution of the project, will provide a current assessment with manufacturing insight and an implementable plan for evaluating commercial MLD gratings. These grating are critical for future deployment of HEL weapon systems on Navy DDG 51 Class destroyers and FFG 62 Class frigates.

Providing Rapid Green Parts with Additive and Casting Manufacturing

SP2965 — Print Plastic to Make Metal

Objective

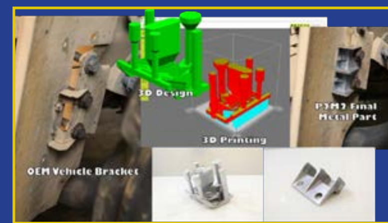
This Institute for Manufacturing and Sustainment Technologies (iMAST) capability-acceleration project will develop standardized tools and processes to create a print plastic to make a metal (P2M2) level-three technical data package (TDP) and associated process documentation sufficient to create parts using the P2M2 process (low-cost desktop printers coupled with casting techniques). This project specifically addresses the obstacles to fielding this capability, which include design capture and conversion to P2M2 suitability, approved and standardized equipment and methods for executing P2M2, and training for U.S. Marine Corps personnel to execute when forward deployed. iMAST is working to address these challenges by developing an expert system for design conversion and standardized processes and equipment, and by developing and delivering training to Marine Corps maintenance trainers for developing an organic capability.

Payoff

Improving operational availability of vehicles in forward locations needs a method for rapid part production of non-critical components (green box). Additive manufacturing processes offer some capabilities but require a significant investment in resources and training in addition to a stable manufacturing environment. The proposed P2M2 process offers greater flexibility than additive-manufacturing processes by combining the design freedom of material extrusion additive with approved materials and well-known characteristics. Additionally, the parts made using this process can be larger in size than direct-metal, 3D printed parts at orders-of-magnitude lower cost.

Implementation

The implementation plan will cover the steps required for the initial acquisition of facilities, TDP, part definitions and implementation details of the P2M2 process. The plan will also outline all training, documentation and hands-on evaluation necessary to instantiate the capability for Marine Corps personnel. The P2M2 TDP, tools, process and training material will be primarily implemented with the support and development of Marine Corps amphibious and expeditionary organizations. Deliverables include train-the-trainer, development of P2M2 TDP packages for exemplar parts, revisions to design tools for expert systems development and evaluation and maturation of P2M2 processes to ensure quality and feasibility afforded by the process.



PERIOD OF PERFORMANCE:
January 2022 to January 2024

PLATFORM:
U.S. Marine Corps systems
(AAV, ammunitions)

CENTER OF EXCELLENCE:
Institute for Manufacturing
and Sustainment Technologies
(iMAST)

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STAKEHOLDERS:
Assault Amphibian School, PEO Land Systems, NSWC-Corona

TOTAL MANTECH INVESTMENT:
$600,000

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*Projects executed by former Center of Excellence Electronics Manufacturing Productivity Facility (EMPF).

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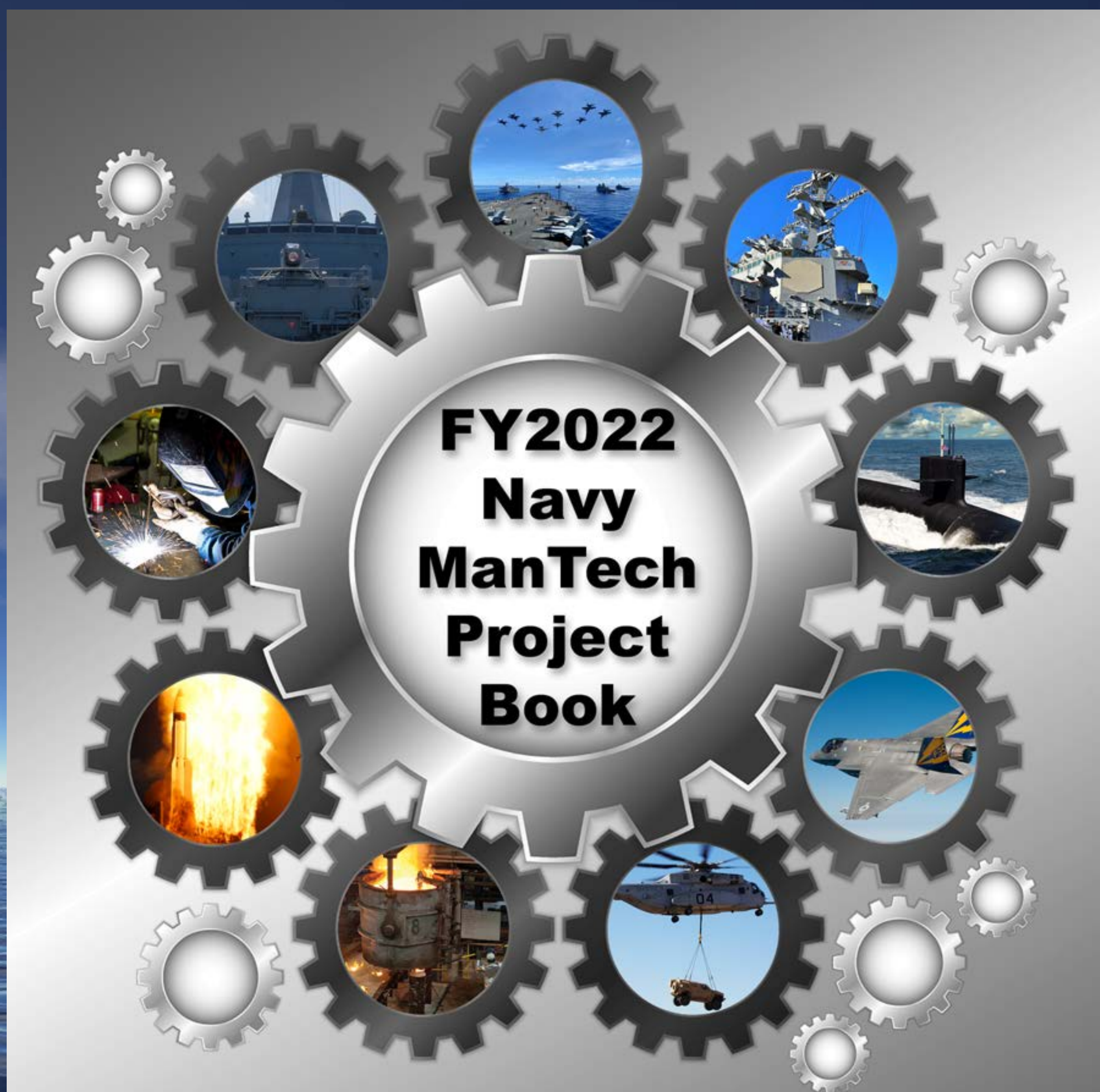
Transitioning advanced manufacturing technology and accelerating capabilities for an affordable fleet



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