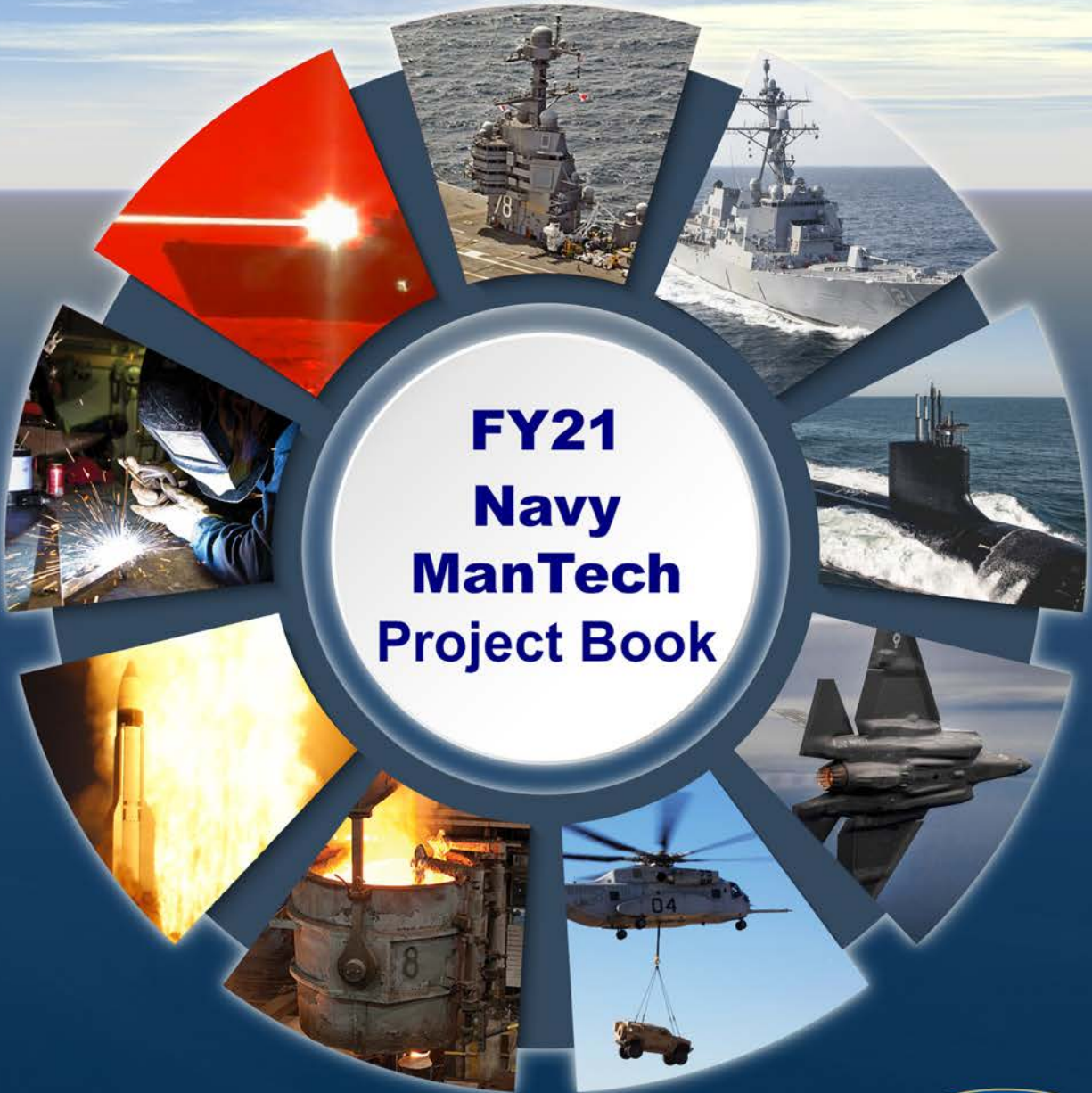




*Transitioning advanced manufacturing technology
and accelerating capabilities for an affordable fleet*



**FY21
Navy
ManTech
Project Book**



DCN# 43-9442-22

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Clockwise from top-center:

1. F/A-18F Super Hornet assigned to Air Test and Evaluation Squadron (VX) 23 approaches the aircraft carrier USS *Gerald R. Ford* (CVN 78) for an arrested landing. (U.S. Navy photo by Erik Hildebrandt/Released)
2. USS *Frank E. Petersen Jr.* (DDG 121) navigates in the Gulf of Mexico during Bravo sea trials. (U.S. Navy photo courtesy Huntington Ingalls Industries/Released)
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. F-35C Lightning II attached to the “Argonauts” of Strike Fighter Squadron (VFA) 147, assigned to Commander, Joint Strike Fighter Wing, completes a flight over Eglin Air Force Base in Fort Walton Beach, Florida. (U.S. Navy photo by Chief Mass Communication Specialist Shannon E. Renfroe/Released)
5. CH-53K King Stallion lifts a Joint Light Tactical Vehicle (JLTV) 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 (SM-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 Director/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. USS *Portland* (LPD-27) successfully disabled an unmanned aerial vehicle (UAV) with a Solid State Laser. (U.S. Navy photo/Released)

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FY21 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 FY21. 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.

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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 bid “Fair Winds and Following Seas” to John Carney who retired in July 2020 after 30 years of service to the Navy and 15 years as the Navy ManTech Director. 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) technology.

FY22 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, and F-35 Lightning II aircraft, and ManTech now has initiated projects to help the FFG 62 Class frigate meet its affordability goals. ManTech highlights include optimizing processes for the F-35 electro-optical targeting system that will save the F-35 program \$224M, 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 \$40M for the Next Generation Surface Search Radar, and verifying the use of an alternative welding process for surface ships that will save \$23.3M over five years.

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, 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 in this book.

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 DoD.

Neil A. Graf
Manufacturing Technology Competency Lead / Program Officer
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.

For greater than 15 years, 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 57 of the portfolio's approximately 135 projects have been implemented, or are in the process of being implemented, resulting in real acquisition cost savings of approximately \$41.0M per hull, verified by our industrial partners and PMS 450.

The Navy ManTech Program is managed by Code 33, Mission Capable, Persistent and Survivable Naval Platforms, of the Office of Naval Research (ONR), with direct oversight from the Chief of Naval Research.

The directors of the ManTech programs of the Army, Navy, Air Force, Defense Logistics Agency, and Missile Defense Agency coordinate their programs through the auspices of the congressionally chartered Joint Defense Manufacturing Technology Panel (JDMTP) with representation from the Office of the Secretary of Defense, the Department of Commerce's National Institute of Standards and Technology, the Department of Energy, the Defense Advanced Research Projects Agency, and industry. The JDMTP is organized to identify and integrate requirements, conduct joint program planning, and develop joint strategies. Department of Defense (DoD) oversight is provided by the Office of Manufacturing and Industrial Base Policy which was established by the 2011 National Defense Authorization Act to ensure that the linkage between industrial policy and manufacturing is firmly established and effectively coordinated.

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, 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 systems, 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 or 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.
- **Implementation** denotes the actual use of the ManTech results on the factory floor. (The resources for

Navy ManTech Investment Strategy

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 sharing 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.

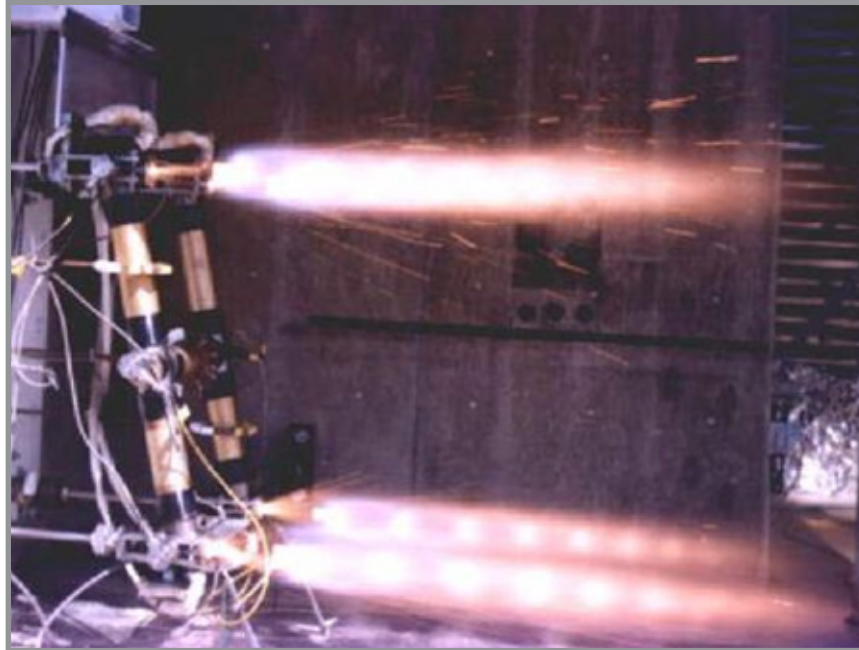
In FY12, Navy ManTech formalized its focus on implementation and risks to implementation by instituting an implementation risk assessment management process to assess potential future projects (those in the planning stages) as well as ongoing projects. For ongoing projects, risks are discussed during 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 implementation and have a real impact on affordability.

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 Navy ManTech's 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 can be found on Page 13.

Navy ManTech Investment Strategy



*Development of Energetics Manufacturing for Primary Explosives.
Courtesy of EMTC.*



*Innovative Cold Spray Repair Technology for Ships.
Courtesy of iMAST.*

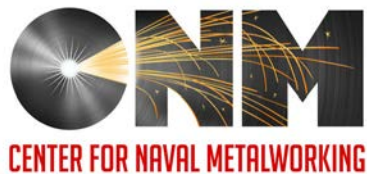
Navy ManTech Execution

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:

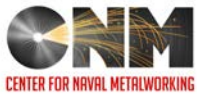
- Execute projects and manage project teams;
- Serve as a corporate expertise in technological areas;
- Collaborate with acquisition Program Offices / PEOs / industry to identify and resolve manufacturing issues;
- Develop and demonstrate manufacturing technology solutions for identified Navy requirements;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

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



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, and partners with EWI, leveraging EWI’s member-based organization that provides applied research, manufacturing support, and strategic services. 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 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: <http://cmtc.ati.org>

Navy ManTech Execution

Electro-Optics Center (EOC)



EOC, operating within the Applied Research Lab (ARL) at Penn State, has served as Navy ManTech's COE for electro-optics since 1999. 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 weapons 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. As the largest research unit at Penn State, ARL continues to do vital work for the world-at-large through cutting-edge research and innovation.

EOC web site: www.eoc.psu.edu

Electronics Manufacturing Productivity Facility (EMPF)



EMPF was established in 1984 to aid the electronics industry in improving electronics manufacturing processes required in the manufacture of military systems. Today, ACI Technologies Inc. operates the Navy's electronics manufacturing COE and is focused on the development, application, and transfer of advanced electronics manufacturing technology. EMPF executes projects that reduce the cost and time to fabricate Navy ships, aircraft, weapon systems, and unmanned systems by partnering with industry, academia, and government centers and laboratories to maximize available research capabilities at the lowest possible cost.

EMPF operates in a modern 36,000-square-foot facility adjacent to the Philadelphia International Airport, which houses a demonstration factory containing the latest electronics manufacturing equipment, fully equipped classrooms for skill-based and professional-level technical training, and an analytical laboratory for materials and environmental testing. EMPF offers many electronics manufacturing services and capabilities to the U.S. Navy, DoD, and the U.S. electronics manufacturing industrial base and is dedicated to the advancement of environmentally safe electronics manufacturing processes, equipment, materials, and practices; flexible electronics manufacturing technologies; and workforce competency.

EMPF web site: www.empf.org

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 (IHD), in Indian Head, MD. 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



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, DoD industrial activities, industry, PEOs, and university laboratories to improve sustainability, reliability, and system availability. iMAST web site: <https://www.arl.psu.edu/content/institute-manufacturing-sustainment-technologies>

Navy ManTech Execution

Naval Shipbuilding and Advanced Manufacturing (NSAM) Center



Since 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 the use of 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 Website** can be accessed at <https://www.onr.navy.mil/en/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 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.

For additional information on participation in the Navy's effort to strengthen the U.S. industrial base, to impact platform affordability, and to increase Navy readiness, contact any of the Navy ManTech Points of Contact listed on individual project pages or consult the 2021 Navy ManTech Points of Contact Directory.



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

High Energy Laser (HEL) Weapon A Joint Approach to Identify

All branches of the Department of Defense (DoD) are planning to deploy High Energy Laser (HEL) weapon systems within the next several years. Many of the technologies that comprise HEL weapon systems are unique to these systems, so prototypes were built by subject matter experts such as the Navy ManTech Electro-Optics Center (EOC) operated by the Penn State Applied Research Center. 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 Missile Defense Agency as well as the Office of the Under Secretary of Defense (OUSD) for (Research & Engineering (OUSD-R&E)) Industrial Base and Sustainment, and the laser weapon system science and technology community of interest recognized the need for manufacturing technology investment in HEL weapon systems and joined forces under the Joint Defense Manufacturing Technology Panel (JDMTP) to develop a comprehensive manufacturing technology roadmap to guide future investment and ensure HEL capability would be available for our warfighters. The roadmap illustrated where gaps existed and directed investment in order to ensure the industrial base was capable of producing the HEL weapon systems the services envisioned 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 the services in laser

on System Manufacturing — Closing Manufacturing Gaps

source components, optics, and pointing subsystems. The team recommendations 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 directed energy applications for all service needs.

The chief benefit of the HEL roadmap project will be an improvement in warfighter readiness for missions that are best addressed using laser weapon solutions. The manufacturing technology roadmap allowed 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 HEL 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.

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 those planned for 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), COLUMBIA Class submarine (CLB), F-35 Lightning II aircraft, 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

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*CVN 78 Class / Aircraft Carriers.
U.S. Navy image.*

Induction Heating to Straighten Deck and Bulkhead Panels Will Reduce Rework



PERIOD OF PERFORMANCE:
June 2016 to May 2022

PLATFORM:
CVN Class / Aircraft Carriers

CENTER OF EXCELLENCE:
NSAM

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

STAKEHOLDER:
PMS 379

TOTAL MANTECH INVESTMENT:
\$2,946,000

S2664 — Induction Straightening for CVN

Objective

Current Ford Class aircraft carrier construction 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. 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 HSLA 65 material properties. The project will also determine 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 FY22.



Industrial Modeling and Simulation Evaluates Current Factory Configurations and New Facility Designs

S2727 — Advanced Steel Production Facility — Industrial Modeling and Simulation

Objective

The Institute for Manufacturing and Sustainment Technologies (iMAST) developed stochastic discrete event simulation models of the entire fabrication process for the products created by Huntington Ingalls Industries - Newport News Shipbuilding's (NNS) current and future state Advanced Steel Production Facility (ASPF). The models provide a means for NNS to assess alternatives for modifications to the current factory configuration as well as new facility design to obtain the productivity increases needed to support accelerated production schedules and cost-reduction initiatives for CVN construction.

NNS has proposed a radical shift in manufacturing within the ASPF. The models enable productivity changes to be assessed globally and at the station level, allowing productivity variations to be determined and technology gaps to be identified. Alternative equipment, process flow configurations, and new stations have been "modeled." Modules representing these stations were inserted into the model to iteratively evaluate alternative scenarios which, in turn, facilitated capital investment decision making.

Payoff

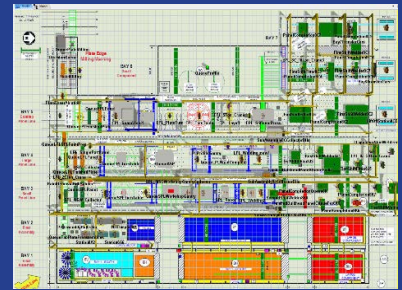
While no benefits may be estimated until the actual completion of the ASPF, the concept itself may be assessed on a global scale. The ASPF is expected to deliver panels with reduced build times due to the use of advanced technology. Additional improvements are expected to include:

- Reduced downtime due to improved machine reliability
- Reduced manual processing for non-standard panel designs (e.g., end butts, dissimilar plate thicknesses)
- Increased automation in paint removal, welding processes, annotation
- Improved material handling processes, including flipping and profile handling
- Streamlined plate preparation processes within the Panel Line facility eliminate reliance on the Fab Shop

The above expected savings will be achieved by conducting concurrent manufacturing technology research and development and validating these improvements using the simulation models transitioned from this project, thus providing data-driven decision support for capital investment planning at NNS.

Implementation

All associated software applications and source code were transitioned to NNS at the conclusion of this project. The system model has been implemented at NNS to support follow-on research and development efforts which are expected to be funded to support planning for the future ASPF concept.



PERIOD OF PERFORMANCE:
Dec 2016 to Mar 2021

PLATFORM:
CVN 78 Class / Aircraft Carriers

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 379

TOTAL MANTECH INVESTMENT:
\$1,038,500



Leveraging ManTech Tool to Connect Digital Thread



PERIOD OF PERFORMANCE:
Feb 2018 to Jun 2020

PLATFORM:
CVN Class / Aircraft Carriers

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
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TOTAL MANTECH INVESTMENT:
\$1,600,000



S2759 — Digital Thread Shipbuilder — Supplier Interface

Objective

Acquisition of shipboard components is entirely based on paper technical documents that are enclosed within purchase orders. Huntington Ingalls Industries - Newport News Shipbuilding (NNS) provides suppliers with 2D fabrication drawings that are developed from 3D component models. Suppliers use the 2D drawings to create their own 3D component models to produce parts using computer numerical control machines. Design and manufacturing collaboration during supplier contract execution is based on traditional spreadsheets, emails, and conference calls. Purchase orders are clouded with requirement noise, relying on the supplier to determine what is and what is not required. With this complexity and overabundance of information comes the inherent risk of supplier delays and quality failures that can have a tremendous impact on cost, quality, and schedule. In addition, there are situations where shipyard quality inspection of engineering components typically takes place after manufacturing and production is complete, eliminating any possibility of in-process corrections. Shipboard construction installation and operation issues are discovered long after the supplier has delivered the product, resulting in rework and schedule delays.

The Digital Thread Shipbuilding — Supplier Interface effort, managed by the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center, incorporated NNS's supply base into the company's digital shipbuilding strategy by connecting the "digital thread" from design through production / fabrication, assembly, test, inspection, integration, and installation / operation. Once fully implemented, the project will help the supply base improve first-time quality, cycle times, schedule performance, and supplier readiness, which will lead to cost savings for the company and the Navy. When a part number is created in the parts catalog system, engineering will use computer-aided logic to assign requirements to help avoid human error and reduce the learning curve. The requirements applied will be clearer, more concise, and specific to the item, component, or assembly being purchased.

Payoff

The project provided a mechanism that simplified technical data packages, produced 3D design disclosures, and used an established secure exchange medium to enable efficient two-way transfer of data with suppliers. Once fully implemented, the process improvement could save an estimated \$6.8M per CVN 78 Class aircraft carrier with a return on investment of 1.41:1.

Implementation

NNS implemented the solution in a production environment beginning in the second quarter of FY20 on CVN 80 and is expected to continue through FY25.

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 man-lifts to inspect areas for defects. This Electro-Optics Center (EOC) project will develop and test a prototype unmanned aerial vehicle (UAV) inspection system and implement processes 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 identify the inspections which 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 is leading the development and selection of the UAV platform, developing hardware and software modifications to commercial-off-the-shelf or custom products. In the final phase, the shipyard and EOC will work cooperatively to test the prototype system in mockups and actual environments in order to validate the UAV inspection process.

Payoff

For the initial business case, which is focused predominantly on CVN 80, savings are estimated at approximately \$4M, 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, and may potentially include new inspections of enclosed areas, voids, tanks, and external structures for DDG 51, LHA, LPD, and NSC, as well as overhaul inspections of all platforms. Additional benefits include reduced occupational, health, and safety risks for personnel and 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

The primary focus of the project is to reduce labor costs and improve safety for the inspection of tanks and surfaces on the CVN 78 Class aircraft carrier. Refinements to procedures and equipment will become evident as the shipyard gains experience with the system. Using the system on other platforms at other shipyards will reveal additional refinements and likely some unexpected benefits as users develop their own methods and implementation plans. NNS is acting as the transition shipyard and expects this technology to be implemented during 2023 to support the build of CVN 80. Additionally, as part of the project team, Huntington Ingalls Industries – Ingalls Shipbuilding will be evaluating this technology for implementation on DDG 51 platforms. EOC will work closely with the shipyards to develop a system that produces the most benefit in reducing labor while increasing safety for inspectors. The shipyards will prioritize those areas that will benefit most from the use of such a system. One hundred percent replacement of human inspectors for all tasks is not likely at the close of this project; however, significant reduction in man-hours for setup, inspections, tear-down, and support is expected.



PERIOD OF PERFORMANCE:
Apr 2019 to Jul 2022

PLATFORM:
CVN Class / Aircraft Carriers

CENTER OF EXCELLENCE:
EOC

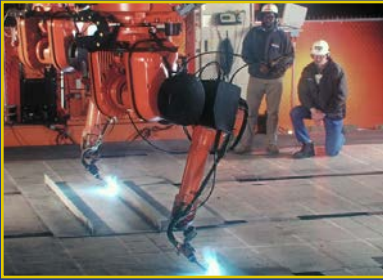
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STAKEHOLDER:
PMS 378

TOTAL MANTECH INVESTMENT:
\$1,950,000



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



PERIOD OF PERFORMANCE:
Apr 2019 to Mar 2024

PLATFORM:
CVN 78 Class / Aircraft Carriers

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 379

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 by 20 percent. 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 considerable labor saving 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. This is accomplished because the R-GMAW-ME solution is able to produce quality welds in a more efficient manner than a human operator. The project team compared the current baseline welds to the welds fabricated with the R-GMAW-ME process, and the team is actively working to prove the technology in a shipyard environment.

Lincoln Electric is providing additional technical insight and feedback to stand up the R-GMAW-ME system. After Lincoln has proved 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 against 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.

Implementation

Upon successful and timely completion of the Adopting GMAW for Robotic Panel Line Fillet Welding Operations ManTech project and 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 fiscal year 2024.

Shroud and Tundish for the Reduction of Ceramic Oxide Defects

S2807 — NNS Foundry Casting Improvements

Objective

In manufacturing, castings are often used to alleviate fabrication costs by delivering a raw material part 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 costs. Internal investigations found a majority of defects in high-strength-low-alloy (HSLA) 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 are two-fold. The first is to develop a shroud and tundish design to reduce air entrainment and cerioxide defects in HSLA cast parts manufactured at the NNS Foundry. The second is to improve modeling software capabilities to increase forecasting accuracy for casting defect areas. This will permit better casting design and first-time quality. The project primarily affects cast parts for the fabrication of CVN 78 Class aircraft carriers. However, successful design will transfer across castings for all Navy platforms.

Payoff

By reducing the air entrainment in the molten metal flow, a minimum 30 percent reduction in repair and cleaning man-hours is forecast as a result of this CNM project. Through increased efficiencies and quality improvements enabled by the technology, NNS anticipates savings up to \$6.5M per CVN hull with an anticipated return on investment of 1.4:1.

Implementation

Based on the results of testing, NNS will generate the data needed for internal NNS process verification and validation, finalize the business case analyses, 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. The potential start of implementation is the third quarter of 2022 with full implementation anticipated by the second quarter of 2023.

Implementation is expected to utilize a phased approach, where the castings similar to the test castings can be implemented first with minimal effort. The results of this ManTech project may be implemented in the production of CVN, VCS, CLB, and DDG castings.



PERIOD OF PERFORMANCE:
Aug 2019 to Jun 2022

PLATFORM:
CVN Class / Aircraft Carriers

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 379

TOTAL MANTECH INVESTMENT:
\$2,016,000



Weld-through Preconstruction Primer Will Reduce Labor for Primer Removal



PERIOD OF PERFORMANCE:
Aug 2019 to Dec 2022

PLATFORM:
CVN Class / Aircraft Carriers

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 379

TOTAL MANTECH INVESTMENT:
\$2,024,000



S2809 — Weld-through Preconstruction Primer for HSLA-65

Objective

To protect steel plates from rust and environmental impacts, they are coated with an organic or inorganic primer to extend the usable life of the steel. Normally, this primer is removed prior to welding until a clean plate is achieved; however, Huntington Ingalls Industries – Newport News Shipbuilding (NNS) uses an inorganic zinc preconstruction primer that has the potential to be welded through. This type of coating removes the need to remove the protective coating to ensure a good quality and acceptable weld is achieved.

The objective of this Center for Naval Metalworking (CNM) project is to test and validate the weld quality when welding through an inorganic zinc primer. This will be accomplished through the use of multiple rounds of coupon testing in a lab and shipyard environment. The team will use a design of experiments approach to determine which variables are crucial for good weld quality when welding through an inorganic zinc primer. Once crucial variables are identified and acceptable parameters are determined, the team will begin validating the process in a representative shipyard environment to ensure good quality welds can be achieved on a shipyard production line. Additionally, data will be collected during welding processes to assess if welding through the various primer configurations creates airborne hazards to nearby personnel. This project aims to help reduce the man-hours associated with construction of CVN 78 Class aircraft carriers.

Payoff

By reducing the labor hours associated with removing the preconstruction primer, as well as increasing efficiencies and quality improvements, NNS anticipates approximate savings from this CNM project to be \$6.0M per CVN hull for a five-year return on investment of 1.83:1.

Implementation

Based on the results of testing, NNS will generate the data needed for internal NNS process verification and validation, finalize the business case analyses, 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 team, stakeholders, and Technical Warrant Holder and will be ready for implementation at NNS. Implementation is anticipated in the second quarter of fiscal year 2023.

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 to be implemented in the production of CVN.

Robotic Mechanized Gas Metal Arc Welding to Increase Panel Line Productivity

S2823 — Adopting GMAW for Robotic Panel Line Fillet Welding Operations

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, which are often laborious, dangerous, and detrimental to the substrates, and/or produce excessive waste materials that may be costly to dispose. 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 (comprising technical, procedural, training, safety, environmental, and financial) may be overcome by appropriately identifying and carefully addressing them on an as-needed basis.

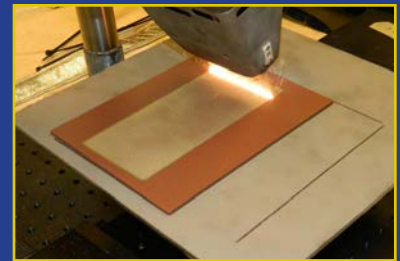
The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project is to qualify and implement laser ablation technology for the semi- or fully-automated removal of PCP from HSLA steels within the NNS SPF that are supporting the more rapid construction schedules of CVN 80 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. The figure does not include yet to be fully 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

For full implementation to occur at the NNS SPF, technical, procedural, safety, environmental, financial, and workforce development aspects must be addressed. Early estimates for implementation costs are nearly \$3M, which include procurement of capital equipment; environmental permitting; 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 FY23 and ending in FY25.



PERIOD OF PERFORMANCE:
Feb 2019 to Sep 2021

PLATFORM:
CVN 78 Class / Aircraft Carriers

CENTER OF EXCELLENCE:
iMAST

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STAKEHOLDER:
PMS 378

TOTAL MANTECH INVESTMENT:
\$1,450,400



Electronic Personal Dosimetry Self-Issue System Optimizes Laborious and Time-Consuming Task



PERIOD OF PERFORMANCE:
Mar 2020 to Jan 2022

PLATFORM:
CVN Class / Aircraft Carriers

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PEO Carriers

TOTAL MANTECH INVESTMENT:
\$243,500

S2865 — Electronic Personal Dosimeter Self-Issue

Objective

For the U.S. Navy and US shipyards who currently build and repair nuclear-powered vessels, there are substantial expensive and extensive safety / security protocols that must be strictly followed in order to maintain Naval Sea Systems Command (NAVSEA) authorization to do nuclear work. Additionally, as the Navy's nuclear fleet ages, there is an increased demand for a nuclear workforce to perform complex overhaul and decommissioning work. NAVSEA has an initiative to be on the cutting edge of performance; dosimetry control can be improved to incorporate more technology yet still maintain the proper amount of control of personnel radiation exposure.

The Electronic Personal Dosimetry Self-Issue project developed a digital system to manage personnel exposure and automate the process of checking out personnel dosimetry devices. At present, there is a major shortfall in labor for radiation control technicians (RCT). Recording personnel exposure can be digitized to reduce administrative effort in data management. These technicians control nuclear work for shipyards and other nuclear facilities and provide access to high radiation areas (HRAs). As part of their responsibilities for controlling access to HRAs, RCTs provide qualified radiation workers with an electronic pocket dosimeter (EPD), which can be a laborious and time-consuming task, especially when there is a backlog of personnel seeking access to a HRA. By allowing for self-issue, an RCT posted at an HRA will be free to perform more pertinent tasks than handing out dosimeters, such as providing oversight of trades workers performing radiological work. This will also free up time for workers, as they should no longer have to wait for the RCT in order to get their EPDs.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center effort developed requirements for the system, developed the system, integrated the equipment, and tested the system. The project team identified and procured the equipment and developed the software interface for the system following system requirement definition. NNS developed the required hardware interface, which included the design and layout of the unmanned HRA control point area where the system will be used. A test plan and training for the EPD self-issue were developed. The system was integrated and mock-up testing was conducted at Huntington Ingalls Industries – Newport News Shipbuilding (NNS).

Payoff

This technology, once implemented, could potentially return estimated five-year savings of \$5.5M for CVN.

Implementation

Upon successful and timely completion of the Electronic Personal Dosimeter Dosimetry Self-Issue ManTech project and 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 by the fourth quarter of FY22.



DDG 51 Class Projects

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Automation of Repetitive Tasks and Flexible Connector Adapter Production



PERIOD OF PERFORMANCE:
Feb 2017 to Aug 2020

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
EOC

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PMS 400D

TOTAL MANTECH INVESTMENT:
\$2,552,000



S2626 — Test Adapter Efficiency Improvement

Objective

This project was built on the theme that the complexity of electrical and optical connections in ships leads to high installation and maintenance costs. In addition to simplifying cabling designs, reducing the cost of complex cable installation and testing are ways to improve acquisition (material) and life-cycle (reliability and maintenance) costs. Previous Navy ManTech and National Shipbuilding Research Program projects have provided some methodology toward decreasing the cost of cable testing. This Electro-Optics Center (EOC) project has validated those methods using the results of the previous projects. The project provided electrical, radio frequency (RF), and fiber optic tests at the Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) Pascagoula shipyard.

The project was executed by four organizations: the Penn State Electro-Optics Center (EOC), Ingalls (providing industrial engineering and integrating the project results), DIT-MCO International (production supplier of the Integrated Link Test System), and Ultra Communications (manufacturer of optical transceivers and hardware).

Payoff

The overall project is estimated to result in \$709k per hull savings at the shipyard; payback is less than four years. Task savings come from reductions in test execution time, data transcription and hookup errors, and lead times for adapter connectors; increased flexibility with the capability of producing test adapter connectors on-site; and the introduction of new test technology.

Implementation

Transition opportunities for this project include process changes related to testing and possible engineering design changes related to cable simplification and RF cable sustainment. Implementation opportunities for this project include process changes related to testing and possible engineering design changes related to cable simplification and RF cable sustainment. Process change implementations will begin with DDG-125. Implementations requiring design changes will be considered beginning in FY22. Transition activities have continued throughout 2021, including new testing hardware and software from the test equipment vendor, and investments in the 3D printing process at the shipyard. Project results may also be implemented on the LHA and LPD platforms.

Increasing Productivity and Reducing Distortion by Employing Hybrid Laser Arc Welding

S2697 — HLAW Process Verification and Implementation for Ship Production

Objective

Huntington Ingalls Industries-Ingalls Shipbuilding (Ingalls) introduced a new panel line to improve productivity in ship manufacturing. A review of joining processes used in commercial shipbuilding worldwide identified that hybrid laser arc welding (HLAW) can reduce the welding heat input used to join metals, thus minimizing distortion and rework costs. Ingalls collaborated extensively with NAVSEA and has approval of the HLAW weld process qualification and certification test plan, supporting post-project implementation. The HLAW project had two phases, wherein Phase I the Edison Welding Institute (EWI) developed HLAW process parameters and the team evaluated the resultant weld quality. In Phase II, the HLAW weldments and the currently qualified baseline submerged arc welding process, a similar mechanized welding process, underwent dynamic-load testing. Ingalls used the EWI-developed parameters on its HLAW panel line to validate weld quality through testing.

Payoff

This technology, which was demonstrated at project completion in April 2020, integrates the highly optimized HLAW process resulting in significant time reductions across all current Navy and Coast Guard platforms constructed at Ingalls. These reductions are estimated to result in potential five-year savings of \$9.4M for DDG 51 and combined five-year savings of \$23.0M for DDG 51, LPD, and LHA platforms.

Implementation

Ingalls implemented the process and system technology developed and refined under this project in the third quarter of FY20, which is applicable to 90 percent of the targeted applications.



PERIOD OF PERFORMANCE:
Jan 2017 to Apr 2020

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
\$2,366,000



Improved Automation and Technology to Optimize Plate Shaping



PERIOD OF PERFORMANCE:
Sep 2018 to Jun 2022

PLATFORM:
DDG 51, LHA, LPD, NSC

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
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 that require mitigation to ensure each hull is in accordance with 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 (COTS) solutions capable of automating or semi-automating these complex sequences are not readily available.

Through the Shaped Plate Automation and Verification project, which is managed by the Center for Naval Metalworking (CNM), Ingalls intends to develop an automated or semi-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 will be performed to determine the new process's impact on material properties. Additionally, tooling and/or fixtures will be developed to set, align, and fabricate shell plates and shell plate assemblies. This will allow 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, and crane support, as well as an increase in throughput. Following implementation in the third quarter of fiscal year 2023, the anticipated benefits of this CNM project are expected to result in five-year savings of \$3.4M for the DDG 51 Class destroyer and an additional \$5.9M 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 fiscal year 2023.

Improved Fabrication Processes Will Increase Quality and Efficiency

S2781 — Work Cell Development

Objective

Huntington Ingalls Industries - Ingalls Shipbuilding (Ingalls) machine shop, integrated products division (IPD) shop, and support shops fabricate and assemble a variety of repetitive parts such as louvers, covers, strainer plates, tanks, filters, vents, lifting lugs, custom bolts, lifting lug repairs, etc. The current processes have a high degree of manual operations performed at workstations in various locations in the shops. Many of these current processes are not automated and require highly skilled labor to efficiently execute. There are currently no readily available commercial-off-the-shelf (COTS) solutions to make these processes more efficient.

The Work Cell Development project, managed by the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center, developed manufacturing solutions focused on improving process efficiency and tooling for the production of repetitive and labor-intensive products. This consists of a work cell approach, advanced tooling and fixtures, as well as modifications to current equipment and processes. The development of manufacturing work cells that automates and/or mechanizes various processes by incorporating lean manufacturing principles and advanced tooling and fixtures will reduce labor, improve quality, and increase throughput. Development of improved fabrication processes in these areas will also result in increased quality.

The project baselined the current processes to fabricate labor-intensive parts and compiled part family data, including size, quantity, manufacturing process, man-hours, and re-work. Process maps were developed to document the current processes for the target parts and part families. Time studies were performed and industrial engineering data was gathered for cost analysis and to document the quality of the target processes. Work cell requirements were developed to identify engineering and operations constraints, processes, tolerances, etc. The project also designed, engineered, and tested the prototypes. The prototypes were produced both by fabrication and by modifying COTS equipment. The initial prototypes were being modified based on user feedback for final evaluations and implementation.

Payoff

Ingalls anticipates the tools and processes will reduce labor in the implementing shops and quality assurance and accuracy control. Implementation of the automated / semi-automated processes and any tools or fixtures developed under this project is estimated to result in five-year savings of \$3.3M for DDG 51 hulls. This project will benefit the other hulls built at Ingalls and those combined five-year savings are \$4.9M across all U.S. Navy and U.S. Coast Guard platforms constructed at Ingalls.

Implementation

Ingalls implemented the solution in a production environment beginning in the first quarter of FY22 on DDG 128, LHA 8, LPD 30, and NCS 11.



PERIOD OF PERFORMANCE:
Sep 2018 to Nov 2021

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
\$1,284,000



Artificial Intelligence to Improve the Shipyard Production Planning Process



PERIOD OF PERFORMANCE:
Oct 2018 to Apr 2021

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
iMAST

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
\$997,000



S2797 — Production Bill of Material Quality Assurance using Artificial Intelligence

Objective

The DDG 51 Production Bill of Material (PBOM) is a hierarchical data structure used to represent the shipyard's manufacturing processes in the context of the ship's design. The conversion of various material lists into this integrated PBOM is what enables the Manufacturing Resource Planning system to effectively back-schedule all the fabrication and procurement activities that support efficient assembly of the ship. Due to the complexity and scale of this data, errors are easily introduced and difficult to identify through basic data analysis.

The Institute for Manufacturing and Sustainment Technologies (iMAST), with support from Bath Iron Works (BIW), developed a web-based PBOM quality assurance software application with embedded artificial intelligence (AI) to increase the effectiveness of PBOM error detection. The implementation of the PBOM quality assurance software with embedded AI (PBOM AI) at BIW will improve business efficiency by reducing product disruption costs due to PBOM errors as well as the necessity to do large-scale manual checking. This will result in small, short-term savings within the planning area and more substantial savings in DDG 51 production spaces.

While the application of AI technology is increasing in the manufacturing domain, successful implementation in the U.S. Navy shipbuilding industry has been limited. After developing a thorough understanding of BIW data systems and the intricacies of the PBOM data, iMAST researched and down-selected effective AI modeling methodologies and integrated these into a user-friendly software application that interfaces with live BIW enterprise data, detects patterns and anomalies within the PBOM, and enables BIW planners to efficiently disposition confirmed errors. While the focus was on PBOM error detection, iMAST generalized the AI error detection approach, making it applicable to other manufacturing domains with big data integrity issues.

Payoff

The PBOM AI technology developed will improve BIW's business efficiency by reducing DDG 51 product disruption costs due to PBOM errors and large-scale manual checking. Specifically, implementation of the PBOM AI system will reduce the number of PBOM errors and associated Bill Change Requests to correct them by 50 percent for six DDG 51 hulls, starting with DDG 130. Total expected savings over a five-year period are \$4.2M (average \$700K savings per DDG 51 hull), and a return of investment of 2.4:1.

Implementation

The PBOM AI software was delivered to BIW at the conclusion of the ManTech project in April 2021. Pending BIW IT deployment activities, process documentation, and initial user introduction, the PBOM AI system is expected to be implemented by BIW in early 2022.

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 this design can meet the required operational capacity.

The objectives, therefore, were to validate the present cold plate design by evaluating the present design manufacturing process and 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 address the root cause effects by the integrated project team is the first milestone in the implementation process, which will result in the approval of the Manufacturing Screening and Mitigation Processes document. In addition, production plates of an alternate material (foil) will be tested for performance quality as alternate production plates. At the end of this project, the Technology Transition Plan will identify the required effort via an 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, no later than the fourth quarter of fiscal year 2022.



PERIOD OF PERFORMANCE:
Jun 2019 to Nov 2021

PLATFORM:
CVN and DDG 51

CENTER OF EXCELLENCE:
EMPF

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STAKEHOLDER:
PEO – Integrated Warfare Systems 2.0 (IWS2), Surface Sensors Program Office

TOTAL MANTECH INVESTMENT:
\$5,190,000



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



PERIOD OF PERFORMANCE:
May 2019 to Apr 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
\$1,640,000



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. Many of the opportunities for process improvements that are applicable to electrical diagram products are also applicable to certain mechanical diagram products.

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 \$924K per DDG 51 hull. This creates five-year savings of \$5.5M and a return on investment of 1.76:1.

Implementation

BIW will deploy the solution at its Bath, ME, facility during FY23. Data migration, tool deployment, and interface deployment will be done throughout the organization. Training will be conducted for users, and tools will start to be used to generate the functional products required for delivery. Training is estimated to occur for three years ensuing project completion.

Trade-Friendly Metrology Solution Will Increase Productivity and Reduce Rework

S2828 — Automated Metrology for Structural Assembly

Objective

Objective

The objective of this Electro-Optics Center (EOC) project is 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 will be 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 will be minimally targeted or targetless to reduce labor and human error and include automated software scripting that conducts comparative measurements of as-built conditions against the designed computer-aided-design model. The project will also demonstrate 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

Successful execution of 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 reduction in rework, less risk of operator error, and greater accuracy control.

Bath Iron Works (BIW) estimates total savings of \$1.6M per hull, which generates a five-year return on investment of 2:1.

The project intent is to realize significant cost savings in labor hours and provide near-real-time (on-demand) measurements of products to the ship fitters, thereby avoiding rework in the current construction stage and, more importantly, identifying errors before products are shipped downstream.

Implementation

The system developed by this project will be demonstrated at BIW during the final task of the project and tested on DDG 51 structural assemblies. Successful demonstration will trigger 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 FY23. Implementation will require a capital investment from BIW, and this investment is supported through its internal CapEX. Justification for implementation of the metrology system will be illustrated through the return on investment generated by the project. Once demonstrated at BIW, this technology will have application at other similar facilities, expanding the impact of the system beyond BIW.



PERIOD OF PERFORMANCE:
Feb 2020 to Sep 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
EOC

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
\$3,431,000



BIW Creates Better Methods to Detect and Eliminate Early Construction Errors



PERIOD OF PERFORMANCE:
Dec 2019 to Oct 2021

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
\$670,000

S2844 — Digital Accuracy Control Management System

Objective

Bath Iron Works (BIW) sees cost savings potential in how it manages accuracy control (AC). At BIW, the AC plan largely relies on paper check sheets, manual data entry, and manual transcription of measured points, and is not able to fully benefit from modern measurement techniques such as laser scanners. The challenge is to optimally utilize the data that is being collected by both shipfitters and surveyors to detect errors immediately, prevent errors more frequently and reliably, and at the right stage of construction.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project will develop a system that transforms the manual, paper-driven AC check and documentation process to a fully digital environment. The Digital Accuracy Control Management System (DACMS) will contain the AC points crucial to fabrication and assembly, as well as their corresponding value within the configured design. Further, DACMS will analyze the data with regard to in / out-of-tolerance and deliver this information to AC engineers who, in turn, will disposition the analysis within the tool and deliver back to the shop floor / deckplates, while interfacing with enterprise planning for timeliness. The system will manage and maintain AC data configuration.

Payoff

This project will reduce labor hours for A / C surveys by 50 percent, reduce unit erection rework by 6 percent and create a user metrics dashboard for the AC engineering 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

The Penn State Applied Research Laboratory led the development of the DACMS that will transition BIW for implementation. Implementation of the 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. BIW will deploy the solution at its Bath, ME, facility during the second quarter of FY22.



BIW Advances Socket Weld Pipe Fitting Scribe Process

M2854 — Automated Pipe Fitting Scriber

Objective

Thousands of welded pipe joints are made during the fabrication of a DDG 51 Class destroyer, many of which are slip-on couplings, socket elbows, and socket flanges that are fillet welded to the pipe. The Navy requires a reference mark (aka, scribe line) be made on the fitting to allow accurate measurement of the fillet weld toes to be used for visual welding inspection (VT). If the edge of the pipe fitting is consumed in the weld, it is impossible to verify the required weld size has been achieved unless a reference mark is present.

General Dynamic Bath Iron Works' (BIW's) method of applying scribe lines on socket weld pipe fittings was a manual effort, and that approach found issue with the marks being easily removed in both pre- and post-weld handling and cleaning processes, rendering difficulty in finding the marks upon inspection. Weld joints potentially had to be cut, re-fit, and welded again if no scribe marks are present at inspection for appropriate weld size.

The goal of this Center for Naval Metalworking (CNM) project was to develop an automated mechanism that could produce permanent and accurate circumferential scribe marks for a range of socket welded pipe fitting sizes. Automating the scribing process reduces shipbuilding costs by reducing scribing labor, handling time, VT labor, and re-work.

Payoff

The results of this effort demonstrated a tool capable of scribing a pipe joint in 30 seconds or less with only a few hours of experience under the operator's belt. This automated process significantly reduces the time required to scribe socket weld pipe fittings and reduces the time required to VT inspect socket weld pipe fitting joints. This equates to five-year cost savings of \$2.6M and a return on investment (ROI) of 2.4:1.

Implementation

BIW led this Navy ManTech development project with support from Edison Welding Institute (EWI). An automated portable prototype scribing unit was created by EWI modifying commercial-off-the-shelf hardware. Requirements were identified, followed by the creation of demonstration test plans. The developed prototype was evaluated by scribing a variety of fittings used as mock-up test articles. Initial assessment demonstration was completed at EWI followed by demonstrations at BIW with shipyard staff. Implementation for this technology started in the first quarter of fiscal year 2022 and full implementation is expected by the end of the fourth quarter fiscal year 2022.



PERIOD OF PERFORMANCE:
Feb 2020 to Nov 2020

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
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TOTAL MANTECH INVESTMENT:
\$645,000



Automation to Optimize Hull Access Hole Cutting and Welding



PERIOD OF PERFORMANCE:
Dec 2020 to Dec 2022

PLATFORM:
DDG 51, LHA, LPD, NSC

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 400

TOTAL MANTECH INVESTMENT:
\$1,205,000



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 have the material removed to open a temporary manhole. The 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 in the ability of the operator to produce first-time quality welds for close-out of 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 will be performed to help leverage solutions, including new commercially off-the-shelf (COTS) 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, 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 \$452K 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 \$5.75M 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 fiscal year 2023.

Ingalls Evaluates Wireless Technology as a Capability Accelerator

Q2858 — Wireless Assessment of Shipyard Production Environments

Objective

Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) sees wireless technology a key enabler to improve the efficiency of many existing shipyard production processes. Many current shipyard construction processes require the collection, storage, and subsequent (often hours later) transmittal of digital information to or from primary data sources. This occurs by either transcription, re-entry, or end-of-shift or end-of-day device docking and download. The ability to collect and store data in real time has the potential to significantly improve processes across the shipyard for things like timekeeping, material status, communications, work instructions, etc.

Ingalls has three primary goals in this project: 1) to identify operational needs and investigate the state of wireless capability in major shipyard production areas, 2) to identify a set of technology solutions that address operational needs and overcome environmental challenges, and 3) to develop deployment concepts and recommend appropriate applications of these solutions.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project defined Ingalls' wireless operational needs, documented existing wireless designs and implementations, and studied existing coverage and signal availability. This project also identified and documented environmental challenges with respect to signal interference, signal strength, and signal propagation, which have been unsurmountable. Lastly, this project identified modern wireless technology solutions that are capable of satisfying the wireless needs of shipyard production areas and recommended potential vendors and technologies the shipyard should investigate in follow-on studies and technology trials.

Payoff

This project provided a technology baseline study to identify the state of wireless capability, as well an environmental survey, a technology survey, and implementation recommendations.

Implementation

Because this project was primarily an investigative effort, implementation was not expected. Of note, any future wireless design project will require consideration of all the relevant shipyard conditions, which can be broken down into three alternative methods for providing wireless services:

1. Fixed wireless, usually provisioned overhead, but sometimes on the sides of permanent construction areas
2. Cabled temporary wireless services brought on board with other temporary services like power and lighting
3. Completely wireless-sourced temporary services using cabling after an initial wireless distribution hop.



PERIOD OF PERFORMANCE:
Apr 2020 to Apr 2021

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
NSAM

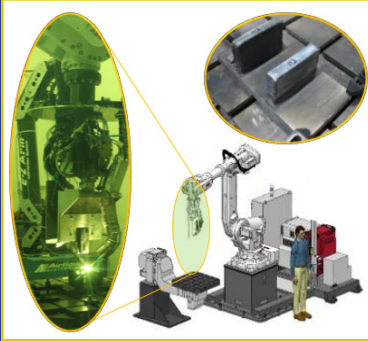
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STAKEHOLDER:
DDG 51

TOTAL MANTECH INVESTMENT:
\$320,000



Innovative Way to Build Traditionally Cast Parts



PERIOD OF PERFORMANCE:
Jul 2020 to Apr 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
\$1,319,000

Q2863 — Large Format Directed Energy Deposition Additive Manufacturing 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 an 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 aims to evaluate the large format directed energy deposition additive manufacturing (DEDAM) process, generate test data to assist in creating Navy guidance documents for the use of DEDAM, and assess the potential benefit as a replacement for large castings in alloys relevant to the U.S. Navy and U.S. shipbuilding industry. Key elements to be addressed include pre- and post-heat capability. Successful completion of the effort will demonstrate capability — and define limitations — of large format DEDAM and establish performance data for alloys suitable for replacement of conventional casting materials. The results will help advance 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 aims to help reduce the man-hours associated with construction of the DDG 51 Class destroyer.

Payoff

At this time, the CNM project does not have a payoff. A follow-on effort is anticipated, which is expected to include cost savings and benefits.

Implementation

Based on the results of testing, a follow-on effort will be pursued and testing will be conducted at Huntington Ingalls Industries — Ingalls Shipbuilding (Ingalls) for feasibility in a shipyard. Ingalls will procure a large format DEDAM machine and conduct further testing and evaluation on a candidate component. Rigorous testing will be required to ensure Technical Warrant Holder approval.



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 step up to the required final size. Clearance for 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, meaning that 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, and 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 the desired outcome. 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 down selection to partner with Hougen Manufacturing to produce a prototype compact magnetic annular cutter 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 of a new drill and 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 man-hours and drill set-up time, NNS estimates that this CNM effort may result in five-year savings of \$3.3M for CVN Class aircraft carriers (new construction and overhaul), and BIW estimates this effort may result in five-year savings of \$2.4M for DDG 51 Class destroyers. The combined five-year return on investment for the project is 3.68:1.

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 fourth quarter of fiscal year 2022 and the first quarter of fiscal year 2023, respectively.



PERIOD OF PERFORMANCE:
Jun 2020 to Jun 2022

PLATFORM:
CVN, DDG 51

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 379, PMS 400

TOTAL MANTECH INVESTMENT:
\$868,200



Reducing Cost for Installation of Temporary Attachments



PERIOD OF PERFORMANCE:
Feb 2020 to Jul 2021

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 400

TOTAL MANTECH INVESTMENT:
\$452,700



S2873 — Structural Fit-Up Applications

Objective

Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) assessed that there is opportunity for the Structural Fit-up Applications project to reduce the cost associated with temporary attachments with 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; and identifying temporary attachments to down select. Ingalls identified 43 temporary attachment use cases and created a use case matrix spreadsheet that detailed weight / holding strength estimate, length of time needed to hold, location, number of instance 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 uses cases created a total of 476 instances since each use case can be used more than once in a unit. After the use cases were identified the project team placed them into functional families and use cases for each family were down selected.

Ingalls researched existing technologies and products that have the potential to improve each of the uses cases. Based on information the project team received from the bid packages sent out, they down selected two companies with adhesive, mechanical and magnetic solutions to pilot test.

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

Payoff

This technology, once implemented, could potentially produce estimated five-year savings of \$2.0M for DDG 51, \$2.6M for LPD, and \$1.4M for LHA.

Implementation

Upon acceptance of both the technology and associated business case by the acquisition Program Offices, the results will transition to the Ingalls facility. Ingalls anticipates implementation in the third quarter of FY22.

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, and 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 may result in less than ideal planning of critical assets leading to production inefficiencies.

In this project, the Institute for Manufacturing and Sustainment Technologies (iMAST) is developing a tool that will interface with the shipyard's current capacity planning tools and provide 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 in the overall resource schedules. This will result in savings for the planning, operations and maintenance areas. Additionally, this software has an asset tracking function integrated into the software.

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

Implementation of the CAM tool will result in an average savings of \$517K per DDG hull and total savings of \$3.1M for nine hulls. The five-year return on investment is 2.4:1.

Implementation

Upon successful and timely completion of the CAM project and acceptance of the technology and associated business case by the PMS 400D, the resulting software and tools will be transitioned to BIW (estimated completion date for transition is the second quarter of FY22). It is expected that the new technologies will be implemented at BIW. Post-project technology insertion will be limited to full-scale deployment of piloted technologies / improvements developed during the project.



PERIOD OF PERFORMANCE:
Dec 2019 to Mar 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
iMAST

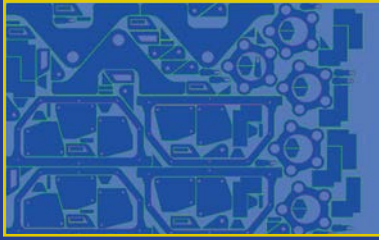
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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
\$776,400



Streamlining Processes for Pipe, Plate, and Shapes



PERIOD OF PERFORMANCE:
Jul 2020 to Aug 2022

PLATFORM:
DDG 51, LHA, LPD, NSC

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
DDG 51, 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, the internal administrative constraints limit the ability to absorb the fluid nature of production (e.g., nesting that addresses just-in-time schedule requirements across contracts, hulls, units, material types / sizes). The Dynamic Rules Based Material Process project will investigate how to make these processes more efficient.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project will create a rules-based process for effective consumption of whole material while reducing overall scrap. A dynamic nesting solution will be evaluated with the goal of eliminating the risk associated with cross nesting (across multiple bills, hulls, or contracts) while decreasing material handling cost. A formal rules-based program will be set up that addresses the handling of excess material. These are expected to add versatility to the processes and minimize manual nesting, touch cost, and material waste. Additionally, the project will address physical marking for material allocation (cost collection), tracking, and locating.

This project will also examine whether the opportunity exists to connect results automatically (via a digital solution) with the technology developed under other ManTech projects in order to leverage existing technology.

Payoff

Once implemented, Ingalls anticipates that this project will create a reduction in material waste (plate and pipe), as well as a reduction in engineering man-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 FY23 on multiple ship platforms, including the construction of LHA 9, LPD 33, DDG 137, and NSC 12.

Ensuring Data Accuracy and Reliability at BIW

M2888 — Manufacturing Support Tools

Objective

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 a large amount of 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

This project will produce estimated savings of \$492K per year, which will create five-year savings of approximately \$3.0M and a return on investment of 2.9:1, by reducing labor costs and avoiding rework associated with poor access to data.

Implementation

Implementation will take place within the second quarter of FY23. As such, it will become widely available for use as an integrated tool starting with DDG 124. 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:
Sep 2020 to Feb 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 400D

TOTAL MANTECH INVESTMENT:
\$684,000



Content-Based Search Will Optimize Parts Lookup



PERIOD OF PERFORMANCE:
Aug 2020 to Sep 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
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TOTAL MANTECH INVESTMENT:
\$1,200,000



S2889 — Visual Search Engine

Objective

A surface combatant such as the Arleigh Burke-class (DDG 51) guided missile 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 engineers to research, identify and select parts and to reduce the number of parts that are 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, will investigate 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 then 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 any 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.

Implementation

The Visual Search Engine technology is expected to be implemented at Ingalls during the fourth quarter of FY23.

Device Offers Safe, Handheld Option to Remove Lifting Pads

S2892 — Cold Cutting Steel

Objective

When building steel ships, it is a common practice to employ “hot work” methods for cutting steel, 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. In many cases, hot work methods employ the use of handheld burning torches and arc gouging equipment, which are prone to imprecise cuts. These 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 is developing a safe, cold-cutting device capable of removing lifting pads with a precise cut line. Bath Iron Works (BIW) and CNM have finished Phase I, which included baselining, use case, and vendor down selection 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 will provide 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 constructions.

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. The anticipated five-year return on investment is 2.39:1.

Implementation

Preliminary plans indicate that full implementation will occur six months after the project concludes. The implementation hull numbers will begin with DDG 126. The results will be implemented primarily in the Outfitting Halls and Land Level Transfer Facility. The transition event will follow the successful demonstration of the prototype at BIW. Detailed implementation plans will continue to develop in the later stages of the project as new information is collected. BIW anticipates implementation in the first quarter of the fiscal year 2023.



PERIOD OF PERFORMANCE:
Sep 2020 to Sep 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 400

TOTAL MANTECH INVESTMENT:
\$748,235



Detecting Interferences with Virtual Reality



PERIOD OF PERFORMANCE:
Feb 2021 to Jul 2022

PLATFORM:
DDG, CLB, VCS

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 400D4, PMS 397, PMS 450

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, government-furnished equipment, 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 way of load-out activities. Planned load outs take place at a specific stage of construction and 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 not accounted for in the design. Unplanned load outs and removals entail movement of major equipment that are not foreseen in the build plan or are 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 application that will 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 computer-aided design models or a 3D scan that corresponds to the shape of the equipment. At Bath Iron Works (BIW), the mechanic using the application will move the virtual object through the load-out path to identify and verify interferences in order to minimize unnecessary rip out. General Dynamics Electric Boat (GDEB) will use this tool to allow 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 estimated savings of \$145K per VIRGINIA Class submarine, \$174K per COLUMBIA Class submarine, and \$268K per DDG 51 Class destroyer for combined five-year estimated savings of \$3.5M.

Implementation

The virtual load out interference detection technology is expected to be implemented at both BIW and GDEB facilities during the first quarter of FY23.

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 track 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 man 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 the final inspection required for vertical and horizontal erection joints. The overall multi-function shipbuilding robot will be developed using a phase-based approach. Phase 1 will establish the requirements for each of the desired processes and research the available technologies on which the system foundation can be based. Phase 2 focuses on implementing the automated robotic welding processes, 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 3 will focus on developing the capability for surface preparation by the robot to automatically perform welding preparation and interpass cleaning. Phase 4 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 eliminate labor hours and resources required to erect scaffolding and track welding set up, as well as decrease labor hours needed to weld erection joints by 50 percent. Implementation of the multi-function shipbuilding robot is estimated to result in savings of \$668K per DDG hull or \$2.96M 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 third quarter of fiscal year 2024.



PERIOD OF PERFORMANCE:
Apr 2021 to Apr 2023

PLATFORM:
DDG 51, LHA, LPD, NSC

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
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TOTAL MANTECH INVESTMENT:
\$1,004,000



Ingalls Shipbuilding Evaluates Use of Public Yard Sustainment Technologies at Private Yards



PERIOD OF PERFORMANCE:
Jun 2021 to Feb 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
NSAM, iMAST

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STAKEHOLDER:
PMS 400

TOTAL MANTECH INVESTMENT:
\$450,000
(\$300K NSAM / \$150K iMAST)



S2918-A-B — Sustainment Technology Insertion Assessment

Objective

Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) sees sustainment technologies successfully demonstrated at public shipyards as enablers for private shipyards to help the U.S. Navy keep up with its need to conduct increased amounts of ship and submarine sustainment and maintenance. This project, conducted by the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center and the 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 Ingalls’ Pascagoula, MS, shipyard. This project conducted a feasibility study to determine how demonstrated benefits of these readily available maintenance and sustainment technologies can be implemented in a private shipyard and what, if any, adaptations or variations may be needed for use at a private shipyard. Specifically, this project identified the technical, economic, and operational feasibility associated with 3D laser scanning and cold spray technologies relative to fleet sustainment and overhaul work at the Ingalls shipyard and for private shipyard use in general. Additionally, the project leveraged the technical, economic, and operational feasibility assessments to develop a list of best practices and a recommended process for future use when transitioning related technologies to private sustainment applications.

Payoff

This project assessed how sustainment technologies developed at public yards can be implemented at private yards, documented lessons learned / best practices, and developed a recommended process for future transitions of additional sustainment technologies developed at public yards for use in private yards.

Implementation

This project delivered a recommended procedure for implementing additional public yard sustainment technologies at private yards.

VCS / CLB Submarines Projects

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

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

S2677 — Plug-and-Play Composites



PERIOD OF PERFORMANCE:
Mar 2017 to Aug 2022

PLATFORM:
VCS

CENTER OF EXCELLENCE:
CMTC

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PMS 450

TOTAL MANTECH INVESTMENT:
\$4,300,000

Objective

External submarine hull components often require significant man-hours to apply supplemental materials in order 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 and successfully demonstrated that a multi-functional “plug-and-play” composite part (a single part with all functional attributes of the original multi-material system) can arrive from the vendor ready for shipboard installation. The proposed technology will balance 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. Many existing composite applications currently require additional coatings; therefore, potential applications could be more desirable as a result of improved business cases.

Payoff

Successfully designed and manufactured plug-and-play composite components are anticipated to 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 \$20M for VIRGINIA Class submarines.

Implementation

Additional applications are being investigated for FY22 implementation of multi-functional “plug-and-play” composites. Potential applications include non-pressure hull access covers / hatches, control surfaces, and external fairings.



Merging Digital Data with New Technology in Component Location Improvements

S2699 — Digital Data for Next Generation Measurement / Locating Tools

Objective

The amount of time required to locate items during outfitting and final installation is a significant contributor to shipbuilding costs. Recent studies have indicated that location activities account for up to 10 percent of touch labor costs. Opportunities to reduce location costs and labor requirements are afforded by recent advancements in projection technologies, specifically when applied to hanger stud and paint masking location identification. While shipyards commonly perform automated extractions from CAD models, manual steps are required to feed data files into the projection systems. For paint masking, drawings are manually developed with dimensions added, providing direction for areas of “no paint” marking and ultimately, masking off prior to painting.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project improved the processes to locate and install paint masking and hanger stud positions by developing software that automatically queries the CAD model and planning databases for the location and work sequencing data needed to drive the projectors. The project designed and developed a mobile optical projection device and the supporting software to receive and process CAD and associated product data and integrate the location data with the appropriate technologies to validate the accuracy and repeatability of an improved process.

The application of automatically extracted location data in advanced location tools is expected to reduce the time and cost required to determine stud and paint masking locations.

Payoff

This project is expected to result in estimated savings of \$510K per DDG hull and \$501K per VIRGINIA and \$809K per COLUMBIA Class submarine hulls for estimated combined five-year savings of \$12.3M (the five-year return on investment is 5:1).

Implementation

The solution technology is expected to be implemented at General Dynamic Electric Boat’s Quonset Point, RI, facility and at Bath Iron Work’s Blast and Paint facility during the first quarter of FY23.



PERIOD OF PERFORMANCE:
Mar 2019 to July 2021

PLATFORMS:
DDG, VCS, CLB

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 400D, PMS 397, PMS 450D

TOTAL MANTECH INVESTMENT:
\$1,680,000



Replacing Paper Weld Records with an Electronic System

S2703 — Electric Weld Record System

Objective

Welding processes at Huntington Ingalls Industries – Newport News Shipbuilding (NNS) require over 25 different forms, including non-destructive testing (NDT). All of these forms are manually filled out 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, misplacing records, and difficult / time-consuming tracking and reviewing / certifying records for accuracy / completeness, which impact NAVSEA audits and system testing.

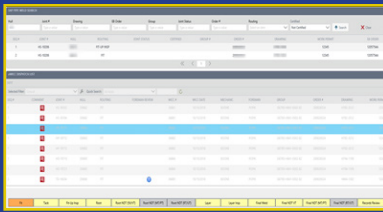
The purpose of this VIRGINIA Class submarine (VCS) project was to develop an electronic weld record system to eliminate the paper records and replace them with an electronic system. The electronic system is web-based and accessible by all users (e.g., welders, auditors, managers, SUPSHIP, fitters, and 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, developed an electronic prototype, and defined the technical requirements. 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 in cost and time. This technology, once implemented, could potentially save an estimated \$1.5M per VCS hull. The estimated savings per year are approximately \$2.9M (based on nine VCS in-process hulls per year) and approximately \$14.5M over five years.

Implementation

User acceptance testing will serve as validation that all applicable parties can electronically sign weld records. Upon successful and timely completion of the Electronic Weld Record ManTech project and 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 FY23.



PERIOD OF PERFORMANCE:
Nov 2016 to Dec 2021

PLATFORM:
VCS Submarines

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 450

TOTAL MANTECH INVESTMENT:
\$1,300,000



Commonality for Temperature Measurement and Control in the Shipyard

S2747— Automated Preheat Temperature Monitoring

Objective

Many facets of submarine construction involve controlled heating of materials during welding processes to ensure the quality of welds. In submarine construction, rigid monitoring and controlling of the temperatures during welding processes were highly manual processes. Workers continuously monitored the temperature of welded sections, and adjusted the heater controls to maintain the correct temperature profiles. Manual weld preheat and post-welding processes, which require manual temperature monitoring, measurement, and documentation, use significant amounts of labor.

This Electro-Optics Center (EOC) project team followed a proven systems engineering approach to develop an automated temperature monitoring and digital reporting solution. Initial phases developed and optimized physical attachment methods, temperature correlation, and logistics in a relevant environment. The project defined the requirements for data processing and their integration with temperature control systems, and a prototype system has been constructed and tested. The project is now transitioning and optimizing automated temperature monitoring in the shipyard environment.

Payoff

General Dynamics Electric Boat (GDEB) has a group of technicians who manually monitor and document the temperatures for critical heating processes in the shipyard. According to GDEB, an automated system could ultimately save \$529k for each VIRGINIA Class submarine hull. There was also the unanticipated benefit in energy saving by getting to temperature faster without overshoot. The vision of this project is to automate the monitoring processes so that these technicians can spend more time performing setup tasks and addressing the correction of out-of-limit processes. By having remote access to critical material temperature data, new levels of traceability could enhance weld issue diagnostics in the future.

Implementation

Because of the wide applicability of temperature monitoring scenarios and methods, this project included specific tasks that drive commonality into implementation of those methods. A large amount of cooperative work between EOC and GDEB engineers are assuring that the resulting functional system specification will be implementable. Where development work was performed at EOC laboratories, there was a corresponding transition to a non-production task at the shipyard to assure that personnel were current with the methods under development. The knowledge gained during the project, in conjunction with the resulting system specification document, is the recipe for successful shipyard implementation.



PERIOD OF PERFORMANCE:
Oct 2018 to Apr 2021

PLATFORM:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
EOC

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STAKEHOLDER:
PMS 450, PMS 397, PEO Subs

TOTAL MANTECH INVESTMENT:
\$1,083,000



Diagnostic and Predictive Monitoring Reduces Downtime of Unplanned Equipment Failure, Improves Planning and Scheduling



PERIOD OF PERFORMANCE:
Jun 2017 to Sep 2021

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
iMAST

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STAKEHOLDER:
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, so the objective of this project was to implement a predictive maintenance (PdM) capability at General Dynamics Electric Boat (GDEB) facilities to improve process efficiencies and decrease costs. In addition, while many capacity and production planning tools can organize the production schedule around planned 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.

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 \$388K per year and five-year savings of \$2.3M for Groton, and \$560K per year and five-year savings of \$3.4M for Quonset Point. The five-year return on investment (ROI) is 2.48:1 for Groton and 3.15:1 for Quonset Point.

Implementation

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) and their dominant failure modes that are candidates for PdM. Focusing on this equipment, the total number of measurement locations for each of the sensor types, including vibration, temperature, and lubrication oil samples, was determined. This led to the ROI assessment of COTS sensor technologies for each equipment application to determine the optimum solution for GDEB. Based on the selected health management system design with the highest ROI, the Phase 2 effort implemented (August 2021) the health management technologies 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. The results of this effort provided labor and material cost savings associated with reducing the number of reactive and preventative maintenance tasks, reducing the time for diagnosing equipment failure, and reducing maintenance actions and lost production due to unscheduled maintenance.

Robotics and Automation Will Improve Installation of Submarine Hull Inserts

S2751 — Robotic Process for Installing Hull Inserts

Objective

The legacy process to install hull inserts in submarine pressure hulls is an intricate sequence of events that consists of multiple manual operations, including cutting, beveling, grinding, and welding processes. Requiring extensive labor in excess of 45,000 hours per hull, installing hull inserts significantly increases the manufacturing span time for the initial outfitting phase. Since weld quality is dependent on tribal knowledge and individual skill level, 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 requires 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 the integral steps of 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 penetrations 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 final solution, achieved robotically, will be capable of cutting and beveling the pressure hull in way 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, a 20 percent reduction in cutting, fitting, and welding labor is forecasted as a result of this CNM project. Through increased efficiencies and quality improvements enabled by the technology, GDEB anticipates savings of approximately \$1.9M per hull for VCS, the VIRGINIA Payload Module.

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 fiscal year 2025.

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, VPM, and CLB. The schedule for implementation activities is dependent on the project results.



PERIOD OF PERFORMANCE:
May 2018 to Sep 2023

PLATFORMS:
VCS, VPM, CLB Submarines

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 450, PMS 397

TOTAL MANTECH INVESTMENT:
\$2,372,000



Producing Savings through Portable Welding Technology



PERIOD OF PERFORMANCE:
March 2019 to Jun 2022

PLATFORMS:
VCS, VPM, CLB Submarines

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
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 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 the 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 savings of \$568K per VCS hull, \$756K per VIRGINIA Payload Module, and \$1.2M per CLB hull for five-year savings of \$10.4M (a five-year return on investment of 1.97:1).

Implementation

The solution technology is expected to be implemented at General Dynamic Electric Boat's Quonset Point, RI, facility during the second quarter of fiscal year 2025.



Advancing the Automated Processing of Welding Submarine Hull Frames

S2760 — Automated Hull Frame Welding for Submarines

Objective

For VIRGINIA Class submarines (VCS), General Dynamics Electric Boat (GDEB) currently uses labor-intensive operations and processes to fabricate hull frames. GDEB performs these operations in permanently located, mechanized welding stations. The objective of this Center for Naval Metalworking (CNM) project is to develop and demonstrate a scalable, automated hull frame welding system that replaces the less efficient, manually adjusted, mechanized systems used for VCS and COLUMBIA Class submarines (CLB). The project will also incorporate an automated measurement system to determine real-time circularity measurement indicators during the welding process. Implementation of an automated welding and measurement system will minimize distortion in the hull frames and allow frequent measurements to be taken at various points during the process to increase circularity quality.

Using enhanced automated welding processes to fabricate hull frames will increase productivity, decrease fabrication costs, decrease inspection costs, and ultimately decrease frame fabrication and installation manufacturing span time. Enhanced automated solutions for the fixtures will expand the use of automated / robotic welding and inspection in shipbuilding. During the first phase, candidate frames and robot system requirements will be developed and a robotic solution will be selected. Test plans will be created to evaluate robotic technologies and to support weld qualification testing. In the second phase, process technologies will be developed on a robot integrator's prototype. Recommended welding parameters and bead plans will then be developed. Prototype technology performance will be determined by testing to evaluate developed parameters and weld qualification testing.

Payoff

This CNM project is expected to provide savings of \$1.3M per VCS hull, \$1.8M per VIRGINIA Payload Module, and \$2.8M per CLB hull for combined five-year savings of \$24.0M across all platforms.

Implementation

Upon successful and timely completion of the Automated Hull Frame Welding for Submarines 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 third quarter of fiscal year 2023.



PERIOD OF PERFORMANCE:
Jul 2020 to Sep 2022

PLATFORMS:
VCS, VPM, CLB Submarines

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 450, PMS 397

TOTAL MANTECH INVESTMENT:
\$3,031,000



Using an Automated System to Replace a Human Skill Set



PERIOD OF PERFORMANCE:
Feb 2018 to Mar 2021

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
\$452,000

S2784 — CNC Forming of Steel Plates for VIRGINIA and COLUMBIA Class Submarines

Objective

Program Offices for the VIRGINIA Class submarine (VCS), VIRGINIA Payload Module (VPM), and COLUMBIA Class submarine (CLB) have directed a reduction in construction costs. At General Dynamics Electric Boat (GDEB), plate forming is a manual process dependent on hydraulic forming equipment, annotated paper sketches, wooden templates, and “tribal knowledge” of various steel behaviors. GDEB recognizes the importance of mechanized / automated processes to reduce the cost of submarine structures and is interested in taking that mechanization to the next level with a computer numerically controlled (CNC) forming process.

The objective of this project was to utilize CNC technology to form steel to computer-generated geometry. This will allow for better throughput of the forming task, creating better formed parts. This manufacturing improvement will result in parts that are easier to fit to requirements of the submarine, further reducing labor hours down-stream from the forming process.

The Naval Shipbuilding and Advanced Manufacturing (NSAM) Center effort researched, prototyped, and validated the concept of utilizing commercial-off-the-shelf CNC forming equipment to produce accurate, cold-formed submarine parts using Navy required plate materials. Computer-controlled forming will be predictable and repeatable and provide faster first-time quality formed parts using work package digital data derived from the design model.

Payoff

This technology, once implemented, could potentially save estimated combined five-year savings of approximately \$9.7M for VCS and CLB.

Implementation

Upon acceptance of both the technology and associated business case by the acquisition Program Offices, the results will transition to the GDEB Quonset Point facility. GDEB anticipates implementation in the second quarter of FY23.



“Locating” Savings with Real-Time Locating Technologies

S2799 — Real Time Locating System (RTLS)

Objective

Production assets such as forklifts, welding units, cranes, etc. are essential components required in submarine construction. Currently at General Dynamics Electric Boat (GDEB), there are no existing systems or processes in place to easily locate these assets. Assets are allocated geographically on an as-needed basis with limited ability to track the path of the asset. This antiquated process results in underutilization of equipment, additional labor costs associated with finding assets, lost labor due to inventory efforts, and work scheduling conflicts due to an inability to effectively plan asset usage. Additionally, there is no current program or universal database to capture details on asset status availability and condition. The absence of this pertinent information often results in uninformed planning and scheduling of work as well as preventative maintenance deferrals due to the inability to locate and schedule assets.

The Real Time Locating System (RTLS) project, managed by the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center, created an effective electronic tracking method to integrate into GDEB’s existing emergent work order systems. This allows GDEB to locate, request, and status production assets on the floor in real time. RTLS technology offers cost-effective solutions to automatically status, track, and locate assets in a shipyard environment. By inserting RTLS technologies capable of tracking assets connected to work orders, the project is expected to enable numerous improvements to equipment utilization, resource allocation, as well as a more effective in-field service program for preventive maintenance.

Payoff

This project is expected to result in estimated savings of \$179K per VIRGINIA Class submarine (VCS), \$232K per VIRGINIA Payload Module, and \$376K per COLUMBIA Class submarine for estimated five-year savings of \$3.4M. The five-year return on investment is 1.56:1.

Implementation

The RTLS technology is expected to be implemented at GDEB’s Quonset Point, RI, facility during the second quarter of FY23.



PERIOD OF PERFORMANCE:
May 2019 to July 2021

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
NSAM

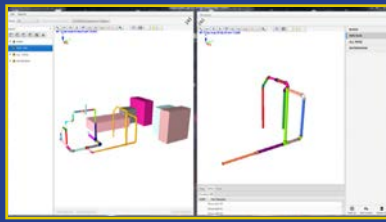
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STAKEHOLDER:
CLB / PEO Subs, PMS 397
VCS / PEO Subs, PMS 450D

TOTAL MANTECH INVESTMENT:
\$523,000



GDEB is Enhancing a Lean, Paperless, and Tablet-Based Work Package Process



PERIOD OF PERFORMANCE:
Jul 2019 to Sep 2021

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
\$831,000



S2803 — Model Based Build Plan

Objective

General Dynamics Electric Boat (GDEB) is moving away from paper drawings and 2D build plans, such as manufacturing assembly plans (MAPs). For the COLUMBIA Class submarine (CLB), GDEB is utilizing lean, tablet-based work instructions that can be broken down to shift-level work assignments. MAPs are a detailed construction / assembly sequence for a given drawing that captures “best practice” information not normally documented on drawings or work orders. In order to make this transition a seamless and enriched process, certain objectives need to be considered and developed. The Model Based Build Plan project’s main objective is to develop and view electronic MAPs (eMAPs).

A previous ManTech project, Mobile Computing Design Build Process (S2653), developed tools such as the Build Plan Editor to help fill this gap for VIRGINIA Class submarine (VCS) structural build plans. However, several gaps and enhancements still need to be addressed. These gaps are based on feedback from both the developers of these work instructions or eMAPs and the trades personnel.

The goal of this Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project is to use the eMAP in conjunction with the Build Plan Editor to develop MAPs rather than the current process (2D MAPs). The project will create a digital build sequence from the legacy VCS product model. This digital build sequence will include only the operations, material, joints, and views that a worker will need to accomplish a particular unit of work. Throughout the tool development, the user-base has continued to expand.

Payoff

Upon completion, this project will reduce annual labor hours for work instructions. Savings are estimated at \$450K per VCS hull, \$585K per VIRGINIA Payload Module, and \$945K per CLB. This will produce combined VCS / CLB savings of \$8.1M over the next five years, with a return on investment of 6.8:1.

Implementation

GDEB will implement the solution at GDEB’s Quonset Point facility beginning in the second quarter of FY22; implementation is expected to be completed by the second quarter of FY24.

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 form and shape 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 are 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 will 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 conducted a market survey to identify metrology items available and in industry. Process parameters and test plans will be developed to assess the metrology technologies and identify any gaps that will require further development to meet production needs.

Payoff

By reducing the labor hours associated with planning, surveying, and reporting, the NNS project team anticipates a considerable reduction in non-value-added work. Through increased efficiencies and quality improvements enabled by the technology, NNS anticipates five-year savings of \$3.6M and a five-year project ROI of 1.7:1.

Implementation

Based on the results of testing, NNS will generate the data needed for internal process verification and validation, finalize the business case analyses, and create shipyard implementation plans. The transition event for this project is NNS'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 at NNS. Implementation is anticipated in the third quarter of FY22.

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:
Aug 2019 to Feb 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
\$944,000



Increasing Efficiency of Steel Processing through Robotic Advancements



PERIOD OF PERFORMANCE:
Jul 2020 to Jul 2022

PLATFORMS:
VCS, VPM, CLB Submarines

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 397, PMS 450

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 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.

Robotic capability has advanced enough to replace these manual functions, eliminating production delays resulting from operator availability and producing bevels and tapers of consistently high quality. Similar proven technologies from the heavy steel fabrication industry will be evaluated and leveraged as the starting point for development under this project.

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 in order to meet the demands of the VIRGINIA Class submarine (VCS), VIRGINIA Payload Module (VPM), and 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 re-work 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 savings of \$538K per VCS hull, \$715K per VPM, and \$1.1M per CLB hull for combined five-year savings of \$9.8M across all platforms. The five-year return on investment for this project is 3.11:1.

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 second quarter of fiscal year 2023.

Robotics Initiative Combines Scanning, Blasting, and Painting into One Innovative Solution

S2817 — Automated Interior Scanning, Blasting, and Painting

Objective

General Dynamics Electric Boat (GDEB), in collaboration with Bath Iron Works (BIW), has embarked on the Automated Interior Scanning, Blasting, and Painting project to investigate opportunities to utilize robotics that will combine scanning, blasting, and painting into one innovative solution for large-scale projects. The current process used for blasting and painting the interior of tanks involves limited access to these areas and requires substantial personal protective equipment to ensure safety in confined spaces. Additionally, these processes require a significant amount of man-hours to complete due to the complex shapes of the tanks, lack of visibility in the confined blasting environment, and associated cleanup.

The objectives of the Automated Interior Scanning, Blasting and Painting project are to develop and demonstrate a fully automated 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 the man-hours required to complete the entire evolution. In addition, the proposed automated system will create a more uniform quality product while maintaining safety. Robotics technology is a proven alternative for manual blasting and painting processes in other industries. The scanning technology proven on a smaller scale will require further research and development to complete on a larger scale. Ultimately, the scanning technology will create a 3D digital representation of the part and then be used to program a robotic path given the dictated parameters for the robot with respect to offset distance, step size, and translation rate. These inputs, in addition to a digital representation of the part, can be used to manufacture a path for the end effector to blast and paint the complex features of the interior tanks.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center effort will define the desired system functionality, identify the candidate tanks and develop the system requirements and functional specifications. A small-scale representative demonstration will be used to down select a robot integrator for the large-scale demonstration. The large-scale test demonstration will be conducted on a representative tank, with test plans created and executed to demonstrate scanning, blasting, and painting functions.

Payoff

This technology, once implemented, could produce estimated five-year DDG 51 savings of \$2.8M and estimated combined five-year VCS / CLB savings of \$7.7M.

Implementation

Upon successful and timely completion of the Automated Interior Scanning, Blasting, and Painting ManTech project and acceptance of both the technology and associated business cases by the acquisition Program Offices, the results will transition to the GDEB and BIW facilities. GDEB and BIW anticipate implementation in the third quarter of FY24.



PERIOD OF PERFORMANCE:
Mar 2020 to Jan 2023

PLATFORMS:
VCS / CLB, VIRGINIA Payload
Module, DDG 51

CENTER OF EXCELLENCE:
NSAM

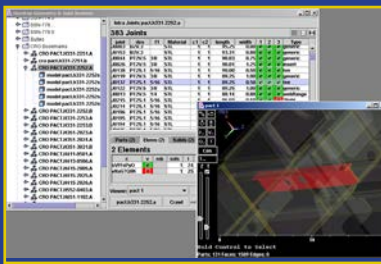
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STAKEHOLDER:
PMS 397, PMS 400D, PMS 450

TOTAL MANTECH INVESTMENT:
\$1,566,000



Enabling a More Comprehensive View of the World of Work in Shipbuilding



PERIOD OF PERFORMANCE:
Nov 2019 to Sep 2021

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 450D, PMS 397

TOTAL MANTECH INVESTMENT:
\$786,000



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 that is capable of providing accurate information to the General Dynamics Electric Boat (GDEB) Planning, Operations, and Process Improvement departments. The software utilized attributes from NX data to provide a central location to easily query and extract key data from the CAD drawings. The development plan followed an incremental and iterative approach in which the tools were built first to address simple shapes and welds and then progressed to address more complex geometry, such as curved shapes and cut-outs. The Envision software is a tool that enables an efficient use of resources by providing key components of a drawing to employees at vital times within the planning and manufacturing process. The tool will also provide sufficient attribute information to determine the primary and secondary forming work centers within steel processing. This will allow the planning staff to identify the work center required for the forming operation and provide information at the work order level necessary to forecast the work load over time by steel processing asset.

Currently GDEB operations create a high-level build plan. Afterward, Quonset Point (QP) Process Improvement examines the level of assembly for individual drawings or design models and re-engineers the manufacturing plan. 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 the 140,000+ structural welds per hull. In addition, these manual efforts can cause quality issues due to 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 translate to estimated one-time savings of \$1.3M and five-year savings of \$3.6M for the VIRGINIA Class submarine and the COLUMBIA Class submarine with a return on investment of 3.2:1.

Implementation

The resulting technology from the Envision for the Model Based Enterprise project will be implemented at the GDEB facility upon receipt of approval from the GDEB Director of Construction Readiness. Implementation is expected to begin by the first quarter of FY22 and be completed by the second quarter of FY22.

General Dynamics Electric Boat Uses GTAW to Increase Productivity

S2831 — Semi-Automated GTAW Welding Process

Objective

For the VIRGINIA Class submarine (VCS), General Dynamics Electric Boat (GDEB) currently uses 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. In addition, 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 will use 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 will be used to evaluate various shipyard applications, including tank welds, cladding inside of tanks, pipe welding, and 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 1 will define the requirements and develop welding parameters. In Phase 2, a test plan will be created and executed 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. GDEB projects that this effort will result in estimated five-year savings of \$456K for VCS, \$5.3M for VPM, and \$2.4M for CLB. This equates to total five-year cost savings of \$8.1M and a return on investment of 1.95:1.

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 fiscal year 2023.



PERIOD OF PERFORMANCE:
Jun 2020 to Jun 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 450, PMS 397

TOTAL MANTECH INVESTMENT:
\$2,100,000



Improving the Valve Cladding Process for COLUMBIA and VIRGINIA Payload Module



PERIOD OF PERFORMANCE:
Feb 2020 to Jul 2023

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 450D, PMS 397

TOTAL MANTECH INVESTMENT:
\$2,470,000

S2832 — Robotic Valve Cladding Cell

Objective

General Dynamics Electric Boat (GDEB) is investigating opportunities with the Robotic Valve Cladding Cell project 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 for 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, and 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 clad valves to meet ship production needs.

This 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 will define the desired system functionality and develop the system requirements and functional specifications. The project team will work with equipment integrators to modify existing robotic cladding systems to specific GDEB applications and demonstrate the desired functionality on 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 anticipated to provide combined five-year savings of \$12.5M for VCS and CLB.

Implementation

Upon successful and timely completion of the Robotic Valve Cladding Cell 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 FY23.



Accurately Locating, Aligning, and Welding Heavy Studs with Robotic Welding Technologies

S2833 — Robotic Fitting and Welding of Heavy Studs

Objective

General Dynamics Electric Boat (GDEB) is investigating opportunities with the Robotic Fitting and Welding of Heavy Studs project to improve the productivity of installing heavy studs on exterior hulls for VIRGINIA and COLUMBIA Class submarines by developing a robotic locate, fit, and tack welding system that can be positioned to accurately locate and align heavy studs, then weld them with the desired profile. The key to the project's success is the use of optical-tooling scan data that will serve as an input to the robot, employing new 'move-measure-correct' technology to ensure the stud is located within tight tolerances with respect to the hull and to other studs. Following the automated layout and tacking of the heavy studs, a robotic welding system will perform high-quality repeatable welds that eliminate the need to machine after welding, a significant improvement over legacy processes.

Currently, GDEB fits and welds heavy studs to the outside of the hull for external features and components. Alignment is critical with respect to the hull (normal to the hull and location) and stud alignment with respect to each other is also critical. For these studs, the welding processes are gas tungsten arc welding (GTAW) and shielded metal arc welding (SMAW). The installation of these studs consists of multiple manual operations that are time-consuming and require a high skill level. The manual legacy process impacts schedule and costs, and left as-is, would impact the overall shipbuilding schedule.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project is developing a robotic process that will automatically locate, fit, and tack weld the studs and produce an acceptable first-time quality weld profile on a critical component. The robotic system will reduce cost and span time, increase GDEB's overall robotic applications, and provide a solution for GTAW welding of heavy studs, ultimately reducing evolution span time from 120 days to a target of 70 days. GDEB is identifying and categorizing candidate studs and baselining legacy stud installation processes. Once completed, likely improvement areas will be identified, and a future state process map will be created to describe how GDEB expects the robot system to operate. Candidate studs with attributes of interest will be selected, and prototype stud welding assemblies will be designed for prototype testing. The project team will develop, build, and demonstrate a robotic stud welding prototype system that meets NAVSEA-type qualification test requirements. Another important output for GDEB is to determine how to expand system scalability for the addition of other potential components.

Payoff

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

Implementation

Upon successful and timely completion of the Robotic Welding of Heavy Studs 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 FY23.



PERIOD OF PERFORMANCE:
Jul 2020 to Aug 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
\$2,651,000



Addressing Increased Energy Storage Needs in Large Marine Platforms

S2836 — Nickel-Zinc Energy Storage Module for Large Platforms



PERIOD OF PERFORMANCE:
Apr 2020 to Apr 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
EMPF

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

TOTAL MANTECH INVESTMENT:
\$4,166,000



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. But the 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 will scale 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 will be 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 & 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 will produce prototype cells and a technical data package in fiscal year 2022, to be followed by extensive battery life-cycle testing and platform qualification during fiscal year 2023.

MSB system development will be necessary to accommodate the enhanced Ni-Zn cells. This includes evaluation of potential architecture solutions resulting in a selection by the end of FY23 (or later depending on when this effort is started), followed by detailed MSB system design, including new battery trays and electrical wiring design during FY23 through FY25. Integration and validation of the Ni-Zn cells with updated a battery monitoring system (BMS) will occur in FY26 with final system testing in FY27 through FY28.

Upon prototype delivery, two years of cycle testing to evaluate Ni-Zn cell performance (through FY23) will be conducted. 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 (FY24 through FY26). First article and formal qualification testing will then be conducted on the production-ready design (FY27 through FY28).

Supporting the Qualification Path for the Production Robotic Appendage Welding System

S2838 — Robotic Appendage Welding Cell

Objective

Huntington Ingalls Industries - Newport News Shipbuilding (NNS) has been investigating ways to meet increases in shipbuilding volume as well as cost and schedule goals. Historically, NNS addressed workload demands by increasing its workforce, but in today's market, the manufacturing labor pool is limited or inexperienced. With VIRGINIA Class submarine (VCS) appendages historically requiring extensive trade hours to complete, NNS is anticipating, at minimum, a proportional increase in labor based on the size for the COLUMBIA Class submarine (CLB) appendages. This is driving NNS to fabricate multiple VCS ship sets concurrently, and NNS anticipates that CLB will require the same.

The objective of this Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project is to develop equipment and processes that fully automate a multi-bead, multi-layer (MBML) welding operation to minimize operator intervention. This project will use similitude as an alternative qualification path that utilizes a non-production unit to qualify the production Appendage Robotic Welding System (A-RWS) funded by the CLB Program Office.

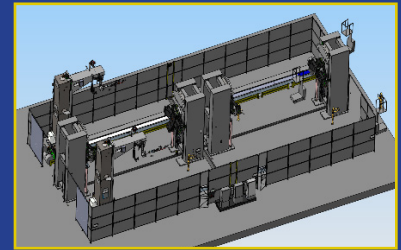
During phase I, The project will categorize and prioritize appendage structures and the pertinent data associated with the manufacturing operations, including those to be addressed using automation. Identification of the automation work will also include determining all controlling specifications and procedure qualification requirements. This data will be used to develop the desired functionality specification, the associated test plans, and the virtual demonstrations. The prototype(s) will be built, and MBML-enabling technologies will be identified, tested, developed, and matured. During phase II, the robot integrator will modify the integrator prototype unit with all of the identified technologies to create a fully integrated cell. Once complete, mockups will be fabricated to demonstrate the ability to meet all operational requirements for full automation.

Payoff

This technology, once implemented, could potentially produce estimated savings of \$3.1M per CLB shipset.

Implementation

Upon successful and timely completion of the Robotic Appendage Welding Cell ManTech project and 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 by the second quarter FY25.



PERIOD OF PERFORMANCE:
Feb 2020 to Feb 2023

PLATFORMS:
COLUMBIA Class Submarines

CENTER OF EXCELLENCE:
NSAM

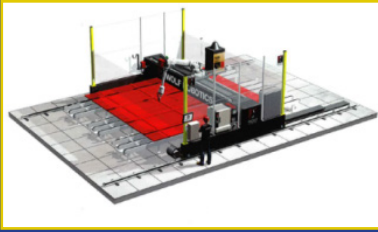
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STAKEHOLDER:
PMS 397

TOTAL MANTECH INVESTMENT:
\$4,177,500



Automated Plate Panel Line for Submarine Bulkhead Assemblies



PERIOD OF PERFORMANCE:
Jun 2020 to Oct 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 450CB, PMS 397

TOTAL MANTECH INVESTMENT:
\$1,750,000



S2856 — Bulkhead Fabrication Cell

Objective

For the VIRGINIA Class submarine (VCS), General Dynamics Electric Boat (GDEB) manufactures plate panels for bulkheads and other structures with a process that consists of multiple manual operations. The trades manually prepare the 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 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 to 12 bulkhead panels per year; the COLUMBIA Class submarine (CLB) will add more than six or more bulkhead panels per year to the current production rate. Because this process is completely manual, an automated panel-line-type 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 project is to develop a panel-line-style system to manufacture VCS and CLB plate panels for bulkheads.

Payoff

This project will establish an integrated panel line to manufacture plate panels for VCS and CLB submarines. The implementation of this vision will represent the first of its kind automated plate panel line for major submarine structural assemblies. GDEB anticipates savings of \$1.9M per Virginia Payload Module (VPM) hull, \$2.7M per CLB hull, and \$1.3M per VCS hull for combined five-year savings of \$25.0M across all programs.

Implementation

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

Implementation is anticipated in the third quarter of FY22 and will be a phased approach, where 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 the project results.

Advancement of Temporary Fitting Attachment Technology

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. This is a non-value-added activity.

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 that 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 in order to meet the demands of the submarine platforms currently fabricated at GDEB. This project will research and validate commercial-off-the-shelf fitting aids (Phase I) as well as design, prototype, and evaluate custom fitting aids (Phase II) to produce accurate submarine components using Navy-required plate materials.

Payoff

GDEB expects the results of this project will reduce the man hours required in the fabrication process, improving accuracy and reducing labor / time costs. This CNM project is expected to provide savings of \$349K per VCS hull, \$465K per VPM, and \$734K per CLB hull for combined five-year savings of \$6.37M 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 second quarter of fiscal year 2023.



PERIOD OF PERFORMANCE:
Jul 2020 to Aug 2022

PLATFORMS:
VCS, VPM, CLB Submarines

CENTER OF EXCELLENCE:
CNM

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STAKEHOLDER:
PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
\$634,000



Common Datums and Inspection Tools Overcome Inconsistencies



PERIOD OF PERFORMANCE:
May 2020 to Jun 2022

PLATFORMS:
VCS, CLB, CVN

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 379, PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
\$899,000



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 – be it 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 1.18:1.

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 first quarter of FY24.

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 is dependent on the project results.

Ship Construction “Planning” with Artificial Intelligence Technologies

S2877 — Artificial Intelligence for Planning

Objective

A current challenge at General Dynamics Electric Boat (GDEB) is the planning of the ship’s construction, which is a complex and costly task. The ship’s build schedule spans years and entails millions of labor hours and thousands of activities. 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). It is envisioned that following CLB and VCS will also benefit from the project’s implementations.

The project, which is managed by the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center, will provide an AI-based planning tool to supplement GDEB’s current multilevel planning approach, in which 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 materials requirements planning (MRP) system. The AI for Planning system will introduce a fourth level, which is model-based parametric planning (MRP). This means that MRP work activities will be associated with the build product model and enable the definition of planning parameters that are computed from the model. The system will compute planning improvements based on objective cost functions for work duration and cost, with an emphasis on structural assembly and welding. Following 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 will include customizations of the Aurora AI software to improve outsource opportunities, out-of-sequence assemblies, and simulations of the variability of durations.

Payoff

This project is expected to result in estimated savings of \$170K per VCS, \$240K per VIRGINIA Payload Module, and approximately \$340K per CLB for combined five-year estimated savings of \$2.6M.

Implementation

The AI for Planning technology is expected to be implemented at GDEB’s Quonset Point, RI, facility during the fourth quarter of FY22.



PERIOD OF PERFORMANCE:
Jun 2020 to Jun 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 397, PMS 450D

TOTAL MANTECH INVESTMENT:
\$967,000



A New Process to Installing Lead Caulking



PERIOD OF PERFORMANCE:
Feb 2021 to Feb 2023

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
PMS 379, PMS 397, PMS 450

TOTAL MANTECH INVESTMENT:
\$1,560,000



S2882 — Improved Lead Caulking Installation Process

Objective

The current process for lead caulking at General Dynamic Electric Boat (GDEB) 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 from an injury / hazards perspective. The tool can exhibit extreme vibrational forces that can be absorbed through the operator's body causing health risks. Due to these vibrational forces, trades have limits on the amount of work they can perform. The fatigue that is experienced results in approximately a third of a standard shift time for active work as dictated by standard safety practices. This, coupled with lead exposure limits and specialized training, results in schedule delays and a significant decrease in efficiency. The objective of this Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project is to improve the lead caulking installation process for the VIRGINIA Payload Module (VPM) and CLB by investigating and developing an improved installation method (tool, machine, automated system, etc.) to replace the current production tools. The main goal of the proposed solution is to remove / minimize the operator's exposure to lead and physically intense / time-consuming work activities. The proposed solution may be automated and/or contain a powerful damping device to absorb the structural vibrations to reduce / minimize the residual vibrations absorbed by the operator. At this time, there is no known exact solution to this problem.

Payoff

By reducing the labor hours associated with installing lead caulking, the GDEB project team anticipates a considerable reduction in labor hours associated with this work. Through improvements enabled by the technology, GDEB anticipates five-year estimated savings of \$7.9M and a five-year project return on investment of 1.20:1.

Implementation

Based on the results of testing, GDEB will generate the data needed for internal process verification and validation, 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 at GDEB. Implementation is anticipated in the fourth quarter of FY23.

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.

Process-Property Relationships Developed to Reduce Cost and Time to Qualify Large Shafts

T2887 — New Qualification Process for HY Steel Shafts

Objective

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project was to develop a method to verify shaft qualify during the ingot manufacturing stage using limited prolongation data coupled with computer models for casting, solidification, and thermomechanical processing. Success for this manufacturing science project would lead to reduced destructive testing and earlier delivery of cast and forged products to the fleet.

This project developed and validated casting / segregation and heat transfer models on test articles through microstructural and mechanical testing. The project used small castings for the initial segregation and thermal modeling to validate the models and developed a method to use the models to predict the properties of full-size components.

Payoff

Implementation of the methodology will reduce the number of shafts that must be sectioned and tested to ensure that the mechanical properties meet the requirements. This method could be used on other large forgings. The cost of a shaft first article test can be as high as \$4.0M. This method will also reduce the time to qualify components.

Implementation

The methodology employed in this project (models and experimental data) will be used by the fabricators and NAVSEA during the production process.



PERIOD OF PERFORMANCE:
Mar 2020 to Sep 2021

PLATFORMS:
VCS, CLB, SSNX Submarines

CENTER OF EXCELLENCE:
iMAST

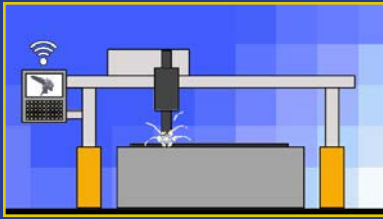
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STAKEHOLDER:
Naval Surface Warfare Center,
Carderock Division, NAVSEA05

TOTAL MANTECH INVESTMENT:
\$350,000



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



PERIOD OF PERFORMANCE:
Dec 2020 to Dec 2022

PLATFORMS:
VCS, CLB, CVN

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
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 (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 are able to 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 FY24.

Recovering Lost Sonar Manufacturing Technology and Insertion of Advanced Materials

S2905 — Advanced Hydrophone Manufacturing and Materials

Objective

The objective of this project is 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. Successful completion of this Institute for Manufacturing and Sustainment Technologies (iMAST) project will yield a detailed, government-owned, technical data package that can be used to support 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 6 inch spherical transducer applications. Second, this project will address continued innovation for undersea threat technology via insertion of textured ceramics for in various Navy systems. Successful completion will yield a restored industrial base as well as enhanced threat and range detection.

Payoff

This Capabilities Acceleration project will immediately fill a gap left by decay of the existing ceramic sonar component industry by creating a robust Navy-owned manufacturing process and documenting 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 will take place in two phases. Phase 1 results will be implemented by existing ceramic sonar component manufacturers. The process is being developed with commercially sourced powder and existing vendors that already possess all of the downstream process capability. Phase 1 of this effort will develop work instructions, and vendors will supply the proper tooling to press the parts and the proper support hardware for sintering based on the process documentation supplied by this project. All existing vendors possess the machining capability to make these parts when given appropriate instructions. Implementation of Phase 2 will require existing vendors to acquire additional fabrication equipment. Details on the required equipment and suppliers will be provided as part of this project documentation. Existing vendors are estimated to possess 90+ percent of the equipment required to manufacture these components. The outcome of transition in this phase will support a variety of hydrophone applications.



PERIOD OF PERFORMANCE:
Jul 2020 to Jun 2022

PLATFORM:
VCS Submarines

CENTER OF EXCELLENCE:
iMAST

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STAKEHOLDER:
NUWC-Newport / PMS 415

TOTAL MANTECH INVESTMENT:
\$600,000



Investigating Drone Operations for Submarine Hull Inspections



PERIOD OF PERFORMANCE:
Jan 2021 to Dec 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
iMAST

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STAKEHOLDER:
PMS 450, PMS 397

TOTAL MANTECH INVESTMENT:
\$720,000



S2919 — Drone Photogrammetry

Objective

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project is 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 man lift and manually take photographs. The gimbal system needs to adapt to photogrammetry cameras currently used and approved for handheld photogrammetry.

The drone and gimbal system will enable the operator to tilt and pan the camera while also providing a visual representation of the camera's line of sight. The drone will need to be equipped with collision prevention technology, and drone operators will need to see and move the alignment of the camera to take photographs while simultaneously flying the drone. Currently, no commercial-off-the-shelf (COTS) equipment is capable of doing what is required. The iMAST project will identify an integrator that will combine COTS equipment into a drone photogrammetry system.

Payoff

The main benefit of this project will be in the areas of reduced labor and construction schedule. The drone photogrammetry will reduce set-up and break-down times associated with moving sections to the aisle way for man-lift access. Supplemental or secondary benefits include 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 will ensure that the required metrics are achieved prior to implementation. An Implementation Plan will be developed during Phase II of the project (based upon research discoveries). The project will compare the costs of updated metrology procedures to legacy procedures to determine cost and safety savings. The project will address the steps required for the initial acquisition of the drone photogrammetry platform, as well as life-cycle considerations. The project will also investigate sources for repair parts, in the event the equipment is damaged or needs to be replaced due to normal operation. The plan will also outline all approvals, training, and licensing needed to instate the drone capability at GDEB Quonset Point.

F-35 Lightning II Projects

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*F-35 Lightning II Aircraft.
U.S. Navy image.*

Process Improvements for New F-35 EOTS Detector Material



PERIOD OF PERFORMANCE:
Mar 2017 to Sep 2020

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
EOC

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

TOTAL MANTECH INVESTMENT:
\$1,909,000 - Navy ManTech
\$ 325,000 - Air Force



J2622 — F-35 Electro-Optical Targeting System (EOTS) Producibility Phase 4

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 first three phases of the F-35 Lightning II EOTS producibility projects, this Electro-Optics Center (EOC) project continued to drive down the cost and risk of key EOTS infrared components while transitioning the EOTS mid-wave infrared integrated dewar-cooler assembly to a high operating temperature advanced detector.

Payoff

Insertion of the new detector into the current EOTS configuration provides multiple affordability advantages, from increased capacity and reduced focal plane array processing hours and span time to increased reliability and maintainability of the integrated dewar-cooler assembly. The focal plane arrays will also be more uniform and manufacturable and have better yield and performance than the current focal plane arrays. Together, these tasks are expected to save over \$62M for the F-35 Lightning II Program.

Implementation

The F-35 Lightning II EOTS is the transition platform. These producibility improvements were implemented in a phased approach. Improvements to the production efforts were qualified, approved, and cut into production during and subsequent to completion of this project. Those manufacturing process-level changes were required to be reviewed and approved by the internal Santa Barbara Focalplane Process Control Review Board. Improvements that were specific to the niobium nitride (nBn) detector material will be implemented upon successful qualification and flight testing to prove there are no adverse performance issues with the new detector material (a parallel effort has been funded outside this ManTech project and is anticipated to complete during the first quarter of FY22). This EOC project implemented multiple industry-approved process changes impacting Lots 13 and beyond. Process changes associated specifically with the nBn detector material are anticipated to be implemented in FY22 and impact Lot 14 and beyond. This project was a joint effort with Air Force Research Laboratory.

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

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 has two primary technical goals. The first is to develop and demonstrate equipment and methods that will reliably detect and characterize all categories of minor optical defects. This includes tooling and fixturing to accurately position the F-35 transparency such that inspection is reliable, repeatable, and safe. The second technical goal is to develop and demonstrate programming capable of processing and applying accept / reject criteria based on the acceptance criteria in the acceptance test plan. The system will be required to operate at a confidence level such that GKN, Lockheed Martin, the F-35 Lightning II Joint Program Office, and Defense Contract Management Agency (DCMA) all 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 in addition to source inspectors from both DCMA and Lockheed Martin at multiple facilities. 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 Lockheed Martin for. In addition, the cost of quality escapes has not been factored in. Factoring in GKN cost savings alone, the project return on investment (ROI) is anticipated to be approximately 6:1. Making assumptions about the Lockheed Martin and DCMA labor, the project ROI could be as much as 8:1.

Implementation

Upon successful completion of the ManTech effort, GKN anticipates working through the F-35 Blueprint for Affordability and F-35 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 deliveries and delivery of spare canopies over the life of the F-35 program. Implementation is anticipated to occur in the fourth quarter of 2022.



PERIOD OF PERFORMANCE:
Oct 2019 to Aug 2022

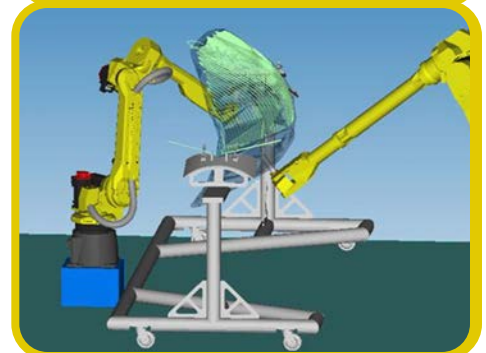
PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
CMTC

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

TOTAL MANTECH INVESTMENT:
\$3,100,000



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



PERIOD OF PERFORMANCE:
Mar 2020 to Jul 2022

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
CMTC

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

TOTAL MANTECH INVESTMENT:
\$1,300,000 (CMTC)
\$ 500,000 (EMTC)
\$1,500,000 (OSD MSTP)



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 death. Automation is particularly critical to removing personnel from the hazardous environments.

New mixing technology, Resonant Acoustic Mixing (RAM) by Resodyn has been introduced to the market that has seen significant success in mixing other energetic materials due to improved safety and reduced mixing times. Additionally, RAM lends itself to automation and has been demonstrated to mix MTV at Naval Surface Warfare Center (NSWC) Crane Division. Additionally, NSWC Indian Head EOD Technology Division (IHEODTD) 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 IHEODTD to 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 that 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 these projects, 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 DoD inventory. Cost savings at Chemring Countermeasures' Kilgore facility for ignition composition alone are estimated to be as much as \$150K per year.

Implementation

The mixing process and automation system developed under the CMTC and EMTC projects are 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 FY22.

Automation Equipment Optimization through Prescriptive Analytics

A2785 — Rapid Automation Technology Evaluation (RATE)

Objective

The reliability of key automated systems used in F-35 drilling and painting application is essential in achieving committed production schedules and cost targets. Predictive failure capability on critical automation assets is required to proactively manage these systems to guarantee their capacity and performance in manufacturing quality parts within program production intervals. Reactive maintenance required when an issue occurs inevitably causes delays to the production line that are costly and jeopardize delivery schedules, part quality, and best-fit assembly. With program ramp-up and product delivery rates increasing every year, these schedule delays, inefficiencies, and quality compromises are exponentially costly and unacceptable for effective program execution.

The Naval Shipbuilding and Advanced Manufacturing (NSAM) Center Rapid Automation Technology Evaluation (RATE) project developed a system that utilizes a combination of commercial-off-the-shelf products and internally developed models and applications to predict high-impact failures or issues leading to downtime. The RATE solution involved establishing a real-time connection to the automation equipment on a large-scale assembly line by incorporating hardware and sensing devices to reach a quality of data that is informative and actionable for maintenance and equipment operations. Additionally, the RATE effort investigated part quality implications of unplanned automation events and utilized condition-based maintenance to optimize part quality and best-fit assembly. Corrective actions are expected to be applied with prescriptive models that take from a combination of knowledge-based, physics-based and/or data-driven modeling.

Payoff

This project is expected to result in savings of \$14.4K per F-35 for five-year savings of \$10.4M with a five-year return on investment of 1.58:1.

Implementation

The solution technology is expected to be implemented at Northrop Grumman Corporation's Palmdale, CA, facility during the third quarter FY22.



PERIOD OF PERFORMANCE:
Dec 2018 to Apr 2021

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
NSAM

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F-35 Lightning II Joint Program Office
(JPO)

TOTAL MANTECH INVESTMENT:
\$2,070,000



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



PERIOD OF PERFORMANCE:
Apr 2021 to Sep 2022

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
CMTC

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

TOTAL MANTECH INVESTMENT:
\$1,600,000

A2818 — Automated Fillet & Cap Seal

Objective

Fillet and Cap Sealing for F-35 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 to 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 increasing cost and subsequently increased aircraft weight. This sealant is utilized on a variety of grooves requiring fillet seals and hardware requiring cap sealing on Eddie-Bolts. An automated sealant dispensing system has significant potential to reduce labor costs and increase uniformity of fillet and cap seal which minimizes aircraft weight. The ManTech project, to include Lockheed Martin and Encore Automation, will implement a phased approach that aims 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 seal have a major payoff in process savings alone with the additional benefit of potential material and quality savings. Total cost savings for the Left / Right F-35 Wings only is estimated at over \$6M. A follow-on implementation is expected on Center Wing resulting in a total F-35 cost savings of over \$12M. In addition, reduced variability in total wing weight resulting from automation is anticipated to allow additional weight margin for the addition of new potential capabilities for the aircraft.

Implementation

Initial implementation is expected at the chosen Lockheed Martin facility with a follow-on implementation at an additional Lockheed Martin facility. The implementation process is expected to commence immediately following the successful conclusion of the ManTech project. 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 EOTS Focal Plane Array Batch Manufacturing and Automated Dewar Test Station Process Improvements

A2820 — Electro-Optical Targeting System (EOTS) Integrated Dewar Cooler Producibility Improvements for F-35 Lightning II

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 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 success.

Payoff

The current focal plane array manufacturing process is very labor intensive and not very efficient. Implementing new 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 (~80 percent reduction)
- increased capacity and throughput (~2x)
- identifying defects at this point saves ~ 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 \$19M 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 Focalplane Process Control Review Board. This EOC project has implemented multiple industry-approved process changes in calendar year 2021 impacting Lots 14 and beyond. This project is also of interest to the Air Force Research Laboratory.



PERIOD OF PERFORMANCE:
Sep 2019 to May 2022

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
EOC

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

TOTAL MANTECH INVESTMENT:
\$1,121,000 - Navy ManTech



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



PERIOD OF PERFORMANCE:
Jul 2020 to Jul 2022

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
CMTC

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

TOTAL MANTECH INVESTMENT:
\$2,577,000

A2849 — PEKK Additive Manufacturing for F-35 Lightning II

Objective

The F-35 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 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 (CMTC) project leverages and builds upon previous data to validate HexPEKK® material and demonstrate performance against F-35 specifications for non-flight critical parts.

Payoff

The benefit to production, which is based on work currently in progress, is estimated at a total potential cost savings over \$28M for the program. This project will develop an alternative method to fabricate non-flight critical parts that will support F-35 production.

Implementation

Assuming technology maturation tasks are completed as expected, candidate parts developed and tested during this CMTC project could be implemented on aircraft as early as the first quarter of 2023. Follow-on implementation efforts will consist of re-design and approval of additional parts utilizing the Design Guide and Qualification Guide deliverables.



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

A2853 — Automated In-Process Inspection for Automated Composite Lamination

Objective

The demanding performance requirements of modern composite structures is predicated on tightly controlling the tolerances of the as-built part. This duteous approach ensures that the as-designed part is manufactured within the established design limits. Defects that cause the part 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 a part that deviates from nominal and violates specification tolerances. To detect, correct, and control these deviations some form of inspection system is required.

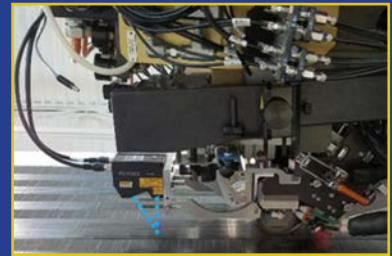
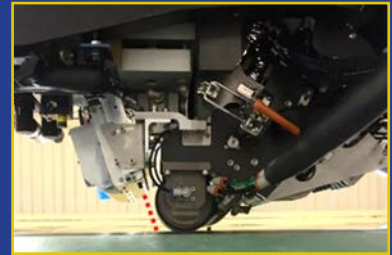
The current industry standard for inspection of composite parts is manual ply-by-ply inspection of the composite layup. This approach to inspecting composite parts has a number of limitations and drawbacks that result in costly rework, excessive material consumption, and reduced production rates. An automated in-process inspection system has significant potential to mitigate and potentially eliminate these aforementioned drawbacks of the current industry standard. This Composite Manufacturing Technology Center (CMTC) project, which includes Northrop Grumman and FIVES, will use 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 due to potential production rate increase, as well as quality savings and reduction in production material waste. Specific benefits include 5 percent increase in machine uptime and 25 percent first pass yield improvement on nacelle type structures. Total cost savings of \$9.6M are estimated for F-35 nacelle production.

Implementation

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



PERIOD OF PERFORMANCE:
Jan 2021 to Jan 2023

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
CMTC

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

TOTAL MANTECH INVESTMENT:
\$2,000,000



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



PERIOD OF PERFORMANCE:
Aug 2020 to Aug 2022

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
CMTC

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

TOTAL MANTECH INVESTMENT:
\$1,705,000

A2867 — Heated Debulk Process Improvement

Objective

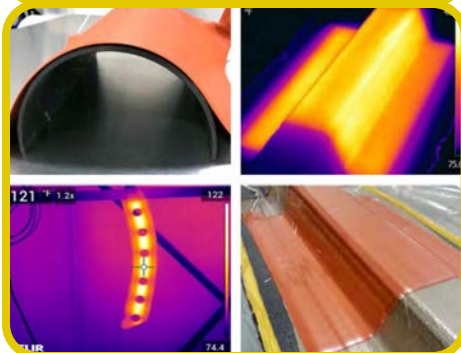
Lockheed Martin Aeronautics is prioritizing efforts to achieve the ramp to full rate production, which focuses on advanced manufacturing technology improvements aimed at reducing F-35 costs. A technology of interest is expanding in-situ or in-process capabilities for composite fabrication to minimize production and sustainment dependency using traditional oven / autoclave processes. In-process composite fabrication and repair capabilities provide opportunities to minimize span times during manufacturing and repair times during sustainment. The objective of this Composites Manufacturing Technology Center (CMTC) project is to eliminate the need for ovens / autoclaves during the composite lay-up and debulk processes. This will be accomplished by leveraging a novel non-metallic heating film to develop and demonstrate an accurate and reusable in-process heating system for production and repair.

Payoff

The benefit to production, which is based on work currently in progress, is estimated at total potential cost savings of over \$7M for the program. This Composites Manufacturing Technology Center (CMTC) project will develop a repeatable method to perform in-situ heated debulks and repair processes that will support F-35 production and sustainment.

Implementation

Assuming technology maturation tasks are completed as expected, the prototype controller and heating elements developed and tested during this CMTC effort could be implemented in production as early as the second quarter of 2023. Follow-on implementation efforts will require development of heating elements for additional candidate parts, which will be prioritized based on individual part return on investment.



F-35 EOTS Process Improvements Expected to Save \$5M

A2883 — F-35 Lightning II Electro-Optical Targeting System (EOTS) Wafer and Focal Plane Array Producibility Improvements

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 EOTS producibility projects, this Electro-Optics Center (EOC) project continues to execute cost and risk reductions for the EOTS infrared detector critical to the 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 and cycle time per unit (reduced 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 decrease the number of process steps. Insertion of in-situ etch and passivation process optimizations 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 \$5M 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 Focalplane Process Control Review Board. This EOC project will implement multiple industry-approved process changes in FY22 impacting Lots 15 and beyond. This project is also of interest to the Air Force Research Laboratory.



PERIOD OF PERFORMANCE:
Sep 2020 to Jan 2023

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
EOC

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

TOTAL MANTECH INVESTMENT:
\$1,059,000 - Navy ManTech



CH-53K Projects

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| A2841 — Large-Area Fuselage Inspection for CH-53K..... | 100 |
| A2847 — Hot Drape Forming Composite Processing Supporting CH-53K Components..... | 101 |



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

Development of Automated Flexbeam Manufacturing Cell Decreases Inefficiencies



PERIOD OF PERFORMANCE:
Nov 2019 to Dec 2022

PLATFORM:
CH-53K

CENTER OF EXCELLENCE:
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 737 individual plies that are manually laid up. 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 (CMTC) project is 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 \$78.8M over 160 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 in 2021.

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 for 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 once the business case is verified, Sikorsky will submit the project into its normal approval cycles required for typical technology insertion on CH-53K.



FRCMC Anticipated to Save the CH-53K Program Nearly \$20M

A2791 — Flexible Robotics Composite Manufacturing Cell (FRCMC)

Objective

Current CH-53K composite part manufacturing processes use a combination of manual and computer numerical control (CNC) processes for part machining and dimensional inspection. Several of the smaller / lower complexity parts are trimmed and drilled on CNC machine centers followed by manual inspection using a 3D measurement system such as laser trackers or inspection arms. The larger CH-53K components are manually trimmed and drilled to indexing lines, and marks are transferred from the cure mold followed by manual inspection using a 3D measurement system.

As an alternative to the Flexible Robotics Composite Manufacturing Cell (FRCMC), Aurora considered CNC machine centers to replace all manual trim and drill operations followed by manual inspection using a 3D measurement system. While CNC machine centers are a viable option, the FRCMC offers several significant advantages over traditional processes while providing greater cost avoidance to the U.S. Navy. This project seeks to develop the FRCMC concept and demonstrate it is capable of meeting CH-53K and other DoD Platform requirements.

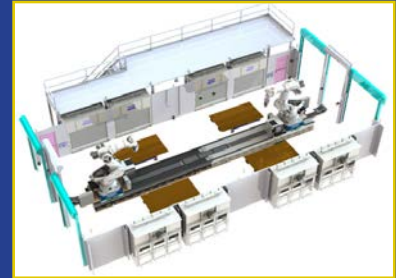
Payoff

FRCMC provides a significant advantage over traditional CNC machine centers and manual 3D inspection. Assuming the same part family as that found on the CH-53K main rotor pylon and nacelles, a total of six CNC machine centers and 16 3D inspection stations would be required to match the FRCMC at full capacity. The FRCMC is estimated to cost approximately 60 percent less than the investment in traditional equipment when compared at full capacity while offering a distinct level of flexibility to perform additional operations that the traditional CNC equipment cannot perform.

In addition to offering a highly flexible manufacturing system, Aurora's FRCMC provides the Navy with significant cost-savings for the CH-53K program. Aurora has determined initial cost savings of nearly \$20M with the FRCMC over the life of CH-53K program compared to current processes.

Implementation

Test and verification efforts performed during this program using actual tooling and representative parts will significantly reduce the technical risks associated with transition of all CH-53K composite parts to the FRCMC. With completion of the Composites Manufacturing Technology Center (CMTc) FRCMC project, non-recurring engineering activities will be performed on the remaining 85 CH-53K composite parts. Affordability and associated cost reductions will continue to be tracked for the FRCMC once implemented in production expected to occur in 2021.



PERIOD OF PERFORMANCE:
Apr 2019 to Aug 2021

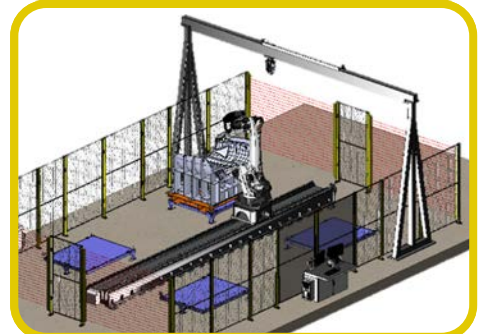
PLATFORM:
CH-53K

CENTER OF EXCELLENCE:
CMTc

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STAKEHOLDER:
PMA 261

TOTAL MANTECH INVESTMENT:
\$8,600,000



Depot Enabling Capability for Damage Inspection



PERIOD OF PERFORMANCE:
Jun 2019 to Sep 2022

PLATFORM:
CH-53K

CENTER OF EXCELLENCE:
iMAST

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STAKEHOLDER:
CH-53K, PMA 261

TOTAL MANTECH INVESTMENT:
\$1,050,000



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

Objective

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project is to identify, test, and transition visual inspection technologies that are capable of detecting barely visible damage, based on existing Naval Air Systems Command (NAVAIR) guidance, for integrated composite fuselages, beginning with CH-53K. The candidate inspection technologies will be assessed for both automated use and the ability to be deployed into 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 will be 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 will down-select to a manageable suite or single inspection technology(ies) that will enable a 50 percent time reduction over current manual inspection methods.

Payoff

This project is providing an enabling capability that the NAVAIR Depot at Havelock, North Carolina, (FRCE) currently does not have – specifically, the ability to 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 \$89K and \$34K, 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. A return on investment of 1.62:1 was estimated based solely on cost savings anticipated for damage inspection of the CH-53K at FRCE. However, the inspection system could also be used for the V-22 and F-35 aircraft.

Implementation

Requirements for implementation include technical, financial, procedural, training, and safety aspects. This project is planned to initiate preliminary implementation efforts in FY22 with the issuance of another contract focused on the automation portion of the effort. Full implementation (i.e., equipment construction, installation, testing, and demonstration) will begin in FY23 and complete in FY24. Specifically, technical requirements to be addressed include providing sufficient positive data to generate a Temporary Engineering Instruction (TEI) to garner approval to use the inspection technology by PMA-261. The approved TEI will be the basis for procedural documents, including local processing and local engineering specifications that will be generated for use at FRCE. Training associated with the automated system will be funded by PMA-261. Use of the inspection technologies and application to the CH-53K will be 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., will also be drafted and reviewed by NAVAIR and other cognizant authorities prior to completion of the project. Financial justification will be required to proceed to full implementation (i.e., fabricate automated equipment). iMAST, with support from PMA-261 and FRCE, will develop the business case required for full implementation and justification to proceed with this enabling inspection capability.

Development of Automated Flexbeam Manufacturing Cell Decreases Inefficiencies

A2847 — Hot Drape Forming Composite Processing Supporting CH-53K Components

Objective

The U.S. Navy has a need to reduce composite structure fabrication costs while maintaining product quality requirements. A primary U.S. Navy focus area to achieve cost reduction is improved and innovative manufacturing processes capable of supporting high-priority platform acquisitions, such as the CH-53K. Aurora Flight Sciences and The Boeing Company offer hot drape forming (HDF) of beam and frames as an innovative manufacturing technology that will satisfy the U.S. Navy's need for cost-reduction benefits through improved process repeatability, performance at production quantities, and reduced risks. These benefits are realized through the automated HDF process compared to the current hand layup process for CH-53K beams and frames. HDF processing technology will meet strict military aerospace tolerance requirements while lowering fabrication costs and provide increased throughput and repeatability in support of rate production.

The principal problem to be addressed under this Composites Manufacturing Technology Center (CMTC) project is to reduce layup costs while minimizing the risk of wrinkles that are possible during HDF processing and to develop a robust repeatable manufacturing process.

Payoff

The HDF process reduces cost and risk and offers increased efficiency for fabrication of CH-53K composite beam and frame structures by using a repeatable automated forming process. The HDF process lowers fabrication costs for the scheduled 140 aircraft shipsets by an average of \$39K per shipset with increased throughput in support of high rate production. The U.S. Navy will realize almost immediate cost savings upon implementation of HDF into the rate production program. Aurora has estimated that the CH-53K Program could save approximately \$5.5M over the course of the program from FY23 through FY28.

Implementation

The CMTC project provides the basis needed for successful implementation to CH-53K rate production. Test and verification efforts performed during this program using actual tooling and parts will significantly reduce the technical risks associated with transition of all candidate CH-53K composite parts to the HDF process. Performing affordability analyses at various fabrication milestones will help to ensure that the developed HDF process achieves the estimated cost reductions for the U.S. Navy.



PERIOD OF PERFORMANCE:
Jun 2020 to May 2022

PLATFORM:
CH-53K

CENTER OF EXCELLENCE:
CMTC

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STAKEHOLDER:
PMA 261

TOTAL MANTECH INVESTMENT:
\$1,900,000



Other Sea Platforms Projects



*AAVP-7A1 Advanced Amphibious Assault Vehicle.
U.S. Navy image.*

Research Data Mining Capability to Bridge the Information Gap



PERIOD OF PERFORMANCE:
Dec 2020 to Jul 2021

PLATFORM:
N/A

CENTER OF EXCELLENCE:
NSAM

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STAKEHOLDER:
Navy ManTech

TOTAL MANTECH INVESTMENT:
\$160,000

R2850 — Automated Portfolio Data Mining

Objective

The ability to leverage information from past Research and Development (R&D) is essential in optimizing efforts, reducing timeframes to achieve desired outcomes, and minimizing rework and duplication of efforts. However, project-related information from past NSAM and NSRP projects is spread across multiple disparate data sources and locations without a central location to search from. The objective of this project is to evaluate the functionality and potential benefit of data mining software applications to determine if they provide the functionality required for use as a central searching platform for indexing disparate data sources. The project will reach out to research centers, such as John Hopkins University and the Joint Artificial Intelligence Center (JAIC), and investigate via a market survey, to determine the current capabilities with regard to database connectivity, indexing, and searching without creating or hosting a new centralized database. Other capabilities will be investigated such as web crawling functionality to obtain project related data from public or private facing websites. This project will result in a detailed study on the current state of each identified application, graded on required criteria, and identify additional development efforts when possible.

The Automated Portfolio Data Mining Analysis project evaluated COTs / GOTs software product's capabilities to connect disparate Naval Shipbuilding and Advance Manufacturing Center (NSAM) and National Shipbuilding Research Program (NSRP) project data sources and provide a central location where users can search, obtain, and display the portfolio data. The project team has installed, AFRL's HyperThought software applications on a secure sandbox environment and attempted to connect multiple data sources; internal Plone data, internal SharePoint data, internal file repository, and an external data source via public facing website via a web crawler. The project team analyzed the capabilities and security risks of each application against a developed requirements document, grade on by required criteria, and provided ONR a recommendation on how to proceed with follow-on effort.

Payoff

The *Automated Portfolio Data Mining* project identified the capability of existing and developing tools and demonstrated the feasibility of enabling data mining of large disparate data sets using a centralized tool. This initial feasibility investigation will guide future data mining R&D efforts in the pursuit of establishing effective data mining capabilities across the constantly increasing number of DoD program databases.

Implementation

This feasibility investigation is anticipated to lead into a follow-on FY23 Navy ManTech effort that will investigate the integration of specific technology solutions to address the data mining needs of Navy ManTech and partnering DoD programs.

Energetics Projects

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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



PERIOD OF PERFORMANCE:
Jul 2014 to Dec 2022

PLATFORM:
Energetics / MK 152

CENTER OF EXCELLENCE:
EMTC

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STAKEHOLDER:
PEO (U&W), PMA 242

TOTAL MANTECH INVESTMENT:
\$2,285,000

A2575 — Energetics Production Utilizing Resonant Acoustic Mixing

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

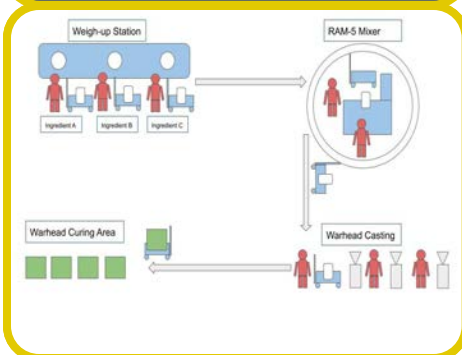
RAM technology offers a number of benefits as compared to current energetics mixing processes. Polymer-bonded explosive, PBXN-110, the explosive fill of the Mk152 warhead, is currently manufactured using planetary vertical mixers. RAM offers a number of benefits over vertical mixing.

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 \$1M 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 lives (solidification times) can be made.

Implementation

The successful completion of this Energetics Manufacturing Technology Center (EMTC) project will result 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.

Techniques and processes developed will support RAM programs elsewhere. Multiple DoD 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.



Obsolete No More: CPPD Antioxidant Manufacturing Capability

A2706 — Development of CPPD 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 are faced with material-related issues, such as material obsolescence, discontinued products, and inconsistent quality or characteristics of material from manufacturers and diminished manufacturing sources.

The objective of this Energetics Manufacturing Technology Center (EMTC) project was to develop and scale a cost-effective method for synthesis and purification of N-Cyclohexyl-N'-Phenyl-p-Phenylene Diamine (CPPD) that meets specification MIL- A-85501(AS). CPPD is a component of the antioxidant package used in certain propellant and rocket motors. Currently, there is no Continental United States (CONUS) source of CPPD. It was last sold as “Naugard I-6” by Chemtura, but it has been discontinued. A secondary objective of this project was to modernize the standards to and methods by which CPPD is tested. The end-user of CPPD, a DoD contractor, was consulted to develop modern test methods and specification limits to supplement MIL-A-85501 (AS).

Payoff

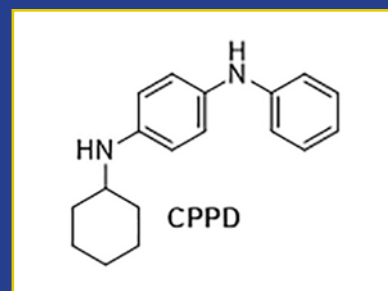
The successful production of CPPD at Naval Surface Warfare Center Indian Head Division (NSWC IHD) provides a reliable, CONUS source of the antioxidant for certain propellant packages, allowing continued production of several rocket motors with the potential for use in other systems. The payoff of this project will be strategic, rather than financial: it will reduce the reliance of energetics manufacturing on internationally-sourced chemicals that may become unavailable on short notice.

Implementation

The successful completion of this project resulted in a reliable source to produce large quantities of CPPD to meet MIL-A-85501(AS). These large quantities are required to prove out the material's performance in qualification studies for existing and future applications. Existing programs have an immediate need for CPPD that can be met by this newly established capability.

As of summer 2019, the CPPD synthesis process reached full scale, and as of spring 2020, the full-scale purification process was completed. The development effort was conducted by NSWC IHD, Chemical Development and Manufacturing Branch. The analytical effort was shared by NSWC IHD, Material Evaluation Division, and a DoD contractor. A sample was provided to the DoD contractor to evaluate the quality of the newly manufactured CPPD as compared to the previous manufacturer's product by performing small-scale propellant mixes and limited accelerated aging studies to qualify NSWC IHD's material for future Sidewinder production.

The contractor contributed analytical effort to aid in the development of updated testing methods and specifications. NSWC IHD and the DoD contractor have agreed on a set of tests and specification limits that supplement or replace the tests and limits in MIL-A-85501 (AS).



PERIOD OF PERFORMANCE:
Feb 2016 to Dec 2020

PLATFORM:
Energetics / Sidewinder (AIM-9X,
AIM-9M)

CENTER OF EXCELLENCE:
EMTC

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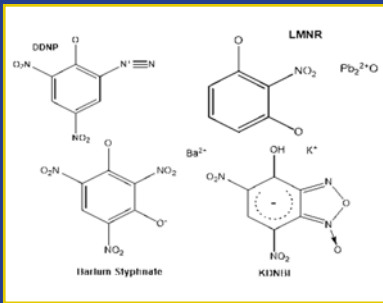
STAKEHOLDER:
PEO (T), PMA 259

TOTAL MANTECH INVESTMENT:
\$1,575,000



Development of Manufacturing Capability for Primary Explosives

A2708 — Primary Explosives Manufacture



PERIOD OF PERFORMANCE:
Oct 2015 to Dec 2022

PLATFORM:
Energetics / CAD, PAD Devices

CENTER OF EXCELLENCE:
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STAKEHOLDER:
PEO U&W, PMA 201

TOTAL MANTECH INVESTMENT:
\$1,500,000

Objective

Many currently fielded military programs were developed 20-30 years ago. As such, these programs are continually faced with material obsolescence issues where current qualified suppliers have discontinued products or product lines. In most instances, the materials that are being discontinued are not available from alternate domestic suppliers, and it is necessary for alternate materials and/or sources to be identified to perform the same or similar function as the material being replaced.

Primary explosives are required as initiators or detonators for virtually every system involving energetic materials. They are typically quite sensitive to impact, friction, and temperature, etc. and used in small quantities to initiate explosives or propellants in everything from small arms to missiles and bombs. Many of the specialized primary explosives are used in cartridge actuated devices (CADs) to transmit a signal to a remote component, sequence events during an ejection, push a piston, eject a bomb, unlock a seat belt, actuate a fire extinguisher, cut and release, etc., as well as in propellant actuated devices (PADs), small rocket motors used for propulsion (e.g., propelling an ejection seat out of an aircraft).

This Energetics Manufacturing Technology Center (EMTC) project's objective is to develop the manufacturing capability for several critical primary explosives to ensure a continued Continental United States (CONUS) availability is being undertaken at Naval Surface Warfare Center Indian Head Division (NSWC IHD).

Payoff

Development of a manufacturing capability for critical primary explosives will ensure continued availability of these qualified materials. CONUS commercial sources for diazodinitrophenol (DDNP), lead mononitroresorcinate (LMNR), potassium dinitrobenzofuroxan (KDNBF), and barium styphnate either cannot meet the current annual requirement or no longer exists. Providing qualified sources of these materials will allow for continued sustainment of critical man-rated systems, such as those provided by the tri-service CAD / PAD Joint Program Office (JPO).

Implementation

The CAD / PAD JPO (PMA-201), as the single manager for CAD / PAD devices used in all DoD components, recognizes the negative impact of the inability and difficulty of procuring these materials. The CAD / PAD JPO endorses this ManTech project to advance the manufacturing methods for these primary explosives and will resource the evaluation and qualification of the new material in CAD / PAD applications.

DDNP, LMNR, KDNBF, and barium styphnate are primary explosives widely used in ordnance systems as components in explosive initiation trains. The primary applications are in cutters, squibs, and other CADs and PADs. DDNP is used in percussion caps and detonators; KDNBF is used in squib switches for missile systems; LMNR is used in Bellows motors and the MK 112 squib switch; and barium styphnate is used in semiconductor bridge ignitors for activation of thermal batteries.



AFR Technology Provides Safer and Cheaper Manufacturing of Energetic Materials

S2719 — Advanced Flow Reactor (AFR) 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.

Butyl NENA synthesis is planned as a second NENA demonstration.

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.

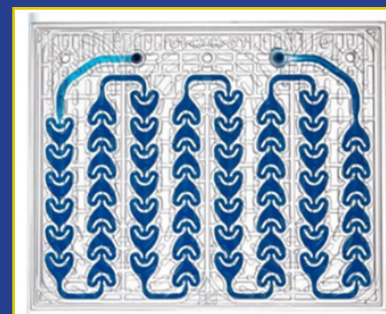
Improved Safety – The actual amount of material participating in the nitration reaction at any given time is reduced from the multi-gallon batch reactor size to grams at the continuous flow reactor size. Due to the small quantity undergoing the synthesis reaction, there is a much higher contact surface 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 meets existing reference quality requirements.



PERIOD OF PERFORMANCE:
Oct 2016 to Dec 2023

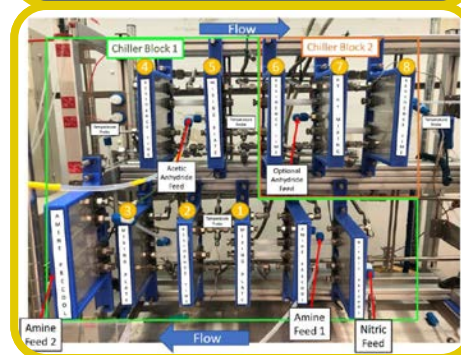
PLATFORM:
Energetics / Navy Gun-Launched
Systems

CENTER OF EXCELLENCE:
EMTC

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STAKEHOLDER:
PEO IWS, 3C

TOTAL MANTECH INVESTMENT:
\$3,170,000



Source of DNPD Antioxidant Manufacturing Capability



PERIOD OF PERFORMANCE:
Oct 2016 to Mar 2022

PLATFORM:
Energetics / AMRAAM Missile
(AIM-120)

CENTER OF EXCELLENCE:
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STAKEHOLDER:
PEO (T), PMA 259

TOTAL MANTECH INVESTMENT:
\$1,897,000



S2720 — Development of DNPD 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 – from material obsolescence and discontinued products to inconsistent quality or characteristics of material from manufacturers and diminished manufacturing sources.

This is the case with the antioxidant N,N'-Di-2-naphthyl-p-phenylenediamine (DNPD). DNPD is a component of the new antioxidant package used in certain air-to-air missile propellant. DNPD is considered the primary antioxidant that inhibits oxidation of the binder network with chain-terminating reactions of free radicals. With a reliable domestic source of DNPD, it could become the antioxidant of choice on future propellant development efforts.

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 the specification HS 6-0089A.

Payoff

The successful production of DNPD at Naval Surface Warfare Center Indian Head Division (NSWC IHD) will provide a reliable, Continental United States (CONUS) source of the antioxidant with the potential for use in a number of propellant formulations as well.

Implementation

The successful results of this project will enable NSWC IHD to produce large quantities of DNPD that meet specification HS 6-0089A. These large quantities are required to prove out the material utility in final (type) qualification studies for existing as well as future applications. An existing program has an immediate need for DNPD, with potential for wider use in a variety of propellants.

The scale-up effort will be conducted by NSWC IHD, Chemical Development and Manufacturing Branch. The analytical effort will be shared by NSWC IHD, Material Evaluation Division, and a DoD contractor. The DoD contractor will evaluate the quality of the DNPD manufactured by NSWC IHD as compared to the OCONUS source by performing small-scale propellant mixes and limited accelerated aging studies.

Enabling the Advanced Manufacture of Propellants

A2774 — Additive Manufacturing for Propellants

Objective

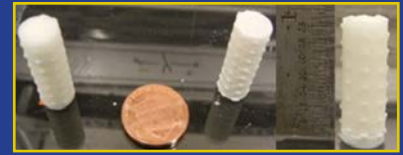
The objective of this Energetics Manufacturing Technology Center (EMTC) effort is to enable the advanced manufacture of Navy / U.S. Marine Corps critical, solid propellant grains for use in cartridge actuated devices (CADs) and propulsion systems. Additive manufacturing (AM) is an advanced manufacturing 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 will be explored for use in propellant manufacturing: material extrusion and vat photopolymerization. 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 is 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 will enable consistent CAD performance due to the potential for higher precision printed grains.

Implementation

The initial focus will be on transitioning AM-produced HES-5808 grains into the M91 Impulse Cartridge utilized on the AV-8, F-15, F-16, and B-52 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.



PERIOD OF PERFORMANCE:
Oct 2017 to Dec 2022

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

CENTER OF EXCELLENCE:
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STAKEHOLDER:
PEO U&W, PMA 201

TOTAL MANTECH INVESTMENT:
\$1,727,000



RAM Enhances Manufacturing of Delay and Ignition Composition



PERIOD OF PERFORMANCE:
Oct 2017 to Sep 2023

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

CENTER OF EXCELLENCE:
EMTC

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STAKEHOLDER:
PEO U&W, PMA 201

TOTAL MANTECH INVESTMENT:
\$602,000

A2775 — Tungsten and T-10 Delay Composition via Resonant Acoustic Mixing (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 United States 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 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 man-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 (FAT) 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 FY23. 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.



Source of HNS Manufacturing Capability

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 – from material obsolescence and discontinued products to 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. There currently exists no consistent continental United States (CONUS) source of hexanitrostilbene (HNS) to meet the projected needs, and the cost Outside CONUS sources have risen significantly in recent years. In order to continue supporting programs using HNS, a cost-effective CONUS source of HNS must be established in the production pipeline.

The objective of this Energetics Manufacturing Technology Center (EMTC) project was to develop a scalable, cost-effective process to produce both types of HNS, Type I and Type II, that meets the material specification PEF-WS-5003K, “HNS Explosive.”

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-I and HNS-II.

Implementation

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

The scale-up effort, based on a two-step synthesis, will be conducted by NSWC IHD, Chemical Development and Manufacturing Branch. The analytical effort will be conducted by NSWC IHD, Material Evaluation Division.



PERIOD OF PERFORMANCE:
Nov 2018 to Dec 2022

PLATFORM:
Energetics / CAD, PAD Devices

CENTER OF EXCELLENCE:
EMTC

POINT OF CONTACT:
Mr. Charles R. Painter
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STAKEHOLDER:
PEO (U&W), PMA 201

TOTAL MANTECH INVESTMENT:
\$509,000



Continuous Acoustic Chemical Reactor for Nitration, Oxidation, and Hydrolysis Reactions for Energetics Production



PERIOD OF PERFORMANCE:
Sep 2018 to Mar 2022

PLATFORM:
Energetics / Low Sensitivity mortar
propelling charges used by USMC

CENTER OF EXCELLENCE:
EMTC

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STAKEHOLDER:
MARCORSYSCOM

TOTAL MANTECH INVESTMENT:
\$1,426,000

S2778 — Resonant Acoustic Continuous Microreactor (RACMR)

Objective

The objective of this Energetics Manufacturing Technology Center (EMTC) initiative is 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 much 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 may provide a solution to this phenomenon and allow effective continuous production of slurries without clogging the reactor.

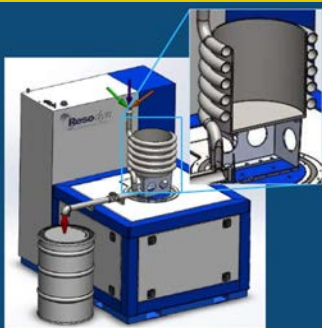
2,6-diaminopyrazine-1-oxide (DAPO) has been chosen as the material to be synthesized to demonstrate this capability. DAPO is the immediate precursor to the energetic compound 2,6 diamino-3,5-dinitropyrazine-1-oxide (LLM-105). DAPO is currently produced via a batch process with low yields. To improve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

Payoff

LLM-105 is being evaluated as a high-energy, low-sensitivity, secondary explosive material to replace varied percentages of Research Department eXplosives (RDX) and High Melting eXplosives (HMX) in propellant formulations, and has found application in the development of high-performance, low-sensitivity, mortar-propelling charges used by the United States 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 will result in a fully operational continuous resonant acoustic chemical production facility at 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. While the RACMR will be developed to produce DAPO as part of this initiative, it will be adaptable to produce other energetic materials and their precursors as well.



Development of the Next Generation of Demolition Explosive

S2900 — Fastpack Demolition Explosive (FPEX)

Objective

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 Composition C-4 (MIL-C-45010) operational limitations and will allow for low-temperature flexibility and high-temperature stability while matching or exceeding C-4 detonation characteristics. M112 C-4 Demolition Block (DODIC M023), the most widely used plastic explosive demolition charge, contains 1.25 pounds of C-4 and, therefore, experiences the same operational limitations. The focus with this Energetics Manufacturing Technology Center (EMTC) effort is to address the JSEOD need by developing a new generation of demolition energetics, referred to as Fastpack Demolition Explosives (FPEX), which utilize a one-step, solvent-free Resonant Acoustic Mixing (RAM)-based manufacturing process.

Payoff

The FPEX RAM-based manufacturing process decreases processing time, reduces / eliminates processing solvents, eliminates process wastewater, reduces / eliminates plasticizer requirements (longer shelf life), 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.

The annual demand for M112 C-4 demolition block is estimated to be \$2.9M. If 1.25 pounds of C-4 is substituted with FPEX, \$13.17 savings per block are expected for total annual cost savings of \$39.5M. Assuming three shifts per day, a total of four RAM 55 units will be required. Buying and installing four RAM 55 units are estimated to cost around \$40M, and the qualification effort is estimated to cost \$1M. Taking into account the ManTech investment of \$597,000, the return on investment (ROI) will be achieved in approximately two years and the five-year ROI is 3.74:1.

Implementation

The FY21 effort focused on the modification of FPEX formulation to match or exceed C-4 performance. During this phase, FPEX was manufactured via LabRAM and the optimum operational parameters were evaluated as well. Once the performance requirements have been met, FPEX formulation will be manufactured via RAM 5 to simulate a medium-scale production operation, which will take place during FY22. FPEX manufacturing and all required testing will be carried out at Naval Surface Warfare Center Indian Head Division.



PERIOD OF PERFORMANCE:
Jun 2020 to Dec 2022

PLATFORM:
Energetics / M112 C-4 Demolition Block

CENTER OF EXCELLENCE:
EMTC

POINT OF CONTACT:
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(301) 744-6772
charles.r.painter@navy.mil

STAKEHOLDER:
PEO USC, PMS 408

TOTAL MANTECH INVESTMENT:
\$597,000



Novel Initiating Explosive for Use in μ LEEFI



PERIOD OF PERFORMANCE:
Jan 2021 to Dec 2024

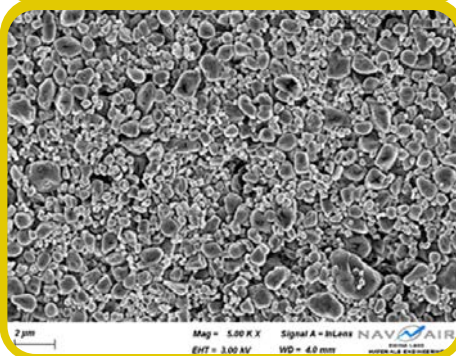
PLATFORM:
Energetics / Special Purpose Munitions
Initiation System

CENTER OF EXCELLENCE:
EMTC

POINT OF CONTACT:
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STAKEHOLDER:
NSWC-Crane

TOTAL MANTECH INVESTMENT:
\$843,000



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

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 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 low energy exploding foil initiator (LEEFI) 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 ultra-low energy exploding foil initiator (μ -LEEFI) 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 Low Energy Exploding Foil Initiators (μ -LEEFI). The μ -LEEFI technology 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 ~ \$2M over the next five years by enabling the use of less expensive components and also guaranteeing a consistent future supply of enhanced explosives that are produced using industrial processes that reduce manufacturing and production supply chain risks and lower cost due to fewer failed lots.

Implementation

After successful demonstration of the reproducible benefits of using the novel explosive in a μ -LEEFI, 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.

RepTech Projects

| | |
|--|-----|
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| RT2837 — Submarine Large Diameter Ball Valve Improvement..... | 119 |
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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.

Improved Thermal Spray Process Results in Higher Quality Coatings and Improved Performance of iLLLV



PERIOD OF PERFORMANCE:
Feb 2016 to Mar 2022

PLATFORMS:
CVN 68 Class / Aircraft Carriers

CENTER OF EXCELLENCE:
iMAST

POINT OF CONTACT:
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STAKEHOLDER:
PMA 251 IPT Launch and Recovery
Equipment

TOTAL MANTECH INVESTMENT:
\$818,000

RT2682 — Low Loss Launch Valve (iLLLV) Plug Maintainability Improvement

Objective

The successful completion of this project will provide an improved coating process that prevents corrosion to extend the life of the Low Loss Launch Valve (iLLLV) plug shaft and a process for restoring shafts to the required dimensions. The current coating system has a bond coat that provides corrosion resistance that is compliant with the ceramic top coat. Analysis shows the performance of the bond coat needs to be improved. The shafts are used on CVN 68-77. An efficient and economical repair process will greatly reduce operating costs, increase system availability, and reduce repair times.

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project is to develop and qualify an improved coating process for the iLLLV plug shaft and transition the coating processes to a Navy-approved thermal spray vendor.

Payoff

The repair and reclamation the iLLLV plugs offer significant savings through extended service, reclamation of legacy plugs, and improved performance and reliability. The estimated cost avoidance for the first five years of implementation is \$3.0M for a return on investment of 4.5:1.

Implementation

The repair process will be developed with a Navy-approved thermal spray vendor. This will make implementation possible as soon as the coating process is approved. Implementation is expected in FY22.



Optimized Ceramic Coating Improves Wear and Prevents Calcareous Deposit

RT2837 — Submarine Large Diameter Ball Valve Improvement

Objective

Submarine seawater backup ball valves have experienced significant problems with elevated opening / closing torques that result in high hydraulic system operating pressures. The seawater-system coatings on valve balls are not meeting design requirements resulting in significant cost for repairs (up to \$250K for each ball). Causes of increased torque are attributed to swelling of valve seats, loss of lubricity between the surface of the valve ball and seat due to the loss of the green Teflon™ coating, and calcareous deposits from marine growth. Damage to the surface finish of the valve ball Teflon™ coatings and bare titanium surfaces requires a full restoration before the valve balls can be reused.

This Institute for Manufacturing and Sustainment Technologies project is evaluating ceramic coatings with an overcoat which have shown promise in hydraulic-actuated valves with high torque output, but the coating system deficiencies (porosity, density, uniformity, adhesion, microstructure, friction, etc.) are unknown, and the failure mechanism of the ceramic / coated titanium and Teflon™-coated titanium valve balls will be identified. The ceramic coating application process, deposition parameters, and coating microstructure will be optimized in order to provide the ultimate solution capabilities of the ceramic coating system. Additionally, optimized processing parameters will be explored for the restoration of valve balls installed in seawater ball valves.

Payoff

The potentially preferred ceramic-coated valve ball system would eliminate a month-long honing operation, and an improved repair manufacturing process would result in significant cost savings. A ceramic-coated valve ball would significantly increase mean-time-between-overhaul, resulting in improved availability, less rework, and reduced delays in complex repairs from the removal process. The coating may also be applied to large and small diameter seawater valve balls, and thus, the total realized cost savings can be increased as the number of valve balls sizes are incorporated. The total life-cycle cost savings for the VIRGINIA Class submarine would be approximately \$125.4M. Additional cost savings would be realized with the COLUMBIA Class at a minimum of \$45.9M depending on the number of seawater ball valves with that design. The potentially preferred ceramic-coated valve ball system could be used for the life of the boat.

Implementation

The seminal transition event will be the satisfactory completion of a laboratory validation test of a 12-inch seawater ball valve system coated with an effective ceramic coating that improves wear and prevents calcareous deposit. This project will be completed in FY22 and will be available for implementation in the seawater system's ball valves on new construction submarines and back-fit on operational hulls.



PERIOD OF PERFORMANCE:
Apr 2020 to Feb 2022

PLATFORMS:
VCS / CLB Submarines

CENTER OF EXCELLENCE:
iMAST

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Mr. Timothy Bair
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STAKEHOLDER:
PMS 450 and PMS 397

TOTAL MANTECH INVESTMENT:
\$1,300,400



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



PERIOD OF PERFORMANCE:
Aug 2020 to May 2022

PLATFORM:
RepTech

CENTER OF EXCELLENCE:
iMAST

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STAKEHOLDER:
PMS 4013

TOTAL MANTECH INVESTMENT:
\$279,000

RT2910 — TR-343 Isolation Ring Modernization

Objective

The objective of this Institute for Manufacturing and Sustainment Technologies project is to improve the isolation capabilities of the TR-343's piezoelectric acoustic ring stacks, to increase reliability and reduce premature failures. By improving the performance of the ring stack isolation and preventing premature failure, an increase in on-board reliability will occur, 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 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 two components, the isolation and centering rings, into one insulation component without degrading the transducers 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, a current issue with legacy materials. Also, should a combined isolation / centering ring be successfully developed, it will reduce the parts list for each ring stack and decrease replacement cost by using common materials available from tens of suppliers, not sole sources.

Implementation

Implementation will occur after prototype demonstration. This demonstration will include identification of alternative materials and processes. Once these stacks have been built, qualification testing, to include UNDEX (underwater explosive shock) testing will be conducted. Once 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.



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 is 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 all 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 depot, transparency of production information, lowers downtime, provides flexible production operations, and reduces quality costs with thorough traceability. It accomplishes all this via the following functions:

- Quality Control management
- Real-time capture of process data in
- Optimized inventory management
- Functionality to track work-in-process, data collection, and traceability of components and assemblies
- Real-time reporting
- Routing management of products, subassemblies, and defective components
- Production line control
- End-to-end integration with ERP
- Real-time analysis and reporting capabilities

MDMC will be the first Navy depot with full ERP functionality in the depot processes.

Payoff

The main benefit of this project will be the foundation to implement a SFC system for the United States Marine Corps (USMC). The benefits and cost-savings have been documented in the open marketplace and include up to 50 percent reduction in inventory, management, production, and logistics costs. Specifically for USMC MDMC, cost-avoidance will initially be determined in reduced refurbishment cost as enabled by less labor and more accurate construction schedules.

Implementation

An implementation plan will be published during the project based upon research developments. This plan will include the USMCERP integration effort accomplishments and define the attributes of a supportive SFC system. Responsibility for implementation will be USMC LOGCOM. A detailed implementation plan will be developed for the selected applications that will include, but is not limited to, the confirmation of USMC LOGCOM sponsorship, an implementation schedule that matches ERP integration, initial development of procedures for integration into USMC operations, and tracking of cost savings.



PERIOD OF PERFORMANCE:
Oct 2020 to Sep 2022

PLATFORMS:
Light Armored Vehicles
Amphibious Assault Vehicles
MRAP Refurbishments

CENTER OF EXCELLENCE:
iMAST

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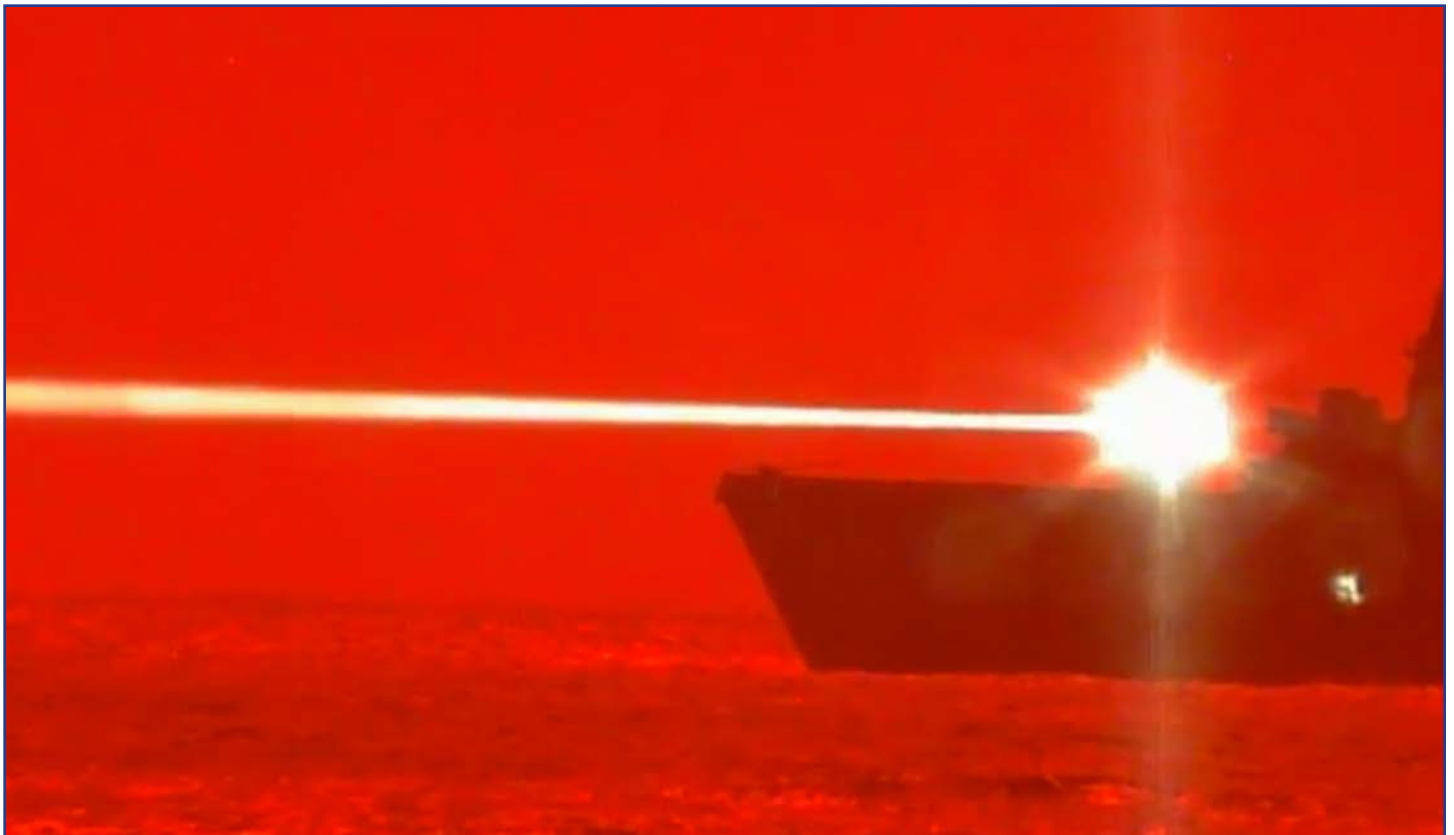
STAKEHOLDER:
USMC LOGCOM

TOTAL MANTECH INVESTMENT:
\$800,000



Capability Acceleration Projects

| | |
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USS Portland (LPD-27) successfully disabled an unmanned aerial vehicle (UAV) with a Solid State Laser. U.S. Navy image.

Designing a Low-Cost Spinel Powder Purification Process to Upgrade HEL Weapons Systems



PERIOD OF PERFORMANCE:
Sep 2019 to Nov 2022

PLATFORM:
Any Navy systems that would benefit
from the use of spinel optics / elements

CENTER OF EXCELLENCE:
EOC

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STAKEHOLDER:
TBD

TOTAL MANTECH INVESTMENT:
\$3,100,000

Q2790 — Laser Quality Spinel Optics

Objective

The objective of this Electro-Optics Center (EOC) project is to develop a low-cost powder purification technique that can produce 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 is to demonstrate the capabilities developed by this project by producing a 50 cm diameter optic that meets or exceeds the requirements for high-energy laser weapon system applications.

Payoff

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

Implementation

Once the project is complete and deemed successful, the subcontractor CeraNova Corporation will have developed a defined process for producing laser-quality spinel optics using the powder purification technique developed by this project. This process then can be leveraged for 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



Lowering Cost of Large Optics with High-Rate Production Methods

S2834 — Production Fabrication of Optics for HEL

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.

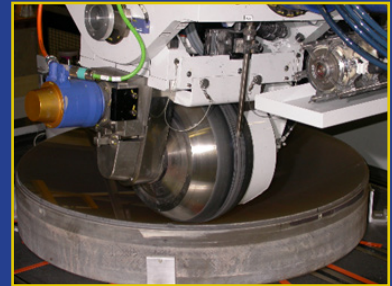
This Electro-Optics Center (EOC) project will develop and demonstrate a high-rate production method for 0.5 meter class off-axis, paraboloid primary mirrors resulting in a lower unit cost while meeting HEL performance requirements. Manufacturing methods to reduce subsurface damage (microscopic fractures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

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 \$150,000. The project seeks to develop a high-rate optical manufacturing process that can produce 15-25 uncoated mirrors annually with a cost reduction of 33 percent. Results of small-scale testing performed on the project to date support these savings estimates.

Implementation

The primary transition platforms for this project are the DDG 51 Class destroyer and FFG62 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 the HEL weapon systems are fielded.



PERIOD OF PERFORMANCE:
Feb 2020 to Jun 2022

PLATFORM:
DDG 51, FFG 62

CENTER OF EXCELLENCE:
EOC

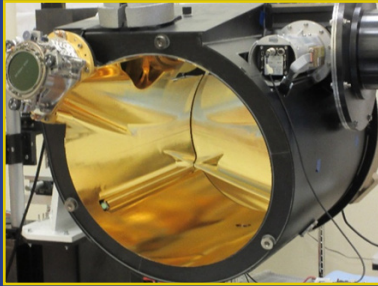
POINT OF CONTACT:
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STAKEHOLDER:
PEO IWS 2.0

TOTAL MANTECH INVESTMENT:
\$2,223,000



Improved Gold Coating Process for High Energy Laser Applications



PERIOD OF PERFORMANCE:
Sep 2019 to Mar 2022

PLATFORM:
DDG 51

CENTER OF EXCELLENCE:
iMAST

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STAKEHOLDER:
PEO IWS 2DE
ONR 035 SSL-TM

TOTAL MANTECH INVESTMENT:
\$1,200,000



S2845 — High Energy Laser (HEL) Weapons System Gold Coating

Objective

Currently there are limited vendors in the United States capable of gold coating surfaces to the required reflectivity. In addition, the current coating system does not meet all performance and reliability requirements due to poor coating adhesion.

This Institute for Manufacturing and Sustainment Technologies (iMAST) project will identify potential gold coating vendors and alternative processes, test and evaluate coating system performance, and scale the manufacturing process to allow uniform, consistent gold coatings on aluminum, titanium, and composite substrate materials to meet the performance requirements for the High Energy Laser Beam Expander Telescope (HELBET).

Once a suitable candidate system is selected, the process will be scaled to meet system and design performance, as well as identify methods to reduce cost and improve affordability. The proposed effort will identify a manufacturing process capable of coating large components for the HELBET.

Payoff

The preliminary business case, based on pre-project figures provided by L3 Harris, shows a reduction in acquisition affordability from \$250K per HELBET system to approximately \$100K.

A reduction in life-cycle affordability from the current cost of \$250K per HELBET system to approximately \$100K is also expected.

A three-month reduction in lead time schedule savings is expected after implementation, which will address high-priority defense / Navy needs for HEL and Integrated Optical-dazzler with Surveillance (HELIOS).

This project addresses manufacturing technology beyond 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 as well.

Implementation

Implementation on DDG 51 will be pursued depending on the construction schedule. Identification of potential gold coating vendors and/or alternative coating processes is expected by March FY22. L3Harris and Northrop Grumman Innovation Systems are committed to this project as a means to reduce acquisition costs and save three-months in lead time schedule. Implementation of this project requires successful coating identification / development by iMAST and L3Harris and qualification and certification approvals by the Program Office technical authorities. Implementation will be funded by PEO IWS.

ManTech Supports Swarm Technology for Advanced SDR and ESC Development

M2864 — Advanced Swarm SDR & ESC Prototype Development

Objective

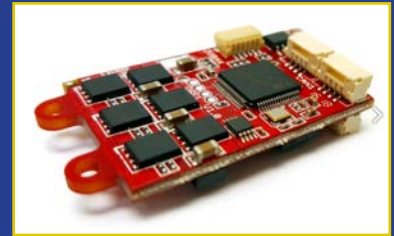
The Electronics Manufacturing Productivity Facility (EMPF) supported the ONR Code 35 swarm effort with three similarly structured projects, each of which included tasks to provide capability enhancements and tasks to manufacture initial system prototypes followed by low-rate initial production (LRIP) of the improved prototypes. ONR Code 35 has subsequently requested additional quantities of both Software Defined Radio (SDR) and Electronic Speed Controller (ESC) prototypes above its initial LRIP numbers (per each respective project). The added SDR and ESC quantities will add to the LRIP quantities with system prototypes produced under optimized manufacturing conditions.

Payoff

This 16-month project resulted in a production run of 15 SDR units and 75 ESC units. The project yielded multiple benefits, including increased system quantities for field test & evaluation activities, matured system manufacturing processes, and potential reduced unit costs at higher production rates.

Implementation

Project activities focused primarily on manufacturing updates to earlier LRIP deliveries for SDR and ESC, with production refinements that potentially include board assembly improvements, augmented quality testing, and other relevant advancements to mature the SDR and ESC manufacturing processes.



PERIOD OF PERFORMANCE:
Sep 2019 to Jan 2021

PLATFORM:
Capability Acceleration

CENTER OF EXCELLENCE:
EMPF

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STAKEHOLDER:
ONR Code 035

TOTAL MANTECH INVESTMENT:
\$99,000



Developing a Robust Product Family for Low-Cost, Rapidly Manufacturable sUAS



PERIOD OF PERFORMANCE:
Jan 2020 to Dec 2021

PLATFORM:
sUAS

CENTER OF EXCELLENCE:
iMAST

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ONR Code 034

TOTAL MANTECH INVESTMENT:
\$400,000



S2878 — MÖWGLER 2.0

Objective

Small Unmanned Aerial Systems (sUAS) are ubiquitous and of valuable military utility. However, these systems are costly and subject to supply chain disruption due to sourcing from a geopolitical competitor. As such, there is a critical need for a U.S. supplier base in response to surge requirements, supply chain constraints, and distributed manufacturing to support global asset development. Rapid manufacture and deployment of a heterogeneous fleet of inexpensive sUAS for mission operations will provide the warfighter with a new, low-cost, attritable asset.

sUAS are not prescribed, single design systems—a variety of solutions exist to create a capability. For instance, the product architecture for a quadcopter does not define the make or manufacturing techniques for the structural design. The arms of the quadcopter can be generated from wooden planks and rods, carbon fiber plates, 3D-printed structures, acrylic sheets, and so on. As long as the system is relatively rigid, most common flight controllers can handle the variability in structural design through stability augmentation.

This Institute for Manufacturing and Sustainment Technologies (iMAST) project worked to design a robust product architecture that utilizes heterogeneous components to fly the mission. Sourcing the design, components, and fabrication solely within the U.S. presents a great challenge for soldiers to perform missions quickly. Attritable, low-cost sUAS design solutions that are easily sourced with U.S. components, flexible in their configuration, and effortlessly built through thorough documentation and build packages will enable the warfighter to take advantage of sUAS and their many capabilities.

Payoff

The key benefits are the rapid employment of cheap drones for military operations as well as reduced cost and increased flexibility in manufacturing drones, resulting in increased warfighter performance and reduced security risk of using foreign-sourced components in fielded systems. An enhanced capability that is resistant to supply disruptions from foreigner manufacturers can enable sUAS in forward-deployed environments. Further, sUAS will provide counter-UAS test articles to validate other ongoing Office of Naval Research (ONR) research efforts.

Implementation

This is a Capability Acceleration project. Transition to the ONR Code 34 stakeholder will occur in FY22 with potential for additional developmental work to design a rapidly deployable system and establish domestic and responsive manufacturing sources.

No Manning Required – ManTech Explores Unmanned Trade Space

M2880 — Small Amphibious Craft Hull Structure Analysis of Alternatives MDG

Objective

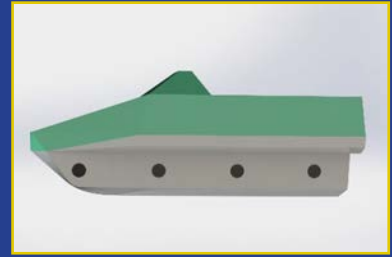
The objective of this Composite Manufacturing Technology (CMTc) project is to identify through conceptual design an improved manufacturing approach to significantly reduce cost of the hull and topsides structure of the Small Amphibious Craft. This project will conduct an Analysis of Alternatives of manufacturing approaches to determine the feasibility / best option to decrease the manufacturing cost of the Small Amphibious Craft with the least impact to other part / assembly attributes and mission objectives. The reduction in manufacturing cost will focus on methods to develop a composite, hybrid or other metallic material solution for the vessel hull and topsides. Any weight savings will be assessed for potential cost and weight reductions in other systems.

Payoff

The anticipated cost savings of an alternative fabrication approach are approximately \$11.M for the first 1,000 units. Technology insertion would occur prior to serial production, presenting an opportunity for approximately \$11.6M in total savings for the first 1,000 units. If 2,000 units were produced, savings would total approximately \$20.4M.

Implementation

At the successful conclusion of this CMTc effort, an improved material solution and manufacturing process aimed at reducing the cost and weight of the initial prototypes will be identified. A select number of prototypes will be manufactured to the method developed in this ManTech effort for Phase IV of an ongoing unmanned program.



PERIOD OF PERFORMANCE:
May 2020 to Dec 2021

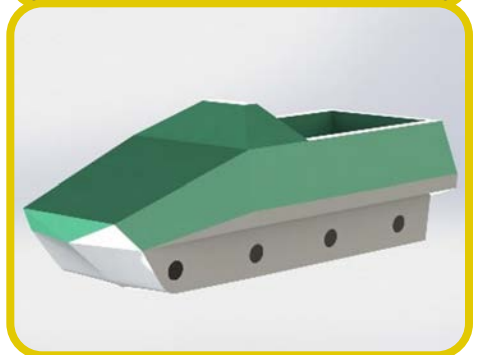
PLATFORM:
Unmanned Small Amphibious Craft

CENTER OF EXCELLENCE:
CMTc

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STAKEHOLDER:
Unmanned Surface Vehicle and Small
Combatant Craft
Advanced Ground and Amphibious
Platforms

TOTAL MANTECH INVESTMENT:
\$415,000



ManTech Supports Swarm Technology for Software Defined Radio (SDR) Follow-On Effort



PERIOD OF PERFORMANCE:

Feb 2020 to Jan 2021

PLATFORM:

Capability Acceleration

CENTER OF EXCELLENCE:

EMPF

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STAKEHOLDER:

ONR CODE 035

TOTAL MANTECH INVESTMENT:

\$402,000

M2881 — Swarm Follow-on Software Defined Radio SDR

Objective

Swarm is a strategic Science and Technology program funded and managed by the Office of Naval Research (ONR) Code 35, Aviation, Force Projection, and Integrated Defense. Swarm is supported by the Deputy Assistant Secretary of the Navy (RDT&E) and many other government stakeholders, including significant interest by each Department of Defense service. The overarching goal of swarm is to develop required fundamental technologies to ultimately deploy groups of inexpensive, unmanned drones, i.e., swarms that conduct operational missions, such as intelligence gathering, reconnaissance, fire control designation, and strike, among many others.

This follow-on project was contiguous with and began before the conclusion of the original M2864 Software Defined Radio SDR project. The original scope of SDR project was truncated at the initial prototype task, which provided additional time for Georgia Tech Research Institute (GTRI) and Electronics Manufacturing Productivity Facility (EMPF) engineers to review, assess, and correct any design parameters before the end of the project period of performance – the first quarter of 2020. This follow-on Software Defined Radio project commenced with a low-rate initial production (LRIP) / second SDR prototype run that incorporated all technical updates and lessons learned from the initial prototype run in the initial SDR project.

Payoff

This 11-month EMPF project developed a production run of 20 SDR units, which will be implemented in ONR Code 35 swarm exercises. The project outcome yielded multiple benefits, including increased swarm performance through enhanced capabilities and the potential for a reduced unit cost at production rates.

Implementation

The GTRI design updates concluded in second quarter 2020, and these changes were submitted to the printed circuit board (PCB) vendor for implementation and production of new PCBs. EMPF provided integral ManTech support to GTRI in optimizing both the baseline and updated SDR design for manufacturability, component supply chain, capabilities evolution, and other engineering parameters appropriate to produce the necessary prototypes. LRIP and testing occurred in the second quarter 2021.

Testing and Process Protocols Improve the Reliability of HEL Optical Coatings

S2884 — HEL 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 have a sufficiently low stress to maintain wavefront 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 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 system 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 weapons system 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 weapons systems. The project also seeks to demonstrate HEL coatings from a commercial supplier 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 DoD use of the HEL coating specification and inspection protocols resulting from phase one 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 system.



PERIOD OF PERFORMANCE:
Aug 2020 to Feb 2023

PLATFORM:
DDG 51, FFG 62

CENTER OF EXCELLENCE:
EOC

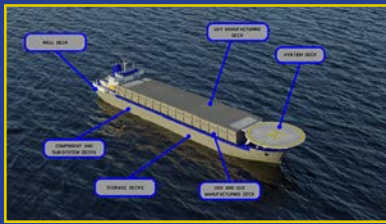
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STAKEHOLDER:
PEO IWS 2.0

TOTAL MANTECH INVESTMENT:
\$1,395,000



ManTech Investigates Supply Chain Alternatives to Support Mission Objectives



PERIOD OF PERFORMANCE:
May 2020 to May 2021

PLATFORM:
Capability Acceleration

CENTER OF EXCELLENCE:
EMPF

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STAKEHOLDER:
ONR Code 035

TOTAL MANTECH INVESTMENT:
\$385,000

M2901 — Electronics Manufacturing Afloat Study

Objective

A significant requirement of any military engagement is the consistent availability of all necessary resources to support mission objectives. Consequently, any prolonged military action cannot be sustained without a robust supply chain, which begins with raw materials and ends with a manufactured final product delivered to the appropriate end-user. Multiple variables factor into supply chain operation, including constituent availability, production quantities, inventory, storage, transportation, scheduling, security, endpoint delivery, and, of course, cost.

Military technological superiority is in large measure a result of superior electronics. Electronic technologies are the underlying enablers of military capabilities and are essential to every category of modern combat systems. A novel, more progressive approach to address these DoD electronics supply chain limitations would be to establish a mobile source for the critical electronic products and relocate the source closer to the conflict zone. Accordingly, this Electronics Manufacturing Productivity Facility (EMPF) study investigated and described “what it would take” to manufacture increasingly complex “layers” of unmanned vehicle electronics on a forward-deployed afloat facility. Additionally, the study identified factors that could facilitate the transition to an afloat-based manufacturing environment.

Targeted platforms that would utilize electronic items manufactured by the afloat facility include:

- Group 1-3 unmanned aerial vehicles (UAVs)
- Unmanned surface vessels up to Sea Mob size (or slightly larger)
- Other air, surface, and underwater systems (UxVs), generally within the scale of the first two examples.

Payoff

A well-planned, executed vision of this paradigm will yield multiple benefits, including significant reductions in the source-to-end distance, time-in-transit, on-demand delivery, inventory, and a likely reduction in overarching costs once the initial process shakeout is complete.

Implementation

This results of this study provide the foundational underpinnings for a future afloat-based production capability for a variety of unmanned vehicles, which are further extendable to other targeted systems. The study presents a compelling case for the art-of-the-possible and provides DoD leadership with investment recommendations to help shore up and refine various supporting technologies that will facilitate improved automation and increased efficiency and ultimately reduce afloat manpower requirements.

Additive Manufacturing Can Replace Wire Bonding to Reduce Losses

Q2902 — Additive Manufacturing for Chip Scale Interconnects

Objective

Radar and electronic warfare (EW) systems on most Navy, Air Force, and Army platforms are costly assets critical to mission performance and platform survivability. Radio frequency (RF) packaging plays a critical role in the integration and operational performance of these electronics systems. Improving RF packaging consistency provides corresponding improvements in power efficiency, operational reliability, and associated cost.

Most RF devices within DoD radar and EW systems have common manufacturing, tuning, and packaging challenges that significantly drive system costs. Wire bonding is a pervasive manufacturing process used to interconnect the die with the remaining circuit assembly. Wire bond consistency becomes increasingly demanding at higher RF frequencies where even the smallest manufacturing defects can profoundly impact operational performance. Wire bond variations further increase fabrication costs due to the resulting degree of manual tuning activities required by highly skilled operators.

A reduction in the bond wire length decreases the delaying inductance of interconnect, resulting in lower inductance, which translates into reduced losses and a lower input power requirement (i.e., increased efficiency). This inductance effect is critical for RF circuit performance at higher frequencies.

Fortunately, wire bonding can be replaced by additive manufacturing, in which material is deposited layer-by-layer to build up structures or features. Modern additive manufacturing is a direct CAD driven process that eliminates expensive hard-tooling and masks and leads to higher precision part fabrication with fewer overall processing steps.

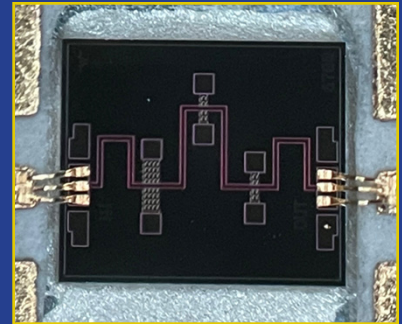
Under this effort, the EMPF designed and developed 100 RF passive samples, including 80 AM printed samples and 20 WB samples respectively. These units were tested both pre and post environmental conditioning over the frequency range of DC to 40GHz for the full 2-port S parameters characterization. After testing a statistical analysis of the results was provided in the final report, along with a standard fabrication process for the AMCSI.

Payoff

RF device packaging can be significantly improved by additively manufacturing the RF interconnects. Additive manufacturing offers lower inductance to reduce losses; lower power requirements for increased efficiency; consistent performance and eliminates the arduous tuning process to reduce the cost of radar and EW systems.

Implementation

AMCSI is a core technology maturity effort that targets risk reduction for future ManTech projects to additive manufacture a complete Gallium Nitride (GaN) high Power Amplifier to support a naval EW platform: Dual Band Decoy (DBD) for F-18 E/F. The planned future GaN HPA project will incorporate multiple discrete tasks to additive manufacture the respective HPA housing, circuit card assembly and RF interconnects. However, due to the high complexity involved in successfully fabricating RF interconnects, AMCSI was proposed & executed to refine this particular technology and ready it to support Additive Manufacturing of GaN HPAs, and potentially other future related work.



PERIOD OF PERFORMANCE:
Jul 2020 to Oct 2021

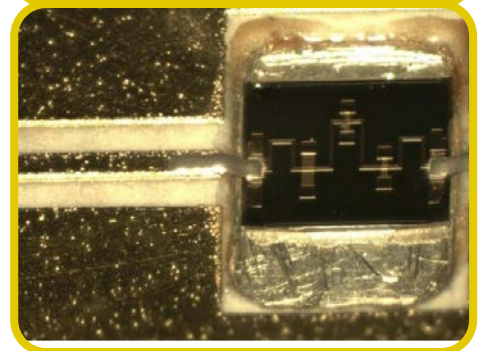
PLATFORM:
Capability Acceleration

CENTER OF EXCELLENCE:
EMPF

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STAKEHOLDER:
ONR

TOTAL MANTECH INVESTMENT:
\$697,000



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



PERIOD OF PERFORMANCE:
Jun 2021 to Jun 2024

PLATFORM:
Joint Direct Attack Munition (JDAM)

CENTER OF EXCELLENCE:
EMPF

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STAKEHOLDER:
Precision Strike Weapons Program
Office, PMA 201

TOTAL MANTECH INVESTMENT:
\$6,826,000

A2906 — DRG IMU for Navigation-Grade Performance

Objective

The Electronics Manufacturing Productivity Facility (EMPF) is addressing GPS-denied navigation by providing a functional IMU prototype that uses a ruggedized Disc Resonator Gyro (DRG) interfaced with a host navigation system for reliable end-use operation for the Joint Direct Attack Munition (JDAM). This ManTech effort will develop 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 (MEMS) technology, the project also has applicability beyond JDAM transition to longer times of flight.

Payoff

Expected benefits to the Navy include a five-year Capabilities Acceleration of the latest MEMS gyroscope technology and increased drift error performance that will contribute to increased target accuracy. By extension, the project will also provide 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 will also benefit from this effort.

Implementation

Acceptance of the final demonstration prototype by the integrated project team is the implementation milestone. It includes approval of the functional demonstration acceptance testing and meeting the technical performance measurements. The project will prepare a final technical data package that will ensure the implementation of the project results for future acquisition procurements of IMUs for all JDAM kits.

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.

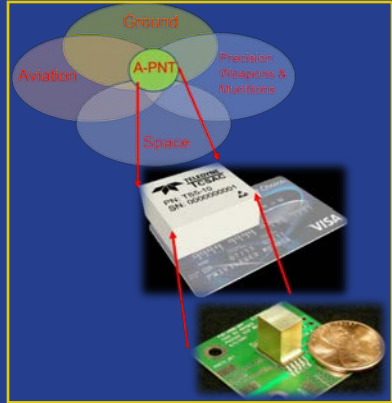
This Electronics Manufacturing Productivity Facility (EMPF) project with Teledyne Scientific Company is part of a larger, four-year Army Research Laboratory (ARL) program that will lower CSAC costs through improvements in physics package assembly and testing; lower-cost materials, fabrication, and assembly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

Payoff

Successful completion of this project will result 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.

Implementation

The outcome of the initial effort is expected to provide low-rate initial production-ready CSACs to the market within the next 3 years.



PERIOD OF PERFORMANCE:
Dec 2021 to Dec 2023

PLATFORM:
Unmanned ground, underwater, and aerial vehicles

CENTER OF EXCELLENCE:
EMPF

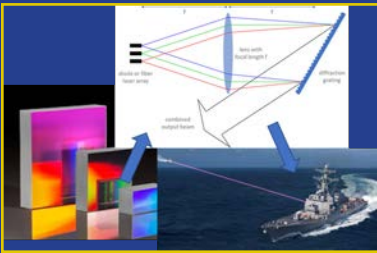
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STAKEHOLDER:
Combat Capabilities Development Command (CCDC) Army Research Laboratory (ARL)

TOTAL MANTECH INVESTMENT:
\$1,374,000

Metrology Tools and Processes Enable Commercial Grating Supply for HEL Weapons

S2909 — Production of MLD Gratings for Laser Weapon Systems



PERIOD OF PERFORMANCE:
Aug 2020 to Feb 2023

PLATFORM:
DDG 51, FFG 62

CENTER OF EXCELLENCE:
EOC

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STAKEHOLDER:
PEO IWS 2.0

TOTAL MANTECH INVESTMENT:
\$763,000

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 DoD 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 – a design spec 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 the 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 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.



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