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Navy Manufacturing Technology Program Significantly Impacts Ship Affordability

SHIP PLATFORMS

VIRGINIA CLASS SUBMARINE

COLUMBIA CLASS SUBMARINE

CVN 78 CLASS AIRCRAFT CARRIER

DDG 51 CLASS DESTROYER

FFG 62 CLASS FRIGATE

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Digital Data and New Technology Merge to Save Millions for Ships and Subs

Location identification can account for up to 10% of labor costs for hanger studs and no paint mark-up areas. Bath Iron Works (BIW) and General Dynamics Electric Boat (GDEB) use projection technologies that were developed years ago, which offer limited options for production. A Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project developed a hardware and software package that improves the process to locate and install hanger stud and paint masking markings. The project designed and developed a mobile optical projection device that receives and processes CAD and product data and integrates the location data with the appropriate technologies to validate the accuracy and repeatability of an improved process. The hardware and software are expected to reduce the time and cost required to determine stud and paint masking locations. Implementation proceeded in FY22 at BIW and GDEB with full implementation anticipated in FY23. Estimated cost savings include:

- $510K recurring per DDG hull
- $501K recurring per VIRGINIA Class submarine hull (+ $1.1M non-recurring)
- $809K recurring per COLUMBIA Class submarine hull (+$1.7M non-recurring)

Automated Plate-Shaping System to Save Over $21M for Ingalls' Ships

Ingalls Shipbuilding employs traditional forming technologies that are labor intensive and heavily dependent on the experience of a few craft workers. A Center for Naval Metalworking (CNM) project developed an automated system that forms shell plates and verifies the geometries of as-built plates in accordance with design data. The prototype improves shaped-plate fabrication and verification processes to automatically form steel into complex, 3D shapes and significantly minimizes lead-time and costly downstream rework. Ingalls anticipates that the project results will significantly reduce labor, rework, material handling, and crane support, as well as increase throughput. Following implementation in FY23, the project is expected to result in five-year savings of $7.6M for the DDG 51 Class destroyer and an additional $13.7M across all other ship platforms constructed by Ingalls (LHA, LPD, and NSC).

Open and Common Modular Building Blocks for Radars Will Save $90M for Next Generation Surface Search Radar

The most expensive and unreliable components of previous generation radars are power tubes and high-voltage power supplies, which are generally unique designs tailored to a specific mission. An Electronics Manufacturing Productivity Facility (EMPF) project facilitated open architecture radar designs based on common commercial components used as modular building blocks. The project produced a prototype that used modular solid-state amplifiers and low-voltage power supplies, which are less costly, more reliable, and will be used in multiple radar designs, beginning with the Navy's Next Generation Surface Search Radar (NGSSR). NGSSR integration began in May 2021 on LHA 8 (USS *Bougainville*), with additional insertions expected on at least 200 Navy surface combatants over the following six years. Total savings are estimated at $90M, which include $50M in sustainability and $40M in acquisition reductions over 200 ship sets.

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AIRCRAFT PLATFORMS

F-35 LIGHTNING II AIRCRAFT

CH-53K HEAVY LIFT HELICOPTER

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F-35 EOTS Producibility Improvements Save More Than $224M

The Electro-Optics Center (EOC) conducted projects executed under multiple phases that are significantly improving the affordability of the F-35 Lightning II Electro-Optical Targeting System (EOTS). EOTS is a high-performance, lightweight, multi-functional system for precision air-to-air and air-to-surface targeting that provides high-resolution imagery, automatic tracking, infrared search-and-track, laser designation with range finding, and laser spot tracking at greatly increased standoff ranges. Funded by the Air Force, Navy, and Defense-Wide Manufacturing Science & Technology Program, the EOTS efforts have optimized manufacturing processes for F-35 infrared components, including the integrated Dewar cooler (IDC) and the focal-plane array (FPA). Phases 1-3 implemented improved and automated FPA and IDC manufacturing processes, tools, and equipment that significantly reduced cost, increased yield and reliability, and advanced the MRL from 4 to 8 while reducing the cost per IDC assembly by 19%, saving over $117M. The ROI is over 25X for the F-35 Program. Phase 2 provided affordability savings of over $18M with an ROI of over 43X. Phase 3 provided affordability savings of over $5M with an ROI of over 7X. Phase 4 transitioned the mid-wave infrared IDC to a high operating temperature advanced detector, which increases capacity, significantly reduced FPA cost, increased reliability, and saved over $62M. Phase 5 used an FPA batch manufacturing process that significantly lowers manufacturing costs; automates the lower vacuum assembly test station, which significantly decreased manufacturing time and rework costs; and saved over $19M. Phase 6 is implementing an in-situ etch and passivation tool that will improve yield and reliability and reduce cost, as well as wafer photolithography improvements that will streamline the manufacturing process and save over $3M when implemented in 2022. The phases are expected to save over $224M for the F-35 Program.

Flexible Robotic Composite Manufacturing Cell Will Save $22M for CH-53K

Current CH-53K composite part manufacturing processes use a combination of manual and computer numerical control (CNC) processes for part machining and dimensional inspection. A Composites Manufacturing Technology Center (CMTC) project leveraged purpose-built, high-accuracy robots and an automated guided vehicle to develop a flexible robotic composite manufacturing cell (FRCMC) that machines and inspects composite parts, resulting in nearly 100% uptime of the equipment. FRCMC provides a significant advantage over traditional CNC machine centers and manual 3D inspection. The manufacturing cell successfully completed Site Acceptance Testing at Aurora's Bridgeport, WV, facility. Use of the FRCMC will save nearly $22M for main rotor pylon and engine nacelles alone over the life of the CH-53K production program. The cell is also intended for use on MQ-4C Triton, MQ-25 Stingray, and T-7A Red Hawk.

Additive Manufacturing Enables Large-Scale Tooling, Reduces Cost

Fleet Readiness Center East (FRC-E) in Cherry Point, NC, needed data to support the use of a large-scale additive manufacturing (AM) system to fabricate rapid, low-cost tooling for composite components. However, not enough data existed for additively manufactured tooling consistent with the needs of the Navy's Fleet Readiness Centers, such as durability, vacuum integrity, and dimensional stability in an autoclave environment. A Composites Manufacturing Technology Center (CMTC) project conducted design and analysis work and successfully printed representative tools. The AM parts could achieve 14 to 74 percent cost reduction for composite cure tooling and reduce lead time by at least 50 percent compared to conventional metallic or composite options.