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

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Mobile Computing Design-Build Process Creates Lean Tablet-based Work Packages
General Dynamics Electric Boat uses cumbersome work instructions and traditional engineering drawings to build the VIRGINIA Class submarine (VCS) that do not contain the same level of data as the COLUMBIA Class submarine (CLB) product design. When VCS data is migrated to the computer-aided-design system, some of the VCS data may be lost. A Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project created a lean paperless work package built from the legacy VCS product model that allows all data to be maintained. The lean work packages include only the operations, material, joints, and views needed for a particular unit of work. This enables shift-sized work instruction packages that can be delivered to a tablet in PDF form and support variable-sized units of work. The tool allows users to create lower level work instructions up to 50% faster with significantly more details, setting the standard for how digital data feeds manufacturing. The tool demonstrates step-by-step fabrication and installation instructions, displays true built and fitted parts, shows temporary structures, and documents the recommended weld times. The improvements have an estimated cost savings of $367K per VCS hull and five-year cost savings of $3.7M. Implementation in a production environment started in the third quarter of FY18 on SSN 798.

Self-Locating, Self-Fixtured Method Optimizes Submarine Construction
A Navy Metalworking Center (NMC) project developed a more efficient way to fit and join deck structures for CLB and the VIRGINIA Payload Module (VPM). Traditionally, deck structures have been constructed of many short, fitted pieces (intercostals) between continuous beams. The self-locating, self-fixtured (SLSF) method enables construction with notched beams that interlock and are continuous in both directions. New profile cutting technology enables intricate notched joints to be cut in the middle of beams, thus many intercostal parts can be combined into semi-continuous notched beams. The beams are assembled to form a grid, which constrains itself against distortion and shrinkage during welding. The SLSF method reduces part count, which directly decreases production and handling costs, and the self-fixturing nature of the parts greatly diminishes the assembly complexity, which lowers the required skill level and shortens the duration of construction. The SLSF process has been incorporated into the design of CLB and VPM; further implementation will occur when construction commences in FY19. Currently, 16 decks on SSBN 826, the lead ship of the CLB Class, and at least 26 decks on the follow-on ships will utilize SLSF construction. An additional five decks are still under consideration. Both VPM decks will utilize SLSF construction. Implementation of the SLSF method will result in estimated savings of $2.2M per CLB hull, $107K per VPM hull, and life-of-program savings for both CLB and VPM of $28.3M.

Retractable Bow Plane Improvements Offer VCS $300M in Life-Cycle Savings
The VCS retractable bow plane extend / retract hydraulic cylinders were experiencing premature failures of rod seals from the buildup of calcareous deposits. When the seals fail, either an unplanned dry-docking or the installation of cofferdams is required to allow for their replacement. A project executed by the Institute for Manufacturing and Sustainment Technologies (iMAST) and the NSAM Center developed a thermal spray coating solution that prevents the damaging buildup – extending the usable life of the affected parts and reducing the need for unscheduled maintenance for submarines. The project developed, tested, and implemented an improved ceramic thermal spray coating that optimized manufacturing parameters for the material system, improved reliability, and lowered maintenance costs. The coating system provides adhesion strengths more than 50 percent higher than previous coatings. Implementation of a reliable coating reduces unplanned maintenance, contributes to the extension of the ship's planned maintenance periodicity between major overhauls, and improves system availability. Life-cycle cost savings resulting from the implementation of the coating are estimated at $9.6M per VCS based on the labor savings for as many as 29 seal replacements over the life of each submarine, which equates to total VCS life-cycle cost savings of approximately $300M.

Navy Manufacturing Technology Program Significantly Impacts Aircraft Affordability

AIRCRAFT PLATFORMS

F-35 LIGHTING II

CH-53K HEAVY LIFT HELICOPTER

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F-35 EOTS Producibility Improvements Save More Than $202M

The Electro-Optics Center (EOC) conducted projects executed under four 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. Phase 1 automated the mid-wave infrared integrated Dewar cooler (IDC) assembly and implemented processes, tools, and equipment to reduce touch labor, increase yields, and improve the reliability of the production line. The project reduced the cost per IDC by 19%, saving over $117M. The ROI is over 25X for the F-35 Program. Phase 2 improved the focal-plane array (FPA) quick test and the Dewar final vacuum bake, which reduced handling, scrap, labor, and span time. A 4-percent reduction in cost per unit and savings of over $18M have been realized to date. Phase 3 is automating the Dewar cold stack and die cleaning and inspection processes, which will reduce cost, cycle time, and scrap by improving the producibility, throughput, and yield. The effort will reduce the cost per unit by $1,800 for total estimated savings of $5.4M and an ROI of more than 7X when implemented in 2020. Phase 4 is transitioning the mid-wave infrared IDC to a high operating temperature advanced detector, which will increase capacity, reduce FPA processing hours and span time, and increase the reliability and maintainability of the IDC assembly. The project is expected to save over $62M for the F-35 Program when implemented in 2021.

Automated and Rapid Seal Installation Saves F-35 $120M

A Composites Manufacturing Technology Center (CMTC) project sponsored by Navy and DOD ManTech Programs optimized the door and panel manufacturing of the F-35 Lightning II. The fifth-generation aircraft require various shaped seals be installed around the perimeter of most removable panels and in-flight opening doors. These complex seals are cut from 4-foot straight sections of seal material supplied by the manufacturer. The process is complex and labor intensive and requires multiple manual processes. Seal installation involves intricate shaping and trimming, adhesively bonding the seals to the panels, and cutting precise holes for fasteners. The project developed a series of technologies to enable affordable fabrication of unique seal shapes to reduce the complexity of installation, the labor required to install seals, and the potential for quality defects. Ultrasonic seal hole cutting reduced the labor required to cut the holes in seals for fasteners, improved the quality of the cut hole, and enabled the use of pressure sensitive adhesive (PSA). The project also developed methods to apply PSA to complex seal profiles that previously could not be done. By implementing the three technologies, significant cost savings were achieved by reducing labor, manufacturing defects, and manufacturing span time. Approximately $120M in cost savings for F-35 have been identified with the potential for more as implementation progresses.

Automated Technical Data Packages Save Nearly $11M Annually for PMA-261

The Naval Shipbuilding and Advanced Manufacturing (NSAM) Center developed a system for the H-53K Helicopters Program Office (PMA-261) that will reduce significantly the time and resources required to create, verify, and validate technical data, resulting in an estimated annual cost savings of $10.8M. The project automated the receipt process of technical data, reduced the cycle time, and increased the accuracy and accessibility of technical data packages (TDPs); streamlined the technical data receipt, verification, validation, and data migration into the Product Lifecycle Management system; produced widely accessible TDPs (3D PDF); provided a secure 3D Data Exchange System for non-CAD consumers to use 3D product data that leverages open standards and available tools; and demonstrated a secure capability to import, validate, export, and execute a logistics procurement function through the Defense Logistics Agency and Naval Supply Systems Command. The project received a 2018 NAVAIR Commander's Award in the Business Innovation category for its efforts.