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REDUCING THE COST AND TIME TO BUILD & REPAIR **NAVY** PLATFORMS

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Government-funded research and development efforts helped form the basis for evaluation strategies paving the way for promising new information technologies.

Photo Courtesy of the US Army

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AI for Planning project intends to improve the planning process for outsourcing, structural assembly and welding activities required during submarine construction.

Photo Courtesy of Navy.mil

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BIW is creating better methods for detection and eliminating errors at the earliest stage of construction.

Photo Courtesy of General Dynamics Bath Iron Works

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NNS is developing a digital layout and inspection system to streamline the inspection process and provide accurate results

Image Courtesy of Newport News Shipbuilding

'Planned' Savings through Artificial Intelligence for Planning Project

AI for Planning project intends to improve the planning process for outsourcing, structural assembly and welding activities required during submarine construction. **- Photo Courtesy of Navy.mil**

A current challenge at Electric Boat (EB) 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. 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 VCS data to arrive at an optimized plan prior to the construction of the lead CLB ship.

The Artificial Intelligence for Planning project, managed by the Naval Shipbuilding and Advanced Manufacturing (NSAM) Center will provide an AI based planning tool to supplement EB's current multilevel planning approach. In the current multilevel planning approach the highest level (Master Assembly Plan) defines the major modules. The second level planning scenario entails high level activities. The third level consists of work orders scheduled in an MRP system. The AI for Planning system will introduce a fourth level, which is model based parametric planning. This means that MRP work activities will be associated with the build product model enabling the definition of planning parameters that are computed from the model. AI for Planning will compute planning improvements based on objective cost functions for work duration and for cost, with an emphasis on structural assembly and welding. 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.

This project is expected to result in savings of approximately $146K per VIRGINIA Class submarine and approximately $236K per COLUMBIA Class submarine for five-year savings of $2.05M. The AI for Planning technology is expected to be implemented at GDEB's Quonset Point, RI, facility during the first quarter of FY23.

Developing an Electronic Personal Dosimetry Self-Issue System

For the US 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 System project will develop a digital system to manage personnel exposure and to 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 including providing access to High Radiation Areas (HRA). As part of their responsibilities for controlling access to HRAs, RCTs provide qualified radiation workers with an electronic pocket dosimeter (EPD). This can be a laborious and time-consuming task, especially when there is a backlog of personnel seeking access to 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 radiological oversight of trades' workers performing radiological work. This will also free up time for the worker, as they should no longer have to wait for the RCT to be ready in order to get their EPDs.

This two-phased, 15-month effort will focus on developing requirements for the system, develop the system, integrate the equipment, and test the system. The project team will identify and procure the equipment and develop the software interface for the system following system requirement definition. The next step is to develop the required hardware interface, which would include the design and layout of the Unmanned HRA Control Point Area where the system will be used. A test plan for the EPD self-issue will be developed, then training for the nuclear workforce will be created. The system will be integrated and mock-up testing will commence at NNS. This technology, once implemented, could potentially return an estimated CVN five-year savings of $5.5M.

NSAM Teams with GDBIW to Leverage use of "Intelligent" 2D Diagrams as DDG-51 Class Cost Saver

The DDG-51 Program initiated in the late 1970s, with the first DDG-51 procured in 1985, 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. As platform capability and complexity increase, costs for the ships have also increased as expectations and requirements for the program have grown. The DDG-51 Program Office has directed a reduction in construction costs with the DDG-51 co-build shipyards. General Dynamics Bath Iron Works (GDBIW) sees cost savings potential in how it preforms Accuracy Control (AC) measurements on each ARLEIGH BURKE Class destroyer through the development of the Digital Accuracy Control Management System.

BIW is creating better methods for detection and eliminating errors at the earliest stage of construction. -**Photo Courtesy of General Dynamics Bath Iron Works**

At GDBIW, the AC plan is resolved into a process, which begins with AC Engineers determining the significant points of geometry and structural intersections of the entire ship. These points are then deconstructed into the manufacturing product structure and correspond to particular stages of construction. There is a need to more reliably manage the entire dataset for a hull and develop information from those data to implement into future construction. The current process largely relies on paper check sheets, manual data entry, 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.

The Digital Accuracy Control Management System (DACMS) project will develop a system that transforms the manual, paper-driven AC check and documentation process to a fully digital environment. The project will facilitate the process of collecting AC data by Shipfitters electronically, via tablet, on the shop floor and deckplates and feed it to a consolidated AC data system. Additionally, it will seamlessly integrate Survey AC data, via a Total Station tool, into the same consolidated data system. DACMS will contain the determined AC points crucial to fabrication and assembly, as well as their corresponding value within the configured design. Further, DACMS will analyze the data in regards 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.

The DACMS aligns with the current industry push towards Digital Shipbuilding and Advanced Manufacturing Enterprise (Connecting the Enterprise, Digital Thread). Specifically, the implementation of the DACMS is the first step in a larger accuracy control Digital Thread strategy at GDBIW. The DACMS will include functionality that will greatly improve the AC data management process and result in immediate benefit to downstream shipbuilding production and it will also serve as the framework for additional innovation in Accuracy Control at GDBIW over the next 5 years.

Once completed, the implemented process improvement is expected to reduce unit erection rework by improving efficiency for development and tracking of checks and to reduce unit erection rework by improving upstream quality. The GDBIW team believes these improved efficiencies can save as much as $277K per DDG-51 Class hull.

Newport News Shipbuilding Promotes Digital Layout and Inspection Technologies to Ensure Tight Tolerance Fit Up

Many of the components and assemblies that are manufactured at Newport News Shipbuilding (NNS) are currently inspected using manual methods. In this manufacturing state, efforts are often duplicated as multiple stakeholders perform independent inspections. Variations in inspection methods can lead to conflicting findings and production delays.

A major thoroughfare for many components and assemblies manufactured at NNS is the machine shop. Currently, when a part arrives at the shop, machinists use manual layout machines to scribe, set up datums, and check for variation from design. These tools require specialized training and are biased heavily towards the inspecting operator's methodology. A datum may be developed very differently by two inspectors simply by virtue of each inspector picking different areas of the surface to measure. In the case of very large parts, the layout machine may need to be moved several times during the course of the layout/inspection process.

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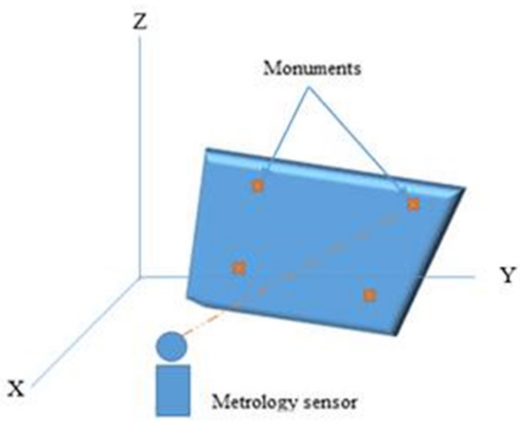
The NSAM-managed ‘Digital Common Layout and Inspection Process’ project with NNS will develop common reference datum targets on components based on the analysis of survey data on key features. These monument systems allow metrology technicians to tie an instrument back into the digital datum coordinate system by resurveying these monuments and performing a transformation analysis. This capability will allow any technician to obtain a monument file, tie into the component, and perform dimensional surveys or layoffs. This capability will persist throughout the build schedule and can be independent of component relocation. The integrity of the monument system is only invalidated if the component has undergone significant deformation.



NNS is developing a digital layout and inspection system to streamline the inspection process and provide accurate results
Image Courtesy of Newport News Shipbuilding

Once proven, NNS will have the ability to integrate an automated solution allowing a non-metrology mechanic or inspector to create a monument system from surveyed datum features. Integration of point probe, scanning, and layoff tools can allow a mechanic to lay off reference or machining lines, and inspect a component for key material deficiencies. The proposed solution will include significant levels of flexibility to allow the inspection of wide varieties of components, and enough control to ensure that the user cannot inadvertently cause errors in their datum and feature sets. Feeding this metrology system will be Product Model Information on the front end to guide the inspections and analysis algorithms paired with statistical process control systems on the back end to feed process improvement efforts in fabrication. Data flow processes will be defined that allow the efficient dissemination of data from fabrication to engineering and downstream work centers. The Digital Common Layout and Inspection Process project, if fully implemented, has an estimated five-year savings of $453K for CVN, $1.73M for VCS, and $482K for CLB.

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To date, NSAM project efforts have led to over $770M in total savings, measured as “per hull” cost reductions across several U.S. Navy platforms.