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- *GDEB 'Robotic Welding of VCS Interim Products' Effort Advances Robotic Manufacturing Technologies for Shipbuilders*
- *Ingalls Develops Automated Unit Lay-Down 'Advisor' with Capacity Planning Tool*
- *Achieving 'Digitally Agile' Strategy with Work Flow Tracking System*

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Commissioning ceremony for the Virginia-class attack submarine USS John Warner (SSN 785) at Naval Station Norfolk.

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Page 2

Interim Products Robot

Photo courtesy of Electric Boat

Improved automated process
Photo Courtesy of Huntington Ingalls Industries – Ingalls Shipbuilding.

Page 3

handheld automated tracking system
Photo Courtesy of Huntington Ingalls Industries – Ingalls Shipbuilding.

Typical ASTM C633 Adhesion Strength Test

Photo courtesy of Electric Boat

Submerged Arc Welding

Photo courtesy of EWI

Back Cover

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GDEB ‘Robotic Welding of VCS Interim Products’ Effort Advances Robotic Manufacturing Technologies for Shipbuilders

The VIRGINIA Class Submarine (VCS) focused ‘Robotic Welding of VCS Interim Products’ project recently completed by Naval Shipbuilding and Advanced Manufacturing Center, General Dynamics Electric Boat (GDEB) Edison Welding Institute (EWI) is poised to change the way US Navy shipbuilders think about automated welding processes. GDEB operations personnel involved with the production of the VCS structural fabrications identified structural welding as a major contributor to construction costs and ripe for improvement. The project team first identified major fabricated structural assemblies by product structure and defined as either “part family”, “interim product”, or “major product” assemblies. The objective of this project was to create a manufacturing cell to robotically weld interim product assemblies that are too complex to be welded with a mechanized process. The team successfully completed Phase I, leading to procurement of the robotic welding cell and initial weld process development for the designated assemblies. In Phase II, following initial programming at EWI, the GDEB team installed the robot at the GDEB Quonset Point Facility. Pushing hard for early implementation, the GDEB team developed the critically important technology implementation plan for the designated welding processes, providing extensive testing data to support ‘robotic’ welding qualifications, and trained production personnel to program and weld with the robotic cell.



Pending NAVSEA approval, GDEB plans to implement the new robotic welding processes at the Quonset Point Facility. The shipyard evaluations have shown greater savings for both the fitting and welding times, now estimated to be over 50%, a significant increase from the initial 30% estimated at the project’s initiation. The first article assemblies have proven the capability that a fully outfitted robotic welding cell will reduce the fitting and welding cost of interim product assemblies. GDEB welders have completed training, passed qualification testing and are eager to use the new robotic welding processes. The robotic welding cell is scheduled for implementation and initial production use later this year. This technology, once fully implemented, is now estimated to save over \$1.2M per VCS hull. Once fully vetted through NAVSEA, this project paves the way for other US Navy shipbuilders to use tailored robotic welding technologies.

Ingalls Develops Automated Unit Lay-Down ‘Advisor’ with Capacity Planning Tool

Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) identified substantial savings potential in the lay-down placement and assignment process that had been previously utilized for managing asset location throughout the construction process. Building four different hull forms in the tight shipyard footprint is a challenge. Ingalls Shipbuilding work instructions define the processes and responsibilities for the proper allocation and optimization of real estate (lay-down spaces) for structural units and assemblies under construction, while providing forward visibility for scheduled or potential overloads to capacity. However, the old capacity planning processes were tedious and overly time-consuming. Resulting real estate allocations were seldom optimal and often required substantial rework to resolve space allocation conflicts, as the construction schedules for each hull form jockey for the same production resources. The Ingalls team developed an automated process that optimizes unit layout and scheduling, and increases the construction of many units under a covered structure, significantly improving production rates—a plus in the hot southern climate.



An improved automated process of scheduling and assignment of build unit lay-down locations can result in a significant savings at the highly functioning Ingalls Shipyard.

In addition to identifying opportunities to mitigate the dependency of the current process upon a limited number of experienced personnel, the project team also developed improvements that reduced rework, caused by manually entered documentation, a labor intensive activity subject to frequent revision, leading to costly inaccuracies in component construction processes. The Ingalls team developed an automated and flexible real-estate allocation process to minimize or eliminate these cost concerns. This automated solution permits a scheduling analyst to rapidly assess multiple changes from the current allocation of units to lay-down areas, largely mitigating the weaknesses of the manual analysis methods that had been traditionally utilized for both initial and rework activities. Referencing various state-of-the-art management tools to provide an accurate foundation for the analysis program, the system uses an applied artificial intelligence in the form of a rules-based ‘Expert-System’ to produce an efficient utilization of available lay-down real estate.

The Ingalls project team is on track to complete the project well ahead of schedule, as the findings have resulted in a substantial change to the current capacity planning process at the Pascagoula facility. Recognizing the immediate benefits of the improved processes, the team has implemented the new Capacity Planning Automation tool early, having entirely replaced previous practices. The new tool has taken a process that historically took 10 weeks to complete and can now finish the scheduling activity in less than an hour. Following project completion and full system implementation, Ingalls expects to reduce ‘real estate’ allocation processing time by 30% and place 20 more units ‘under cover’ annually, with an estimated cost savings of over \$990K per year.

Achieving ‘Digitally Agile’ Strategy with Work Flow Tracking System

The Pipe Shop at Huntington Ingalls Industries – HII Ingalls simultaneously provides fabricated piping segments, known as pipe details, to multiple construction projects throughout the shipyard resulting in constantly shifting priorities and scheduling of efforts. Utilizing traditional tracking methods, the elevated quantity and erratic focus of concurrent evolutions results in challenging tracking efforts and can become exceptionally burdensome to the shop managers. The current activity to manually track pipe details, update reports, and record man-hours utilized in the fabrication of each pipe detail impacts the availability to provide technical support and guidance to this critical manufacturing area, affecting shop efficiency and production rates.



Improvements such as a handheld automated tracking system to improve the tracking of pipe details helps Ingalls meet DDG build schedules and allow the US Navy to place more ships out on the open ocean and at a lower cost and a higher rate than ever before.

The ‘Work Flow Tracking’ project team has developed an automated tracking system that, through real-time updates, allows for better accuracy of tracking and status of individual pipe details during the fabrication process. In addition to improving the status visibility of individual pipe details from initial development to final delivery, this modernized system also minimizes the efforts required to determine the labor associated with individual pipe details by incorporating a data-driven tracking solution. The barcode is affixed to each pipe detail when work is first commenced and enables a quick scan to gather status, completion, and labor information with a negligible impact on production. The improved process transforms a highly involved process that required significant time and effort from the most experienced personnel into an efficient evolution conducted transparently in the background.

Similar to other Ingalls projects, the technology solution has been demonstrated well ahead of schedule. Ingalls Shipbuilding is on track to fully implement the ‘Workflow Tracking’ tool in early 2016. One of the unique features of this tool is the ability to continually refine its functionality, with improvements continually incorporated into the system to support the production teams as needs and capability needs change. Once fully implemented, Ingalls expects to see at least a 4% increase in pipe detail throughput, forecasting an annual cost reduction of over \$1.1M for the DDG-51 Program. Ingalls also anticipates expanding the use of the technology to the other ship construction disciplines and platforms.

GDEB ‘Retractable Bow Planes Extend/Retract System Improvements’ Effort Addresses VCS Issues

The recently completed VIRGINIA Class Submarine (VCS) focused ‘Retractable Bow Planes Extend/Retract System Improvements’ project should reduce VCS lifecycle costs, eliminating a significant cost element along with unplanned docking activities. The VCS retractable bow plane extend/retract hydraulic cylinders have experienced premature failures of hydraulic seals due to buildup of calcareous deposits on the bow planes actuating cylinder rods. The combined team included the Pennsylvania State University Applied Research Laboratory, General Dynamics Electric Boat (GDEB), NAVSEA (VCS Program Office) and the Naval Shipbuilding and Advanced Manufacturing Center focused on optimizing the process for applying a selected coating, applying to a full-scale cylinder rod for system testing at GDEB. During Phase I, a selected coating was applied to a full-scale prototype hydraulic cylinder rod for use in component testing. The test evaluated the compatibility of the coating with the seals and the ability of the coating to meet the system requirements. The Phase II efforts focused on the qualification of the coating system with the cognizant technical authorities, followed by identification and certification of an appropriate vendor for fabricating the coating system.



Typical ASTM C633 Adhesion Strength Test

This technology, once implemented, can potentially reduce unplanned maintenance and enable an extension of the planned maintenance periodicity from 72 months out to 96 months, and provide a \$9.2M per VCS hull overall life cycle savings.

NNS ‘High Deposition Submerged Arc Welding for FORD Class Aircraft Carriers’ Effort Advances Welding Technologies for Shipbuilders

The Office of Naval Research recently awarded the Aircraft Carrier (CVN) focused ‘High Deposition Submerged Arc Welding for FORD Class Aircraft Carriers’ project to the Naval Shipbuilding and Advanced Manufacturing Center, a project that teams Newport News Shipbuilding (NNS) with the Edison Welding Institute to ‘look over the horizon’ for innovative submerged arc welding technologies. Compared to the NIMITZ class, the FORD-class aircraft carriers have been designed with larger quantities of thicker and thinner plating. These changes in plate thicknesses have negatively impacted fabrication costs by increasing welding hours and distortion, respectively.

To achieve CVN 79/80 cost reduction goals, NNS is actively working to improve its welding infrastructure. This includes selecting the optimal fabrication process so that the highest metal deposition rate processes, where appropriate, are qualified for production use. For example, submerged arc welding processes (SAW) have a higher deposition rate when compared to gas metal arc welding (GMAW). The NNS-led project will work to implement the use of higher deposition SAW processes and expand the use of SAW to increase productivity. The objective of this project is to support NNS’s welding infrastructure improvement effort by piloting and validating advanced commercial SAW technology/equipment. Tied with other ongoing NNS efforts, meeting these technical objectives enables NNS to assess and validate new welding equipment to achieve the highest weld deposition for FORD-class aircraft carrier fabrication.

The NNS/EWI project team commenced this 24-month project in this past June. The project is divided into two distinct phases, with the first phase determining requirements for baseline SAW welding technology and candidate SAW processes. The second phase will evaluate and quantify the performance of candidate SAW processes relative to current SAW processes at NNS in order to identify the preferred process for implementation at NNS, determining the technical feasibility of implementing new SAW technology in aircraft carrier fabrication. This technology, once implemented, could potentially save an estimated \$3.38M per CVN hull, primarily based on increasing submerged arc welding deposition rates.



Submerged Arc Welding



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