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

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Cover

Shipbuilders at Newport News Shipbuilding *are working night and day to finish the aircraft carrier* Gerald R. Ford *(CVN 78) Photo by John Whalen*

Photo courtesy of aircraftcarriers.tumblr.com

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Photo courtesy of Huntington Ingalls Industries – Ingalls Shipbuilding

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Flame Straightening Spot heating

Photo Courtesy of Huntington Ingalls

MoveInspect XR system

Photo courtesy of AICON 3D Systems/Germany

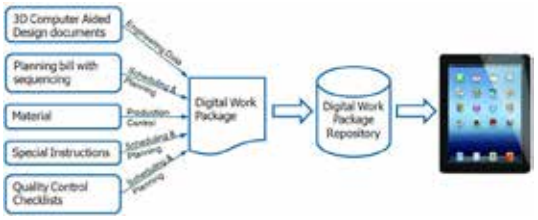
Sharing Critical Resources Requires Detailed Advanced Planning

Submarine construction strategies that involve multiple shipyards and the construction of very large ship units require careful planning of critical assets to meet ship delivery dates, assets such as larger lifting and handling devices and work platforms. Another key asset is the Sea Shuttle, a towable barge capable of transporting VIRGINIA Class submarine (VCS) modules/cargo between General Dynamics Electric Boat's two shipyards (GDEB), Quonset Point, RI and Groton, CT, and the VCS co-build partner, Huntington Ingalls Industries - Newport News Shipbuilding (HII-NNS). Planning for these types of resources can be an extremely labor intensive process that requires careful consideration of the schedule requirements for the resources, identifying other potential uses of the resources during the planned dates, and understanding the specfic resource capacities/capabilities.

The GDEB team is working with the Naval Shipbuilding and Advanced Manufacturing Center and the Institute for Manufacturing and Sustainable Technologies (NSAM and iMAST, Navy ManTech Centers of

Ingalls Shipbuilding Moves Toward use of Digital Work Packages

For Ingalls Shipbuilding the ability to convey digital information to the deck plate craftsman was either nonexistent or very limited in applications. The amount of digital data in shipbuilding had increased throughout every shipbuilding discipline--engineering, planning, manufacturing, training, essentially the entire shipyard. In order to improve production, there exists a need to migrate from paper dependency and provide digital information to the point-of-production activity in real time. Development of laptop computers, tablets, smart handheld devices, and other recent technologies offers the capability for supplying this digital information and the Ingalls team views the 'storyboarding' capability as vital to their overall "Digital Strategy." The Office of Naval Research awarded the DDG-51 focused DDG Digital Storyboard project to the Naval Shipbuilding and Advanced Manufacturing Center (NSAM-a Navy ManTech Center of Excellence) for execution, teaming with Ingalls, with the objective to develop the process and demonstrate the capability to provide a digital work package to production craftsmen.



Process Flow for Digital Storyboarding

Digital Storyboarding is the process of providing information by interactive digital screens into the hands of the craftsman, which enables visualization of the ship compartment as designed, and provides instructions regarding construction. The existing work packages are paper-based, and include engineering drawings, planning bills with sequencing, material requirements, special instructions, and quality control checklists. The Digital Work Package includes product sequence and assembly visualization, manufacturing instructions, material lists, quality control checklists, any other special instructions or related information and provides a work package to craftsmen electronically, using a mobile device to support production efforts.

The project team successfully completed a series of digital work instructions that were delivered in a tablet format to designated production foremen. Using only the electronic work package, the foremen were able to communicate clearly and concisely, relaying work instructions to the craftsman for execution. Originally designated for only one area, the Ingalls team was able to expand the pilot testing, incorporating an additional work package for piloting. The initial pilot was a success and demonstrated that the craftsman had no trouble using the digital work package. The piloted 'work bill' was completed without issue and achieved a degree of savings with similar results from the second digital work package pilot. The most important benefits of using the 3D digital work packages was the ability to troubleshoot or avoid interferences before they occur, anticipate following work in an area to better plan execution, and to better convey design intent which then increases work comprehension through context.

The improved process, once fully implemented, will reduce ship construction costs in several ways:

- Increasing craft and foreman productivity, quality, and mobility,
- provide visualization of the work layout and sequence to the craftsmen and foremen,
- facilitate transfer of design intentions into work,
- decrease the travel time to and from offices and field engineering locations at Ingalls.

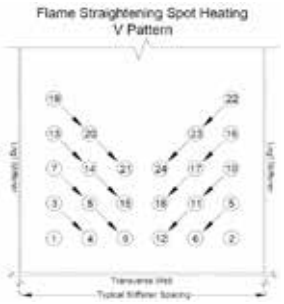
The project focused on reducing pipe outfitting man-hours by 10% and potentially saves an estimated $3.4M per DDG-51 hull once fully implemented. The ability to move data digitally between organizations in the Design, Planning, and Construction cycles will decrease total cycle time and increase process efficiency. It also facilitates a rapid response to the engineering change process, reduces the frequency and size of waterfront changes, and provides an opportunity to improve platform build schedules.

Excellence) to develop a process to monitor and forecast the use of critical resources at Electric Boat. The focus of this project is a software-based tool that is capable of providing accurate information to the GDEB Planning Department regarding the use and availability of critical resources at GDEB and its HII-NNS partner. The tool will be capable of providing statistical data regarding the implication of schedule changes, added work, or changes in a manufacturing assembly plan. The data generated within the tool can then be used to estimate the total cost of a planned/unplanned change event or develop the total cost of a proposed plan.

The GDEB project was awarded in September 2015 and is being executed in two phases. The first phase includes a thorough requirements gathering from potential end users and GDEB management, development of recommendations and the design of a prototype critical resource planning tool graphical user interface, and the inventory and data storage of all GDEB critical resources. Phase Two will include the development or extension of the data to feed the critical resource planning tool, the development of a prototype graphical user interface that accesses planning data and incorporates requirements as defined in Phase I, and the development of specific use cases to be tested with initial deployments of the critical resource planning software. Once the testing process is complete, this new tool could potentially save an estimated $352K per VCS hull and over $2M per OHIO Replacement Submarine hull.

Ingalls Shipbuilding Finds Cost Savings through Improved Flame Straightening Processes

The practice of 'Flame straightening' is synonymous with re-work, and a significant cost driver throughout the shipbuilding industry. Huntington Ingalls Industries—Ingalls Shipbuilding (Ingalls) found that the 'artisan's touch' can make a difference in how much work goes into flame straightening. Looking to standardize the process, Ingalls approached the Office of Naval Research with the Structural Fairing Process Improvement project and it was awarded to the Naval Shipbuilding and Advanced Manufacturing Center (NSAM-a Navy ManTech Center of Excellence) for execution. The objective of the Structural Fairing Process Improvement project was to investigate the current procedures used to straighten deck plate, gain an understanding of the limits to which distortion can be safely brought into tolerance without compromising material strength, and revise the guidance procedures used by fairing personnel.



Through vigilant data collection and analysis, the project was able to identify procedural issues of a complex production process and execute testing to bring a consistent, controlled, and efficient procedure to flame straightening. This project isolated key factors causing process delays, structural damage, and cost overruns that the team evaluated and improved. The improvements led to revised procedures and improved personnel training. The new procedures were expected to reduce flame straightening process time by up to 75% and bring consistency and repeatability, addressing ineffective legacy processes. During the project's execution, it became evident to the flame straightening supervisors that the new process was working, and the team observed the trades' personnel trying the new processes immediately. Ingalls developed a handbook simple enough to follow while on the job, though detailed enough to allow an inexperienced operator to fully execute the correct procedures. With the new "less is best" philosophy to flame straightening and the implementation of the new procedures, it is expected that secondary damage to structural members due to overheating will be eliminated.

The improved process, nearly fully implemented, potentially saves an estimated $453K per DDG-51 hull. The flame straightening labor cost savings associated with this project are estimated strictly based on the process time improvement. Another benefit, while difficult to quantify, is the savings from early compartment completion and reduced paint rework. The Ingalls team has already benefitted from this project's findings having developed and issued an innovative tool along with tradesmen 'flame straightening' handbooks and completed training of all flame straighteners on use of the tool, which is currently being used shipboard.

MoveInspect XR system

Trade Friendly Locating Dimensional Techniques

Metrology technologies have dramatically increased their functionality and purpose for modern manufacturing. General Dynamics Electric Boat (GDEB) has capitalized on this technology by acquiring and using modern metrology systems for various VCS submarine alignments and inspections. But the technologies of choice are currently limited to certified and highly trained tradesmen and engineers. GDEB VCS modular construction (hull sections and hull decks) requires the tradesman's ability to quickly and accurately obtain metrology coordinate placement data during manufacturing operations, not post-manufacturing inspection and alignments. The goal is to determine the feasibility and cost-effectiveness of GDEB "trade personnel" friendly dimensional locating metrology technology for immediate incorporation into the VCS manufacturing processes. During Phase I a comprehensive investigation of alignment inspection processes was conducted to identify the time and quality drivers to obtain a quality metrology alignment and assembly data points as required. The project team focused on both the physical requirements as well as the information requirements to prepare a tradesman to perform their work. New technology solutions were evaluated. As part of Phase II, testing of the down-selected technology is ongoing with encouraging initial results. While the primary focus of this project is the VCS Program, it also offers opportunities to improve manufacturing processes for the Ohio Replacement Program (ORP). Initial estimated cost savings are $860K for each VCS and OR hull.

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