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Diagram and Ship Construction
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Horizontal Welding Machine
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VCS Construction
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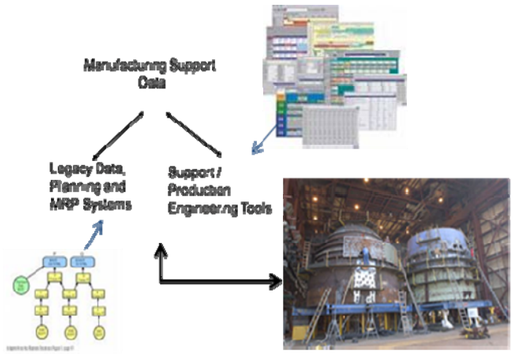
Improved Production Engineering Management Tools

Improving the Planning and Scheduling Processes for Construction of the VIRGINIA-Class Submarine



Shipbuilders are constantly striving to eliminate waste from their production processes. Often, this waste is nothing more than downtime due to an unavailable resource or a scheduling conflict. The resulting delay can jeopardize delivery dates and drive up costs associated with the labor overtime and short fused emergency work necessary to meet construction milestones. In the recently completed *Improved Production Engineering Management Tools* project, General Dynamics Electric Boat (EB) identified the need to improve upon planning and scheduling processes for construction of the VIRGINIA-Class Submarine (VCS). EB developed tools that have the ability to collect many types of manufacturing data from several sources and integrate that information to point out obstacles and identify best solutions for manufacturing processes based on critical and often limited resources. Previous systems allowed planners to schedule resources, work sites, and even additional personnel, but these systems lacked the capability to digest the multiple planning efforts in such a way that could point out possible overburdening or unavailability of those resources. The resources in question range from certain cranes or forklifts, special tools, to potentially a limited number of facilities that can accommodate the nature of certain tasks (e.g., high bays). This project aimed to give production control planners a complete picture when scheduling their efforts so that they would have visibility on their projects and the resources needed to complete those projects.

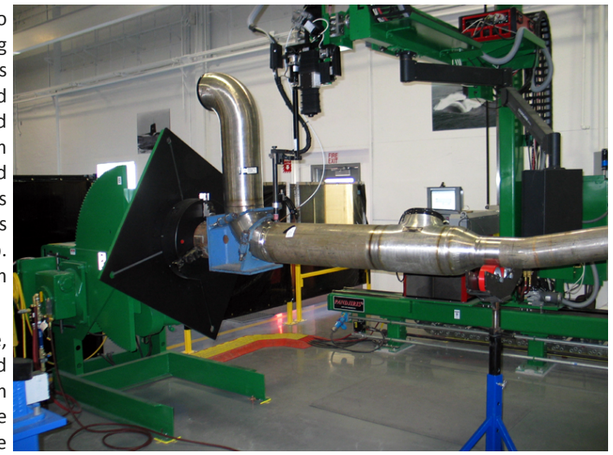
The project team defined the necessary requirements for the improved management system and developed the backbone of the system. The software development plan was defined and the team developed a series of software releases; each one adding a new variable, level of complexity, and capability. The five planned releases were completed, which has enabled the viewing of build plans and their effect on critical assets and resources, the balancing of critical resources, facilitating development of long and short-range level loaded production schedules, and an enhanced user interface to aid planners and production controllers in the planning of labor resources. Additionally, planners now have the ability to create "what-if" scenarios by adding or removing resources and immediately realizing the impact of such changes. As a result of the successful execution of the project, EB is committed to deploying the Improved Production Engineering Management tools and database in the 4th Quarter 2011, with an expected cost savings of over $860K per VCS hull.

Two CNST Projects Successfully Transition to Phase II

Digital Radiography Transition for Inspection of Welds and Castings: In a previous CNST project, Newport News Shipbuilding (NNS) identified and acquired state-of-the-art computed radiography capabilities, knowledge and supporting technical resources that are being tested in a practical shipyard environment to assess overall potential benefit. The team is working to ascertain inspection confidence with isotopes and high energy applications in addition to resolving technical and implementation issues that will lead to full implementation.

VCS Supply Chain Technology Review: The General Dynamics Electric Boat (EB) and Newport News Shipbuilding (NNS) shipyards have identified an opportunity to reduce cost from the VCS program by identifying key cost drivers for these 40 vendor furnished components, and will leverage in-house expertise in the areas of design, engineering, procurement, and operations to work with vendors to reduce costs where possible. Based on the success of Phase I, the Office of Naval Research has authorized work to begin on Phase II to substantiate supply chain material cost reduction for future VIRGINIA-Class submarine procurements.

Pipe Shop Process Reengineering - *Revitalizing Pipe Manufacturing Processes*

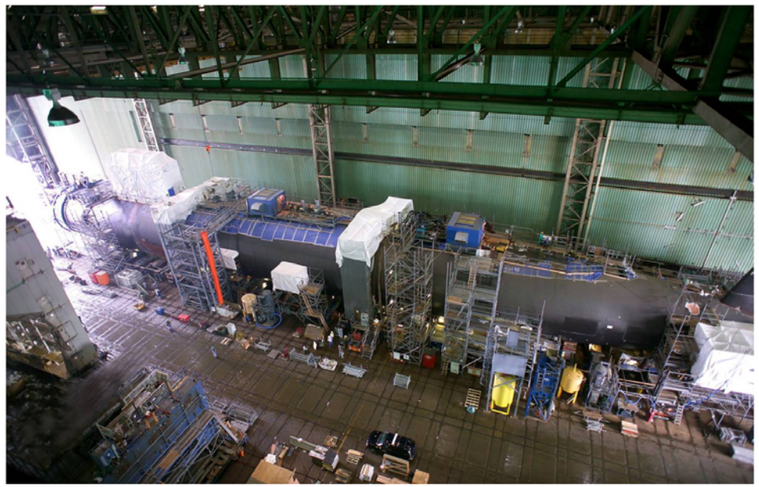


General Dynamics Electric Boat (EB) recently completed a project to revitalize pipe manufacturing processes and improve pipe fabricating sequence practices at their Quonset Point, RI facility. This project is considered a tremendous success and as such is a critical step toward enhancing EB's ability to meet the requirements of increased construction rates for the VIRGINIA-Class Submarine (VCS). The team ultimately realized their primary goals of designing processes and technologies that streamline planning and manufacturing practices while developing self-sufficient, cellular work centers and process lanes that support a more efficient product flow through the pipe shop. Implementation is ongoing, and once fully implemented, savings from this effort are expected to exceed $1.3 million per VCS hull.

EB executed this CNST led project in two phases. During the first phase, the team concentrated on mapping out the "as is" process and developing the "future state" process map. During Phase 2, the team focused on the technology insertion possibilities to address the problems identified during Phase 1. Pipe detail deliverables were identified and classified into specific classes based upon common manufacturing and assembly characteristics. The identified product families were assigned to specific work centers and process lanes in order to further streamline the pipe detail fabrication process.

These efforts resulted in the overall modernization of the pipe shop facility at Quonest Point including streamlined process lanes, centrally located primary work centers, an expanded nuclear pipe shop, centralized gas bottle management system, and updated tooling for fitters and welders. The project team also developed business rules for the discrete sequencing of joint-to-joint pipe fit-up and welding to provide pipe fitters and welders with written direction for pipe detail weld sequencing. EB expects the implementation of the production control and work package routing changes as well as final implementation of pipe fit and weld sequencing software to be completed during the fourth quarter of 2011. All pipe shop modernization efforts are expected to be fully implemented by the second quarter of 2013.

Sequencing and Scheduling - *Improving the Outfitting Process with OneStop*



This General Dynamics Electric Boat (EB)-led CNST project took on the challenge of improving tools to enable better planning and sequencing of the various tasks involved in outfitting a VIRGINIA-Class Submarine (VCS) hull. This project began in June 2009 and has recently come to a successful completion. It is expected that when fully implemented, this project will result in a savings of $1.3M per VCS hull.

The major objectives of this project were to develop an advanced visualization application and capability to validate build sequence and ensure critical scheduling and sequencing of work. In support of this project, the team advanced the functionality of EB's *OneStop* Software, a tool that extracts geometric data for the VCS structure and facilitates the planning process. The project was executed in two Phases. During Phase I the team successfully integrated *OneStop* visualization capability with the manufacturing resource planning (MRP) order processing system in support of work sequence and location re-engineering. They also incorporated piping design discipline into the *OneStop* program, which formerly supported only structural disciplines. These developments provided the ability to quickly and easily analyze where work was being accomplished and ensure that it was being done in the correct sequence and as early as possible in the manufacturing and outfitting schedule.

During Phase II the team focused on further enhancing the capabilities of *OneStop*. They were successful in generating a complete ship view (at least 80%) including all disciplines. This addition to the software makes it considerably easier for users to automatically find opportunities for re-sequencing. It also simplifies communication between the planners who recommend changes and the planners who must then enter that data into the business system. Implementation of this project's results is currently underway at EB's Quonset Point, RI facility.