



A Sea Change for Shipbuilding: Digital Integration and Automation are Critical to Meeting Rising Demand

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When it comes to shipbuilding, the numbers are staggering: hundreds of millions of parts in one aircraft carrier. Billions of dollars proposed for Naval fleet development in the latest NDAA. Hundreds of thousands of private sector jobs in the U.S. alone. A 2015 MARAD report, for example, pegged the total economic impact associate with the industry at 400,000 jobs, \$25 billion in labor income, and 37 billion in GDP (based on data from 2013).

When the financing, jobs, technological developments and supply chain trade dedicated to shipbuilding around the world are added in, the global economic impact is astonishing. Epochal state-driven shipbuilding programs already underway in Australia, India, China, South Korea, Britain and right here at home in the United States, are certain to reshape the industry and push technological advances to the very boundaries of human knowledge.

Global Dynamics Drive Historic Change

In the U.S., historically a worldwide leader in commercial and military shipbuilding, the pressure is on. Growing international threats, a recovering economy and the ongoing rise of global trade have combined to fuel an increasing demand to build new ships – and to build them faster. Existing ships need to be upgraded to incorporate the latest defense and automation technologies and kept in an optimal state of repair to extend longevity and efficiency. Stealth, multi-mission capability, e-navigation, cleaner emissions, energy efficiency and modular ship design enhancements are high priorities for naval forces around the world. Pending vessel obsolescence, rival fleet expansion and unpredictable threats are converging to spur on the build-up, stimulating a global market expansion.

The drive to drastically improve both productivity and technological sophistication has intensified alongside international competition that wasn't a significant factor, just a few decades ago. This raises formidable challenges and opportunities for the industry. The

Trump Administration has ordered major increases in fleet size and promised to make defense spending more efficient. In reality, these widely praised goals belie even more astonishing numbers. The Congressional Budget Office reported in April that under current conditions, building up to a 355-ship fleet would cost \$26.6 billion per year for the next 30 years (2017 dollars), which is 60 percent more than the average annual spend over the past 30 years.

In order to meet these commercial and military needs on time and on budget, shipyard processes will have to be radically streamlined. To minimize bottlenecks and reduce redundancies, they must move from sequential paper-based steps to automated parallel processes. To take operations to new levels of productivity, quality and integration, shipyards will have to modernize the entire enterprise by leveraging digital technologies and smart manufacturing innovations.

Digital Transformation and Integration

The model based enterprise (MBE) approach is transforming highly engineered, discrete manufacturing and is the core framework driving the evolution of smart manufacturing. This approach leverages 3D models from design through MRO. Several technology innovations have converged to enable the integration, automation, and analytics advances that are moving the theoretical concept of MBE into real-world practice in factories, aircraft hangars and shipyards around the world. The IIoT of embedded sensors and diagnostic connectivity on assets and components, 3D illustrated work packages, robotics and UAVs, augmented reality for guided production and repair, integrated manufacturing management platforms (powerful combinations of PLM, ERP, MES), and advanced machine learning capabilities — all these innovations and more are vital to enabling a new era of shipbuilding.

Complexity is obviously a central challenge when building something like an aircraft carrier, submarine, or super large containership. The complexity of far-flung supply networks and hundreds of sub-assemblies adds another layer. The life-or-death criticality of accuracy, quality, and cyber security leaves no room for error and leads to exacting and burdensome regulations and inspection requirements.

To answer these challenges and more, shipbuilders need to adopt the MBE approach, and leverage the “single version of the truth” represented by the Digital Thread. The Digital Thread represents the sum of all data digitally linked to form a single, contiguous definition of all value-added decisions made during an asset’s (or component’s) manufacturing journey from design to obsolescence. The Digital Thread includes the 3D definition of a product, its configuration and specifications, all manufacturing and repair processes, logistics and operational support. It ensures that design, engineering, manufacturing, suppliers and change and quality management all work in concert.

Emerging Innovations

With the Digital Thread (and it’s corollary, the Digital Twin; a comprehensive digital replica and record of a particular ship or submarine), shipbuilders gain greater control, agility and insight. Data is entered only once and available to all associated stakeholders and processes; digital handover is structured and revision controlled; and downstream processes and problem-solving are fully integrated.

As more industries (notably Aerospace and Defense) leverage IT platforms that enable the MBE by integrating PLM, ERP and MES solutions with data-driven innovations like connected sensors and diagnostics, UAV inspection drones, and [advanced guidance systems](#) for build and repair, transformative advantages emerge.

Improved asset utilization, process standardization, closed [loop quality management](#), reduced TCO for IT components, optimized employee competency and productivity, and compressed launch times are among the benefits being realized through the continuous performance feedback and real-time intelligence made possible by smart manufacturing innovations. These improvements, and many more, are a direct answer to the daunting and complex challenges faced by a shipbuilding industry entering a new era of demand and competition.

Of course, digital transformation of this magnitude represents a challenge in itself. Implementing the MBE approach, integrating technology platforms across fragmented supply chains, and automating production and inspection processes is “extra” work on top of the already daunting mandate to deliver ships on time and on budget. The military procurement system is slow, SOPs evolve slowly, and shipbuilding culture is notoriously resistant to change — “if it isn’t broken, don’t mess with it.” Moving to “fix it, even if it doesn’t seem broken, or you won’t make your deadline a decade from now” is a tough sell in an entrenched industry. Strict regulations, deadly serious security concerns, and widespread technical skills shortages are major roadblocks that will have to be addressed through coordinated initiatives across government and industry organizations.

MRO Can Lead the Way

In the A&D sector, MRO operations have lead the way to digital transformation. Shipbuilders could follow the same trajectory. Efficiency, reliability, and performance intelligence improvements in MRO operations will significantly impact fleet readiness, a reality that is reflected in increased funding for ship maintenance depots by U.S. and foreign governments. The use of connected sensor data to optimize routine maintenance scheduling, prevent problems before they occur, and provide vital performance feedback to every stage of design and production has obvious merits and is being widely adopted. Inspection drones can operate more safely and flexibly than human inspectors, sending visual and measurement data directly to digital systems and detecting microscopic material defects that can’t be seen by the human eye.

For example, augmented reality and natural language systems promise a step-change in the accuracy and efficiency of repair work; 3D digital overlays work in conjunction with “chat bots”, smart glasses and [mobile devices](#) to provide advanced guidance to mechanics. These systems will also help address increased retraining needs and pervasive skills shortages. Digital thread and digital twin data repositories will replace the cumbersome and error-prone practice of performing inspections, maintenance and repair by referring to complicated (and sometimes conflicting or outdated) sets of manuals.

Setting a Course for the Future

While many of these innovations sound futuristic, digital shipyards are already being funded and developed in many countries, including the U.S. (Newport News), Australia

(the \$89 billion Future Frigates initiative), South Korea (Geoje shipyard and Samsung Heavy Industries), Brazil (EAS shipyard) and India (Cochin Shipyard Ltd).

These leading edge programs underscore the enormity of investment and vision required. In addition to financial backing from governments and major industry players, an international push for interoperability standards and workforce training is essential. Shipbuilding enterprises must dedicate themselves to digital transformation by leading from the top; C-level and managerial support for innovative processes and pilot projects are vital to real-world implementation and practice. Above all, digital integration has to be prioritized by linking processes and systems and developing collaborative workflows. Disciplined change management will be a key capability at every step along the way.

The next decade will be characterized by immense challenge and opportunity for the shipbuilding industry. Ramping up new ship production and boosting MRO efficiency will only be possible through strategic and comprehensive adoption of the MBE model and the emerging automation and analytics innovations that are bringing it to fruition. Driven by the power of enterprise-wide digital transformation, shipbuilders are set to embark on the journey of a lifetime.