Maritime 4.0

Set to change the face of defense and commercial shipbuilding forever



How enterprise software is essential to cut through complexity as organizations move to the truly digital shipyard

Four critical areas for digital shipbuilding success:

The defense and commercial shipbuilding sectors are poised for "Maritime 4.0." The groundwork has been laid by key Industry 4.0 technologies and widescale digital transformation within naval forces, but making this digital shift involves grappling with a far greater complexity of projects, components, and data on a scale way beyond traditional Industry 4.0 manufacturing.

The scale of the transition is far beyond the deployment of techniques used to build some of the defense sector's most complex assets such as next-generation fighter aircraft and unmanned systems. It is because of the size of their operations and complexity of the assets they build and operate, that many ship manufacturers and naval organizations are now moving towards an integrated data environment (IDE).

An IDE is essential to enable organizations to fully capitalize on the efficiency, visibility, security, and sustainability benefits of Maritime 4.0 in an increasingly digitized sector.

The convergence of the digital shipyard and Maritime 4.0 knows few boundaries

Maritime 4.0 and the digital shipyard encompass designing, building, maintaining ships and submarines as well as using technology to monitor and maintain the associated infrastructure. It's a huge estate to manage.

A digital shipyard begins in the design stage of a build. Sea vessels are large and complex, with design models and physical mock-ups costing a lot and proving difficult to modify. Here, by combining the Internet of Things (IoT) with cyber-physical systems (CPS), shipbuilders can produce virtual models in a fraction of the time. These are used to test, modify, and improve designs before physical production commences. The benefits at this stage are enormous, especially the cost savings from finding and correcting errors as early in the design process as possible.

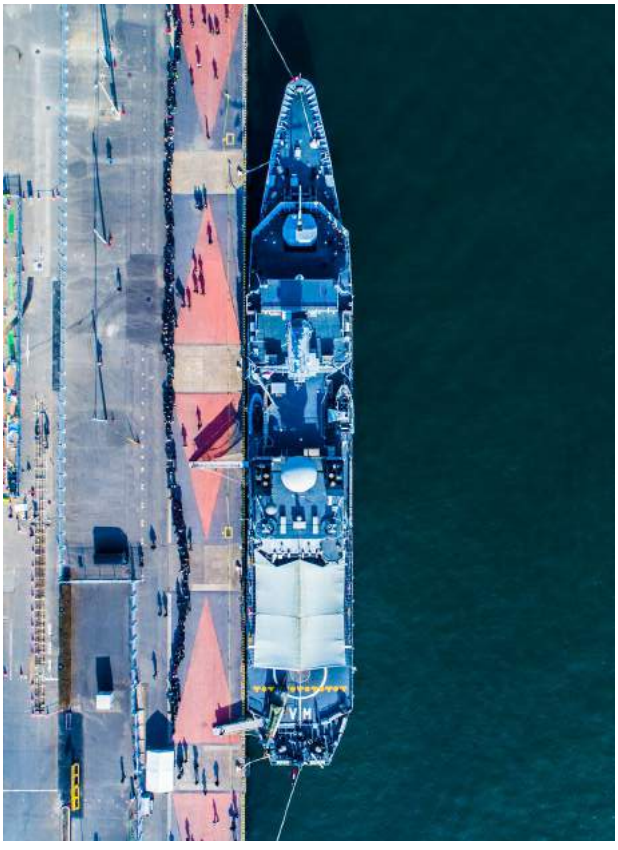
Manufacturing processes themselves have a huge amount to gain from Maritime 4.0. Enhanced integration between systems and greater use of real-time data to drive decision-making throughout shipbuilding organizations will lead to better project time and cost control. It will also speed take-up of emerging technologies such as augmented reality and robotics. These can be embedded into supporting software to modernize and automate current production and operation capabilities at the shipyard.

But Maritime 4.0's remit is far and wide. Even after a ship or submarine has been launched, digital shipyards can utilize the Maritime 4.0 capabilities of CPS and IoT to evolve shipyards' support for ships between visits to the dockyard. The sensors and monitoring systems deployed by CPS can communicate enormous quantities of data to an IoT device, providing an enhanced capacity for predicting and planning future maintenance. This greatly reduces operational downtime. The collected data can be shared with other IoT devices in an industrial environment, collectively called the Industrial IoT, or IIoT. Having a connected shipyard can reduce maintenance costs through Predictive Maintenance–and include energy monitoring for improved efficiencies.

Industry-wide transformation – growth on the horizon

The rationale and motivation for the adoption of Maritime 4.0 is clearly explained by the Australian Industrial Transformation Institute: "In line with all other forms of manufacturing, Industry 4.0 offers a vision for transformation of the shipbuilding industry though the establishment of 'Digital Shipyards' and adoption of a 'Shipyard 4.0' agenda. It is important to acknowledge just how transformative such a vision is and how challenging it will be to realize. The motivations and drivers must be powerful and the benefits extensive. The idea of Digital Shipbuilding and importantly, sustainment, is propelled by the prospect of significant improvements in productivity, efficiency, reliability, quality and safety over the lifecycle of vessels."

Market projections support this growth trajectory. ResearchAndMarkets data sees the digital shipbuilding sector poised for explosive growth–from $591 million in 2019 to $2.7 billion by 2027, with an impressive 21.1% compound annual growth rate.



Maritime 4.0 – impacting all the essential touchpoints

According to a recent study in the Procedia Manufacturing industry journal published as part of the International Conference on Industry 4.0 and Smart Manufacturing, Maritime 4.0 impacts all the essential touchpoints of shipbuilding–from efficiency, to sustainability, to safety. It allows:

- The automated integration of real data into decision making
- The adoption and implementation of connected technologies for design, production, and operation
- Reduction of vessel environmental impact, related to production, operation, disposal (including emissions, underwater noise, and material utilization)
- Affordable and sustainable operation
- Reduction of risk, increasing safety and security

It is essential that shipbuilders themselves prioritize digital advancements. The digital oversight of maritime and naval assets begins not at sea, but right at the beginning of a ship's lifecycle–in the design process and at the manufacturing stage.

Enterprise software and Maritime 4.0 are intrinsically linked

Success or failure of Maritime 4.0 implementations depends on addressing four critical areas. First, implementations must cope with a breadth and depth of complexity that Industry 4.0 never encountered. This means that secondly, technology implementation must not be piecemeal but part of a much wider integrated environment. Thirdly, all implementations must establish the highest possible security within this digital thread–and finally, no implementation can ignore the need to build in sustainability.

In all four of these areas, enterprise software has a critical enabling role. The true potential for both naval and commercial vessels to be commissioned more rapidly, operate more reliably and cost less over their lifecycle will depend on shipbuilders' ability to drive these Maritime 4.0 principles, processes and technologies into multiple areas of their operations.

Given such complexity and project size and scope, powerful maritime Enterprise Resource Planning (ERP) software is essential to achieve this, delivering improved operational control, project cost & time management, and enabling shipyards to create vessels that conform to environmental mandates.

1. Driving technologies – the catalyst for digital change on and offshore

Naturally, the transformational technologies that are an essential part of Industry 4.0, from AI and machine-learning to 3D printing and digital twins, will play a defining role in Maritime 4.0 strategies. Taking advantage of these technologies requires digital transformation. In response, major naval forces have been taking steps to digitize in recent years.

In 2017 the UK Royal Navy announced Project NELSON, specifically designed to deliver digital transformation across the service. Likewise, the U.S. Navy has made great strides with its Naval Operational Business Logistics Enterprise (NOBLE). This program will eliminate over 700 database/application servers and consolidate over 23 currently isolated application systems– ultimately aiming to improve asset readiness both on a shore and material basis.

IFS is supporting the NOBLE project alongside Lockheed Martin, providing a software solution that combines Industry 4.0 technology such as artificial intelligence (AI), digital twin capabilities, and predictive analytics to anticipate and react to potential equipment failures before they happen, which will contribute to the enhanced support of maintenance, supply logistics, real-time fleet management, and other business functions for more than 200,000 sailors.

An Integrated Data Environment (IDE) is essential to cross the digital chasm

Now shipbuilders themselves must cross the digital chasm. The journey means putting in place a full Integrated Data Environment (IDE) requiring close collaboration from defense organizations, industry players and, of course, software providers. Operating without an IDE is like owning a piece of an old pirate treasure map– you've only got a portion of the story, there's plenty of room for misinterpretation, and you're unclear on next steps and the direction forward. It's clear that a fully digital shipyard needs to be underpinned by a software system that's agile enough to act on the increasing data volume and complexity to deliver quantifiable operational benefits.

When it comes to embracing transformative technology effectively and maximizing business value from assets, there is simply no substitute for sector-specific knowledge and integration expertise of an industry-specific enterprise software provider.



Take IFS customer, submarine and warship builder ASC, Australia's largest defense prime contractor. The company recently announced a company-wide digital transformation program. The comprehensive program will set the ground for the ASC transition to becoming a digital shipyard–facilitating more streamlined processes, enhanced integration between systems, and the expanded use of real-time data to drive optimized decision-making across the organization.

2. These are complex projects – further complicated by defense requirements

Difference in scale means difference in kind– manufacturing a sea vessel is more akin to managing a full-scale construction project than traditional manufacturing of parts and products. Consider the latest aircraft carriers currently in service and under construction such as the U.S. Navy Gerald R. Ford Class. The USS Gerald R. Ford (CVN 78) features a 78m-wide flight deck equipped with an electromagnetic aircraft launch system and advanced arresting gear. The carrier has the capacity to carry more than 75 aircraft and can accommodate 4,539 personnel.

Or consider a submarine build for additional complexity and expected lifecycle. The U.S. Navy operates 18 Ohio class nuclear-powered submarines, which are the biggest ever built for the U.S. Each sub has a submerged displacement of 18,750t and a length of 170m, a 13m beam, and a 10.8m draught–and its lifespan is over 40 years.

Manufacturing such complex, state-of-the-art assets requires supporting systems to effectively manage a full-scale construction project. Even commercial shipbuilding, though often less complex in design, comes with its own set of complexities–stringent import/export rules that vary widely by country, new requirements for infectious disease control, and high labor costs, just to name a few. Global competition is fierce and dominated by low-cost labor countries: More than 90% of global shipbuilding takes place in just three countries–China, South Korea, and Japan.

Enterprise software to balance complexity against project efficiency

Coming to grips with such complexity needs the support of an industry-specific and enterprise-breadth system that can manage such a unique manufacturing process. These kinds of complex builds take years to complete and must be managed extremely closely from a time and cost perspective. That means support for project management is critical.

It means managing supply chain processes to optimize scarce resources and parts that are delivered from multiple tier two and three manufacturers around the world. It means asset management functionality that can manage maintenance, repair, and overhaul (MRO) throughout the lifecycle of a vessel for those shipbuilders who continue to support asset management after initial construction and deployment.

Every shipbuilding project has two sides–financial management and operational work management. Shipbuilding ERP from IFS can encompass both a cost breakdown structure and a work breakdown structure to comprehensively track if a project is being delivered on time and on budget throughout its lifecycle.

Reporting on achievement of project deliverables takes on additional importance for shipbuilders completing work for defense organizations. They are part of government supply chains where there may be specific types of contract instruments including cost reimbursement and cost-plus contracts, which require rigorous tracking of a project or system.

3. Security at the core – increased digitization should not mean increased cyber vulnerability

The unique requirements of the defense ecosystem also apply to securing the shipbuilding digital thread generated by new technologies and a supporting IDE. Cybersecurity is just as pervasive in the shipbuilding sector as in any other, and even more so in the defense context. This is recognized by a recently published U.S. Congressional Research office paper on U.S. Navy force structure and shipbuilding plans:

"The digital thread from manned ships and autonomous platforms provides enormous opportunities for efficiencies in coordination, operation, maintenance, and cyber-resilience. However, this thread of critical data, including location, heading, and platform health, presents one of the biggest opportunities for cyber threats and cyber-attacks to Navy vessels. End-to-end cybersecurity and anti-tamper technology need to be addressed for a wide range of systems, from small man-portable autonomous vessels to systems as large as carrier groups."

Defense-specific security requirements need software to match

IFS expertise in supporting the defense sector gives it first-hand experience of how this sector is well ahead of the curve when it comes to cybersecurity best-practices. Shipbuilders servicing defense customers will need to ensure compliance with strict regulations. Regulatory-compliant software can be a key differentiator when bidding for ship manufacturing contracts.

To this end, enterprise software should be a strategic enabler for information assurance and cybersecurity. It should be designed from the ground up with security in mind and address risks and threats throughout all phases of the software development lifecycle.



With industry-leading security approaches for a client base that provides services to departments of defense across the globe, IFS acts as a fully compliant software partner, with secure applications to give shipbuilders peace of mind that that they are well-served to compete in an increasingly digital and cyber-aware defense ecosystem. IFS software can be deployed to an organization's own secure infrastructure or to an external secure cloud environment. IFS has partnered globally with Microsoft to provide IFS software on the MS Azure platform, including on the International Traffic in Arms Regulations (ITAR) compliant MS Azure Government environment within the U.S., which is also fully compliant with DoD Impact Level 4, CMMC 2.0, and DFARS 7012 at the GCC High level.

Should on-premise installation be desired, IFS supports its clients with implementation best practices for secure operation of its solutions, including supporting the development of Security Technical Implementation Guides (STIG), as required for some programs.

4. Sustainable manufacturing – measuring the sustainability impact of shipbuilding

Maritime sustainability has been a huge focus in recent years–and Maritime 4.0 will of course positively impact sustainability. The International Maritime Organization IMO has been spearheading an industry-wide effort to accelerate a major fuel and technology transition in response to the climate challenge–its goal is to reduce annual CO2 emissions by at least 50% by 2050. At the same time, defense forces are also looking at greener operations for newly built ships. The UK Royal Navy has recently implemented a catalytic reduction system in two of its newest warships that reduces emissions of nitrogen oxide by up to 97%.

One recent academic paper from the Department of Mechanical Engineering and Industrial Design at Cadiz University highlighted 12 key Industry 4.0 technologies as most impactful to make the shipbuilding supply chain more sustainable–including additive manufacturing, big data analytics, augmented reality, and more. In all of this, supporting enterprise software has an essential role to play in this green maritime future.

The road to the digital shipyard of the future will pass through sustainability

Good supply chain optimization can help manage composite materials and new manufacturing techniques that will drastically reduce unnecessary emissions.

Again, IDE and supporting enterprise software have a key role to play here. IFS recognizes the need and pressures for many customers to monitor, manage, and report on their own sustainability goals and commitments. In response, IFS has recently developed and launched a Sustainability Module designed to enable customers to track sustainability progress in short-, medium- and long-term goals, in conjunction with tracking business goals. When shipbuilding data is funnelled through one system, enterprise software can actually assign a sustainability score to every process across a shipbuilding organization's value chain. IFS will donate a share of the license revenue generated by the module to sustainability causes.

IFS has proven defense and commercial maritime ERP experience and a customer base to match

Given the sheer size and complexity of Maritime 4.0 projects, ERP systems that lack industry-specificity often require heavy customization to even stand up and function initially, let alone deal with changes to manufacturing processes or business models going forward. Research from Technology Evaluation Centers (TEC) shows 50% of ERP projects fail and that implementation can commonly take 30% longer than anticipated.



TEC explains “ERP failure comes from selecting the wrong system for your needs, signing on with a vendor or partner that doesn’t understand your industry or business, and/or finding that a significant number of your employees don’t like or engage well with the new system. Failure can be seen in major budget overruns, never-ending implementations, half-used systems, and poor return on investment (ROI).”

At every stage of these four essential areas that go into building a successful Maritime 4.0 project, IFS has proven experience. Additionally, IFS enterprise software is helping cut through complexity for many other defense and commercial shipbuilding organizations. Babcock International leverages IFS as a full ERP system across multiple business units. Building, managing, and maintaining highly complex critical assets as part of multiple, high-value projects, Babcock has completed over 4,600 projects for its Energy and Marine Division with the support of IFS software.

Dutch maritime specialist Royal IHC managed to roll out a global ERP backbone based on IFS across 37 operating units worldwide in just 2½ years. Royal IHC is clear on what it wants to achieve with IFS software and through their plans for a single ERP system, all part of what it describes as “One IHC”, which embraces three elements: one set of master data, one set of procedures, and one set of processes across the entire organization.

Setting sail for the digital shipyard

Commercial and defense shipbuilding is leaving behind traditional processes and embracing a digital future, brought about by Maritime 4.0. Key to crossing this digital chasm will be leveraging new technologies, keeping increasingly complex projects on time and on budget, securing a digital supply chain ecosystem and maintaining sustainable operations. Adopting an Integrated Data Environment with industry-specific ERP at its foundation will be the cornerstone of the digital shipyard of the future.

About IFS

IFS develops and delivers enterprise software for companies around the world who manufacture and distribute goods, build and maintain assets, and manage service-focused operations. Within our single platform, our industry specific products are innately connected to a single data model and use embedded digital innovation so that our customers can be their best when it really matters to their customers– at the Moment of Service™.

The industry expertise of our people and of our growing ecosystem, together with a commitment to deliver value at every single step, has made IFS a recognized leader and the most recommended supplier in our sector. Our team of 4,500 employees every day live our values of agility, trustworthiness and collaboration in how we support our 10,000+ customers.

Learn more about how our enterprise software solutions can help your business today at ifs.com

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Production: IFS, April 2022.