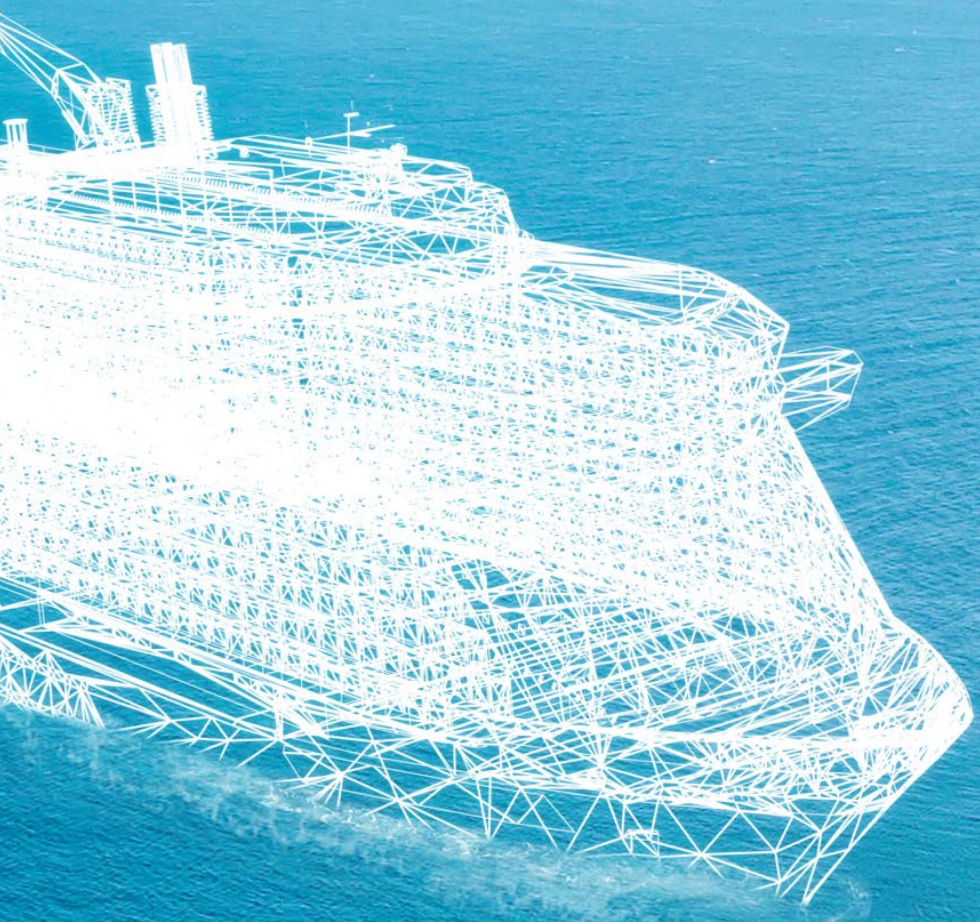
PROSTEP
integrate the future

WHITEPAPER

THE POTENTIAL FOR DIGITALIZATION IN THE SHIPBUILDING INDUSTRY

The digital transformation gives European shipyards, their suppliers and partners the opportunity to maintain and expand their leadership in international competition. To do this, however, information flows and business processes need to be made even more efficient using digital technologies. The aim of digitalization in shipbuilding is to develop a product model that can be used throughout all phases of the ship's life cycle, from planning through construction to operation.

This PROSTEP white paper describes possible starting points for a sustainable digitalization offensive in the shipbuilding industry.



Content

Management Summary

European shipbuilders are currently swimming on a wave of success that is carrying them across some shallows. Also about the shallows of an incomplete digitalization, which although allowing a comparably high degree of industrialization of ship production with the participation of a multitude of suppliers, is still by far not as consistent as it could be. To secure their leadership in international competition, European shipyards, their suppliers and partners must therefore continue to drive forward the digitalization of their business processes. Especially at the interface between development and production, but also during the exchange with partners and suppliers and the transfer of ship documentation to the owners or operators, digital information flows are repeatedly interrupted. Bringing the information together in a digital product model that accompanies the entire ship life cycle, including the operating phase, as a digital master and later as digital twins, not only promises enormous rationalization potential in the processes, but also opens up the opportunity for companies to offer new value-added services. The digital master includes not only the mechanical product models, but also electrics/electronics and software. Ships are increasingly becoming cyber-physical systems in which things such as propulsion control, dynamic positioning or ship management are functionally determined by software and can be changed during operating life by updates.

This PROSTEP white paper describes the challenges faced by shipbuilding companies in digitalizing their information flows and processes and points out possible solutions for a sustainable digitalization offensive.

The strength(s) of European shipbuilding

While ship newbuilding has been declining worldwide for more than ten years and two thirds of all shipyards have disappeared from the scene since 2009 alone, most European shipyards are doing well. They are currently receiving more orders than they can process and are thus expanding their order backlog. This also applies to German shipyards, as a recent analysis by the Association for Shipbuilding and Marine Technology (VSM) shows. The success of European shipbuilding is not least the result of the concentration on the construction of complex products such as cruise ships, whose demand continues to boom, and in the case of Germany is also supported by a very competitive shipbuilding and offshore suppler industry, which is the world leader in terms of production and exports with a sales volume of 11.1 billion euros (2016).

The successes of European shipbuilding are arousing desires especially in the Far East, which is leading to intense competitive pressure. Shipbuilders can only assert themselves in global competition if they succeed in defending their leading edge in know-how in the field of highly industrialized production of ships and still not evade cooperation with the growth markets. The use of digital technologies plays a key role – with respect to both, the efficiency of internal processes between development, procurement, production, etc., and an efficient integration of the supply chain, which contributes more than 75 percent to value creation in cruise ship construction. The ability to manage the entire process logistically as general contractor and thus ensure on-time delivery of the ships is a key success factor and competitive advantage for European shipbuilders.

European shipyards and suppliers started digitalizing their business processes earlier than their competitors in the Far East, but they are far from being in a safe harbor. And their lead is melting. That is why they need to think about where and how they are moving forward with their digitalization. As an independent PLM consulting and software development company, PROSTEP AG supports companies in the shipbuilding industry in the digital transformation and implementation of Industry 4.0 initiatives. Over the last 10 years, the company has developed into a recognized partner for the maritime industry and today counts renowned companies such as DNV GL, Lürssen Group, Meyer Group or thyssenkrupp Marine Systems (tk MS) among its customers.

The shallows of digitalization

In ship development, vast amounts of digital information is generated with different IT systems. The great challenge shipyards and their suppliers are facing is the efficient provision and consistent use of this information in all phases of the ship's life cycle, from development through production to operations. To achieve this, the integration of the heterogeneous system landscapes in the companies and their supply chains must be improved. Especially the exchange between mechanical CAD systems (such as NX, CATIA) and shipbuilding specific applications like AVEVA Marine, CADMATIC or NAPA is a highly complex topic due to the different system approaches.
In the mechanical CAD world, parts and assemblies are primarily created and saved as explicit surface or volume models. The special CAD applications in shipbuilding, on the other hand, primarily record the way how components are created and how they are related to other parts, so that part geometry can be generated when needed. Therefore we speak of intent-driven CAD systems. Their main advantage, playing an important role in the early days of computerization, especially in shipbuilding, is the significantly lower demand for storage capacity and required bandwidth between database and application. Without this approach, it would not have been possible to handle hundreds of thousands of parts and components that make up a ship efficiently. Both system worlds have converged functionally over the years, but the internal data models are still so different that conversion requires special interfaces and substantial know-how.

The different philosophies not only complicate the horizontal data exchange between mechanical and intent-driven CAD systems and the provision of data into applications for production preparation and production control, but also the vertical integration with the enterprise PDM and ERP applications. These applications are the basis for consistent management of data and change statuses throughout the entire ship life cycle. In practice, these are often located in different file-based or database silos that are hardly integrated with each other. As a result, the digital flow of information within companies and between shipyards, suppliers and other exchange partners such as classification societies or shipowners is often difficult due to format and even media breaks. Under such circumstances, digital traceability is virtually impossible to guarantee.

In the absence of a continuous and consistent digital ship model concept, the exchange of digital information between the departments and companies is usually still drawing-based and often even paper-based. Coordination during development, production and assembly therefore involves a great deal of organizational effort. With the delivery of the ship, the owners receive a huge stack of paper documentation, which they have to process manually and import into their IT systems to support operations or maintenance. Trace back of changes to ships during their operational life to the digital model implies lots of effort or is not possible at all.

The aim of digitalization in shipbuilding - as in other industries - is to develop a digital product model that reflects the exact construction status of the ship throughout its entire life. This digital master, from which digital twins of the delivered product are derived later, is to a certain extent the driver for digital transformation. It not only supports the optimization of existing business processes, but also enables the development of new value-added services and service-oriented business models in combination with the information collected during operations.

Approaches in a digitalization initiative

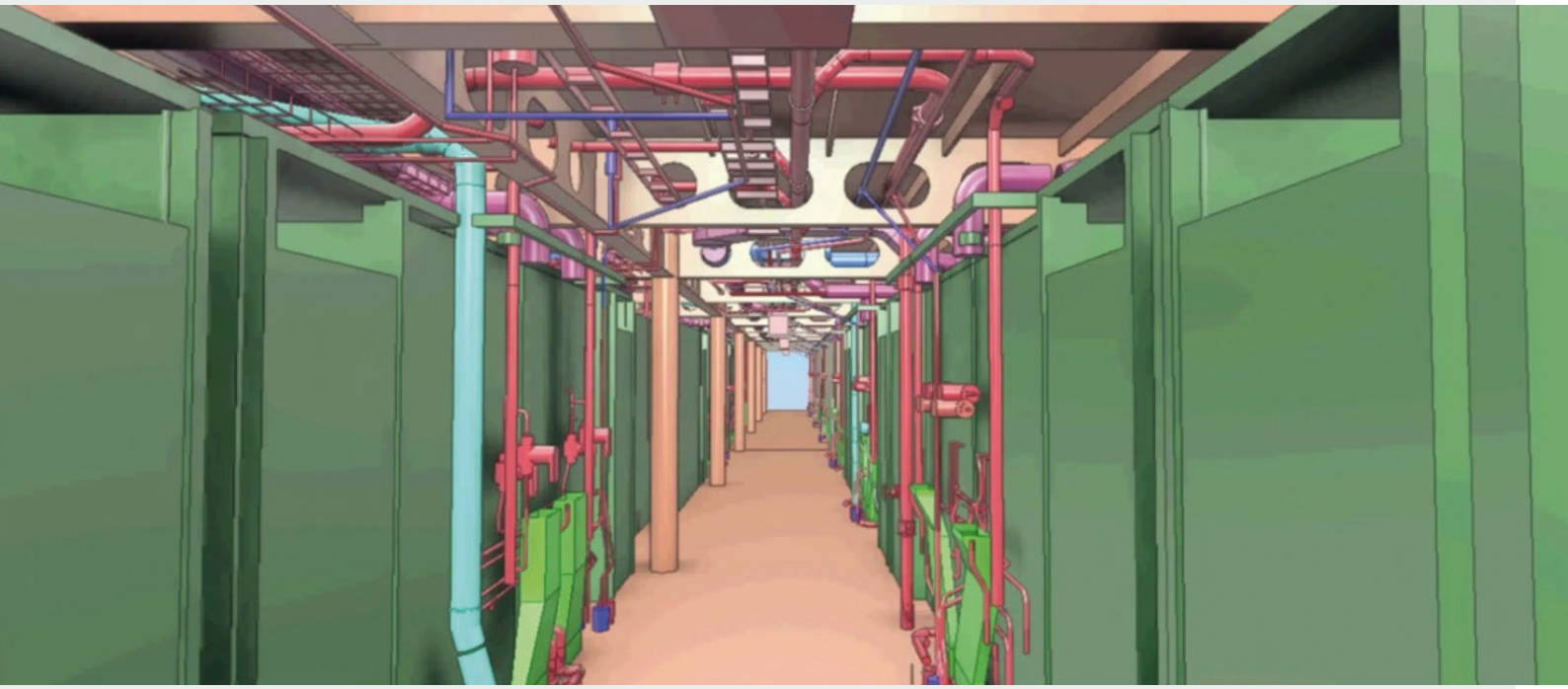
European shipbuilders are aware of the importance of digitalization to secure their competitiveness but are often facing the question where to start with their digitalization initiative in order to achieve rapid benefits. In PROSTEP's understanding based on numerous projects in a wide variety of discrete manufacturing industries, there are three aspects in a sustainable digitalization initiative:

a. The creation of a digital platform
b. The ensuring of digital continuity
c. The digitalization of business processes

The creation of a digital platform is a necessary but not sufficient prerequisite for the continuous digitalization of business processes and information flows. As important is the careful investigation of existing redundancies, bottlenecks and media breaks. Information flows and processes can be, but do not have to be identical, because information may come from another process or may be required as input in again different subsequent processes. However, a consistency of information is the basis for the digitization of processes. At the same time, this ensures traceability making it possible to track changes in the digital ship model over time and eventually enrich it with information from the ship's operational life.

a. The creation of a digital platform

The vertical and horizontal integration of the various IT systems is the basis for an efficient flow of information and its consistency. The development and maintenance of point-to-point interfaces is time-consuming and costly thereby tending to limit the update capability of the entire setup. As an alternative, PROSTEP recommends the implementation of an information hub enabling the relevant IT systems to be connected quickly and ensuring consistency of product information without having to put it redundantly to a central location. Based on numerous customer projects, the company has developed a solution to integrate shipbuilding specific tools to the common mechanical CAD and PDM/PLM systems. The solution forms the heart of a digital platform that supports Configuration Lifecycle Management (CLM) across system boundaries and enables collaboration across companies. OpenCLM makes the changes of digital master and digital twin traceable along the time axis without being a giant sink for redundant data.



The digital platform not only enables the management of information relevant to shipbuilding with common PDM/PLM systems such as ARAS, ENOVIA or Teamcenter, but also the exchange between different CAD systems. An essential component of the solution is the functionality for transferring models from mechanical to intent-driven CAD systems- and vice versa. The functionality was used on a large scale in the conversion of CATIA models from Meyer Werft into AVEVA Marine and CADMATIC data for the Finnish sister shipyard in Turku. The solution allows Meyer Group to develop different cruise ships based on a common platform, while retaining the different CAD tools of both shipyards. Meyer has now decided to use CATIA V6 and CADMATIC in parallel at all locations as part of their multi-CAD strategy. With its integration solution, PROSTEP makes a significant contribution to the coexistence of these two CAD system environments.

The modules for integration and conversion contain a great amount of system and data model know-how that is required to correctly map the data structures using common standards such as IFC or STEP. IFC (Industry Foundation Classes) is an open standard to describe building models in civil engineering and construction. However, it is also becoming increasingly popular in shipbuilding because the requirements for data exchange in the field of outfitting are quite close to those for buildings. Complex ship outfitting information can be exchanged via IFC without major loss of semantics.

b. Ensuring digital continuity

The creation of a digital platform does not automatically result in better continuity of the digital information. It is also necessary to analyze the existing information flow and determine which information objects are required by which process and who is the respective supplier of them. This is of particular importance at places where media breaks are currently slowing down or preventing the flow. Based on the value stream analysis method, PROSTEP uses a standardized approach to evaluate information flows in companies to uncover redundancies, bottlenecks and interruptions in the information flow more efficiently without having to carry out a complex process analysis. The aim is to improve the consistency of digital information along the entire value creation chain. Improvement measures can be derived directly from the analysis results.

PROSTEP has developed best practices to improve the information flow from numerous customer projects in industries such as aerospace, automotive, energy and shipbuilding. The company enjoys the trust of its customers and gains deep insights into the processes and information structures. The experience gained is made available in a neutralized form for the benefit of all PROSTEP customers.

The basis to implement digital continuity are the standardized tools and functions for CAD conversion that are part of PROSTEP's digital platform described in paragraph a. ***The creation of a digital platform***. They support the efficient implementation of measures to improve digital information flows in shipbuilding PLM landscapes.

c. The digitalization of business processes

Based on the results of the information flow analysis, solutions for the digitalization of business processes can be developed and implemented based on the digital platform. Using technologies such as 3D PDF or browser-based 3D visualization, PROSTEP has developed solutions for various business processes categories, such as drawing-less production, 3D assembly planning or electronic spare part catalogs, which are also suitable for shipbuilding. The company is currently working with Meyer Werft to remove the barriers between development and production or production preparation by providing the 3D models from development together with the business logic for planning the construction sequences, quality assurance, and other subsequent processes in 3D PDF containers. This significantly reduces the time and effort required to provide the production documents.

Class Approval is also traditionally a paper-based process for which the shipyards must generate a huge number of large-format drawings and send them to the classification societies for approval. In the meantime, there are first attempts to digitalize this process with the help of 3D PDF technology. To speed up the classification process, Meyer Werft will send DNV GL 3D models with associated metadata in 3D PDF containers in addition to the 2D drawings, so that the inspectors can visualize the models with Adobe Reader and annotate them. The long-term goal of the "3D Approval" project is to completely replace with 2D drawings.

From the digital ship model to the Digital Twin

Today, frictional losses primarily occur in the communication between shipyard and shipping company or ship operator. A lot of information relevant to operation and maintenance is passed on as documents - often on paper- so that it must be post-processed manually on the operator's side. However, this is less a technical issue than a problem of trust: technologies such as 3D PDF offer the possibility of making information available to shipping companies in a way that can be processed mechanically or even automatically. This applies not only to the geometry models but also to non-geometric information like structures, relationships, and attribute values such as PMI (Product Manufacturing Information).

Among operators there is a growing demand for a provision of digital ship information. Shipyards however fear that too much of their intellectual property will be disclosed and could be misused. They therefore need a solution that, following the need-to-know principle, only transfers the information in a quality and detail that the operator really needs and that also allows to protect this information with appropriate mechanisms against tampering and misuse. PROSTEP has the know-how about processes and technology required to build such solutions allowing to provide tailored information appropriately protected, thus ensuring safeguarded intellectual property.

The provision of ship documentation in digital form offers advantages to all stakeholders involved in development, production, operation and use of ships:

- It enables shipping companies to map the current condition of their ships in digital twins and to feed these twins with operational information in order to maintain their ships more efficiently.
- Cruise operators can use the Digital Twins to offer passengers a new customer experience, e.g. in the form of a virtual tour through the ships.
- The classification societies that regularly inspect the ships can offer operators new value-added services such as system simulations or predictive maintenance based on digital twins.
- For shipyards, the digital provision of ship documentation can be a unique selling point and opens the possibility to use the operational information from the Digital Twins for the optimization of the next ship generation. Of course, only if the operators are prepared to make the information available to them.

Shipbuilders, shipping companies and classification societies should therefore agree on how they can jointly meet the challenges of digitalization to the benefit of all. The technical solutions are now available and pilot projects have provided the technical proof of concept.

Conclusion

Maritime companies must continue to push ahead with their digitalization in order to maintain their leading position in global competition. Due to the inherently heterogeneous and only incompletely integrated IT system landscapes, digital information flows across system boundaries are characterized today by numerous breaks, which make it difficult to consistently use the digital information assets. The creation of a digital platform, ensuring consistency of digital information and the digitalization of processes are the most important aspects for a sustainable digitalization offensive. At the same time, they enable the transition of digital ship models to digital twins, which also support operation and maintenance of ships. With its PLM consulting and software development expertise, PROSTEP can support maritime companies in defining and implementing their digitalization strategy. However, the digital transformation of shipbuilding can only succeed if all parties involved- shipyards, suppliers, shipping companies and classification societies- understand digitalization as a coordinated approach that benefits all of them.

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Do you have any comments or questions?

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