DIGITAL INDUSTRIES SOFTWARE

The power of low code in ship design and engineering

Accelerate innovation and achieve more value from your IT landscape

Executive summary

For a shipyard to flourish in the midst of the complex forces and fluctuations of today's marketplace, your digital industry solution must accomplish two objectives. First, it must provide a way to leverage the wealth of capabilities found in disparate digital systems across your enterprise – systems that often were adopted to meet the needs of a particular domain within your company but that now must meet cross-domain needs. Second, your digital assets must provide rapid (if not instant) visibility and access to up-to-date resources across the value chain. The goal is to provide your team members with personalized user experiences (UXs), enabling them to easily access and comprehend the information they need to perform their jobs with the utmost efficiency – regardless of the source system. By executing this approach, you will achieve the speed and performance needed to gain and keep your competitive edge. The enabling technologies for this transformational solution are a low-code, multi-experience development platform coupled with the power and flexibility of a core, mission-critical enterprise product lifecycle management (PLM) system.

Digitalization and visibility are essential in today's shipyard

Shipyards today must manage an escalating pace of sustainable, interconnected, high-tech and cost-effective vessels – all while meeting demands for ever-shorter time to market. For your company to thrive in this complex environment, a transformational approach to ship design, engineering, manufacturing and operations is needed, one that begins with a robust product lifecycle management (PLM) solution.

Siemens Teamcenter PLM software can accelerate planning, development and delivery of innovative vessels. The leading choice in PLM, Teamcenter is the digital thread backbone that connects people across your value chain. You can automate and streamline product lifecycle processes with visibility for everyone to make innovative product decisions. By connecting and optimizing processes from initial design to decommissioning, Teamcenter brings together the digital twin of your ship and shipyard, enabling your team to analyze and predict performance before you invest in physical parts and production.

Teamcenter helps you make decisions based on up-to-date product information across departments and disciplines, even externally with customers, suppliers and partners. Teamcenter is easily accessible from a web browser, on any device, and within the design tools and office applications you use every day.

Rather than burdening your IT team with traditional, labor-intensive customized coding tasks to tailor PLM capabilities to your unique business processes, Teamcenter empowers them with simple configuration tools to deliver an adaptive PLM environment. By taking advantage of administrative tools to simplify IT management and maintenance, you can reduce your cost of ownership and focus your resources on the most important strategic business priorities for Teamcenter.

Thus, Teamcenter provides the digitalization and visibility needed for BOM and configuration management, change management, and global collaboration across multiple sites as well as with partners, suppliers and class societies. Beyond these PLM capabilities, Siemens offers tools that allow you to derive more value from your full IT landscape, especially through Mendix, the low-code, multi-experience development platform.

To gather the information and workflows for their specific responsibilities, engineering and manufacturing teams have probably become quite adept at manually navigating through multiple digital systems across your enterprise, including PLM. But searching through this increasingly complex IT landscape has become progressively more difficult and time-consuming. Manual navigation is becoming untenable for many companies, no matter how skilled teams are.

What if team members could instead quickly develop their own personalized applications and extensions to access everything they need, from anywhere in the IT ecosystem, all on one screen?

Low code extends the value of PLM to help shipyards maximize their IT investment

Siemens Teamcenter customers from every industry are beginning to capitalize on just such a set of composite capabilities with the power of Mendix:

- A German-based shipbuilder had challenges with data consistency and reliability, relying on a huge Excel file that was administered on a network drive for all site managers and contractors to access. The company needed a better system for issue management that would interface to its PLM system.

  The solution: The company leveraged the Mendix low code platform to quickly build an issue management app as a "single source of truth," replacing the Excel file and significantly improving data consistency and reliability. The team improved its collaboration and decreased the time spent every day just discussing the status of an issue. The app helped prevent frustrating system crashes and data loss.

Mercury Systems provides mission-critical technologies to the aerospace and defense (A&D) industry, such as radar systems and mission computing. Like many manufacturing organizations – including the marine industry – Mercury serves customers that have an IT landscape consisting of disparate digital systems, each originally deployed to support a particular domain within the organization but now needing to meet cross-domain requirements. Mercury is helping its customers create a digital thread to unify these systems including Teamcenter PLM but must do so while adhering to strict A&D security standards.

The solution: The Mendix low-code platform enables the company to support a cloud-native environment, provide robust security and governance features, and employ CAD visualization.

- Early in a new product development, a major task is to collect, review and manage critical information for a large volume of newly introduced parts. To efficiently accomplish this task, the project manager needs deep collaboration with various teams, automated workflows, data fidelity and control, and the right analytics. Of particular importance is collaboration with new suppliers at this early stage to help the company plan the quality steps required to implement product innovations and reengineering. This approach, known as plan for every part (PFEP), requires data from an extensive BOM, Teamcenter PLM, enterprise resource planning (ERP), and other sources.

  The solution: A highly adaptable low-code Mendix app enables the project manager to support data gathering and approval with an automated PFEP workflow and deep collaboration capabilities that leverage all information sources.

Part attributes can be validated against configurable objectives. The PFEP app also enables diversity in viewing a large, complex BOM with part status, and it provides analytics for reports and dashboards that enable the project manager to efficiently manage the plan behind every new part.

- During ship construction, performing an interim inclining test is a painstaking process that requires end-to-end inventories of the vessel in its current state. These inventories must include equipment or fittings yet to be installed, as well as construction equipment present that will be removed before the ship is complete.

  The solution: A Mendix low-code application connected to Teamcenter allows inspectors to indicate exactly what equipment is present on a 3D rendering. This gives much higher accuracy in pinpointing addition weights, leading to higher accuracy in center-of-gravity calculations. Inspectors have immediate feedback on whether a ship meets the 2% weight difference target. The app can work offline with no wi-fi network access required.

The advantages of low code application development to connect domains and systems, including PLM

Until recently, digital solutions to circumstances like the ones described above have required the expert services of frontend software developers, possibly on staff but often from a software vendor or a certified third-party integrator. Conventional coding by these specialists is costly not only in terms of financial expense but also in terms of development time. Coding is a labor-intensive process, especially when it involves multiple integrated systems that must tailor data and workflow representation to individual personas based on their responsibilities and needs.

Moreover, such coding must be performed by talent that is in short supply. Indeed, a global shortage of software developers, combined with considerable growth in demand for customized applications, means your requested applications may sit in the queue of a developer's job list – too long to truly benefit your end users. In the meantime, your constantly evolving business demands may render the application obsolete before it is even assembled.

Siemens Teamcenter customers have overcome these difficulties by bypassing frontend coding of personalized and extended applications through the Mendix low-code, multi-experience platform. Low-code application development is a visual, model-driven way to build and deploy software applications. It employs a drag-and-drop interface with the ability to add more complex programming as needed. Business users and professional developers of all skill levels can build apps that bring new functionality and interconnectivity to existing or new systems so they can continue to provide value.

The Mendix platform creates a business layer that non-IT specialists can wield as "citizen developers."

By abstracting the complexities of the underlying technologies and data infrastructure, the low-code platform enables data connectivity and process automation with workflow simplicity. The low-code platform's simple tools empower your workforce to quickly bring their ideas to realization.

To turn your product developers and engineers into low code citizen developers, and to enjoy new efficiencies and productivity, three elements are essential:

1. Digital support to enable collaboration across various IT domains that have historically been siloed: ERP, PLM, supply chain management (SCM), homegrown point solutions, and more.
2. Rapid customized and/or cross-domain application development to support timely change management.
3. The simple tools of a low-code, multi-experience platform to enable this agile collaboration and development.

This white paper explores the market and technological forces spurring this transformational approach to marine engineering, then describes the novel capabilities of low-code personalization and extension for our Teamcenter PLM solution. Your product and process initiatives, powered by the rich capabilities of Teamcenter and implemented on our Mendix low-code platform, promise to spark new business vitality both today and into the future.

The value of low code for design and engineering

The shortage of IT resources and growth of digital system personalization comprise the most direct drivers prompting manufacturers to implement low-code capabilities. The broader context of the manufacturing marketplace helps explain why a low-code platform is a such a suitable option for personalizing and extending your digital capabilities while keeping your core systems intact.

One aspect of this broader context is the phenomenon of digital technology convergence. Historically, digital systems have been developed and deployed to accelerate specific engineering, manufacturing or business functions in specific ways for specific applications. These systems typically have focused solely on one technological area: information processing and management (IT), product creation and engineering (ET), or the monitoring and control of production operations (OT). Today, the demand for cross-domain data and processes has blurred these distinctions and created a need to leverage capabilities from numerous disparate systems across the three technological areas.

Another part of the broader context driving low code application development is the rise of business technologists – employees who report outside of IT departments and create technology or analytics capabilities for work. Gartner reports that business technologists now make up 41% of all digital technologists. Another 49% are technology end users, leaving only 10% inside the IT department. Business technologists within a product development and engineering team are tech savvy, but they typically are not high-end software developers. A low-code platform makes it possible for these employees themselves to develop applications that personalize or extend core system capabilities.

https://www.gartner.com/webinar/4005892

Finally, manufacturing industries recognize the competitive advantage they might enjoy if they could create meaningful, open access to both the industry know-how and tribal knowledge of their employees and the massive data generated within their facilities and across their industries on a daily basis. Most companies have long appreciated the valuable firsthand knowledge their employees possess regarding detailed aspects of complex projects. They also see the potential for new business opportunities fueled by the data explosion they are experiencing – regulatory and sustainability data, supplier material and component data, manufacturing data, and customer use data.

Low code is a critical enabling technology for data capture and access to tribal knowledge, which can be leveraged for product innovations and improvements as well as process improvements and equipment upgrades. By providing democratized access to these untapped resources, low-code technology empowers your domain experts to participate in the creation of personalized applications, so that they can make better, faster decisions about business operations and innovation.

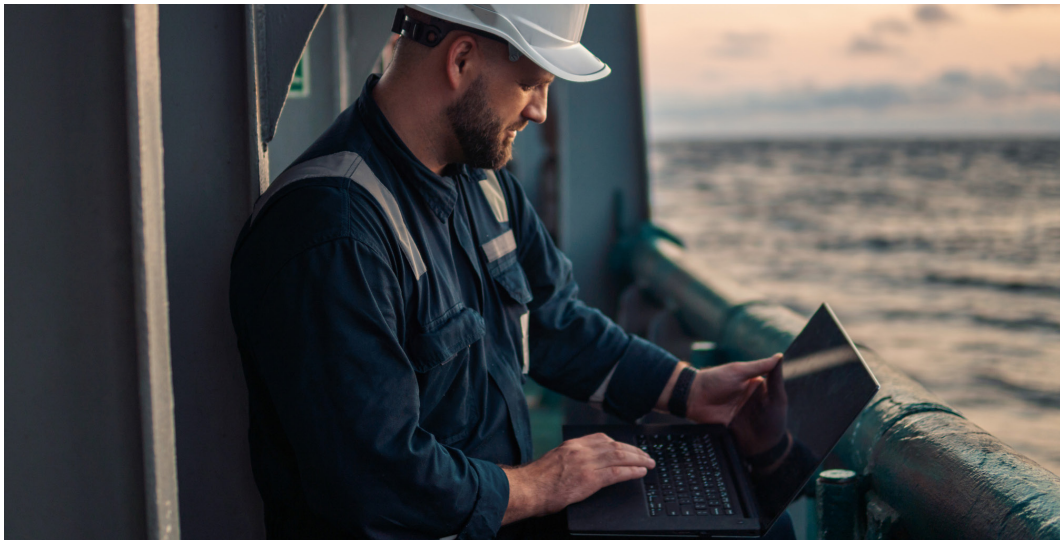
Consider as a case in point how project management could benefit if each project stakeholder had a home page and dashboard that included all – and only – the information needed to look holistically at their responsibilities within the project. To make realistic commitments to a particular project regarding timing and deliverables, what if a personalized app showed a buyer (for example):

- An overview of the parts on hand and the parts needed for all programs the buyer is serving
- Supplier RFQ status, current demands, and any issues being encountered
- Engineering drawings, critical characteristics, and special material requirements
- Target pricing
- Target dates
- Procurement status

Without a personalized app, the buyer would have to access information from multiple systems – PLM, MES, CAD, ERP, and possibly others – before developing a realistic delivery schedule and communicating it to the project manager. In reality, buyers typically do not have time for this labor-intensive data collection for each and every part associated with each and every program they buy for. Instead, the buyer often provides the manager with a commitment based on incomplete information and gut feel. With all the interdependencies within and among a manufacturer's projects, even one inaccuracy may cascade into major delays. Better, faster decisions based on comprehensive information from a personalized app is highly valuable, and a low-code platform makes rapid application development possible for each project stakeholder.

Innovative ideas for new or enhanced products generated by your team members also are more easily and quickly realized when direct access to data outside the core system is provided in a personalized user experience (UX). Imagine, for example, that you have just hired a materials scientist to investigate lighter weight materials. Imagine that new hire having immediate access to all pertinent information – in a digestible format – from the existing component's design files, materials database, testing data, production quality data, part weight, field testing data; and to all information on the material under consideration – a list of suppliers for material test coupons as well as prototype component fabrication, availability and cost of each, and data and forms needed to generate purchase orders. Instead of spending the first few weeks under your employ learning how to extract this information from multiple digital systems, your new researcher is able to promptly begin the work you are paying for. A low-code platform enables rapid development of this personalized app.

How low-code personalization and extension across disparate systems empowers design, engineering and manufacturing



A modern PLM like Teamcenter already has the powerful functionality and flexibility to drive your business into an innovation leadership position in your industry. To accelerate this competitive advantage, low-code personalization and extension tap your digital technology ecosystem's wealth of data and workflows across disparate digital systems. The resulting user experiences are custom fitted to the distinct needs of each team member, enabling them to develop and engineer your products with the utmost efficiency.

How can your teams gain the power of customization without the long delay of an IT backlog? First, low code helps eliminate the backlog itself by accelerating the work of your IT specialists. Depending on the availability and skill sets of your team members, your IT department will continue to head up numerous personalization and extension projects. Low-code tools enable them to collaborate more closely with domain experts and make changes much more quickly – often without assistance of the software vendor that may have previously been required. Additionally, the IT department will continue to oversee business-critical IT, ensuring that citizen developers work within established governance and security.

Second, some digital customization projects can be removed from the IT queue and handed off to these citizen developers. Business technologists within a design and engineering team, for example, typically are not high-end software developers. A low-code platform makes it possible to give these employees the responsibility to build customized apps for their teams. Additionally, the person seeking the customized app also may possess the requisite skills to assemble it with low-code tools. Ultimately, a low-code platform enables a transformed division of labor among IT, business technologists and the whole design and engineering team.

Building each customized app quickly and cost-effectively requires a few simple visual steps using low-code assembly tools:

- Templates are prepackaged frameworks that provide a starting point for the application. In a few simple visual steps, the template can be customized to address a specific need.
- Snippets and widgets are tools that simplify and speed up screen creation starting from a set of reusable building blocks. These are graphical components and modular pieces of the user experience created in Teamcenter and other enterprise systems.
- App services provide domain-specific sets of capabilities. For example, a 3D viewer app enables the user to view CAD drawings much like one would within the CAD program – rotating, zooming in, etc.
- Connectors enable users to reach specific data and pull it into a workflow or experience.

What is the scope of customization that these low-code tools enable? To this point, we have discussed personalization and extension together, but they constitute two different capabilities powered by low code. To create a personalized app for Teamcenter (connecting PLM with other enterprise systems), Mendix low-code capabilities are embedded within the enterprise development tool set, enriching the development experience. The user creates a tab within Teamcenter to launch a low-code template into which desired building blocks are assembled. Information from non-PLM sources is pulled into the Teamcenter PLM environment.

As a user employs these personalization tools, behind the scenes Mendix performs the data extraction and workflow generation processes for the customized user experience, processes that previously required high-level coding. Meantime, the enterprise system continues to host and power data-model definitions and business logics implementation.

The Plan for Every Part example described earlier represents a low-code extension of Teamcenter to connect multiple sources of information in a simple portal or composite application view. For these applications, users may start with a template on the low-code platform itself. They use connectors to pull data into their application from various digital systems. App services such as a 3D viewer provide desired functionality. As the building blocks are pulled into the composite app, users specify elements to include in a frontend dashboard. The user has now created a UX that supports interaction with all relevant information. Because the composite app interacts directly with the enterprise systems, users are always interacting with the live, up-to-date data from the enterprise backend thanks to standard Data protocol and REST APIs.

As a multi-experience platform, Mendix also supports the use of low-code assembly tools to create a mobile user experience. This UX can be tailored to the device a user employs and to that individual's specific responsibilities – service and maintenance, for example. Manufacturing companies may develop a new profit center through service planning and delivery for products after they are purchased and added to a customer's portfolio of physical assets. Service programs are supported by the service lifecycle management (SLM) capabilities within the manufacturer's PLM. The software manages the complex web of information associated with a finished product, reducing the cost and time needed to create and deliver critical service documentation while also improving the quality and efficacy of the information.

Low code and PLM is an opportunity for new, rapid advancements in the marine industry

Outpacing the competition has never been as challenging for shipbuilding companies as it is today. To thrive, you must respond by accelerating innovation, modernizing legacy systems, and increasing operational efficiency in a new digital environment. By employing a low-code platform to support design, engineering, and other critical functions within your shipyard ecosystem, you will gain the competitive upper hand as you tackle the unique demands of your industry and marketplace.

Importantly, the kinds of customization suggested in this white paper support what is known as a human-centric approach to digitalization: you develop solutions to business problems that make the user's work easier, rather than requiring users to manually negotiate their way around and through multiple digital systems. By listening to employees and co-developing solutions with them, we have found, companies experience greater enthusiasm and buy-in from their managers and engineers, accelerating product development and time to market.

Another important aspect of Mendix low code for Teamcenter is that it represents a great entry point for low-code technology. Manufacturing companies today are looking across their enterprises for ways that low-code solutions will accelerate digitalization. A low-code PLM initiative at your company may serve as a springboard to more widespread use of low-code technology, beginning with the efficiency and accelerated time to market you realize by applying low code to PLM-dependent processes. All in all, low-code technology represents a watershed opportunity to advance your agility, accelerate your innovation, and maximize your productivity for greater business vitality.

The rich and mature PLM functionalities of Teamcenter, combined with low code capabilites from Mendix, create the perfect landscape to support your entire team's individual information and functionality needs, in a way that is unrivaled in today's market.

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