SIEMENS

How low-code solutions help **accelerate industrial machinery's digital transformation**

In the past few years, manufacturing has been buffeted by a host of digitally oriented trends.

Consumer-driven customization, smart machines, hyperautomation and globalized competition pose a threat for any machine builder hampered by legacy processes. Traditional machine development methods can't meet these trends in the moment. To stay relevant, machine builders must adopt emerging technologies that actively respond to supply, demand and industry shifts.

One such technology is low-code and multi-experience application development, which machine builders can use to create applications that complement existing software services. A low-code platform empowers machine builders to assemble digital experiences that simplify customer and consumer engagement, automate workflows across IT, OT and ET, and accelerate the development of digital services across the value chain. It provides the speed, flexibility and resilience to digitally transform and continuously improve their practices for operational excellence.

Use this e-book to learn about:

- The four major trends driving change for machine builders
- Challenges that machine builders face as they futureproof their plans
- Industry solutions that can overcome challenges and drive growth
- What the future can look like with low-code solutions

Industry trends: What does the future hold?

Before machine builders can prepare their business for the future, they must understand the transformational trends at play within Industry 4.0. Specifically, manufacturing technologies have grown increasingly automated, with more and more companies adopting smart factories and digitally connected enterprise processes that leverage machine-to-machine communication and machine-to-enterprise data insights. Through this interconnected network, manufacturers can share information internally and leverage analytics that bridge organizational and operational gaps. As they adapt to Industry 4.0, companies inevitably create a cycle of driving and responding to the very trends shaping the engineering, manufacturing and service operations sectors.

Trend #1
Consumer-driven customization

Consumers expect more and more personalized products and customized services. To meet this demand, machine builders must create machines that support rapid and frequent changeovers. Fluctuating customer preferences add even more pressure to innovate quickly and compress delivery schedules. This requires a simplified customer and internal stakeholder engagement experience.

Take the example of a simple potato chip package. This single product has the potential for multiple alternates in size, shape, packages per box, recyclability, regionality and much more. Machine builders need adaptive technology that can produce the variations required to satisfy customer demand.

Trend #2
Smart machines

More and more each year, the Internet of Things (IoT) permeates the industrial machinery environment. Machines use sensors to capture and transmit data across the IoT network to existing software systems. Machine builders then act upon this data to enhance and predict machine performance. For example, a bottling machine's sensors capture how many bottles pass through an assembly in one hour. Machine builders use this data to determine whether to speed up or slow down the assembly, influencing total bottle output. Usage patterns also impact maintenance requirements, allowing machine builders to adopt predictive maintenance approaches.

Since the IoT can maximize efficiency, machine builders are quickly embracing IoT-enabled technology in their products and services. Machine builders are keen to keep up and take advantage of the petabytes of data that today's machinery generates, especially as smart machines pull in data from all areas of manufacturing and across the value chain. Machine builders are ready to harness the untapped intelligence coming from smart devices, but there is a steep learning curve involved.

For instance, electrical and control automation engineers must contend with huge increases in input/output (i/o) channels and new communication protocols such as 5G. They must also develop intelligent programming that provides more interactive and granular control over devices – feats that are all easier said than done. In sum, industrial IoT is a game-changing opportunity for machine builders eager to digitalize their operations for enhanced performance, but companies must adopt the appropriate tools to tame this complexity.

Trend #3
Hyperautomation

Another significant development is the rise of intelligent automation, a technology that continually improves automation in response to outcomes. Intelligent automation eliminates time-consuming menial work, giving machine builders more time to devote to projects. Unfortunately, intelligent automation is often isolated from wider company practices. The big challenge lies in scaling and connecting automated workflows across the business to create a hyper-automized organization.

Hyperautomation goes beyond machines and sensors and involves entire enterprise processes, converging IT and OT. It connects diverse technologies, tools and platforms from across the enterprise, automating workflows with smart machines and devices in the loop. Hyperautomation combines robotics with artificial intelligence (AI) and advanced machine learning (ML). AI determines which tasks can be automated, while ML improves a machine's analysis abilities.

Take the example of an RPA-enabled weaving machine. Onboard sensors monitor speed, vibration, noise and temperature and pass that data along for AI and ML analysis. This results in suggestions for improving the machine's performance and throughput.

Hyperautomation requires vast amounts of data – and the ability to analyze it. Adding sensors to machines will capture more data, but sensors alone cannot analyze it with the capacity and speed to capture automation and optimization opportunities. To fully utilize this collected information, machine builders need additional digital tools.

Trend #4
Global competition and new business models

The global field is crowded with flexible, agile startup companies that build on a foundation of machine learning, unencumbered by existing business processes and legacy customer engagements. Their ability to adapt and innovate within the competitive industrial machinery environment creates opportunities to capture new market share, posing a threat to traditional machineries.

New business models, such as equipment as a service or production line as a service, can yield new opportunities for legacy machine builders, but they require transitioning away from a product-centric methodology and embracing a service-centric approach. This requires smart machines that their builders can monitor. It also means using smart devices to augment service offerings and provide machine users the ability to add their own processes and data for additional value.

At the same time, machine builders can leverage these remote monitoring capabilities to execute service contacts, resolve issues, replace components before they break down and improve the quality of products built by the machines – all in coordination with connected enterprise systems to ensure proper billing.

Challenges for the future

The confluence of these four trends creates increasingly complex challenges for machine builders. Companies must adopt greater flexibility, reliability, productivity and connectivity to stay relevant in today's digitally centered world.

Challenge #1
Flexibility

In the past, machine builders would adjust settings by manually swapping mechanical components and tooling during changeovers. Production runs were longer and companies were unwilling to pay for automated options. Now, production runs last a few days – or even a few hours – and the unproductive time caused by manual changes becomes a significant hinderance.

Improving changeover speeds to meet customer requirements means creating machines that can quickly adapt to expanding options and capabilities. This versatility, of course, comes at the expense of greater design and manufacturing complexity.

Challenge #2
Reliability

Machines are becoming more complex as machine builders integrate diverse behaviors, electrification and software-driven functionality into one system. All these variables make it challenging to ensure machines consistently produce day in and day out. Machine builders need complex simulation solutions to drive reliability.

With design-level simulation, machine builders can replicate real-world environments to see how a machine would perform. They can also simulate machines made from different materials, sizes, actuator types and other factors, helping produce the most reliable machine. As a result, many machine shortcomings rarely make it to production. However, to further enforce machine reliability, machine builders can use machine performance stress-vibration tests. These tests combine closer tolerances, higher production rates and other multi-physics factors to identify performance engineering areas for improvement.

Challenge #3
Production speed and productivity

In addition to the increases in complexity and flexibility for today's machines, there is also a need for greater efficiency, defined as achieving maximum output with minimal expense. As productivity increases continue to dominate customer requirements, machine builders must validate machine reliability, speed and productivity over a wider range of operating scenarios. By simulating, testing and validating machine performance, machine builders can bring the fastest, most efficient machines to market.

Challenge #4
Connectivity

Connectivity makes flexibility, reliability and productivity possible. Customers recognize this fact and they increasingly demand connected machines that use industrial IoT, smart sensors, cloud analytics and AI/ML to adapt to their environments. In turn, machine builders need to offer connected, collaborative systems that accelerate information exchanges across the entire product lifecycle. They also need a way to upgrade and manage thousands of connected machines deployed in the field – all of which deliver huge volumes of data for analysis.

Connectivity isn't limited to the factory floor. Smart, connected manufacturing includes pivotal partnerships. Many machine builders are partnering with their customers to provide new, AI-enabled business models, including servitization subscriptions, production-as-a-service opportunities and other software-based solutions.

Where to focus change: Five industry solutions

Today’s industry challenges can be summarized in one word: complexity. From original equipment manufacturers (OEMs) to suppliers or even customers, everyone can become an industry disruptor by harnessing complexity into a key competitive advantage.

By tapping into the power of technology, anyone can master complexity to:

- Bring innovative machines to market faster than the competition
- Lower development, production and operating costs
- Create new business models
- Build differentiation through insights that are not easily duplicated
- Propel digital transformation by connecting existing systems with new technologies

Industry disruptors rethink nearly every aspect of their operations. Specifically, they seek new approaches for:

Advanced machine engineering

Smart manufacturing

Intelligent performance engineering

Service lifecycle and analytics

Digital parts production

Let's look at each industry solution next.

Advanced machine engineering

New demands for customization, smart machines and hyperautomation are changing the way machine builders engineer equipment and respond to global competition. Advanced machine engineering lets mechanical, automation and electrical departments work in parallel using a comprehensive digital twin. The digital twin is a virtual, visual representation of an entire organization's processes, metrics and data analysis; any changes made in this digital environment can translate to the physical environment.

Advanced machine engineering therefore brings multi-discipline machine development processes into a single environment to accelerate and validate automation code development. For example, Siemens Xcelerator is a comprehensive, integrated portfolio of software and services that supports machine builders with an integrated end-to-end product development process.

Low-code solutions for advanced machine engineering

By using a low-code platform such as Mendix – the low-code application platform that is part of Siemens Xcelerator – machine builders can create tailored product lifecycle management solutions to extend across existing software. Some examples include:

Product portfolio manager
Accelerate product launches with the support of stakeholder collaboration. Leverage ideas and suggestions from across the enterprise. Provide a rigorous qualification process to quantify expected value.

Product view 360
Connect Teamcenter, Simcenter, Opcenter, MindSphere and SAP using a single, easy-to-use application. Get a 360-degree view of products so users can execute specific processes, all from a single experience.

Customer portal
Enable self-service for clients and improve access to information. Enhance the customer experience with personalized portals that easily integrate with and extend back-end system functions.

NX reporting and analytics
Gain insight into data to oversee product development progress, explore product data and review product quality.

New materials introduction into machinery and components
Mendix PLM, ERP, LAB Connect lets users search and find data from multiple systems, making it easy to add, subtract or change materials across systems.

Intelligent performance engineering

Intelligent performance engineering automates the sharing of information between design teams, analysts, production test teams and service engineers to improve collaboration and reduce manual processes. Teams can efficiently evaluate the capabilities and limitations of machines and their product variations.

Simcenter, a key component within Xcelerator, is a flexible, open and scalable portfolio of predictive simulation and test applications. Simcenter helps companies implement the digital twin, gaining insight into the real-world performance of a product or process.

Low-code solutions for intelligent performance engineering

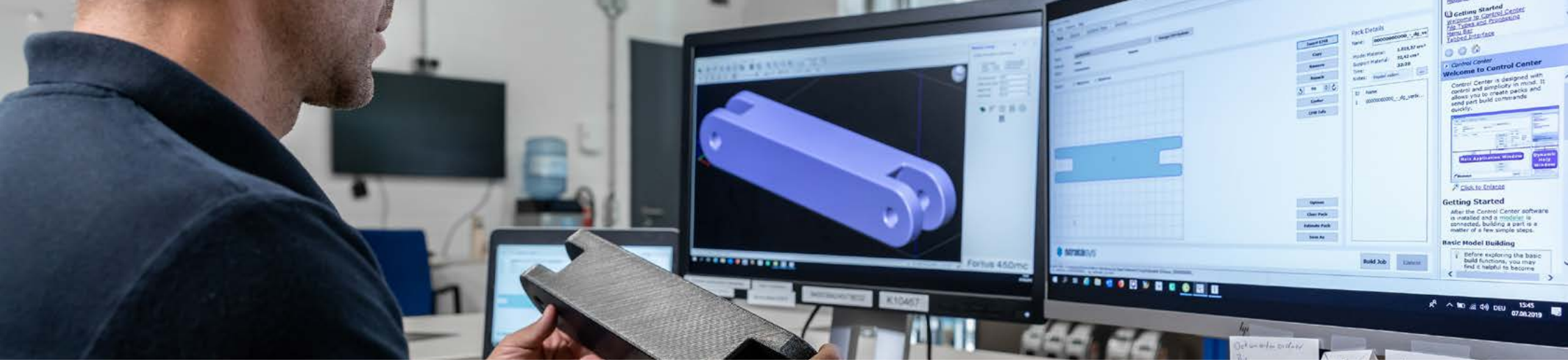
Low-code applications, built using Mendix, can automate performance engineering and IoT/lifecycle analytics. Examples include:

Simulations anywhere
Democratize system simulation by giving project engineers and technical salespeople access to the digital twin. They can share this valuable information with customers without the need for dedicated devices.

Predictive maintenance
Reduce a machine's downtime with simplified machine insights in correlation to product or tool or other combinations, connecting with automated or action needed workflows.

Closed loop validation
Create easy-to-use applications to support machine simulation and validation. Leverage the relationship between requirements, machine layout and physical/logical implementation to continuously improve machine performance.

Integrate design and simulation
A single low-code platform drives alignment by allowing engineers and designers to work across the same models, tools and data.



Digital parts production

It is critical for OEMs and their supply chain partners to efficiently manufacture reliable, high-quality industrial machinery parts. These parts must integrate into the larger machine while meeting high tolerance and precision needs – all while maximizing production capacity. Low-code solutions can automate traditionally manual workflows that span across domains to streamline processes and facilitate collaboration.

Low-code solutions for digital parts production

Mendix provides low-code capabilities for solutions that can automate tooling and parts manufacturing, production planning and scheduling, and quality management:

Smart warehousing
Automate, simplify and speed up material handling. Leverage RFID to increase transparency and eliminate manual runs using dashboards indicating where items are stored.

Automated manufacturing procedures
Utilize low-code solutions to store and re-use digital parts production data. By using the same data across similar or repeat orders, machine builders optimize the parts production process, saving time and resources.

Streamlined production operations
Unify digital parts production operations by automating low-level processes, such as logging proposals, archiving orders, creating calendar holds for scheduling and so much more.

Enhanced quality control (QC)
ModernizeQC mechanisms for enhanced efficiency. Identify what does and what does not work with existing QC systems, then implement a low-code solution to augment or replace the existing systems.

Smart manufacturing

Smart manufacturing aligns engineering, operations management and quality control by consolidating data in a digital twin for complete bidirectional consistency. Machine builders who adopt smart manufacturing across operations can maximize existing assets, personnel and space, as well as make informed decisions that address the growing need for customization. Smart manufacturing improves first-pass yield by increasing flexibility and throughput while reducing changeover time and errors.

Low-code solutions for smart manufacturing

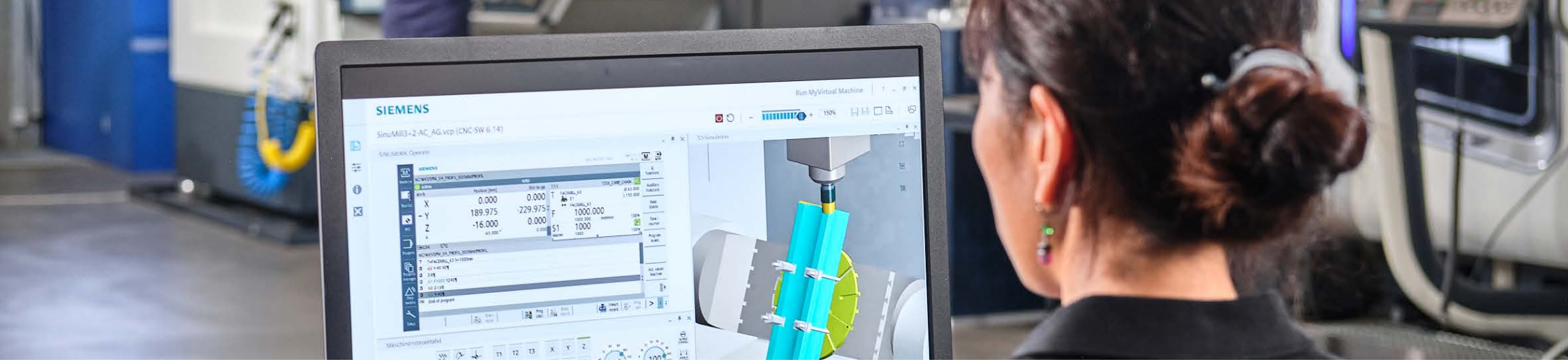
Machine builders can leverage low-code development to improve manufacturing operations, such as:

Shop floor management and communications
Use low-code applications as a repository for information and knowledge management. Seamlessly share information and connect communications between the shop floor, design, engineering and other domains for greater organizational efficiency.

Key performance indicators (KPIs) and Excel replacement
Access unlimited KPIs and analytics through low-code application solutions. Use this data to make informed business decisions; never rely on complex Excel spreadsheets ever again.

Unify production planning/scheduling
Use low-code applications to augment production planning and scheduling. Simulate production conditions and environmental constraints to identify areas of improvement, then adjust planning and scheduling functions as needed.

Augment quality execution processes
Support existing quality management systems with low-code applications. Low code helps digitalize existing manual quality management processes and optimize workflow automation intelligently to provide actionable insights to meet organizational needs. Low code can modernize legacy quality systems, provide mobile access to quality data and processes and eliminate ad-hoc processes that rely on spreadsheets or paper.



Service lifecycle and analytics

Service lifecycle and analytics offer powerful insights on machine behavior while promoting both machine monitoring and service management. They also extend the digital twin across a machine's entire lifecycle, enabling closed-loop simulation and adaptive machine learning for improved production performance.

A service lifecycle and analytics solution leverages IoT to collect information from machinery in the field and make it available wherever it's needed, overcoming traditional data silos. This allows organizations to track service requirements, resolve issues and provide operational and performance information to support design, testing and manufacturing – all while automating and streamlining workflows.

Low-code solutions for service lifecycle and analytics

Low-code apps can assist with service operations and lifecycle maintenance in several ways, for example:

High-value asset field service
Manage, maintain and schedule service operations for high-value assets, including workorder management and execution. Leverage AI-assisted scheduling and crew management. Account for spare parts procurement and planning.

Smart fleet management
Monitor connected vehicles to maximize utilization, reduce service costs and improve customer satisfaction. Leverage fleet telemetry, real-time intelligence and service optimization using simulation models built in Simcenter.

Service operations reinvention
Connect low-code applications to automate and drive machine builders reputation for service levels. Leverage low-code's warranty operations and asset management functionality to reduce the cost of machine ownership.

Traceable digital twin
Use low code to follow the digital twin. Virtually track and simplify engagement experiences from machine builders customer service to end users.

Face the future with low code

Between customization requirements, smart machines and hyperautomation, machine builders face massive challenges and must adopt new technology to keep pace with global competition. When machine builders harness the power of digitalization, complexity becomes an opportunity to improve machine flexibility, reliability, production speed and connectivity.

Low-code development provides the perfect foundation for machine builders to strengthen their product development and machine performance capabilities. It opens new opportunities in advanced machine engineering, intelligent performance engineering, digital parts production, smart manufacturing and service lifecycle and analytics. Low-code development enables machine builders to take the steps necessary in their digital transformation journey, so they can meet tomorrow's challenges today.

Siemens offers the leading low-code development platform, Mendix, that integrates across a broad portfolio of engineering and manufacturing services. Learn how to master complexity and become a market leader with personalized, adaptable solutions.

Start for free.

About Siemens Digital Industries Software

Siemens Digital Industries Software is driving transformation to enable a digital enterprise where engineering, manufacturing and electronics design meet tomorrow. Xcelerator, our comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software, helps companies of all sizes create and leverage a comprehensive digital twin that provides organizations with new insights, opportunities and levels of automation to drive innovation. For more information on Siemens Digital Industries Software products and services, visit siemens.com/software or follow us on LinkedIn, Twitter, Facebook and Instagram. Siemens Digital Industries Software – Where today meets tomorrow.

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