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SIEMENS DIGITAL INDUSTRIES SOFTWARE

The executive's guide to digital manufacturing

Transforming business to achieve strategic objectives
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Siemens Digital Industries Software helps organizations of all sizes digitally transform using software, hardware and services from the Siemens Xcelerator business platform. Siemens' software and the comprehensive digital twin enable companies to optimize their design, engineering and manufacturing processes to turn today's ideas into the sustainable products of the future. From chips to entire systems, from product to process, across all industries, [Siemens Digital Industries Software](#) – Accelerating transformation.

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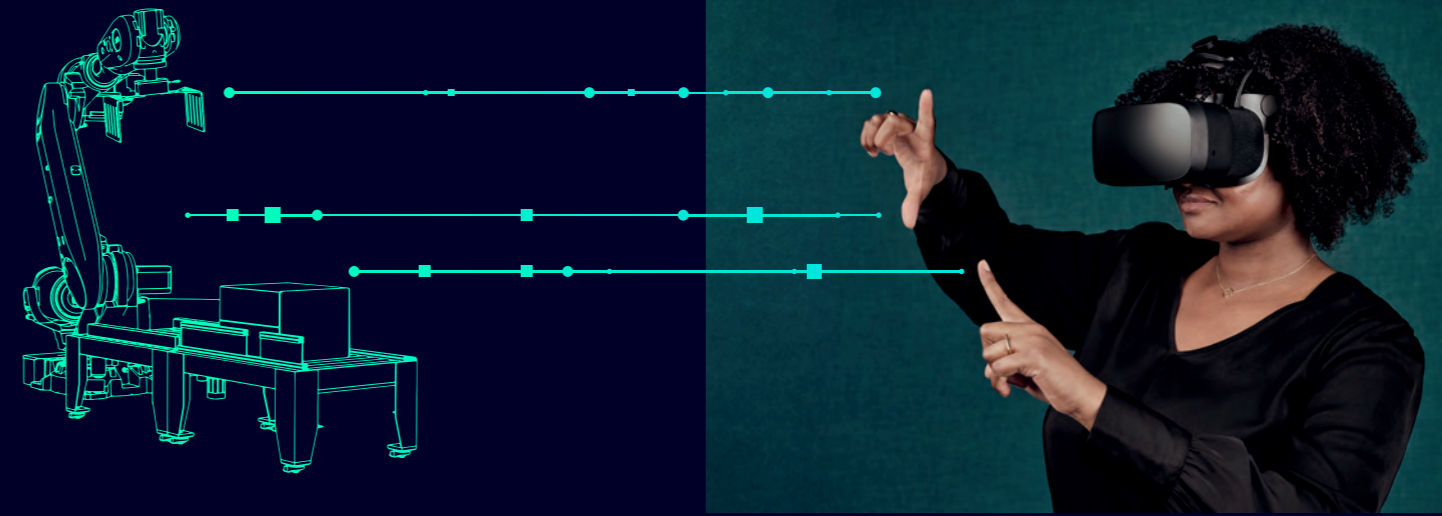
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The future of manufacturing

Today's executives are acutely aware the future of manufacturing is digital, which has become a necessary element of the successful manufacturer's business strategy. Digital tools are essential to solve complex production problems and improve business.

Companies that embrace digital manufacturing are realizing reduced risks, greater speed-to-market, increased margins, enhanced market position and streamlined supply chain performance.

In parallel, incorporating technologies like the industrial metaverse serves as an essential asset for manufacturers and emphasizes a whole new level of collaboration. Using AI (Artificial Intelligence) as a foundational building block, they can drive rapid digital and sustainability transformations at speed and scale. Manufacturers utilizing these technologies are positioned to achieve more efficient, flexible, and reliable production. By leveraging big data from Industry 4.0, manufacturing processes can be optimized using autonomous identification of trends and patterns, without requiring operator input.

Digital manufacturing software creates continuity between innovative product designs and best-in class performance.

Starting from the perspective of manufacturing executives who are achieving their strategic objectives by digitally transforming their enterprises, this eBook is designed to help companies flourish even while their markets experience singular disruptions and extraordinary challenges.

The challenge

Whether your manufacturing company is a startup or a well-established multinational, whether you make nanotechnology, airliner structures or anything in between, recent market conditions have shown that doing business the same way no longer works. To get and keep the edge, you must provide exceptional ingenuity and speed.

Your manufacturing initiatives must deliver new ways to operate your business today and in the future.



The executive experience

Feeling the weight of fierce competition for his company's 60 million world-class products made in 53 plants across the globe, Electrolux Director Bernd Ebert spurs efforts to accelerate product innovation and improve customer experience.



The factory is too expensive to use as an experimental field. We must deliver better quality with less cost while eliminating production downtime."

Bernd Ebert

Senior Director Group Manufacturing Engineering, Food Preparation, Electrolux



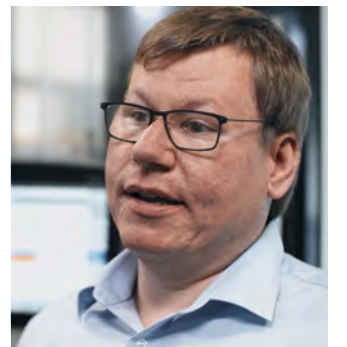
Andreas Pfeiffer, owner of Pfeiffer machine manufacturer, faced intense competition and strict quality standards during a critical business transition. Limited facility expansion options prompted Pfeiffer to urgently adopt advanced technologies to stay competitive.



Many contract manufacturing companies in our region have had to close their doors for good in recent years."

Andreas Pfeiffer

CEO, W.A. Pfeiffer



The business purpose of digital manufacturing

To drive your business forward – despite volatile and unpredictable market conditions – digital tools become effective change agents for implementing your vision, bringing about:

- **Speed-to-market** – Accelerating tasks across all manufacturing disciplines
- **Reduced risks to company reputation** – Improving quality and real-time performance feedback across the value chain
- **Increased margins** – Fully employing the virtual realm before investing in actual production
- **Industry leadership** – Creating innovation efficiencies and continuous improvement
- **Streamlined supply chain performance** – Monitoring on-time delivery metrics, real-time tracking of goods, and reliable delivery fulfillment

Intensified market conditions exacerbate the challenges

Digital manufacturing has become an existential imperative. New market pressures are compressing the timetable for manufacturing executives to decide how to use digitalization to their strategic advantage. This reality holds true for any company or industry no matter where you are in your digital transformation journey.

Digitalization solves modern market challenges

Digitalization promised – and is delivering – the means for manufacturers to thrive in the midst of today's market conditions:

- Globalization is addressed with data infrastructure and digital management that supports design-anywhere, build-everywhere initiatives
- Mass customization can be accommodated with digital tools that facilitate new flexibility in the design-engineer-build cycle
- Regulatory proliferation generates a complex maze that digital systems navigate with ease as they monitor, track, enforce and document compliance
- Digitalization strategies tackle the skills gap by using automation to train and free up the workforce, overcome location barriers, and enable real-time, multi-disciplinary teamwork

The BioNTech SE biotechnology company based in Mainz, Germany has converted an existing facility to produce the Covid-19 vaccine in record time with assistance from Siemens Digital Industries Software.



What the manufacturing executive faces today

Businesses must rethink conventional processes from product design and manufacturing to asset utilization

Today's reality

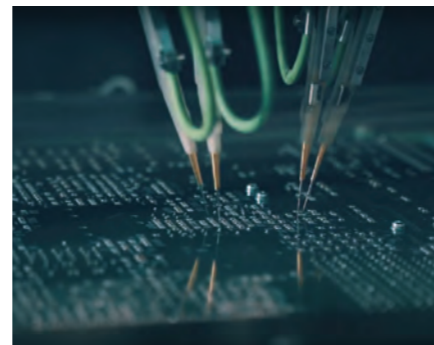
All manufacturers, including companies that produce transportation systems, medical devices, power generation and transmission systems, printed circuit boards (PCBs), food and medicine, follow a similar product development and production process.

In the simplest terms, product development and production consists of four steps:

- Product engineering designs products
- Manufacturing engineering defines operations and production systems
- Manufacturing operations schedules and executes production
- Utilization and performance assesses products and production

Many manufacturers run conventional processes that get the job done – but are not the most efficient. Operational issues such as disconnected systems, partial automation, silos of information, lack of collaboration and challenging logistics impact quality, efficiency and the bottom line.

Executives recognize that they must transform their manufacturing process to remove the barriers between these steps, streamline information flow and enhance collaboration throughout the entire process.



With individual solutions, there is inefficient integration that requires manual input. When you rely on manual operations, you can make mistakes.”

Franco Oliaro
Chief Executive Officer, ROJ Srl

The five key objectives of the manufacturing executive

Digital manufacturing powers the next big advancements

Tomorrow's success

Digitalization is profoundly changing the world for the better. Progressive manufacturers are already using digital tools but recognize the need for a more comprehensive approach to improve their business and become more competitive in today's challenging markets.

Siemens customers use digital manufacturing solutions to achieve five key objectives:

- Accelerate innovation – Rapid technical advances and growing demand for mass customization lead to rapid introductions of new products and innovations.

- Engineer flawless production – With lot and batch sizes shrinking, manufacturers want to anticipate every issue and resolve it virtually before the first production run.
- Ensure quality and efficiency – Instead of choosing between quality and efficiency (historically raising one reduced the other), manufacturers use digital technologies to make gains in both.
- Orchestrate production excellence – Maintain a reputation for end-to-end optimal performance with data-driven optimization across the enterprise.
- Resilient supply chain – Optimize transportation costs and sustainability using real-time insights, smart inventory, and efficient logistics.

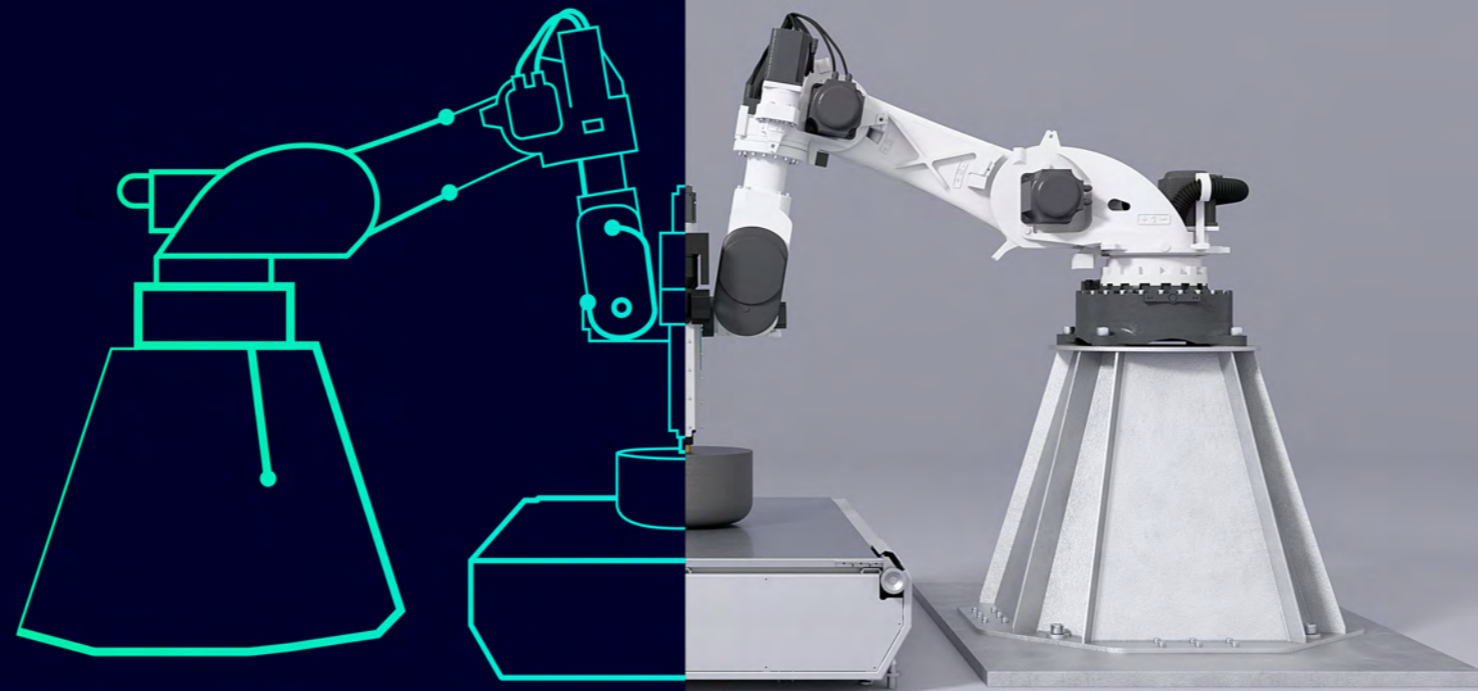
Using digital manufacturing to create a digital twin is crucial to meeting these objectives.



The important question for us was if we could make what we designed. Now, with NX's CAD and CAM tools, we know we can.”

Gary Puhl
Vice President, JP Pattern





The digital twin is the workhorse of a digital enterprise

In the virtual realm, a comprehensive digital twin represents every aspect of a product's life, from design all the way to in-use performance, including the processes employed to manufacture the product.

The comprehensive digital twin is used to simulate, predict and optimize the product and production system before investing in physical prototypes and assets. It provides valuable foresight prior to production as well as insights that drive continuous manufacturing improvements.

The digital twin in action

Digital manufacturing opens new avenues to market success

In the next four real-world examples, you will see how the digital twin helps attain these key objectives through the lens of executives.



Having an accurate digital twin of your complete manufacturing process is essential. It not only helps you produce higher quality products at a lower cost today, but also forms the backbone for manufacturing technologies that are just around the corner.”

Zvi Feuer
Senior Vice President of Digital Manufacturing Software Solutions, Siemens Digital Industries Software



1. Speed-to-market – how digital manufacturing accelerates innovation

50%
reduction in design time



Seamless connectivity speeds the dialogue across design and production

The executive experience

As an automotive industry supplier with 70 locations throughout Europe, the Wiesbaden, Germany-based EDAG Group has found you cannot compromise time-to-market even when you are implementing new bionic designs and additive manufacturing (AM) techniques. EDAG's aim is to stay competitive by seizing the opportunities provided by automotive electrification.

EDAG redesigned the cooling system ducts for an electric vehicle battery pack. To get as much coolant as possible to the battery, the new design needed to maximize mass flow and minimize pressure drop.

Digital twin technology enabled EDAG to perform generative engineering, simulation and 3D print preparation in one software ecosystem. The end results included:

- Cutting design time by 50 percent
- Producing a 6.4 percent increase in mass flow
- Achieving a 47 percent reduction in the outlet pressure drop

Innovation requires digital speed

The digital transformation

For a competitive advantage, your manufacturing enterprise incorporates innovative designs, materials and manufacturing processes on a seemingly continuous basis.

How can introducing these innovations bolster – and not disrupt – product and process performance? The key is tighter collaboration between product design and manufacturing engineering, enabled by the digital twin.

Operating in a common digital ecosystem and sharing a common data infrastructure, design and manufacturing engineers are empowered to collaborate directly.

Product designers can consider manufacturing options before committing to a particular design

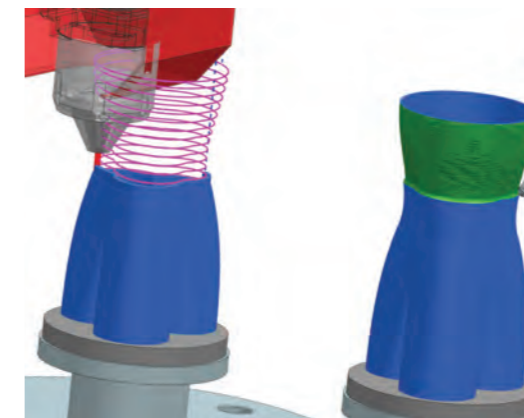
Manufacturing engineers can study designs early in the development cycle to ensure they can be manufactured efficiently

- Feedback can be shared between product design and manufacturing engineering teams
- Change management is streamlined, enabling more agile processes. NPI timetables are reduced
- A unified knowledge base is built on a shared data backbone

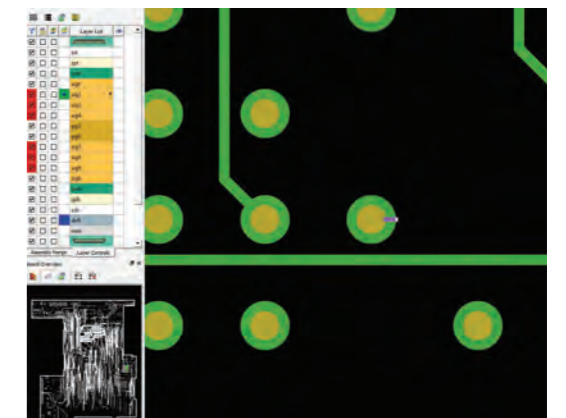


We demonstrated that additive manufacturing is also suitable for high-volume production to solve real challenges in the automotive industry.”

Sebastian Flügel
Scalebat Project Leader, EDAG



Hybrid manufacturing unifies additive and subtractive operations, enabling production of next-generation designs with tight tolerances.



Design for manufacturing (DFM) capabilities for electronics help identify opportunities for improving yield, cost and reliability.

2. Reduced risk – how digital manufacturing helps engineer flawless production

Identifying issues before they occur is at the heart of digital manufacturing

The executive experience

Automotive manufacturers rely on prompt implementation and dependable operation of their manufacturing systems. As the largest and most comprehensive automotive equipment company in South China, Guangzhou MINO Equipment Co., Ltd. (MINO) set out to meet these needs by reducing delivery time of the production system, eliminating trials on the factory floor and achieving more predictable launches.

MINO achieved these goals by breaking down functional silos and integrating production engineering with onsite control systems.

With comprehensive digital twin software, MINO designs and plans its systems in 3D and virtually commissions them well in advance of real production.

The company has achieved:

- Ninety-eight percent accuracy in production line simulation
- Thirty-five percent reduction in on-site debug time
- Thirty percent reduction in project cycles

The engineering software solution provides design, analysis, simulation and optimization capabilities for plants, production lines and work cells.

30%
reduction in
project cycles



Digital manufacturing virtually eliminates real production problems

The digital transformation

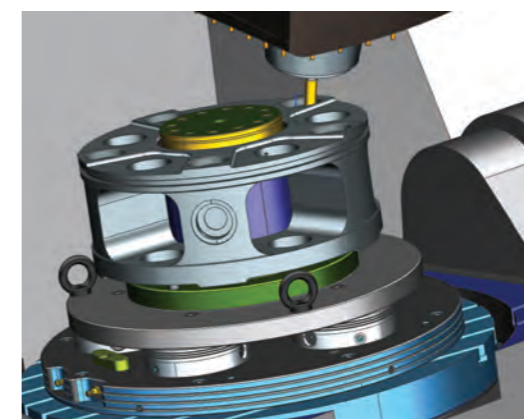
The digital twin reduces risk and costly downstream issues by enabling accurate production planning, simulation and validation. It helps a manufacturer quickly identify and resolve any issues that may arise during production. With timely collaboration between manufacturing engineering, manufacturing operations (production) and business systems, the digital twin helps companies to:

- Accurately and completely verify resource availability, capability and capacity prior to actual production
- Perform virtual validations that identify and facilitate the resolution of potentially costly problems
- Proactively consider engineering or supply chain changes to better plan the required process changes
- Use closed-loop insights from production to perform virtual analysis of recurring issues
- Perform corrective actions and impact analysis for error-proof incorporation of changes in production



By simulating the whole production line, we can identify defects and problems in the design to make necessary corrections before real production.”

He Wei
Production Director, Guangzhou MINO



The accurate digital twin of machining processes, helps part manufacturers eliminate errors on the shop floor, enabling lights-out production.



Advanced robotic simulation with automated motion planning reduces the most time-consuming tasks in programming by up to 80 percent.

3. Better margins – how digital manufacturing ensures quality and efficiency

90%
reduction in
root cause
analysis time



Success relies on improving both product quality and production efficiency

The executive experience

To meet demands for timely and cost-competitive fulfillment of customer requests while growing from a local Italian to a global manufacturer of mechanical seals, Meccanotecnica Umbra (MTU) recognizes that it must provide products of the highest quality regardless of which production site makes them.

The company manages facilities in 10 countries from its headquarters in Campello sul Clitunno, Perugia, Italy.

MTU accomplishes this goal by leveraging centralized digital twin technology in its quality management and quality control systems. Integrating manufacturing operations management (MOM) software with business software has enabled MTU to:

- Realize the paperless factory
- Improve production efficiency
- Attain full traceability of each finished product with the raw material batches and production resources used to manufacture them
- Reduce the time needed for root cause analysis by more than 90 percent

Digital tools optimize manufacturing performance

The digital transformation

The market forces of globalization and mass customization spawn uncertainty and the need for flexibility in the manufacturing enterprise. Product and process variation continue to grow, and global to local manufacturing requirements and supply chain dynamics multiply the complexity. Under these conditions, the executive must think creatively to ensure better margins. To achieve and maintain this required flexibility, manufacturers must digitally connect manufacturing engineering, manufacturing operations and the performance of plant resources in concert with enterprise and automation systems. This new approach:

- Ensures optimal performance of operations with closed-loop collaboration
- Decreases cost of change and quality by synchronizing product, process, plant/asset and supply chain changes
- Accelerates innovations while maintaining the highest quality and operational efficiencies
- Establishes a digital process for continuous improvement
- Enables corrective actions and impact analysis for error-proof incorporation of changes to production



MTU has been transformed over the years from a small company to a multinational company capable of withstanding the challenges of a global market thanks to an increasingly digital infrastructure.”

Gianluca Paoli
Corporate Head of Information and Communications Technology, Meccanotecnica Umbra



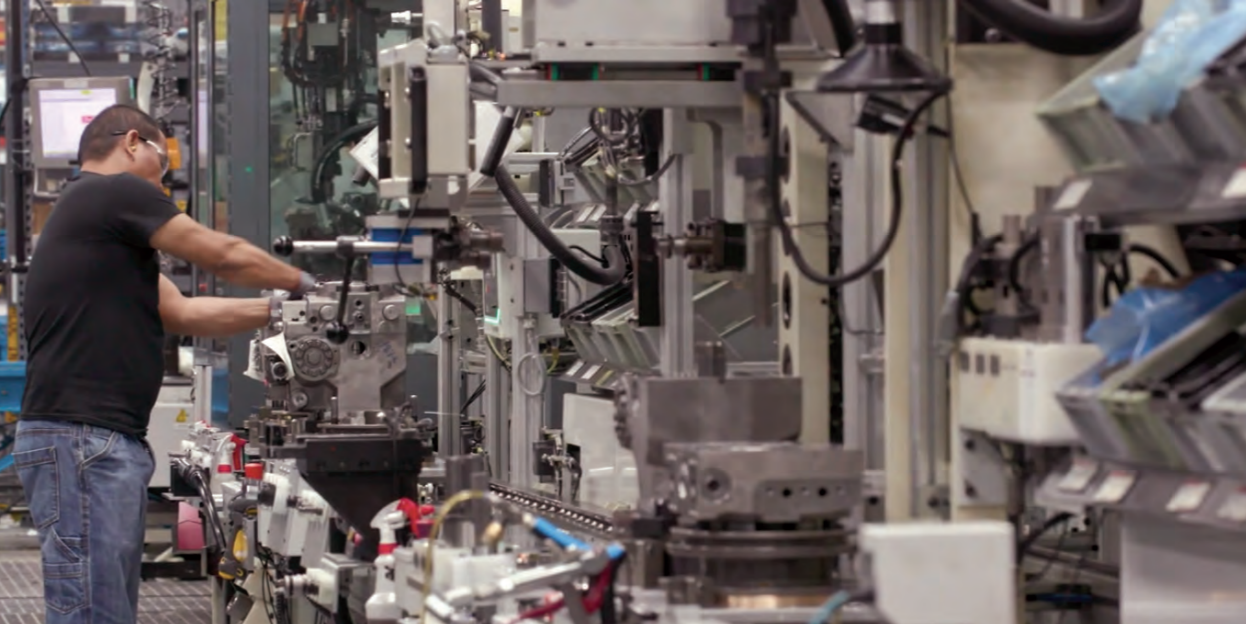
Manufacturing execution system (MES) capabilities enable paperless manufacturing and full electronic batch recording for the medical device industry.



Internet of Things (IoT) technologies help meet industry standards and customer compliance demands by collecting accurate, real-time data at the machine level for every process.

4. Industry leadership – how digital manufacturing orchestrates production excellence

Improved flexibility with reduced operational risk



Excellence is achieved with complete visibility and control throughout the production process

The executive experience

Demand for quick delivery of more complex and personalized products prompted Danfoss, a Nordborg, Denmark manufacturer with an expansive portfolio of industrial solutions and components, to set a new goal: reconcile highly configurable products with high volume and high variation – all without compromising efficiency or quality. At its 71 factory sites worldwide, Danfoss is managing mass customization and closed-loop manufac-

turing of its diverse product line by leveraging the flexibility of an end-to-end digital manufacturing architecture. This approach enables quick adaptation to new configurations for a larger mix of products. Key to this digital transformation is seamless integration with automation systems on the shop floor and modular systems that link to the existing legacy system. Benefits include:

- Increased speed of innovation of new products
- Elevated product quality and transparency
- Reduced administrative efforts and costs by more than 90 percent

Data-driven manufacturing accelerates optimization using production insights

The digital transformation

Many executives today are spearheading a cultural shift in how data is shared, communicated and used across their organizations. This data-driven approach helps them achieve production excellence in fluid market conditions.

Data-driven manufacturing helps remove the guesswork and allows companies to better predict what will happen, improving their response to real-time trends on the shop floor. Ultimately, they can realize closed-loop processes that can help

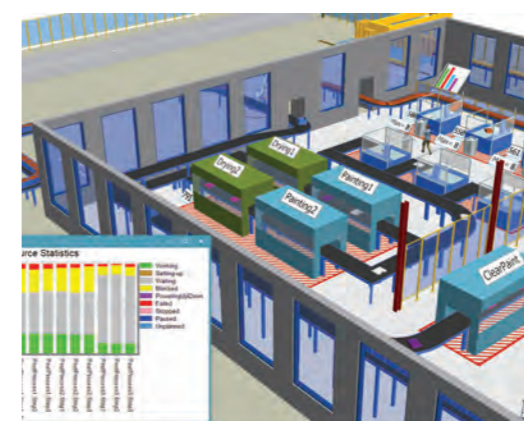
them anticipate well in advance any unforeseen issues arising in production.

For instance, IoT and data analytics generates actionable manufacturing insights that bring about continuous improvement, reducing production costs and improving quality. Data-driven manufacturing enables companies to orchestrate production excellence end-to-end, from design concept to production and product performance – and back again. Companies can realize immense benefits and transform into digital manufacturers by implementing data-driven manufacturing.

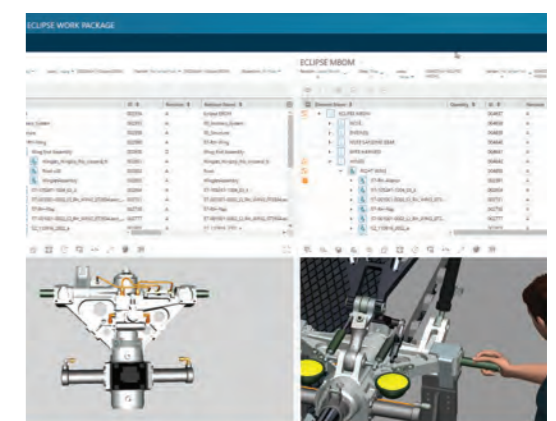


Siemens' MES allows us to spread process improvements and eliminate legacy tools. The dual benefit helps improve product quality and process efficiency, while also reducing operational risk and setting the stage for future shared improvements."

Allan Pedersen
IT Senior Director Engineering and Manufacturing, Danfoss



Factory design and simulation capabilities help create the digital twin using real-time data to optimize manufacturing and logistics systems before and during production.



Process and data management software helps you leverage existing design and manufacturing information to create complete process plans, optimize operations, capture shop floor feedback and manage changes effectively.

5. Streamlined supply chain performance – driving supply chain visibility with digital tools

Simplified logistics operations and reduced errors



Improving operational efficiency and customer service using advanced logistics and supply chain integration

The executive experience

Leoni, a global supplier of wires, cables, and complex wiring systems to automotive and electrical industries, aimed to maintain high customer service standards while improving operational efficiency. By focusing on innovative logistics and supply chain integration, Leoni enhanced end-to-end operations. Advanced logistics solutions allowed Leoni to integrate 2,000+ suppliers and streamline global communication. This inte-

gration enabled efficient order and shipping data sharing across locations, ensuring timely performance and real-time tracking of goods. Electronic document management reduced manual data entry, minimizing errors and simplifying operations, improving efficiency and meeting customer demands effectively.

Success highlights:

- Comprehensive supply chain coverage across suppliers, plants, logistics partners, and distribution centers
- Using enhanced visibility and optimized transport logistics to meet industry standards and sustainability goals
- Enhancing operational efficiency and customer satisfaction with innovative logistics and supply chain practices

Supply chain resilience from design to fulfillment

The digital transformation

Today's supply chains face unprecedented challenges, with volatility across complex value chains disrupting operations. Geopolitical, environmental, and security risks threaten production and supply chain stability, requiring solutions that balance cost, risk, sustainability, and quality goals.

Digital transformation offers a pathway to addressing these challenges and achieving operational goals. Leveraging advanced technologies and tools, organizations can benefit from:

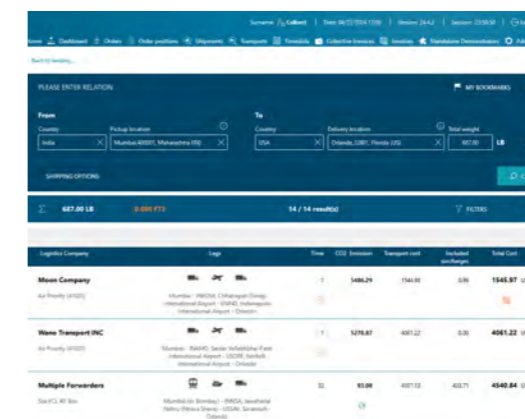
- Supply chain visibility: Gain a clear view of the entire supply chain, internally and externally.
- Collaboration across silos: Foster seamless communication between product design, engineering, sourcing, and manufacturing teams.
- Data-driven decision-making: Utilize real-time data and insights for informed choices.

The goal is to empower organizations to continuously enhance operational excellence and ensure business continuity. By adopting digital tools and automation systems to streamline workflows and provide real-time insights, companies achieve improved efficiency, reduced costs, enhanced customer satisfaction, and overall business performance. Prioritizing operational excellence with modern technologies and best practices ensures sustainable growth and a competitive edge in dynamic markets.

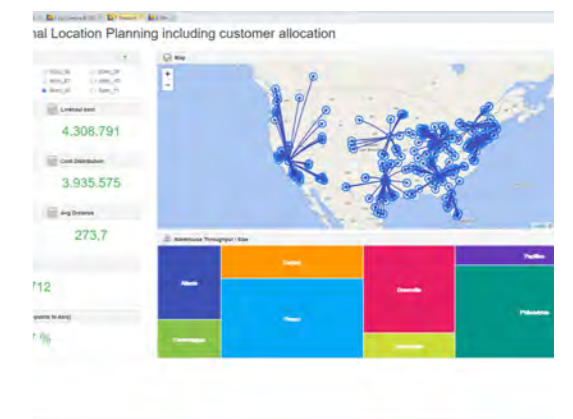


The AX4 solution makes it possible for us to automate time-consuming and error-prone processes and achieve better supply chain performance."

Michael Achtmann
Director Supply Chain Planning, Leoni AG



Supply Chain collaboration and execution streamlines operations, leveraging data analytics to recommend optimal transport solutions that save CO2 emissions.



Location Planning enables strategic positioning of new facilities to optimize efficiency and minimize costs within your supply chain, utilizing holistic, data-driven insights aligned with Industry 4.0 standards.

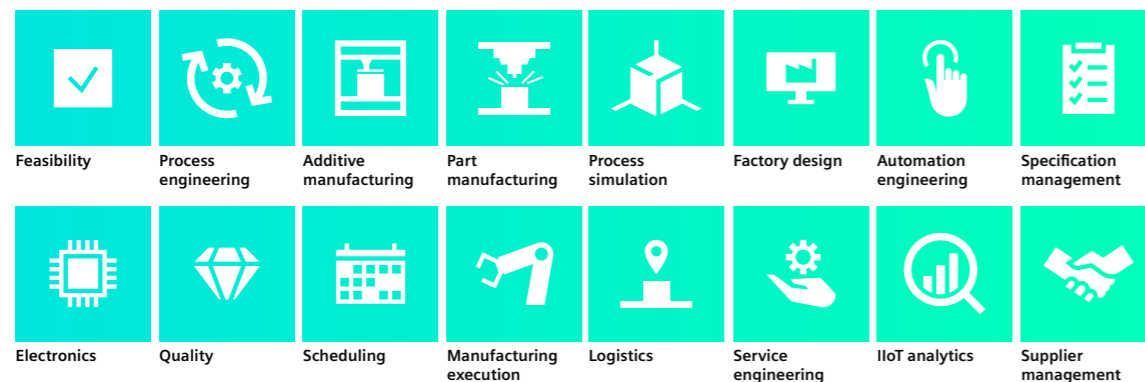
What the executive needs to know about a digital manufacturing solution

Digitalization generates immediate returns today and sets the foundation for future success

As the executive experiences throughout this eBook have illustrated, a powerful digital manufacturing solution can transform your business by:

- Accelerating speed-to-market with streamlined dialogue across design and production
- Reducing risks by identifying potential manufacturing issues before they occur
- Increasing margins with fully optimized manufacturing operations
- Enhancing industry leadership using data-driven processes that fuel continuous improvement and growth

Siemens offers robust digital manufacturing capabilities, leveraging a variety of technologies tailored to meet diverse customer needs, including Software-as-a-Service (SaaS) and cloud solutions.



Digital transformation: how Siemens supports the manufacturing executive

Siemens Xcelerator – the catalyst for the digital enterprise

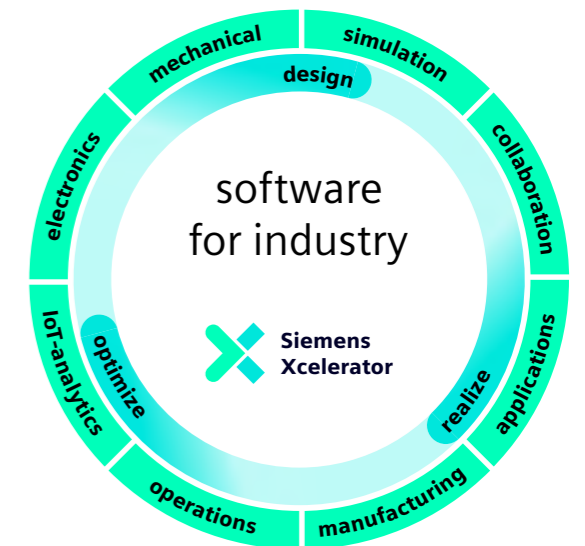
The Siemens Xcelerator™ portfolio is our comprehensive, integrated portfolio of software and services.

It is designed to form a software foundation for digital business transformation. Siemens Xcelerator is a catalyst, helping companies accelerate their evolution into digital enterprises, enabling them to be poised for ongoing success.

Siemens helps its customers embrace three business imperatives that will lead to operational excellence and hence a competitive advantage:

Comprehensive digital twin: We help companies blur the boundaries between industry domains by integrating the digital and real, hardware and software, design and manufacturing worlds.

Personalized, adaptable/modern: We offer flexible and scalable applications for new ways of working.



Using insights and data, we can predict and adapt products to future needs, allowing you to meet rapidly changing consume preferences.

Flexible open ecosystem: Access to a diverse field of partners in an open ecosystem gives you the opportunity to build on your investment. We offer application development services along with native cloud and cloud-connected products.



We are confident that Siemens is the most competent and reliable partner with whom to undertake this digital transformation journey.”

Gianluca Paoli

Corporate Head of Information and Communication Technology, Meccanotecnica Umbra