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Why Are Digital Twins Considered Better than Simulations for Supply Chain Optimization?

In this episode, we cover the use of digital twins in supply chain operations — how they help manufacturers predict and manage supply chain disruptions and assess the impact of raw material shortages or logistics delays. We also explore the key data sources manufacturers need to build an effective supply chain digital twin.

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Universal Robots and Nvidia Collaborate on the AI Accelerator

The UR AI Accelerator was developed in collaboration with Nvidia using Nvidia Isaac's CUDA-accelerated libraries and models and running on the NVIDIA Jetson AGX Orin system-on-module.

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Automation World® (USPS [Permit 22435], ISSN 1553-1244) is published six issues per year in Jan/Feb, Mar/Apr, May/Jun, Jul/Aug, Sep/Oct, Nov/Dec by Endeavor Business Media, LLC. 201 N Main St., 5th Floor., Fort Atkinson, WI 53538. Periodicals postage paid at Fort Atkinson, WI, and additional mailing offices. POSTMASTER: Send address changes to Automation World, PO Box 3257, Northbrook, IL 60065-3257. SUBSCRIPTIONS: Publisher reserves the right to reject non-qualified subscriptions. Subscription prices: USA $120.00 per year; Canada/Mexico $250.00 per year; All other countries $250.00 per year. All subscriptions payable in U.S. funds.

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Is Agentic AI the Next Big Industrial AI Application Since Data Analytics?

By David Greenfield
editor-in-chief

If you haven't yet heard much about agentic AI yet, brace yourself because you're about to get flooded with references to it. Why? Because it's fast becoming an integral aspect of artificial intelligence use in industrial operations software — just like we've seen with AI data analytics and, more recently, with generative AI applications in industrial AI assistants and co-pilot technologies.

To help frame agentic AI's applicability to industrial production operations, Aveva provided a very useful demonstration at its Aveva World 2025 event in San Francisco. The demo showcased Aveva's forthcoming industrial AI assistant running on the Microsoft Azure OpenAI Service.

In this demo, Arti Garg, chief technologist at Aveva, began by explaining that an AI agent is a system that leverages AI to perform a task by accessing system data such as operating temperature, pressure specifics or a safety metric. The key here is that, based on a prompt from a user, the AI agent can gather the data needed to create a dashboard for the user showing them the information they need without needing to hard code a new dashboard visual.

She noted that these AI agents can also work with sub-agents that know how to select and retrieve the right data for, say, an asset monitoring dashboard. Here, Garg explained the agent isn't just building the dashboard, it can also suggest the right operating thresholds for the asset it's monitoring and create alarms.

"What's really critical to understand here is that the AI agent can do this on its own by drawing upon its contextual knowledge," she said. "It is this autonomous nature of agentic AI that has huge potential to bring new efficiency gains to industry. It will change how we carry out our work today."

Creating an asset monitoring agent

For the demo, Garg and Iju Vijaya Raj, executive vice president of R&D at Aveva, showed how an operator who wants to do an unplanned optimization of a condenser can use agentic AI for this task.

The initial dashboard view used in this demo came from Aveva Connect — Aveva's platform to aggregate, curate and share information across multiple sites and data types to provide a holistic view of a business. This dashboard view displayed contextualized data from an air-cooled condenser at a power plant.

In the example, the operator, concerned about a drop in the plant's performance, wants to assess the impact of fouling on the condenser and asks the industrial AI assistant to monitor its performance and diagnose any issues it finds.

Based on this prompt, the AI Assistant retrieves a list of available agents deployed at the power plant to verify that such a monitoring agent hasn't already been developed for this condenser. Seeing that one has not yet been set up, it asks the operator if one should be created and deployed on the unit. The operator then asks the AI assistant to create a condenser monitoring agent and train it to monitor the active power of the unit and turbine exhaust pressure based on relevant parameters that could affect its performance. Following this prompt, the AI assistant initiates the agent creation process, the details of which are visualized for transparency to the operator.

This transparency is a key issue of importance for AI applications in industry, as many experts have expressed concerns about how AI technologies arrive at the answers they provide. With this transparency, the operator can see the data sources and tags associated with this agent to verify that it is being assembled correctly.

The operator then asks for deployment of the agent and to run the model on a 30-minute interval.

According to Aveva, that's all it takes to set up the industrial AI assistant to perform a task.

Two weeks later, the operator revisits the unit and asks the AI assistant to show the results of the deployed agent. These results show a degradation in performance of the condenser due to fouling. Visualization of the data trend lines help the operator determine if the issue needs to be corrected immediately or if it can wait until the next maintenance event.

Garg noted here that "this is an example of using AI to make something complicated very simple. The operator could create a new agent without developing complicated code and do it through same interface they already use every day." AW

Read the complete article on industrial agentic AI

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Boston Dynamics Working with Nvidia on Next-Gen Humanoid Robots

Boston Dynamics, a developer of mobile robotics, has expanded its collaboration with Nvidia to build the next generation of AI capabilities for humanoid robots using the Nvidia Jetson Thor computing platform.

According to Boston Dynamics, the compact size, high performance and efficiency of Jetson Thor enables Atlas to run complex, multimodal AI models for Boston Dynamics' whole-body and manipulation controllers.

The two companies are collaborating to define specific platform parameters including functional safety and security architectures, as well as key learning and computer vision pipelines using Nvidia's training and simulation platforms.

Developers at Boston Dynamics and its research partners also note that they are making breakthroughs in learned dexterity and locomotion AI policies using Nvidia's Isaac Lab, an open-source, modular framework for robot learning in physically accurate virtual environments. Isaac Lab is built on Nvidia Isaac Sim and Nvidia Omniverse technologies.

In addition to the ongoing work on Atlas, Boston Dynamics has also continued introducing new AI capabilities for Spot, the company's quadruped, and Orbit, its robot fleet management and data analysis software. New reinforcement learning tools are improving Spot's locomotion control and advanced foundation models are helping it avoid specific kinds of hazards that might appear in its path. AW

▶ Boston Dynamics' Atlas humanoid robot.

Omron and Cognizant Partner on IT/OT Integration

Omron Corporation and Cognizant have signed a strategic partnership to help the manufacturing industries integrate information technology (IT) and operations technology (OT).

Through this collaboration, the companies will provide industry with technology consultancy as well as on-site implementation, operation and maintenance services. Sectors focused on by this partnership include the automotive, semiconductor, electronics, industrial manufacturing, life science and consumer goods industries.

According to the companies, the combination of Omron's automation technology with Cognizant's expertise in IT/OT convergence, enable the companies to provide industry with a "one-stop solution for digital transformation." More specifically, the partnership combines Omron's OT products, such as sensors, controllers, servo motors, safety equipment and robots, with Cognizant's cloud, AI (artificial intelligence), IoT (Internet of Things) and digital twin technologies.

In this partnership, Omron's products are used to gather high-quality field data for Cognizant's Asset Performance Excellence (APEx) platform and its OnePlant Industry 4.0/5.0 maturity assessment tool. This combination of technologies helps analyze IT-side issues and prioritize improvements. Results are then fed back via Omron's control application and the i-Belt data utilization service, to address on-site challenges in a comprehensive manner.

"Together, we are committed to bridging the gap between OT and IT to drive the development of state-of-the-art futuristic factories, which will not only solve pressing issues faced by manufacturing sites — such as significantly enhancing productivity, reducing operational losses and accelerating management decisions — but will also ensure the sustainability of operations," said Junta Tsujinaga, CEO of Omron Corporation. AW

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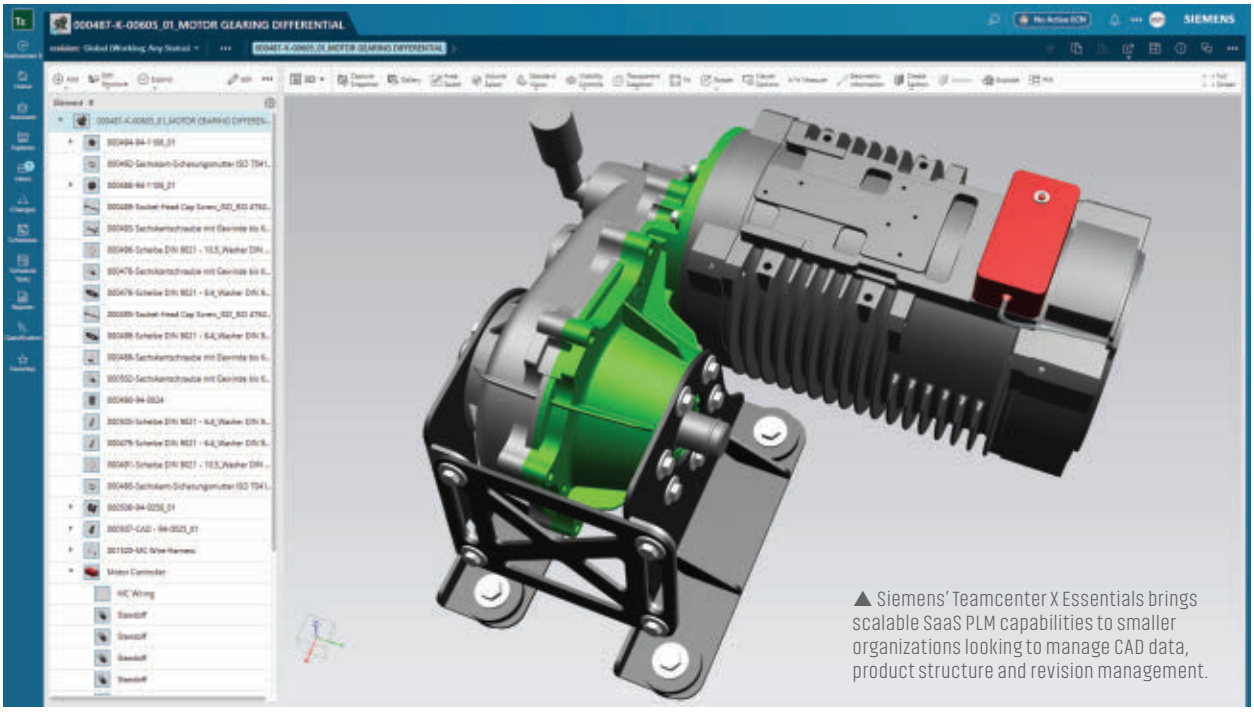

▲ Siemens' Teamcenter X Essentials brings scalable SaaS PLM capabilities to smaller organizations looking to manage CAD data, product structure and revision management.

Siemens Makes Teamcenter X Accessible to Companies of All Sizes

Siemens Digital Industries Software has introduced new versions of its Teamcenter X software that are designed to enable organizations of all sizes to use its SaaS (software as a service) product lifecycle management (PLM) software. The new Teamcenter X offerings introduce pre-packaged capabilities which include process management and cross-domain capabilities that bring together mechanical, electrical and electronics development and other advanced functionality.

"This expansion of Teamcenter X continues Siemens' mission of making SaaS PLM more accessible for companies of all sizes," said Frances Evans, senior vice president of lifecycle collaboration software at Siemens Digital Industries Software. "The new additions to Teamcenter X help even more customers get started quickly with PLM and then scale to solve more business challenges using more of the Teamcenter portfolio."

With this update, Teamcenter X now has four available offerings:

Teamcenter X Essentials: Designed with ease of deployment and low cost of administration, Teamcenter X Essentials delivers data management for companies focused on mechanical design. It includes CAD data management and product structures with revision management, where-used search, check-in/check-out and 3D view and mark-up. This offering can scale with the user company as it grows.

Teamcenter X Standard: Teamcenter X Standard extends the capabilities of Teamcenter X Essentials, adding additional PLM functionality such as simple change management, project scheduling, document management and report generation. These features are all delivered with out-of-the-box configurations and can be tailored to meet customer needs.

Teamcenter X Advanced: Teamcenter X Advanced supports companies in need of cross-domain collaboration across mechanical, electronic and electrical design throughout their products' lifecycle. Teamcenter X Advanced builds on the Standard offering to add data management for electrical and electronic design integration and classification. As with the Standard version, Advanced is delivered with out-of-the-box configurations and can be tailored to meet customer needs.

Teamcenter X Premium: This is the full PLM offering available on the user's choice of cloud provider. It is designed for companies who want to harness the full capabilities — from enterprise BOM and business system integration, model-based systems engineering and manufacturing planning to quality and compliance management, product cost and service lifecycle management. The Premium tier also delivers preconfigured solutions tailored for industries such as industrial machinery, medical devices and semiconductor. AW

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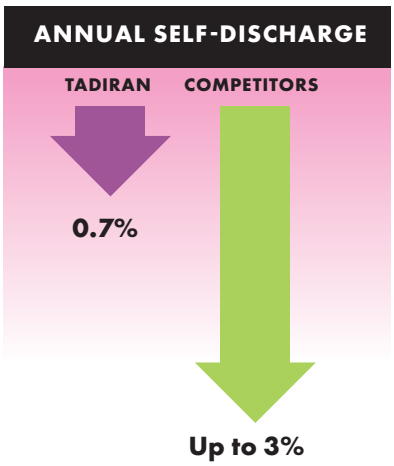

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Snowflake Expands its AI Data Cloud Tech for Automotive Manufacturing

The automotive industry-focused expansion of Snowflake's AI Data Cloud addresses production, supply chain and maintenance-related issues via data sharing, predictive analytics and real-time insights across the automotive lifecycle.

By David Greenfield, editor-in-chief

Snowflake, a supplier of cloud, data and AI technologies, has expanded its AI Data Cloud for Manufacturing with a focus on automotive-specific solutions.

The company cited four key trends in the automotive industry driving Snowflake's expansion in this manufacturing vertical: connected and software defined vehicles, autonomous driving, electrification and advanced manufacturing (Industry 4.0).

According to Snowflake, each these factors generates massive volumes of data across vehicle development, manufacturing, supply chain and after-sales services. Snowflake's data sharing and AI capabilities are designed to enable automotive industry suppliers, original equipment manufacturers (OEMs), distribution, sales and service providers to collaborate on vehicle development and optimize production processes by accessing real-time data insights across the automotive value chain.

The company noted that 80% of major automotive OEMs already use Snowflake's platform for their data and AI initiatives.

To learn more about what Snowflake's expanded technology offering for the automotive industry means to manufacturers in this vertical, Automation World connected with Tim Long, global head of manufacturing at Snowflake.

AW: Does Snowflake have pre-built analytics or AI/ML models for auto manufacturers and their suppliers related to this expanded offering?

TL: What makes Snowflake unique for automotive manufacturing is our ability to enable the convergence of IT, OT and IoT data, which is critical for effective AI/ML (artificial intelligence/machine learning) implementation. This convergence allows for more comprehensive analytics and AI/ML use cases by bringing together diverse

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data sources — from factory floor sensors and equipment logs to ERP and CRM systems, along with high-velocity data from connected vehicles.

Our partner ecosystem includes companies like Siemens and DXC Technology, who offer specialized solutions and expertise. For example, Siemens accelerates software-defined vehicle innovation through digital twin simulations and AI-driven virtual validation that enhance automotive system development.

Snowflake's strength lies in enabling manufacturers to rapidly build and deploy their own AI/ML solutions or use those from our partners. Automotive manufacturers are already using AI/ML within Snowflake for demand forecasting, production optimization and predictive maintenance.

AW: Snowflake's AI/ML has been used for predictive maintenance in automotive production, but does this expansion extend that into connected vehicle data once the car is in use?

TL: Absolutely. Snowflake's capabilities now extend predictive maintenance beyond the factory and into vehicles on the road through streaming connected vehicle data.

Our platform is designed to handle the massive volume and velocity of data from connected vehicles — including sensor readings and operational metrics. By combining this with warranty claims and service records, manufacturers gain a holistic view of vehicle health throughout its entire lifecycle.

Connected vehicle data allows OEMs to predict potential failures before they occur, provide proactive service recommendations and optimize maintenance schedules to reduce downtime.

AW: Can you provide any examples of how auto manufacturers are sharing data between production, service and warranty systems using Snowflake?

TL: Automotive manufacturers like Toyota Motor Europe are using Snowflake to unify data across these critical functions. As an example of how this works, consider an OEM working to improve production quality while reducing warranty costs. With Snowflake, they can integrate data from previously disconnected systems onto a single platform. The manufacturer stores production data from manufacturing execution systems, quality control processes and factory sensors alongside service records from dealership networks and warranty claim information.

And this capability extends beyond car manufacturers — we've seen similar implementations with industrial equipment producers sharing data across dealership networks to enhance customer service and supply chain performance.

Snowflake's secure data sharing enables cross-functional analytics that reveal how production variations affect service issues, identify root causes of defects, streamline collaboration with suppliers to improve component quality and provide service centers with insights into potential warranty issues based on production data.

AW: Can you explain more about how Snowflake provides real-time visibility across global automotive supply chains?

TL: Snowflake integrates information from numerous first- and third-party sources including suppliers, logistics providers, inventory systems and transportation management platforms. Our platform supports continuous data ingestion, giving customers up-to-the-minute visibility into operations. And our secure data sharing capabilities allow OEMs and suppliers to exchange critical information on inventory levels, shipment status and potential disruptions.

Our partner ecosystem also plays a crucial role in delivering specialized analytics on top of this foundation. For example:

- Blue Yonder provides supply chain control towers offering real-time views of the entire supply chain for monitoring key metrics and identifying issues.
- LandingAI's LandingLens, a Snowflake native application, offers visual AI for automotive manufacturing to improve quality control, while also providing intelligent document extraction to process complex manufacturing documents like flow diagrams and inspection reports.
- Sigma helps manufacturers identify trends and predict anomalies by analyzing huge volumes of data natively within Snowflake, enabling use cases ranging from energy optimization to quality control automation.
- And partners like Cirrus Link, HighByte, and LTIMindtree facilitate the ingestion of IT/OT data into Snowflake with minimal network burden.

By combining our data platform with these partner solutions, automotive companies can spot disruptions early, assess their impact and take proactive steps — whether finding alternative suppliers or adjusting production schedules — before customer deliveries are affected.

AW: Do you have any examples of how Snowflake supports collaboration between automotive OEMs and their suppliers to improve delivery timelines and reduce costs?

TL: Consider a scenario where an OEM must coordinate critical component deliveries from multiple suppliers to meet production schedules. Using Snowflake, the OEM securely shares production forecasts, inventory levels and delivery timelines with their supplier network. Suppliers reciprocate by sharing production capacity, lead times and potential constraints.

With Snowflake as the central data platform, both OEMs and suppliers operate from a single source of truth to eliminate discrepancies, improving communication and ensuring alignment across the supply network.

This collaborative approach delivers multiple benefits: improved delivery timelines as suppliers better align with OEM production needs; reduced costs through minimized expedited shipping and optimized inventory levels; more accurate demand forecasting that helps suppliers plan production more effectively; and enhanced supply chain transparency that allows all parties to track order progress, identify bottlenecks and resolve issues quickly. AW

Siemens Bets Big on Industrial AI's Future with Altair Acquisition and Industrial Foundation Model

While technology hype cycles come and go, Siemens indicates it's playing the long game with the acquisition of Altair and plans for a specialized AI model trained exclusively on engineering data.

By David Greenfield, editor-in-chief

"People tend to overestimate the promise of technology in the short run and underestimate it in the long run," said Tony Hemmelgarn, president and CEO of Siemens Digital Industries Software, at the company's RealizeLive 2025 event.

While there are plenty of technologies this statement can be applied to, at the moment, this is most clearly about AI and its many variants and applications. Illustrating Siemens' focus on the long run when it comes to AI is its intent to develop what it refers to as an "Industrial Foundation Model".

One of the biggest downsides to generative AI (genAI) tools is the fact that they are trained on such a wide base of information. This means that when concrete answers can't be found to specific prompts, AI "hallucinations" can occur as the LLM attempts to compile a useful answer.

Siemens sees its "Industrial Foundation Model" as being the antidote to this by creating an LLM from specific, verified data sources to avoid the issue of hallucinations or incorrect responses.

Joe Bohman, executive vice president of PLM products at Siemens Digital Industries Software, explained: "AI doesn't know engineering and manufacturing, that's why we're creating this Industrial Foundation Model, which will be built with 150 petabytes of product data and patents."

Initial use cases for this model include identifying machining features, development of maintenance strategies and accelerating P&ID creation. To enable this, the model will be able to able to understand text and images, as well as 3D models, 2D drawings and other industry-specific structures.

Siemens' acquisition of Altair and extended collaboration with IBM

A major topic at RealizeLive 2025 was Siemens recent $10 billion acquisition of Altair Engineering Inc.

According to Siemens, this acquisition "significantly expands Siemens industrial AI and digital twin capabilities that will help make advanced simulation accessible to companies of all sizes."

Explaining the Altair acquisition, Siemens said it "delivers three key technology pillars to Siemens: advanced simulation capabilities in mechanical, structural, crash and electromagnetic analysis; high-performance computing through HPCWorks; and comprehensive AI/ML (machine learning) tools via RapidMiner."

At first glance, many Altair technologies such as digital twins, AI, cloud and hybrid computing and physics-driven simulation, for example, could be seen as overlapping with much of Siemens Digital Industries Software's existing catalog. However, Siemens maintains that there are "minimal overlaps" between the two companies' technology, but plenty of additional capabilities that "substantially strengthen Siemens' digital twin offerings."

Siemens also introduced the Systems Modeler for SysML v2 Standard software as part of the Siemens Xcelerator portfolio. This software was developed in collaboration with IBM using IBM's Rhapsody Systems Engineering. SysML v2 is a new modeling language for the specification, analysis, design, verification and validation of complex systems and systems-of-systems that feature mechanical, electrical, electronic and software components — an increasing feature of intelligent products.

Manufacturing and processing success stories

To illustrate the widening applications for Siemens Digital Industries software across industry, the company highlighted use of its technologies by several customers, such as:

- **Rolls-Royce** consolidated multiple legacy document systems using Siemens' digital thread technology and Insights Hub to create a production copilot that interprets telemetry data error messages and generates step-by-step maintenance guides as well as a customized OEE application.
- **Unilever** is addressing the challenge of smaller batch sizes in consumer goods manufacturing. Previously

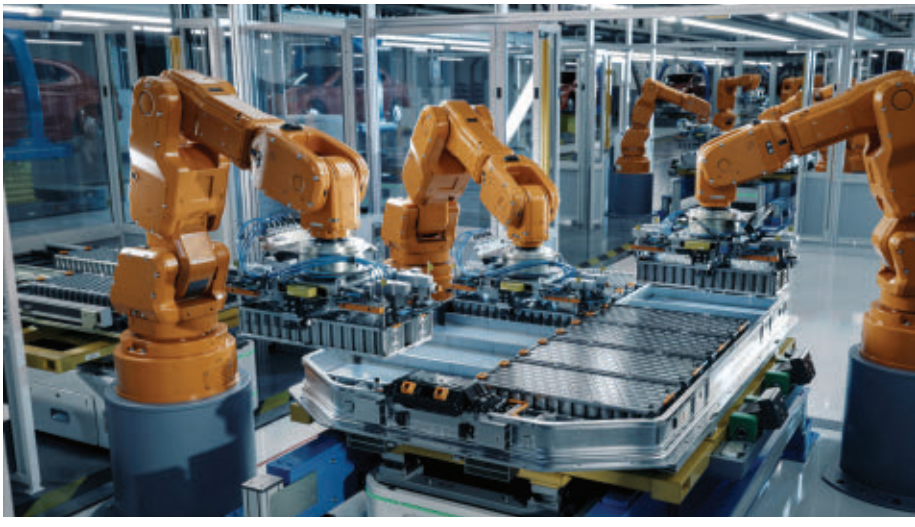
requiring up to a million manual interventions for product changes, the company now uses Siemens' Enterprise Recipe Transformation to automate change processes in minutes rather than weeks by connecting equipment to BOMs.

- **Workhorse**, an electric truck manufacturer, completed a six-month implementation of TeamCenter X to manage 2,700 part numbers for each truck across five truck models with 1,300 suppliers. Jeff Mowry, CIO at Workhorse, said the cloud-based software required minimal internal IT resources — which was key for Workhorse considering they only had one full-time IT support employee — while providing out-of-the-box BOM management and engineering change notice processing.
- **Northrop Grumman** announced that it has renewed its collaboration with Siemens for another three years to expand its use of the Xcelerator portfolio to streamline development cycles and accelerate the design and production of its defense system technologies.
- Frank Helmke, head of product lifecycle management at **BSH Home Appliances Group** (manufacturer of Bosch, Siemens, Thermador and Gaggenau brands) explained the company's use of Siemens' technologies such as Teamcenter, Designcenter, Xpedition and Mendix across its product development and manufacturing processes as part of the company's digital twin strategy. This approach has helped the company avoid the creation of data silos to ensure consistent information flow across 9,000 users and more than 1,000 product variants. More specifically, it has enabled BSH to standardize processes, reduce customization and create a more agile product development ecosystem at the company. Helmke added that BSH uses the Mendix low-code platform to add capabilities to Teamcenter without resorting to mass customization efforts and to provide a bridge to greater use of AI agents.
- **Sachsenmilch**, a European processor of milk, butter, yogurt, cheese and dairy derivatives for products ranging from baby food to bioethanol, has been using Siemens' AI-powered Senseye Predictive Maintenance. According to Sachsenmilch, Senseye successfully detected a failing pump before breakdown, generating cost savings in the low six figures. The implementation of Senseye at Sachsenmilch included the integration of existing control system data with new vibration sensors and Siemens SiPlus CMS 1200 condition monitoring system. Sachsenmilch now plans to integrate Senseye with its SAP Plant Maintenance to automatically transfer maintenance notifications and improve planning. AW

WHY FLEXIBLE MANUFACTURING ISN'T ENOUGH: The Case for Adaptive Production

While flexible manufacturing systems can switch between product types, **adaptive production** creates intelligent operations to address issues ranging from equipment behavior to supply disruptions and environmental changes.

In this exclusive interview, **Annemarie Breu, senior director of automation software deployment and incubation at Siemens AG**, reveals how AI, edge computing and real-time optimization are being used to build resilient adaptive production systems that continuously improve themselves.



▲ Adaptive production is a smart manufacturing approach that uses real-time data, AI and automation to continuously adjust processes. Siemens AG

AW: Explain the concept of "adaptive production" — what it means in terms of changes to traditional manufacturing production operations, which type and size of manufacturing operation it typically applies to and why it's considered necessary.

AB: **Adaptive production** represents a shift from traditional, efficiency-focused manufacturing to systems that are intelligent, responsive and resilient. Rather than optimizing for scale alone, adaptive production enables real-time reactions to disruptions in demand, supply or operations — such as shifts in consumer behavior, geopolitical events or pandemics.

By leveraging **AI**, predictive analytics and automation, adaptive systems dynamically optimize production and resource allocation. Crucially, they don't replace workers but support them by tailoring systems to operators, engineers and managers. This approach applies across all manufacturing scales, from small businesses to global enterprises, using plug-and-play technologies that reduce the need for specialized technical skills.

AW: How does "adaptive production" differ from "flexible manufacturing," a term that has been used for years to describe a production system designed to adapt to changes in the type and quantity of the product(s) being produced?

AB: While flexible manufacturing focuses on switching between product types — especially in high-mix, low-volume environments — adaptive production goes further. It doesn't just respond to product variation, but to the entire spectrum of process conditions, including equipment behavior, environmental factors and supply inconsistencies.

Adaptive systems continuously monitor performance, detect quality deviations, trace root causes and adjust parameters in real time to prevent future issues. This makes them suitable for any production mix or volume and central to long-term improvement in yield, quality and throughput.

AW: What are the key technologies needed to enable adaptive production?

AB: Adaptive production is powered by a layered tech stack that builds on existing infrastructure, especially in brownfield environments. At the core of this stack is edge computing, which processes data close to machines for real-time functions like visual inspection, anomaly detection and predictive maintenance.

Data integration is equally critical. Information from control systems, ERP

software, quality databases and staffing schedules must be unified and contextualized. Graph databases, which connect the data they store to relevant network nodes and edges, make this possible by mapping relationships between machines, sensors and processes to create a coherent model of the production environment. This enables the data to be linked together and retrieved more easily.

Once data is modeled, generative AI and large language models unlock accessibility. Users can ask plain-language questions about performance or problems, receiving actionable, data-driven answers without needing to navigate complex systems.

AW: How do these technologies deliver on the interconnected feedback and optimization cycle that enable the continuous adaptation and improvement that is key to adaptive production?

AB: These technologies form a closed feedback loop — from sensing to analysis to action. **Edge devices** collect and process real-time data, identifying deviations in quality or performance. This data is contextualized through graph-based models, enabling in-depth root cause analysis.

With this insight, generative AI can answer operational questions in natural language to bridge the gap between technical complexity and user intuition. When appropriate, corrective actions, such as parameter adjustments, are automatically sent back to the control layer, completing the loop.

This system allows manufacturers to quickly react to issues and continuously improve processes to make operations smarter, more efficient and more resilient.

AW: What is the recommendation for brownfield manufacturing sites that already have production equipment and processes in place to enable an efficient and effective move toward adaptive production?

▲ Adaptive production makes manufacturing more scalable, people-centric and resilient. Siemens AG

AB: For brownfield environments, the goal isn't replacement, but augmentation. Adaptive production begins by layering edge computing onto existing systems, using protocol connectors to access data from various vendors and legacy equipment.

Manufacturers can add low-cost, intelligent sensors, such as cameras, microphones and environmental monitors, to collect additional insights. These data points, which are often stored in diverse formats, must be harmonized through efficient modeling and semantic mapping to build a unified, meaningful representation of the production environment. This can be done with the use of graph databases, as I noted earlier.

This scalable approach enables gradual adoption of adaptive capabilities, like AI-driven monitoring, root cause analysis and self-optimization, without disrupting day-to-day operations or requiring a full infrastructure overhaul.

AW: Can you highlight any companies who have made this move already — how they did it and what the benefits have been so far?

AB: Yes. Tyson Foods is a strong example. They've embedded **AI copilots** directly into daily operations, where the systems assist in shift planning and decision-making by drawing on years of historical data. Because the AI fits naturally into existing workflows, adoption has been high and minimal change management has been necessary.

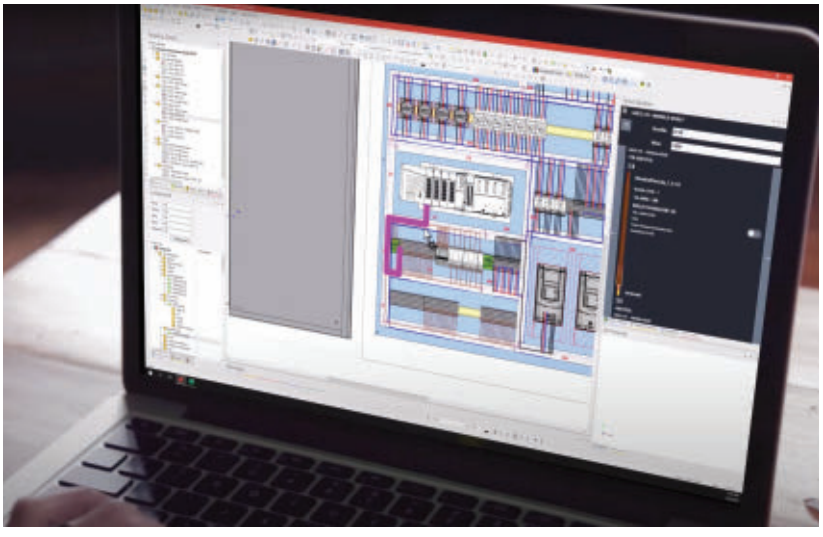
Across the successful implementations we've done for adaptive production, two themes stand out: the need for strong data foundations and user-centered design. Companies that invest in data modeling and contextualization to clearly define relationships between machines, sensors and lines can unlock the full value of advanced AI tools.

We've also seen that these adaptive systems work best when designed with frontline users in mind. By involving machine operators, plant managers and maintenance staff early in the process, companies ensure usability and adoption. This is critical because these systems don't replace people, they capture their know-how to support better decision-making by human engineers and operators and reduce manual troubleshooting.

The impact is both operational and cultural. With the implementation of adaptive production, we've seen better performance metrics related to yield, quality and uptime, as well as faster problem resolution and more engaging, tech-supported work environments. These last two points are critical to successfully addressing the manufacturing workforce gap. AW

How Digitization and Automation Enables More Efficient Panel Building

Sanu Warrier with nVent, a supplier of electrical connection and protection solutions, explains how design-to-manufacturing software helps panel builders overcome labor shortages, reduce errors, improve margins and capture critical knowledge while transitioning smoothly from traditional processes to Industry 4.0.



nVent's DTM software lets you customize panel designs, enclosures, machines and factory systems using a single source of truth to enable sharing of real-time schematics, design files and project plans across teams.

Source: nVent

Digital technologies are fast becoming core aspects of modern manufacturing as industry increasingly adopts Industry 4.0 concepts for more efficient production processes. But what about the industrial control systems panels that the manufacturing industry relies on to power and control the automated equipment central to their operations?

To find out how the push toward Industry 4.0 is impacting panel builders, we connected with Sanu Warrier (SW), product director for software at nVent, for a recent episode of the Automation World Gets Your Questions Answered podcast. nVent is a supplier of electrical connection and protection solutions including design software and automation machines, electrical enclosures and climate control products that ensure protection for critical components and operations.

Below are a few highlights from our discussion. Hear the complete interview at automationworld.com/55302220.

AW: For panel builders who might be skeptical about the ROI related to Industry 4.0's digitization and automation approach, what's your take on separating the hype from the practical benefits?

SW: When people think about what Industry 4.0 means, they tend to imagine a futuristic, fully autonomous operation that's all about machines and the Internet of Things. For panel builders, this sounds like it's eliminating manual work, but in reality, it's about making incremental gains — it's not about getting 100% automated on the first day. The practical benefits of Industry 4.0 reach from data-driven design to manufacturing to inventory management support. Given that Industry 4.0 is about incremental gains across manufacturing functions, the practical thing to do is start with a pilot project and assess how it benefits your operation. Industry 4.0 is about how many bites you can take at a time and move forward with the process.

AW: You mentioned design to manufacturing, can you explain how that differs from traditional CAD?

SW: The main purpose of design to manufacturing (DTM) software is to bridge the gap between design and manufacturing to increase overall productivity. Traditional CAD was created to get rid of pen and paper and make it easier to put things together. DTM software is about optimizing the entire design-to-manufacturing process that can drive the creation of digital twins and connect the design process to Industry 4.0.

DTM also helps address long-standing issues such as the friction between engineering and manufacturing by coordinating the work between these two groups with minimal back and forth effort to get more product out the door

in less time. This friction between engineering and manufacturing often leads to miscommunication or too much communication, which is not efficient and can lead to errors when people communicate from different perspectives. That's where DTM comes in to provide a simple solution that enables both groups to store and access the specific data they need.

We've seen manufacturers and panel builders save over 20 hours a month just storing all their parts information in DTM software. DTM's data accessibility and collaboration capabilities help improve accuracy and productivity without increasing headcount, while capturing a company's inherent knowledge across manufacturing and engineering.

Sanu Warrier, product director for software at nVent.

Source: nVent

Because the DTM software's database holds the manufacturing data, it provides the manufacturing perspective to the design engineer right from the start. This enables the design engineer to think about manufacturing even if they not necessarily thinking about it directly — the software is thinking about it when they're doing the design. That's how DTM makes the whole Industry 4.0 transformation process much easier to start.

For example, the parts library in the software holds all the schematics and panel layout data. That enables the designer to work more efficiently because the software ensures all these data points are up to date. If someone makes a change in one place, it's updated everywhere. This dramatically reduces the errors that can occur in design — and this unified data source drives through to manufacturing.

With the design developed with manufacturing in mind from the start, when it gets to the point where the panel builders are doing the wiring on the shop floor, the DTM software has ensured the holes are routed and aligned correctly and even tells them what lengths of wire they'll need.

AW: If you had to convince a skeptical panel builder why DTM isn't just another software expense but more of a competitive necessity, what would you tell them?

SW: I would say there are three reasons to consider. Number one, labor costs are not going down and price pressures are rising. This means panel builders need to be thinking about their margins and how they can produce more. These increasing labor and parts costs are causing the margins panel builders once enjoyed to shrink. In addition, there's the issue of operational margins compared to competitors who are using DTM software. Those costs drop when using DTM software and the machines that go around it for panel building. So, you might be able to continue doing many of the things you need to do without DTM software, but you won't be able to keep up with the market pace.

The second reason is the expert workers that panel builders have relied on for the last few decades are retiring and it can be difficult to train and retain new employees today. If you want to keep new people around, you need more modern processes. The new generation of workers grew up with iPhones and the internet, so they want more than just a pen and paper to keep their jobs interesting.

The third reason is that many owners of panel building companies want to pass their business on to a successor or sell it. Hanging on to your old approach to panel building can make it tougher for someone else to take over the business because they won't necessarily know how you do everything. DTM software enables the capture and transfer of critical panel building knowledge by solidifying it inside the software, inside processes and inside the machines. Even if you're not looking to sell your business, as I mentioned earlier, if a key person is retiring, you're not losing that knowledge they've built over the years.

AW: For panel builders who are onboard with the idea of adopting DTM software for its benefits but are worried about moving away from their current panel building processes, what's your advice to them about getting started with DTM without disrupting their current operations?

SW: That's actually a conversation we have all the time. We tell those panel builders that if you don't want to disrupt what you're doing, then you're in the right track because change is never easy. This gets back to what I was saying earlier about Industry 4.0 and starting with a pilot project. You don't need to do everything on day one.

With this pilot project, make sure you're not disrupting your current operations. Pick one or two people that can start with it and go all in on it mentally but start small. Do one or two projects and learn from them what needs to change about a specific process. These champions can then bring in other people to the software and its processes, but it's important to invest in training and implementation at this stage because different people will take to change differently. Be sure to remain focused on making small changes to help with acceptance.

And give yourself a timeline to phase it in. Don't pick the biggest project you've ever done to start with this new software. Pick some process you know well to start with so that you can get quick insights with DTM compared to how you have traditionally performed the process.

nVent also helps provide the training and support that's important at this early stage, because a customer's success is our success. If the customer is not successful in the long run, we're not going to be successful. So, it's not about throwing boxes of software at them, it's about providing a solution and then growing with that customer.

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How Low-Code AI Robotics Software is Transforming Manufacturing Shop Floor Work

Palladyne AI's low-code robotics platform enables operators and engineers to train robots in minutes, not weeks, enabling flexible automation in high-mix manufacturing without the need for specialized robotics programming skills.

The use of low-code software has been spreading rapidly throughout industry, allowing non-coding operators and engineers to develop apps to track asset performance, establish and track workflow procedures, and even program robots. To learn more about this, Automation World connected with Kristi Martindale (KM), chief commercial officer at Palladyne AI, a supplier of low-code AI platform software for robotics, for a recent episode of the Automation World Gets Your Question Answered podcast.

Following are a few highlights from the interview. Access the full podcast at automationworld.com/55300776.

AW: Can you walk us through what low-code software means for a shop floor operator or engineer as it relates to enabling them to develop robotic automation workflows.

Kristi Martindale, chief commercial officer at Palladyne AI

KM: Palladyne AI's process is very simple and allows for two different approaches. First, with low-code task training, we have a chatbot user interface where the user can input simplistic commands, such as pick this, place this, or send it here. This can be done by anyone on the shop floor. We've had people learn to operate the software and demonstrate it to their bosses in less than four hours. The second approach is what we call task-based training, where someone will perform the task to show the robot how it's done. That task will be replicated and autonomized by our software. Essentially, it's demonstration-based training.

AW: Palladyne AI's software platforms uses a closed-loop system to process data at the edge. Can you explain this and how it's used to improve day-to-day manufacturing operations?

KM: What we mean by closed loop is that we've developed the full stack of functionality required to do robotic tasks from start to finish. It includes object detection, motion planning, collision avoidance, and the reasoning and learning for the system. It's really doing everything in a closed-loop fashion that you need to identify the object, determine what needs to be done with that object from an automation standpoint, execute the task, and then refine and learn to adjust if the environment changes so it can continue to complete the task it was trained to do.

A lot of AI-powered robotics systems out there are just doing one piece of this. For example, they might be doing object detection or motion planning, but ours is really looking at the full loop of all those functions and tying them together to complete the task and enable robots to do it autonomously.

The benefit of using edge-based processing here is that you eliminate any latency when you're sending information out to the cloud and waiting for that decision to come back. It's also lower cost because you're not incurring the costs associated with cloud services to do your compute. This is one of the things our customers tell us they really appreciate about edge-based computing, as well as the fact that it can be more secure since you're not sending data out into the cloud — it's all contained within their ecosystem and their environment.

AW: What technologies are used in your closed-loop system in terms of hardware and software?

KM: Our standard platform is the full closed-loop software package I described. In addition to that, users can deploy inexpensive or high-end cameras — we can integrate with any commercial off-the-shelf camera as a sensor point. And since the software is designed for use in a robotic environment, there will likely be end-effector hardware and force feedback mechanisms used. Our system can recognize and adapt to multiple types of sensor modalities.

AW: A major issue in manufacturing now is the need for process and system flexibility to deal with changing consumer requirements or custom demands. How does your software for robotics learn and adapt to things like new parts or new processes?

KM: One of the great things about our software is the ease of training it to do a task. One of the big areas of opportunity for this is in high-mix, low-volume manufacturing operations that have traditionally been difficult to automate because the cost of automation was too great — you had to hard-code the programming. With our software, you're able to easily train it on the part, on the environment in which it is operating, and on the task without any hard coding. It's very simple and straightforward and it enables companies to make changes very quickly to adapt to either a new part, a new workflow or a completely new environment.

AW: While the training timeline is obviously going to vary depending on how many parts or processes are changing, can you describe the typical time frame required to train the system when it comes to making changes?

KM: It's very quick. Often, the longest part is the computation time, but you can train the system on something new in 20 minutes. It's not something that takes days or weeks. Of course, it depends on what you're doing. If the system is being asked to ingest a totally new part, that maybe puts you into the 30-minute time frame because there's more computation that will be happening.

AW: You mentioned high-mix, low-volume manufacturing as a target area for this software, but are there other types of manufacturing applications that would benefit from this technology?

KM: End-of-line quality inspections are an area of opportunity. And one of the big applications we've been really digging into lately involves surface preparation and finishing tasks like sanding, grinding and media blasting. This is a big area of potential for our software because the parts change often, but the manufacturers are not sanding through millions of pieces per month. They typically process hundreds a month.

AW: How should manufacturers approach the use of AI-enabled robotics software to ensure they'll get the kinds of results they're looking for and position themselves for incremental process improvements?

KM: We recently did a research paper with ABI about speeding time-to-value using AI-enabled robotic software for manufacturing, and they identified three best practices which we agree with.

First and foremost is identifying the core issue and pain point. What is that burning issue in your organization that you haven't been able to resolve through automation historically? I'm surprised at how many people are still doing certain tasks manually because they haven't been automated due to high mix variability.

The next step is to define the human's role in the feedback loop. You need to determine how the human stays in the loop. This is necessary because full stack computing enables such a high degree of system autonomy. You want to make sure that humans are monitoring the process and making sure the task is being completed as expected.

The third step is to start small — start in one area of your plant and then scale it across the group or division before expanding more globally. AW

What's Driving the Next Stage of HMI/SCADA Development?

HMI and SCADA systems are increasingly integrating IIoT devices, migrating to hybrid-cloud architectures and preparing for AI capabilities. These emerging trends are reshaping how manufacturers monitor, control and optimize their operations.

By James R. Koelsch, contributing writer

As computing and communications technologies progress, they have a way of changing the look and feel of the devices and processes that use them. Human-machine interfaces (HMIs) and supervisory control and data acquisition (SCADA) technologies are, of course, no exception.

"Among the most important trends in industrial automation today is the integration of IIoT devices into SCADA systems and HMIs," said Silvia Gonzalez, director of controls, software and intelligent automation at Emerson. "We're seeing widespread use of smart sensors, energy meters and wireless transmitters feeding data directly into HMI/SCADA platforms. It's a shift that is fundamentally transforming how operations are monitored, visualized and optimized."

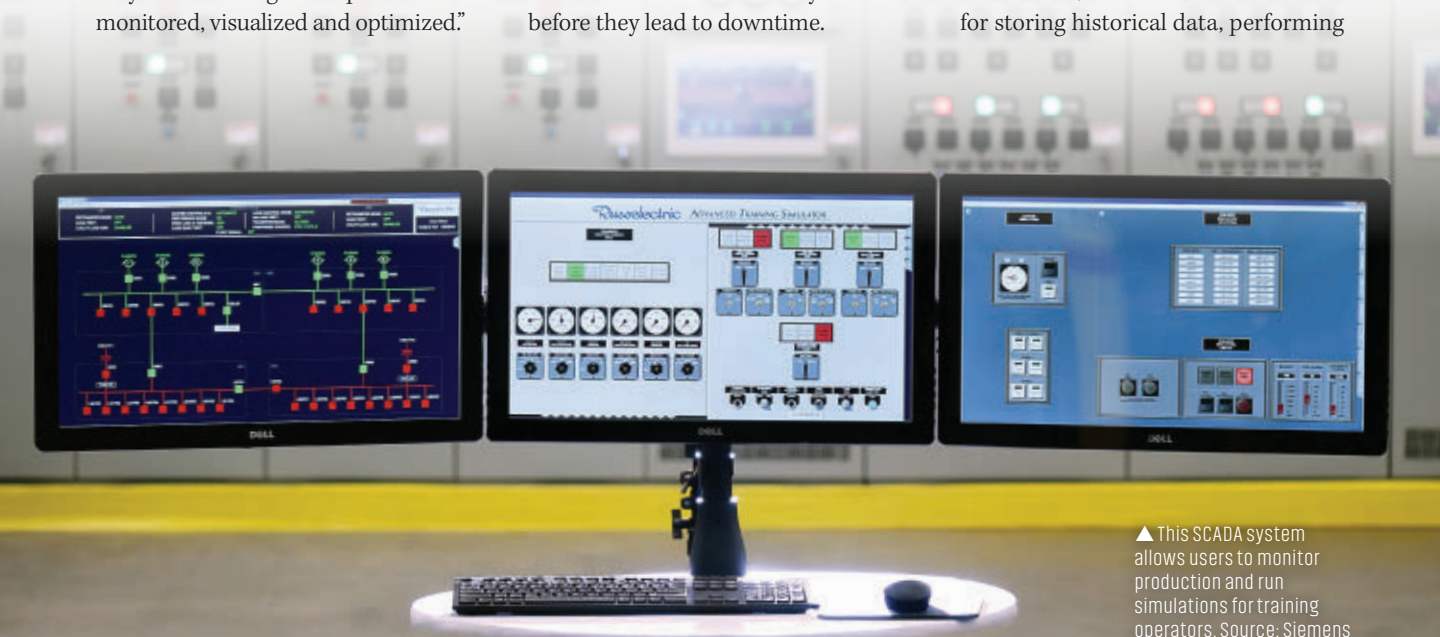
These IIoT devices are generating vast amounts of data, leading to a "need for robust and reliable industrial computing platforms to aggregate, process and visualize this information at the edge," said David Zhu-Grant, director of product management at OnLogic. "By pulling sensor data and analytics closer to where the HMI runtime is located, manufacturing organizations can reduce latency in decision-making and lower overall system costs."

Some of the more common IIoT device integrations with HMI/SCADA involve the use of temperature and vibration sensors attached to equipment and transmitting their data to an HMI. With this information, the equipment anomalies can be more easily detected before they lead to downtime.

Hybrid edge-cloud architectures

Another HMI/SCADA trend is a rising connection to the cloud. "Although the conversation around cloud-based SCADA has gained significant traction, the actual shift from traditional on-premises systems has been more evolutionary than revolutionary," said Zhu-Grant. "Industries with stringent security requirements, low-latency needs or well-established infrastructure will often maintain their core SCADA functionalities on-premises."

For this reason, much of the gradual evolution toward cloud-based SCADA has resulted in hybrid architectures. "In this model, edge computing platforms handle real-time control and data acquisition locally," explained Zhu-Grant. Meanwhile, cloud services are used for storing historical data, performing



▲ This SCADA system allows users to monitor production and run simulations for training operators. Source: Siemens

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In these hybrid architectures, the use of containers enables users to scale from on-premises applications out to the cloud. "This strategy allows manufacturers to harness the scalability and accessibility of the cloud, yet retain the reliability, performance and security required for critical control functions at the edge or on-site," he says. Benefits include better data accessibility, enhanced collaboration and access to cloud-based analytics tools.

Some automation vendors also talk about a two-cloud approach — one public and one private. "Many manufacturing organizations adopt hybrid models that combine the security and control of private, on-premises clouds with the flexibility, scalability and remote accessibility of public cloud platforms," adds Karthik Gopalakrishnan, solutions consultant at Yokogawa.

For an example of technology that supports integrating cloud environments with SCADA, Gopalakrishnan pointed to Yokogawa's CI Server. "This type of hybrid architecture provides secure, low-latency data communication between private and public clouds," he said. "It ensures that critical process control remains robust and provides global access to operational data."

The impact of unified namespace (UNS)

A parallel development supporting edge-to-cloud architectures has been the trend to replace proprietary or legacy protocols with open communication standards like MQTT and OPC UA. "These standards enable the exchange of scalable, vendor-neutral data and support for modern integration patterns such as publish-subscribe messaging," said Gonzalez. "These patterns are essential for managing the complexity of growing device networks."

Another approach gaining traction in edge-to-cloud architectures is unified namespace (UNS), a standardized way to name, organize and access real-time data across an enterprise. "IIoT data is increasingly contextualized at the edge, structured into a UNS, and shared upward with cloud-based SCADA and analytics, such as those offered on Aveva Connect," explained John Krajewski, vice president of product management—operations control at Aveva.

"The rise of UNS enables all IIoT devices, SCADA systems, MES and cloud analytics tools to publish and subscribe to a single, centralized real-time data model," he added. This means that operations, IT and engineering can all access the same real-time data in context.

HMI/SCADA poised for increased use of AI

To date, artificial intelligence has not been widely used in day-to-day SCADA applications. "We have seen AI being used in predictive maintenance and anomaly detection," said Ramey Miller, HMI product portfolio manager at Siemens, "but not as much in process evaluation."

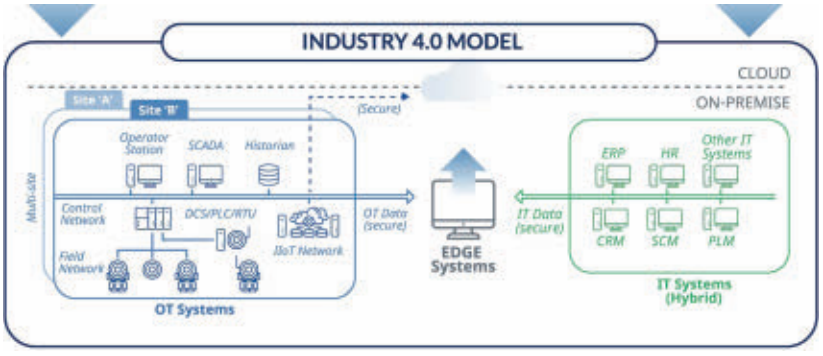
However, some automation companies are beginning to incorporate computing power capable of supporting AI applications. For example, HMIs are being developed with on-device AI inference, adaptive user interfaces and context-aware content delivery.

Although AI has largely been proliferating in SCADA analytics applications, Yokogawa has gone a step further to incorporate it into closed-loop system using its Factorial Kernel Dynamic Policy Programing. "This is a reinforcement AI methodology for solving specific process issues where PID and APC (advanced process control) have been considered but found lacking," said Anu Mahesh, product and industry marketing specialist at Yokogawa. These types of AI technologies will sit on top of SCADA or distributed control systems (DCSs).

Despite the benefits that AI can offer, especially for SCADA-driven analytics, adoption in discrete manufacturing has been slow. "In our experience, most companies are not yet actively implementing AI in their SCADA environments, nor is it a frequent topic in discussions with customers," said Danny Andree, a sales engineer at Emerson. "Although interest is high, actual implementation is still confined to pilots and isolated use cases, mostly within large enterprises."

Challenges such as fragmented data, legacy infrastructure, buy-in from operators, unclear ROI and limited in-house AI expertise are slowing widespread adoption. Even so, Andree said to say tuned. "Momentum is building. The next few years will likely determine how quickly these technologies move from concept to standard practice."

▲ Emerson's Movicon.NExT HMI/SCADA software platform goes beyond just providing basic visualization of a coke oven dust collector (shown). It also supports IIoT integration, offers local and remote user-interface options, supports cybersecure connectivity, and works with on-premises, hybrid, and cloud-based architectures. Source: Emerson



▲ HMI and SCADA applications can readily exchange information with both on-premise and cloud-based platforms. Source: Yokogawa

HMIs become more like smartphones

Yet another trend in HMI/SCADA has been a continued evolution in the design of the HMI itself. "A primary driver has been to make the interface more familiar to users by making it more like their everyday devices — that is, more like their tablets and cell phones," said Miller. The goal is for the familiarity and intuitiveness of the design to help users to feel comfortable using the HMI and streamline training for new workers.

"Touchscreen interfaces have become standard, replacing physical buttons with high-resolution, multi-touch panels that enable faster interaction and greater flexibility," added Andree. This allows users to interact with the HMI through touch gestures like swiping and pinching on the touch screen.

"More experimental, but rapidly evolving technologies, include voice-controlled HMIs, gesture interfaces and augmented-reality overlays," said Andree. These largely experimental approaches permit hands-free interaction and promote safety.

"Voice-based commands and hands-free gesture control are emerging in high-safety or mobile operations," added Krajewski. "But they are not yet widespread in industrial settings."

Meanwhile, the screens themselves have been evolving, too. "High-resolution projected capacitive touchscreens with optical bonding and wet tracking capability are becoming standard," said Zhu-Grant, along with the use of larger screens to allow visualization of more complex datasets with brighter backgrounds to enhance readability in bright light environments. AW

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Is Workforce Automation the Cure for Manufacturing's Talent Woes?

With 1.9 million manufacturing jobs expected to go unfilled by 2033, companies like Nestlé and Merck are turning to AI-powered workforce automation to make workers more effective and create higher-paying roles that appeal to the next generation.

By Beth Stackpole, contributing writer

Effective workforce automation has become an important technology given the challenges of today's industrial business climate. Though the U.S. manufacturing sector has experienced sustained growth post pandemic, more recent global trade and economic conditions have industrial players scrambling to cover more ground with fewer resources.

The key reasons for this scramble: retiring boomers and the reluctance of younger workers to enter the manufacturing field have created a talent and skills crunch that threatens to undermine industry's sustained productivity and revenue growth.

To put this into perspective, there could be as many as 3.8 million net new employees needed in the manufacturing sector by 2033 with around half (1.9 million) of the positions left unfilled unless the skills and talent issue is resolved, according to a 2024 study from Deloitte and The Manufacturing Institute. The scope of the problem is significant, with 65% of survey respondents noting that attracting and retaining talent is their primary business challenge.

Smarter, more flexible and holistic use of automation is crucial to solving these challenges, according to the McKinsey Global Institute. McKinsey research found modern automation technologies applied at scale address industry's talent issue in two critical ways: 1) Automation reduces the number of low-skill roles and eliminates repetitive, manual tasks that can lead to high turnover while 2) creating new higher-paying roles that have greater appeal to the next-generation workforce.

"Finding people for many [manufacturing roles] is getting harder and harder, especially in smaller towns," noted Scott Reynolds, 2025 president of the International Society of Automation and senior manager for cybersecurity at Johns Manville, a manufacturer of insulation and commercial roofing, as well as glass fibers and nonwovens for commercial, industrial and residential applications. "Now that AI is a hot topic, people are more open to talking about how automation can help people do their jobs more effectively. The key is to upskill people and leverage new skills and processes to be more competitive in the market."

Nestle's experience with workforce automation

Historically, workflow automation was associated with automating tasks performed by humans to reduce errors and capture required data. Here, the emphasis has largely focused on "paper on glass" workflow tools, which replicate paper-based processes in a digital format.

But with new capabilities, such as AI-fueled anomaly detection and GenAI assistants, automation's role is expanding to augment the efforts of human workers, helping to boost productivity and performance to new levels, said Keith Chambers, vice president for manufacturing solutions at Aveva.

Unlike a command-and-control scenario, which issues specific instructions and automates a particular set of tasks, Chambers sees a shift to human-centric automation, leveraging technology to serve up everything operators need to know about how to perform a job optimally. Using automation in this manner, workers can operate with greater knowledge and independence, boosting overall productivity and delivering intelligent — and often real-time — insights that facilitate higher-value decision making.

"The big push in Industry 4.0 around lights-out operations has given way to a more human-centric way of work," Chambers explained. This involves "leveraging the capabilities and contributions people can make."

At Nestlé, a critical agglomeration process — specifically, the wetting and drying of powder for beverage products such as Nesquik and Ovaltine — was handled manually, often producing unwanted variabilities in moisture and density. While the process yielded the specified weight criteria, fill levels per container were inconsistent, requiring operators to manually fill jars for a more visually satisfying appearance. This workaround also generated costly waste.

The combination of Aveva Historian, Advanced Analytics and the Connect cloud service enabled Nestlé to use real-time data to predict quality parameters for powder production and recommend optimal setpoints. This helped operators improve product consistency while also decreasing product waste on production and packaging lines, Chambers said.

This automated approach also helped Nestlé achieve the highest quality product output without total reliance on a small cadre of industry experts.

"It would take a 30-year operator to know how to manage the front-end processes to get this level of quality," Chambers explained. "Nestlé was able to achieve this level of quality output with a team [that had been] in place for only a year or two."

The control loop plays a critical role

While it has many potential applications, the workforce automation concept typically lends itself to streamlining the repetitive tasks associated with collecting, analyzing and prioritizing operations and production data. For example, consider the experience of a

▼ The emaint CMMS software helps Havco's crew make smarter decisions about when to repair or replace assets, reducing downtime. Source: Fluke Reliability

◀ PlantESP CLPM software and state-based analytics help users gain visibility into plant operations to optimize production performance. Source: Control Station

food and beverage manufacturer facing challenges in the production of edible oils, where each product variation requires unique settings and configuration tuning to get the best results.

Manual adjustments, predictive modeling and automation of basic configurations helped improve operations and the company's final product, but the changes didn't make a big difference in performance and productivity gains. By implementing Control Loop Performance Monitoring (CLPM) technology with state-based analytics from Control Station, the edible oil processing facility was able to give workers an accurate assessment of operating conditions for each product, boosting their visibility into specific operations and allowing them to make adjustments to fully optimize production performance.

With this software, "they get an actionable list of problems to fix

rather than having to go around and find them or respond to alarms," explained Bob Rice, vice president of engineering for Control Station. "It lets them be proactive."

Merck's use of workforce automation

Pharmaceutical giant Merck is also using workforce automation to elevate its operational availability (OA) and overall equipment effectiveness (OEE) practices. Here, using the Seeq predictive analytics platform has replaced manual processes and after-the-fact downtime reporting with a digital approach that automates and standardizes data, calculations and output.

"Traditionally, you need a lot of people to perform analytics at scale, but our technology lets one person look across many results," noted Joanna Zinsli, product manager at Seeq. "We are enabling [the use of] different types of [workflow] automation so workers can spend less time in manual workflows to see value."

Piloted at a Merck filling facility for vaccines and biologics, the automated OA/OEE tool decreased turnaround variability and facilitated the identification of key improvement opportunities for new materials and turnaround stages. The traditional process required a dedicated manufacturing engineer in each area of the operation to manage the data, perform calculations and visualizations, and do presentations. With this process — and the time it took to go through all those stages — the data was no longer as valuable.

"If you have a really manual process, by the time you get all the data in it's already old, so you're looking at something you can't really act upon," said Henny Hampton, Merck's associate director of data and digital manufacturing.

Reducing unplanned downtime

Workflow automation is also helping Havco Wood Products better manage asset health to reduce breakdowns and unplanned downtime and more effectively manage its spare parts inventory. The manufacturer of oak laminate flooring for trucks and containers hit a wall using manual processes to manage 500 critical assets such as planers, dryers and saws and ensure its spare parts inventory of more than 3,500 stock items was consistently up to date.

Using Fluke Reliability's eMaint CMMS (computerized maintenance management system), the Havco maintenance team now gets data-driven insights that help them decide when to replace an asset or make repairs, proactively. Spare part requirements are automatically added to work orders, which helps the crews show up prepared while reducing downtime.

How to focus workflow automation applications

Regardless of technology, the first step towards successful workforce automation is figuring out exactly what to automate based on a variety of factors, including addressing long-standing pain points in areas like quality, worker safety or unplanned downtime. It's also important to conduct a rigorous cost analysis to determine what delivers the optimal ROI.

From a technical standpoint, organizations need to work through data quality and integration issues as well as cybersecurity concerns — a vector that was not an issue with traditional manual workflows and processes. Integration and connectivity between systems and data silos is particularly important for automation use cases that are heavily dependent on real-time data and analytics. "You can't have silos of data. Everything has to be linked together," said Rice. "It's not one system improving a controller that's important — the ultimate goal is to improve the efficiency of the plant."

> "Regardless of technology, the first step towards successful workforce automation is figuring out exactly what to automate based on a variety of factors, including addressing long-standing pain points in areas like quality, worker safety or unplanned downtime.

As with most transformation initiatives, change management issues are the biggest challenge, and that is especially true when automating worker tasks. Engage the people who are instrumental to the process in the upfront work to determine what can be automated and be transparent about the objectives of every use case, noted Zinsli. It's imperative to put training and skills building initiatives in place so workers are comfortable not only using the software but settling in to redefined workflows.

As use of AI-enabled automation spreads, resolving the trust issue is critical. Pick tools capable of creating reasonable patterns and predictive ways to solve problems, and don't blindly automate. Instead, apply the technology only if it can be shown to improve workers' day-to-day tasks and working conditions.

The most important change management missive is to tamp down the common misconception that AI and automation are all about taking people's jobs. While some jobs will be eliminated, workforce automation is not a zero-sum game. "With the right skills, knowledge and training, a lot of people will be able to take on new responsibilities," said Reynolds. "It's about allowing people in existing roles to do more." AW

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Robot End-of-Arm Tooling Interoperability Cuts Costs and Boosts ROI

Experts from Universal Robots and OnRobot offer insights into how to select versatile end-of-arm robot tools that work seamlessly with different robotic systems. | By James R. Koelsch, contributing writer

The quest for ever more flexibility from industrial automation tech continues — even extending to robots, the kings of flexible automation. For this reason, demand for greater interoperability between robots and end-of-arm tooling (EOAT) has grown.

The good news is that many EOAT suppliers have responded. "There are many end-effectors on the market today offering interoperability between various kinds of robotic systems," said Mike DeGrace, OEM solution sales and head of ecosystem success at Universal Robots. "Some examples include tools from suppliers like Schunk, SMC, Festo, Robotiq and OnRobot.

OnRobot, for example, offers EOAT such as grippers, sanders and screwdrivers that integrate with all major robot brands. "We do this through our One System, Zero Complexity concept," explained James Taylor, chief commercial officer at OnRobot. "It allows our Quick Changer-enabled tools to be exchanged quickly during switchovers between applications or robot brands."

For more detailed insights into robot EOAT interoperability, we interviewed DeGrace (MD) and Taylor (JT).

AW: What are the common challenges for integrating end-of-arm tooling with different robot-arm interfaces and controllers?

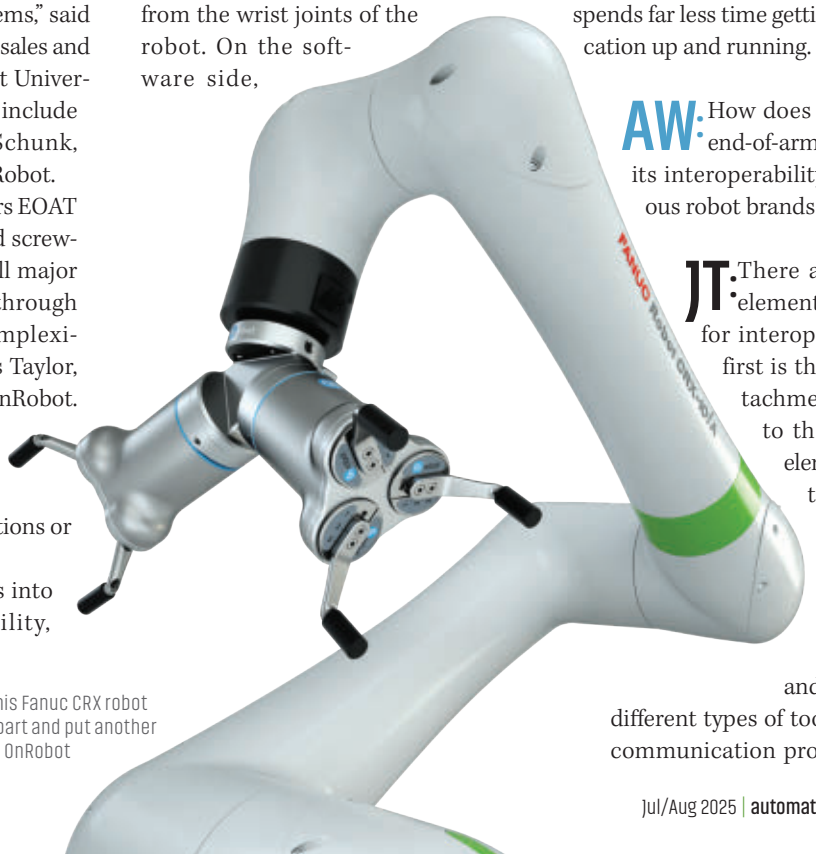
MD: On the hardware side, challenges include the mounting profile from tool to robot flange, the tool size and the fingertip position from the wrist joints of the robot. On the software side, communications present the main challenge. How will the robot interface with the end effector and how will the end-effector be configured in the program? Some brands, such as Universal Robots, give tooling manufacturers the ability to create APIs to simplify configurating end-effectors from the robot's programming interface. Others require more advanced scripting or even separate controllers to configure specific end-of-arm tools.

JT: There are so many different types of robots and specialized tools that many customers face incredible complexity just trying to get all the components to work together, let alone get them programmed for the application. In many cases, this requires additional wiring or custom coding, which dramatically increases the time and cost needed for integration.

Another issue is user experience. If your production team has to relearn how to use a tool every time a different robot is used, you are using valuable time and money. A consistent easy-to-use interface significantly shortens the learning curve, meaning your team spends far less time getting each application up and running.

AW: How does the design of end-of-arm tooling affect its interoperability across various robot brands and models?

JT: There are two main elements to consider for interoperability. The first is the physical attachment of the tool to the robot. This element has both the mechanical and communications component. Many robot brands and models have different types of tool flanges and communication protocols, so it's



▶ OnRobot's Dual QuickChanger on this Fanuc CRX robot uses two 3FG15 grippers to pick up a part and put another in its place in the same cycle.Source: OnRobot

important to harmonize the mechanical interface and communication links. The communications component is a common friction point in tooling integration. Each brand of robot has its own way of handling communication, and if a tool isn't designed to support those differences, integration becomes time-consuming and expensive. Look for tools that are designed to manage these challenges.

MD: The availability of the communication protocols on the robotic platforms being used may affect interoperability. For example, many simple end-effectors may be powered and actuated with discrete I/O, which is available on a wide range of robotic platforms.

JT: Another important element for EOAT interoperability is the user interface for programming the gripper.

MD: An important mechanical standard [related to EOAT interoperability] is the ISO 9409 pattern for the tool-flange connector. (According to ISO, this standard "defines the main dimensions, designation and marking for a circular plate as mechanical interface. It is intended to ensure the exchangeability and to keep the orientation of hand-mounted end effectors.") Incorporating a hardware and software focused approach to interoperability is critical for creating the most flexible form-factor across robotic systems.

AW: What are the top maintenance or calibration considerations for using EOAT on multiple robots?

MD: There are usually hardware and software considerations. Some may include mounting, cabling and dress-pack management, as well as programming considerations and power management. For example: Is the gripper powered pneumatically or electrically? Other maintenance considerations could be the actual gripping mechanisms, such as the rack and pinion, gears or cylinders. Maintaining stock of some common wear parts is always a good idea.

JT: This is highly variable depending on the type of end-of-arm tooling that you are using, especially if it's a custom tool. One of the benefits of a standard, out-of-the-box EOAT is that they require less maintenance. Of course, with any mechanical tool, you need to monitor it for the normal wear and tear that happens over long periods of time.

AW: How does end-of-arm tooling interoperability influence the total cost of ownership for robotic systems?

JT: Interoperability reduces costs at every stage. Using a versatile tool that can be programmed consistently and redeployed across applications quickly avoids duplicating investment and engineering work. It also minimizes downtime during changeovers. In many cases, users cut deployment time from days to hours, which dramatically reduces overall costs and improves ROI (return on investment).

MD: The interoperability of end-of-arm tooling may affect total cost of ownership and ROI of robotic systems, but the results are highly dependent on the application. Some applications require extremely high tool flexibility, while others can take advantage of quick, flexible programming native to some robotic platforms. There are also manual and automated tool changers which can increase interoperability. So, in some cases, tool interoperability may help with the total cost of ownership and decrease the time for realizing a return.

AW: What advice would you give to manufacturers for selecting interoperable end-of-arm tooling?

MD: Users should carefully consider their applications and their approach to automation before specifying any tooling. There are often many programmatic ways to give them great flexibility. For applications that require frequent tool changes, it is important to consider how these tools will be used and replaced by other tools. For example, will there be a tool changer positioned alongside the robotic platforms?

JT: Users need to look for a tool that is best suited for their applications in terms of specifications. Equally important and often overlooked, though, is looking for a tool that is simple and can be up and running quickly. By simplicity, I mean:

- A quick-and-easy connection to your robot.
- Easy to program and adjust to your production needs. A consistent software interface means operators don't have to relearn everything when making changes.
- Electric grippers tend to be more convenient when compressed air is not needed.
- Quick tool-changing capability, so you can swap tools in seconds without slowing down production.

AW: What kinds of partnerships or collaborations on interoperability exist between end-of-arm tooling manufacturers and robot builders?

MD: Universal Robots has an ecosystem of partners that have created pre-integrated solutions on the UR platform. These solutions range from simple peripheral devices, such as grippers and vision systems, all the way up to turnkey solutions, such as palletizers and welders. This ecosystem consists of more than 300 partners and 500 products.

JT: We collaborate directly with leading robot manufacturers to ensure seamless integration with each brand. In many cases, these are plug-ins specific to a robot controller. AW

I/O WITH RESTFUL API

Acromag's BusWorks NT series remote I/O modules now offer a Restful API (Representational State Transfer Application Program Interface) to simplify development of web-based services. The NT I/O module system firmware embeds the API to support reading/writing of I/O data. Web services can use HTTP POST and GET requests to exchange information with the NT's I/O server. NTE Ethernet I/O models have dual RJ45 ports and a webserver allowing remote system controllers to read or write data on connected sensors and actuators. Each I/O module offers up to 16 input or output channels for voltage, current, temperature and relay control signals. Fifteen I/O configurations are available as either NTE Ethernet I/O or NTX expansion I/O models.

Acromag, acromag.com

UPDATED IDE SOFTWARE

The PAC Machine Edition (PME) 10.6 is integrated development environment software used to configure and manage control system devices, including PACSystems PLCs and QuickPanel HMIs. The addition of PACSystems Simulator enables users to write, test and troubleshoot control logic on a PLC emulator. An all-new data monitor component empowers developers to quickly diagnose and resolve logic issues using plotted data, whether the data is sourced from a physical PLC or the simulator. New OPC-UA PAC server and Profinet enhancements accelerate PLC communication performance, with double the tag count capacity, faster startup speeds and improved processing efficiency. Enhanced user-defined types (UDTs) now propagate data element descriptions across all application instances.

Emerson, emerson.com

SCARA ROBOTS

The MELFA RH-10CRH and RH-20CRH SCARA robots have maximum reach radii ranging from 600mm to 1000mm and payload capacities of up to 10kg and 20kg, respectively. The RH-10CRH is designed for transportation and assembly in the food and automotive industries, while the RH-20CRH specializes in handling and packaging heavy items. The RH-CRH series robots' simplified design and use of battery-less motors significantly reduces the number of components, resulting in up to 69% weight reduction compared to previous models. The RH-CRH series also offers tracking operations, support for 3D and 2D vision sensors, and force sensing.

Mitsubishi Electric, mitsubishielectric.com

MANAGED GIGABIT SWITCHES

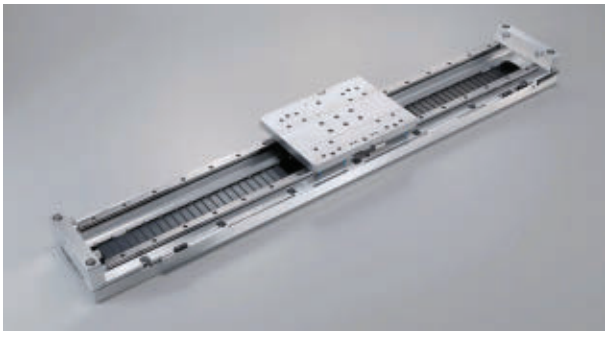
The LMP-2804G-4XS-24-T and LMP-2812G-4X8S-24-T managed gigabit switch models cater to low-voltage industrial networking applications. These models have built-in dual power inputs, which can handle input voltages between 12 and 55V DC. An internal DC-to-DC power boost function increases low input power from 12-36V DC up to the necessary 48-55V DC required by IEEE PoE standards. The low-voltage switch options are available in multiple configurations of 1G/2.5G/10G SFP+ ports, 1G SFP ports and 1G Ethernet PoE+ ports, and feature a shallow 8-in. depth housing to fit in almost any cabinet. They feature a fanless design with an extended operating temperature (-40°F to 167°F) for extreme environments. These models also feature iPoE Budget Control, an intelligent power management technology that dynamically adjusts the PoE budget based on input voltage.

Antaira, antaira.com

INDUCTIVE ANGLE ENCODERS

Flux has released a new 300mm size option for its Ind-Max range of inductive angle encoders for harsh environments. These encoders use inductive technology to deliver non-contact, wear-free measurement. Features include real-time and absolute position measurement, immunity to magnetic and electromagnetic interference, an IP67-rated design, an enhanced temperature range, and broad operating and mounting options. Ind-Max units come standard with thousands of configuration options and are available in sizes ranging from 125 to 375mm OD.

Flux, flux.gmbh



LINEAR MOTOR

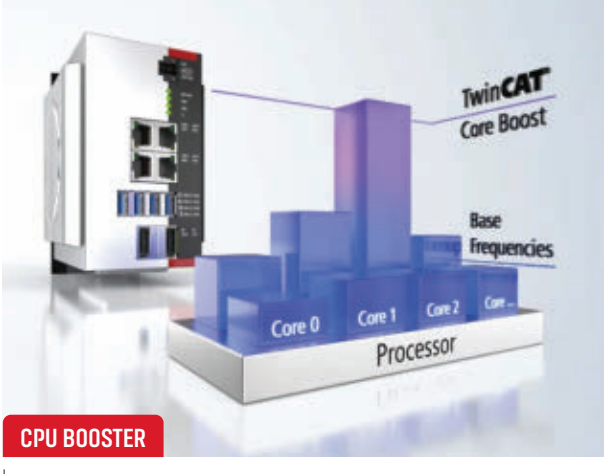
This latest addition to the LT family of linear motor stages delivers 260N of rated force and up to 500N maximum. This linear motor uses direct drive technology that is free of mechanical power transmission parts that can otherwise hinder positioning accuracy. The LT170H2 comes with C-Lube linear bearings for guidance. Additional features and specifications include high speeds up to 3,000mm per second, a low cogging motor design, reduced cycle times, strokes up to 2750mm, a 170mm width and low power consumption.

IKO, ikont.com

STEPPER DRIVES

AutomationDirect has added the new Titanio series of stepper drives from Ever Motion Solutions that work with AutomationDirect SureStep stepper motors. Unlike typical stepper drives, Titanio steppers can detect stalls in open-loop control mode by monitoring the motor's back EMF. The Titanio drives use sinusoidal current control to provide smooth motor movement with reduced audible noise, significant dampening of vibration and resonances, higher system efficiency and increased, more consistent torque output at all speeds. The LW3A model is a high-bus-voltage unit that accepts 100-240V AC power input and is compatible with all STP-MTRACx series high-bus-voltage stepper motors. Ever Studio configuration software (a free download) allows advanced configuration of the LW3A and LW4D stepper drives, including the setup of additional micro-stepping resolutions.

AutomationDirect, automationdirect.com



CPU BOOSTER

TwinCAT Core Boost increases the computing performance of individual real-time or user-mode cores up to 50% by enabling users to configure the clock frequency of individual processor cores. The clock rate per core can be defined for real-time transmission and user-mode applications. Individual cores can operate permanently and in real-time using this turbo mode. TwinCAT Core Boost monitors the permitted power consumption and temperature of each processor core (and of the overall system) to ensure reliable operation even when turbo mode is used. TwinCAT Core Boost supports all Beckhoff industrial PCs with Intel Core I processors from the 11th generation onwards.

Beckhoff, Beckhoff.com

IOT CONTROLLER

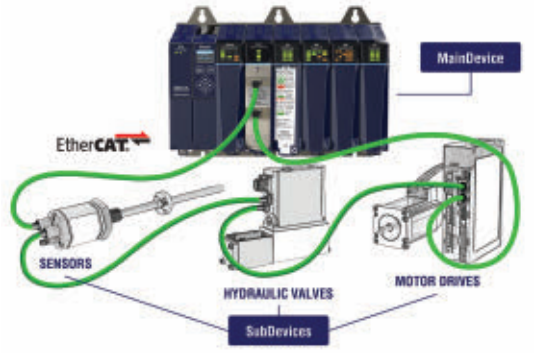
The iEP-7040E Series Industrial IoT Controller is powered by Intel Core Ultra 200H Processors (Arrow Lake-H), with integrated AI-optimized CPU, GPU and NPU technologies. Key capabilities include built-in Intel Arc Graphics for enhanced visual computing, NPU for dedicated AI acceleration, as well as Intel In-Band ECC support for mission-critical edge processes. The iEP-7040E Series offers an adaptive I/O and expansion architecture, supporting 4G LTE, 5G, Wi-Fi 7/6E and Bluetooth 5.4. It features a rugged, fanless design with an operating range of -25 to 50°C and 9-36V DC power inputs.

ASRock Industrial, asrockind.com

DELTA ROBOT

The DR1000 four-axis delta robot from igus has a 1,000mm working diameter and an additional rotary axis that provides four degrees of freedom. Its pick rate of 96 picks per minute makes it suitable for end-of-line pick-and-place operations as well as conveyor belt picking or stacking tasks in three-dimensional spaces. The DR1000 has a modular design for integration into existing automation systems and can be equipped with a gripper or suction cup to execute complex tasks. Each axis can be operated with individual motor controllers or optional igus Robot Control (iRC) software.

igus, igus.com



UPDATED MOTION CONTROLLER

Delta Motion announced the addition of EtherCAT MainDevice capability to its RMC200 Motion Controller for connecting to and controlling any devices needed for high-performance hydraulic and electric motion control in industrial applications. The RMC200 can handle up to 50 axes of position and pressure control and supports any combination of directly connected and EtherCAT I/O. For example, on machines incorporating both hydraulic and electric motion, users may choose EtherCAT-enabled drives for electric axes, paired with traditional directly connected servo-proportional valves and feedback sensors for the hydraulic axes.

Delta Motion, deltamotion.com

LINEAR POSITION SENSORS

NewTek's NT-HL-750 LVDTs are linear position sensors certified for safe operation in hazardous locations with explosive gases, vapors, dust and other dangerous substances. Approved by Intertek Testing Laboratories and carrying the ETL mark, these LVDTs are intrinsically safe for use in Class I, Zone 0 and Zone 2 areas. Constructed with stainless-steel and featuring a welded ¾-in. hermetically sealed housing, these sensors are rugged, robust and resistant to shock and vibration. The NT-HL-750 LVDTs can measure from +1.0 to +10 inches and operate effectively in temperature ranges from -65°F to 275°F. They are available with either radially or axially mounted connectors, and electrical connections are made via lead wires exiting from a 1/20-in. NPT fitting.

NewTek, newteksensors.com

MEDIUM VOLTAGE MOTOR

ABB's MV Titanium concept is a medium-voltage (MV) motor in the 1-to-5-megawatt (MW) range that brings the benefits of energy efficiency to MV motor-driven processes, which use 10% of all the world's electricity. This motor offers energy savings of up to 40% for pumps, compressors, fans and other applications across multiple industries. Additionally, it has built-in intelligence with analytical and connectivity capabilities for integration into existing systems, as well as providing software libraries and interfaces for process monitoring and optimization.

ABB, abb.com

MULTI-FUNCTIONAL DRIVE

The new Frenic-Mega is a 3-in-1 multi-functional inverter that helps reduce energy use. Features include a fan/pump function, UL12 type heatsink, Frenic mobile loader, network communication and a UL61800-5-1/2 rating, as well as expanded power ratings and flexible configurations that support 1/2 hp up to 1,000 hp. Additional features include 14 new functions including customizable logic, PID control with 4 PIDS and prevention of filter clogging.

Fuji Electric, fujielectric.com

STEPPER MOTORS

The ASI8100 stepper motor combines a stepper motor, stepper motor output stage and fieldbus connection in an integrated design. These EtherCAT devices mount directly on the machine without a control cabinet or upstream I/O, allowing for highly compact, control cabinet-free machines. The ASI8100 series covers all motion requirements for stepper motors in the power range up to 250W. Easy-to-read status LEDs report drive conditions. Pre-assembled cables and infrastructure components, such as IP67 distribution box modules, are available as accessories.

Beckhoff, beckhoff.com

VARIABLE SPEED DRIVES

ABB's new ACS880 high-speed VSDs are designed to maximize the efficiency of high-speed motor applications while minimizing output current derating. They are designed for use with turbo blowers and compressors requiring an output frequency of up to 1500Hz. The ACS880 high-speed drives feature a standard choke for harmonic filtering. With frame sizes available from R1 to R11 up to 880A, the ACS880 drives are customizable to meet specific power, voltage and space requirements, resulting in greater energy efficiency, cost savings and CO2 reductions.

ABB, abb.com

UPGRADED CPU

Simatic S7-1500 CPUs for motion control have been upgraded to firmware version 4.0, which increases the performance, programming and data memory. Motion control runtime is increased by a factor of up to 2.5x. Communication performance is also considerably improved, resulting in higher data throughput and greater determinism of the user program. The CPUs' motion control resources are substantially increased to address applications ranging from speed, positioning and following axes to cams, cam tracks and measuring inputs. Typical number of positioning axes supported range from 115-205 at 4 ms servo/ipo cycle time and 35% CPU load due to motion control.

Siemens, siemens.com

SERVO FIRMWARE UPDATE

The MELServo-J5 Servo Series now supports EtherNet/IP and EtherCAT, enabling network switching without extra hardware. The series comes with pre-configured instructions and compatibility with popular controllers such as ControlLogix and CompactLogix. MR-J5 features include: auto tuning to control vibration and overshoot; advanced vibration suppression control to suppress low-frequency vibrations of approximately 100Hz or less generated at the end of an arm and in a machine; a machine resonance supression filter for frequencies between 10Hz and 8000Hz to improve machine vibration suppression performance; and an MR-CM simple converter that uses regenerative power through a common bus connection to save energy and reduce the number of molded-case circuit breakers and magnet contactors.

Mitsubishi Electric, mitsubishielectric.com

SAFETY WHEEL DRIVE

IDEC Corporation is expanding its ez-Wheel product family with the new SWD Safety Wheel Drive. The SWD combines wheels, gearboxes, motors, encoders, controllers and power systems into a single, compact and maintenance-free system, reducing component count by up to 50%. With a modular architecture enabling it to flexibly scale as needed, the SWD reduces engineering time. The SWD is available in a light/medium SWD 125 model or a heavy-duty SWD 150 model, both with a load supporting cast iron frame. A shockproof IP66 housing protects its internal electronics and ensures the SWD is adaptable for a range of applications.

IDEC, idec.com

SERVO MOTORS

The 1SA family of servos feature advanced motion safety functions to enable risk reduction strategies and machine downtime reduction. The 1SA servos help improve overall equipment effectiveness (OEE) while keeping people safe and improving productivity by enabling manufacturing and maintenance to occur without machine stoppage. It also maintains machine control during unexpected shutdowns and provides zero-loss production with a synchronized emergency stop. The Sysmac Studio automation software enables standard and safety control to be designed and simulated in a sequential manner.

Omron, omron.com

COBOT TRANSFER UNIT

The Thomson Movotrak CTU (cobot transfer unit) 7th axis ships as a kit, including the linear units, gearhead, motor, drives, control box, software, end-of-stroke limit switches and cable management. The CTU features a Kollmorgen servo motor and linear-unit-driven guide rails that move a cobot assembly from one task location to another – up to 10 meters. It also provides collision detection that stops the cobot when it encounters an obstacle. Users can adjust collision sensitivity settings on a control tablet during setup, and the Movotrak CTU motor drive and digital I/O manage collision monitoring and shutdown. Like the freedrive of cobot joints, the Movotrak CTU 7th axis freedrive functionality enables hand-driven setting of linear waypoints during programming. Users manually slide the cobot where they would like it to be in a sequence along the 7th axis and register it with a push button.

Regal Rexnord, regalrexnord.com

MOTION CONTROLLER

The Modicon M660 is an industrial PC motion controller that enables integration of control, data processing and communication in any application where real-time control, low latency and immediate decision-making are crucial. Programmed through EcoStruxure Automation Expert–Motion Module, the single engineering environment simplifies the connectivity of advanced data-driven functionalities such as artificial intelligence, machine learning and digital twin development. Features include: multi-core processor Intel 13th gen (U300, i3, i5, i7), 64 bit system, multiple field connections and interfaces, up to 64 GB RAM, Sercos for synchronized motion control, and cybersecurity protections such as: ISO 13849 and IEC 62061, safe stop categories 0,1, 2; TPM (Trusted Platform Module); ready for CRA (Cyber Resilience Act); and is IEC 62443 4-1 and 2 compliant.

Schneider Electric, se.com

GEAR UNIT

The W..9HG Spiroplan right-angle gear unit is a compact unit for slow speed, high-torque applications. With gear ratios greater than 2,000 and output torque capabilities up to 600Nm, the W..9HG series provides the high gear reduction required for extremely low output speeds. Compared to traditional compound gear units, the W..9HG is up to 27% shorter and 34% lighter, without sacrificing output torque or durability. With optimized tooth geometry and low internal friction, the W..9HG runs significantly quieter than worm gear equivalents or bevel-helical configurations for applications in noise-sensitive environments.

SEW Eurodrive, seweurodrive.com

MEDIUM VOLTAGE DRIVE

The ACS8080 can achieve up to 98% efficiency. It also reduces harmonic distortions by around 50% compared to classic control and modulation systems. The modular design allows for use of an external transformer and selection of a sine filter option for new applications and retrofitting existing drive systems or direct online (DOL) machines. Enhanced sensing capabilities and next-generation control hardware enable the collection of up to 10 times more diagnostic data for improved monitoring.

ABB, abb.com

Nikhil Makhija

Vibe Coding: How Natural Language Programming is Changing Manufacturing Software Development

Vibe coding is an application of AI for code generation that converts clear instructions into functional code, enabling non-technical staff to create applications for tasks such as predictive maintenance and quality control.

The term "vibe coding" was coined by computer scientist Andrej Karpathy, co-founder of OpenAI, in 2025 to describe an AI-based development process that turns human instructions into code using natural language inputs. This method is built on large language models and AI tools including ChatGPT, GitHub Copilot, Replit and Cursor. The platforms operate to understand user commands while offering code recommendations along with real-time task automation and issue resolution capabilities. Vibe coding also extends into agentic AI when those assistants are empowered to take multi-step actions autonomously. In effect, vibe coding encompasses both LLMs and agentic AI, with an emphasis on the shift from rigid programming to natural language-driven, goal-oriented workflows.

Why vibe coding matters for manufacturers

Vibe coding creates a system which allows production engineers, operational staff and even non-technical personnel to express their needs using everyday speech for the AI to produce the necessary software components.

For example, a production manager can instruct an AI assistant with the following command: "Build a monitoring dashboard to check machine temperatures while alerting when any measurement exceeds 80°C." The AI system would automatically produce the required programming code which allows users to deploy new solutions quickly because developer resources are not limited by a lack of time.

Some of the most immediate applications for vibe coding in the manufacturing industries include:

- Equipment failure prediction through sensor data analysis.
- Vision-based inspection systems, using the command "detect surface defects on product X using camera feeds."
- Automatic management of inventory tracking alongside demand forecasting and logistics operations.
- Create intuitive dashboards and control panels.

The vibe coding workflow

Following is the workflow process using vibe coding to create a program:

1. Select an AI coding assistant: Choose a platform such as Replit, GitHub Copilot or Cursor based on technical needs and integration requirements.

2. Define the requirements: Clearly state the desired outcome in plain language.

3. Review and refine: The AI produces initial code, which is then reviewed and refined by human experts. This iterative process ensures that the software meets operational and safety standards.

4. Deploy and monitor: After final review, the code is deployed in the production environment. Continuous monitoring and feedback help further optimize the solution.

Vibe coding challenges and considerations

While vibe coding offers significant advantages, it is not without challenges. The most critical ones are:

- **Code quality and security:** AI-generated code may contain vulnerabilities or inefficiencies. Studies show that AI-generated code snippets have security flaws, underscoring the need for human oversight and rigorous testing.
- **Complexity limitations:** Vibe coding excels at standard tasks but may struggle with highly specialized or novel technical challenges that require deep domain expertise.
- **Dependence on training data:** The quality and relevance of AI-generated code depend on the data used to train the underlying models. Outdated or biased data can lead to suboptimal solutions.
- **Human oversight required:** True creativity, goal alignment and critical thinking remain the domain of human experts. Vibe coding should be seen as a collaborative tool, not a replacement for skilled engineers.
- **Regulatory compliance**: For industries such as pharmaceuticals and medical devices, where software development must adhere to strict regulatory standards, vibe coding introduces additional challenges. For example, AI-generated code used in systems subject to FDA 21 CFR Part 11 regulations must be thoroughly validated, documented and audited to comply with Part 11 requirements, including maintaining audit trails, ensuring data integrity and implementing proper access controls. AW

Nikhil Makhija is a member of MESA International and an SAP Manufacturing Suite expert with more than 16 years of specialized experience in optimizing manufacturing processes with SAP solutions.

Kelly Collins
Principal engineer
Concept Systems

Why Now Is the Time to Plan Servo Drive Upgrades

When key automation technologies, such as servo drives, are discontinued, manufacturers face critical decisions. Adopting a proactive approach to upgrades offers performance improvements and reduced downtime risks versus reactive replacements made under pressure.

Servo drive technology continues to evolve, and with this progress comes inevitable product lifecycle changes. For example, at the end of 2025, Rockwell Automation's Kinetix 6000 servo drive model series will be officially discontinued, following several years of phased discontinuation across the product line.

This shift raises important questions for plant managers, engineers and maintenance teams: How long can we rely on an aging motion control system? What are the risks of waiting to upgrade? And how can we approach the upgrade process in a way that minimizes disruption to production?

For many operations, the first signs of challenge come in the form of replacement parts. As discontinued components become harder to source, downtime risks increase. Even refurbished parts — sometimes the only option — carry uncertainty in both availability and reliability. Unplanned downtime tied to a failed servo drive can translate to significant production losses, especially in high-throughput environments.

The modernization opportunity and challenge

But the challenge of obsolescence also brings an opportunity. Newer servo drive platforms, such as the Kinetix 5700, introduce improvements not just in availability but also in performance, scalability and integration. These systems offer higher performance motion control, improved diagnostics and support for integrated safety features. They also align more seamlessly with modern network architectures like EtherNet/IP, simplifying overall control system design.

These benefits can help manufacturers reduce downtime, improve system reliability and better align with digital transformation initiatives.

Key improvements that can be obtained with newer servo drive platforms. Source: Concept Systems

The upgrade process, however, is not a direct hardware swap. Transitioning from older platforms requires evaluation of existing PLC capacity, network infrastructure and software compatibility. Manufacturers should expect that at least some PLC programming changes will be necessary due to differences in data structures and communication protocols.

Planning ahead for such changes allows teams to address these technical considerations on their own schedule, rather than under the pressure of a failure-driven replacement.

A key advantage of proactive planning here is that necessary PLC code updates can often be performed offline while the system remains in production. The PLC code can also be tested with the physical hardware prior to installation onsite, although the level of testing that can occur offsite depends on the complexity of the system and how much can be replicated.

While much of the existing code can often be reused, certain pieces inevitably need to be modified due to different tag data types and control structures. By testing and validating code ahead of installation, teams can significantly reduce the risk of unexpected downtime during the switchover.

Beyond mitigating downtime risk, proactive planning enables manufacturers to align an upgrade with broader operational goals. Whether that involves expanding capacity, improving diagnostics or positioning for future automation initiatives, the choice to modernize motion control systems can support long-term productivity and flexibility.

For plants still operating legacy servo drive systems, now is an opportune time to begin evaluating upgrade paths. By understanding the technical requirements and potential benefits early, manufacturers can make informed decisions that protect both their uptime and their ability to adapt in the years ahead. AW

Kelly Collins is principal engineer at Concept Systems, certified members of the Control System Integrators Association (CSIA).

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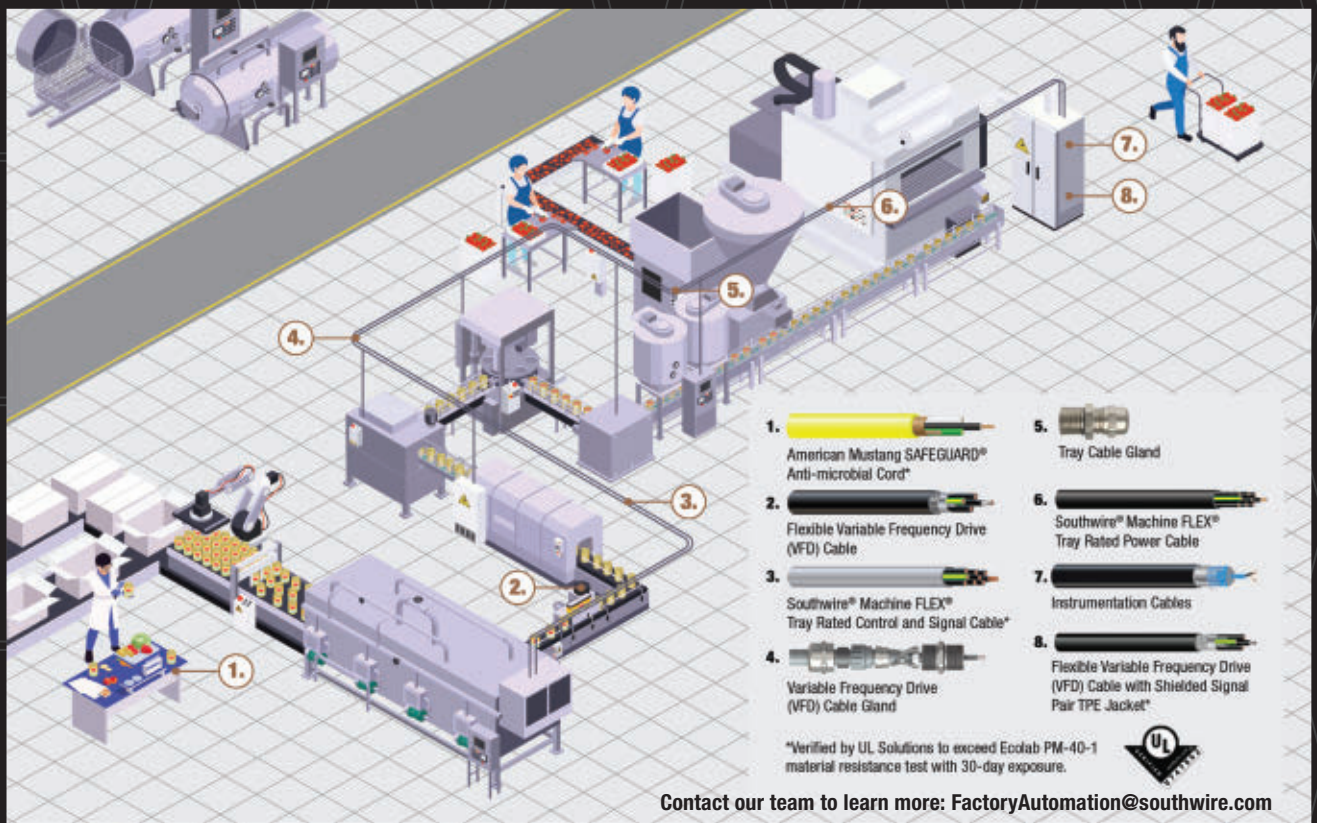

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