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The Practical Side of AI

Beyond the hype, artificial intelligence demonstrates tangible results for shops of all sizes

Karen Haywood Queen Nov 24, 2025 8 min to read

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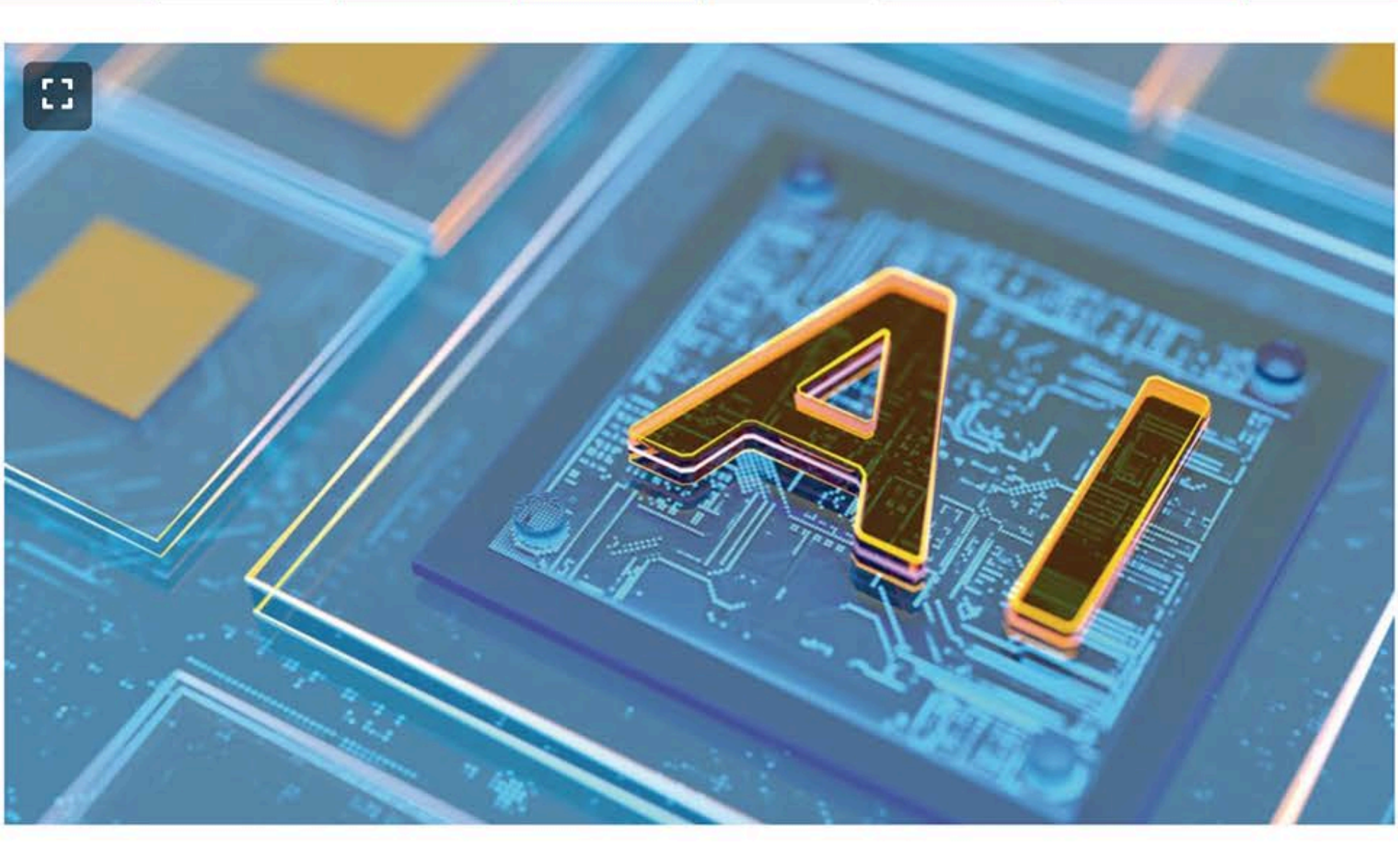

Practical applications for artificial intelligence are improving efficiency, quality and safety in manufacturing—and making factories more dynamically adaptive.

Key Takeaways

1) Quality control, improved design and predictive maintenance are top use cases for AI.

2) Artificial intelligence makes manufacturing more resilient and adaptive.

3) AI doesn't replace good judgment, it enables better decision-making.

“We are entering a new era where AI and generative AI are no longer just supportive functions, but drivers of production outcomes,” says Richard Howells, vice president of solution management for enterprise resource planning (ERP), finance and supply chain management at SAP SE.

“AI's most significant returns are coming from its ability to make manufacturing not just more efficient, but more adaptive,” adds John Davis, CTO of Global Shop Solutions Inc. “Predictive maintenance and intelligent quality control reduce unplanned downtime and defects, but the deeper value comes from AI's ability to anticipate disruptions before they materialize.”

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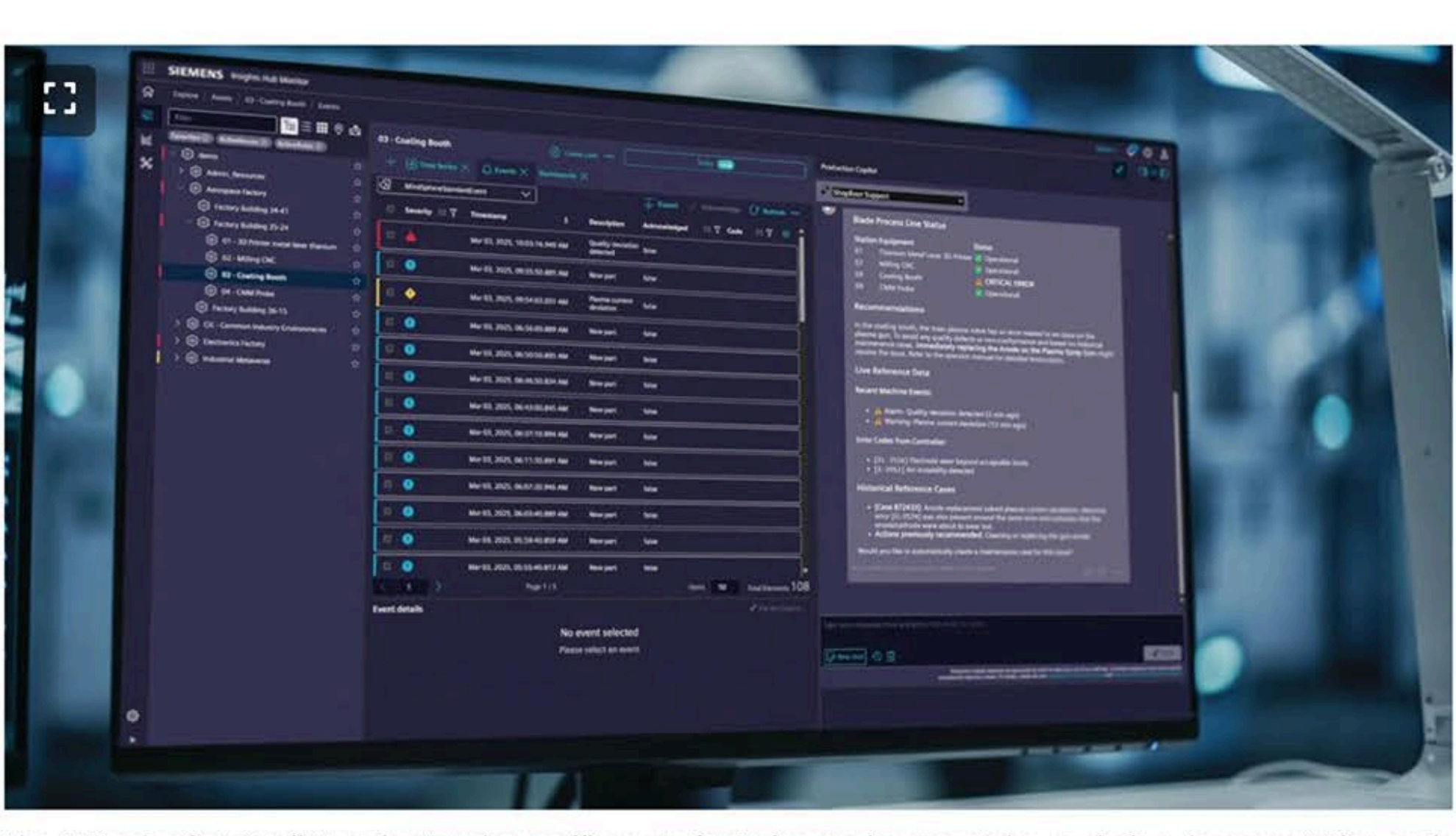
For example, AI-driven supply chain orchestration allows manufacturers to reroute goods, reallocate inventory and shift production in real time when conditions change. AI also embeds foresight into every decision, from optimizing energy use to meeting sustainability targets.

“Manufacturers that apply AI in these high-impact areas are building more resilient, competitive operations for the future,” Davis says. “It's a competitive differentiator that turns operational excellence into strategic resilience.”

Several manufacturing sectors, including automotive, aerospace, electronics and pharmaceutical, are adopting AI with a good return on investment (ROI), observes Mat Gilbert, director of AI and data at Synapse, which is part of the consulting firm Capgemini Invent.

Overall, AI's integration into manufacturing delivers significant ROI through multiple avenues, says Shirley Segev, director of marketing for the digital manufacturing division of Siemens Digital Industries Software.



The AI Production Copilot understands specific manufacturing environments by analyzing documentation and pulling insights from real-time machine and operations data.
(Provided by Siemens)

“AI drives productivity gains by automating tasks and providing intelligent assistance, leading to higher output per engineer and operator,” Segev says. “Operational costs are reduced thanks to predictive maintenance, optimized scheduling and early quality-issue detection, minimizing downtime and waste. Manufacturers also achieve a faster time-to-market by streamlining planning and execution, alongside accelerated training for new personnel. Furthermore, AI ensures enhanced quality and consistency by reducing defects and delivering high-quality products. Ultimately, these cumulative effects lead to a more efficient, agile and high-performing manufacturing operation that is both resilient and consistently delivers quality.”

Streamlined Operations

At Bosch Power Tools GmbH, the process for handling millions of service tickets every year was bogged down by hundreds of static routes that frustrated both teams and customers. After replacing rigid, rule-based routing with SAP's intelligent automation, Bosch reduced workflow complexity, accelerated response times and improved first-touch resolution rates, cutting adjustment times from weeks to minutes, Howells says.

Consider a production manager who notices late orders. With an ERP system, that manager has hundreds of standard reports and dashboards at their fingertips on everything from on-time delivery to inventory accuracy, Davis says. That's valuable information, but limited only to what happened—not how or why.

“AI takes it several steps further by identifying why it happened and what's likely to happen next,” Davis explains. “Instead of manually digging through dashboards, a query to AI could reveal, ‘Delays occur when machine number 12 runs at 80% capacity, which happens whenever parts from supplier X are in use.’ That's a level of correlation no single report can show.”

Supercharged Predictive Maintenance

AI models analyze data from sensors on machinery to predict when maintenance will be needed. For example, General Motors Co. uses machine learning to predict malfunctions across its robotics and conveyor systems, Gilbert says.

“This proactive approach reduces downtime and maintenance costs,” he notes, “and can also be integrated with external systems, like a CMMS (computerized maintenance management system), to automatically create tickets and schedule technician time.”

By layering AI onto ERP, manufacturers can move from reactive reporting to predictive decision-making.

“The ERP provides the structured foundation of accurate data, while AI brings the analytical horsepower to connect the dots, automate insights and drive smarter scheduling, purchasing and production strategies,” Davis explains, noting that manufacturers shift from requesting another report to unlocking answers to questions they didn't know to ask.

That shift allows shops to move from fixed maintenance schedules or past experience to accurate, predictive data when deciding when a machine needs service.

Take a CNC machine, for example, that generates an enormous stream of information, including vibration patterns, temperature fluctuations, tool wear and cycle times. AI can analyze the sensor data in real time and detect when something is starting to drift. A spindle vibrating outside its normal pattern is an early warning sign that maintenance is due, long before an operator would notice.

“Airlines already use this approach with jet engines, where the volume of data is simply too great for humans to process,” Davis says. “By bringing that same predictive capability into the manufacturing environment AI can help shops avoid costly breakdowns, extend machine life and keep production flowing smoothly.”

More Than Efficiency

To see success with AI, manufacturers need connected technology that goes beyond isolated efficiency gains, Howells says. “By breaking down silos and contextualizing data, AI insights can drive action in real time. At SAP, our focus is on embedding AI into end-to-end manufacturing and supply chain processes, enabling companies to operate as truly intelligent enterprises.”

Moreover, what once took hours to analyze now can be done in mere seconds. “The leap is massive,” Davis says. “But more important than speed is accessibility.”

Getting insight from ERP sometimes requires running complex reports or knowing structured query language, creating a barrier between decision-makers and the data they need.

“With AI, managers can simply ask, ‘Which orders are behind schedule?’ or ‘Where are my bottlenecks today?’ and get an immediate, plain-language answer,” Davis says. “Sales reps, managers and even shop-floor supervisors don't need to hunt through tables or request custom reports—they just ask and act. That kind of real-time, natural-language access means decisions are made faster, customer communication is more accurate and opportunities to improve are caught in the moment, not weeks later.”

Barriers to Entry

Depending on the application, the barrier to entry can be high, according to Al Whatmough, CEO of Toolpath Labs Inc. in Bedford Heights, Ohio.

“Generative artificial intelligence has proven particularly useful for applications like lightweighting and additive design, where advanced algorithms generate part geometries that a human likely would not have considered,” Whatmough says. “But those use cases typically require manufacturers to adopt an entirely new workflow, which is a high barrier to entry for most shops.”

AI also makes an immediate impact in areas that don't require a complete overhaul of how a shop works.

Toolpath CEO Al Whatmough in the Toolpath shop in Ohio where software is tested.
(Provided by Toolpath)

“The real value right now comes from automating the repetitive but essential tasks—such as estimating job cost, identifying which tools are needed and recommending machining strategies based on a shop's existing equipment,” Whatmough says. “These are areas where artificial intelligence can slot into the current workflow and quietly remove friction without demanding that the entire process be rebuilt from the ground up.”

Beyond the Shop Floor

AI systems use real-time data from sensors to update digital twins, allowing for simulation, analysis and optimization of the physical part without disrupting production, Gilbert says. For example, Tata Steel Ltd. uses digital twins to improve energy efficiency.

As far as workforce training, generative AI delivers interactive, tailored experiences to speed skills development and improve safety compliance on shop floors, according to Howells.

Segev adds, “Crucially, AI bridges the knowledge gap by effectively transferring institutional expertise to a new generation of workers.”

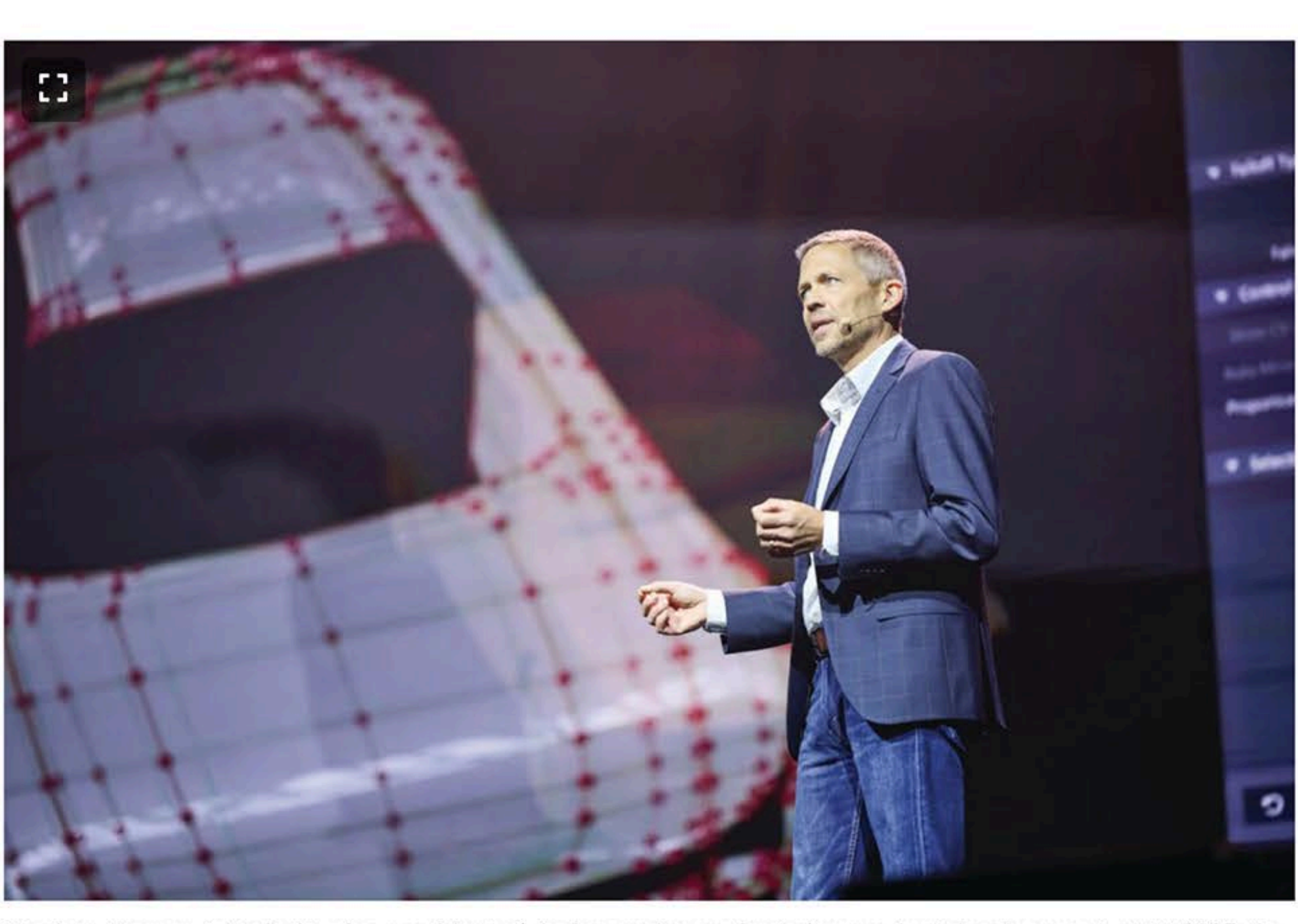
Job quoting can also be a bottleneck—and AI can improve and speed up the process. For example, a Toolpath customer had a quote package that would have taken 40 hours, Whatmough says. With Toolpath, the quote took three hours.

“The greatest ROI is in helping shops say no to the wrong work,” he confides, “and filtering the right, profitable work into the shop.”

Improving Design

Another area AI powers efficiencies is design, says Stephen Hooper, vice president of design and manufacturing product development at Autodesk Inc.

“With tools like Alias Form Explorer, generative AI learns a brand's historical design language, allowing automotive OEMs to rapidly explore new concepts while maintaining brand identity,” Hooper says. “Designers can collaborate with AI to iterate faster and ensure every design balances styling and performance. Real-time aerodynamic simulation powered by AI means designers understand the implications of form on function as they work.”



Stephen Hooper, Autodesk's vice president of design and manufacturing product development, at AU 2025: the Design & Make Conference (Nashville), discusses the future manufacturing in an era defined by AI.
(Provided by Autodesk)

Autodesk's Fusion automated drawing tools use AI to generate 2D documentation from 3D models, saving engineering teams significant time, with as much as 40% of their effort previously spent on manual documentation.

Transforming Quality Control

AI-powered quality and sustainability improvements use computer vision to detect defects earlier and help manufacturers optimize energy use, reduce scrap and predict environmental impact.

Davis contends that one of the strongest applications of AI in manufacturing is visual quality control. Using AI-powered image recognition, a camera on the line can compare each finished part against engineering drawings or gold-standard samples. AI instantly identifies subtle defects—such as small surface scratches, dimensional variances and assembly misalignments—that a human inspector might miss after hours on the job, he adds.

“Instead of depending solely on manual inspection, manufacturers can train AI to serve as a tireless second set of eyes,” Davis says. “This reduces costly rework, ensures only conforming parts move downstream and strengthens customer trust. In industries where quality cannot be compromised, such as aerospace or medical devices, automated defect detection powered by AI isn't just helpful; it's transformative.”

But not every defect is a deal-breaker—it depends on tolerances, Davis cautions. With well-defined dimensional and geometric tolerances, AI can be trained to separate cosmetic imperfections from true quality failures.

“For example, a paint finish with a small blemish may still pass customer requirements, while a hole drilled even half a millimeter off-spec is unacceptable,” Davis explains. “Instead of simply flagging the (imperfect) part, AI can classify the issue against tolerance thresholds. That means fewer unnecessary rejects, better scrap management and a sharper focus on the defects that actually matter. AI acts as a digital quality agent on the assembly line—ensuring every part that ships meets the standards that define quality, without over-policing minor imperfections.”

Enhanced Scheduling

Dynamic production scheduling adjusts plans in real time based on supply availability, workforce changes or market shifts, Howell says.

AI can make scheduling smarter by constantly learning from how jobs actually flow, Davis adds. If historical data shows machine X consistently runs faster on certain part families, AI can adjust future schedules accordingly.

If customer orders shift midweek, AI can dynamically re-sequence jobs to protect delivery dates.

“Instead of reacting to problems, the scheduler becomes a proactive, self-optimizing system helping shops maximize throughput while keeping promises to customers,” Davis says.

Barriers to Implementation

While the technology is ready, many experts say the biggest barrier to success is leadership. AI projects often fail due to a lack of clearly stated goals and change management strategies.

“The biggest challenge is cultural, not technical,” Whatmough says. “A lot of shops operate with deep knowledge and hard-earned intuition. There is pride in how things have always been done, and that pride is absolutely justified But that same pride can create resistance to adopting new tools.’

While there's a fear that artificial intelligence will replace people or eliminate craftsmanship, Whatmough says the opposite is true in reality. “Artificial intelligence gives people better tools so they can spend more time doing the parts of the job that matter most.

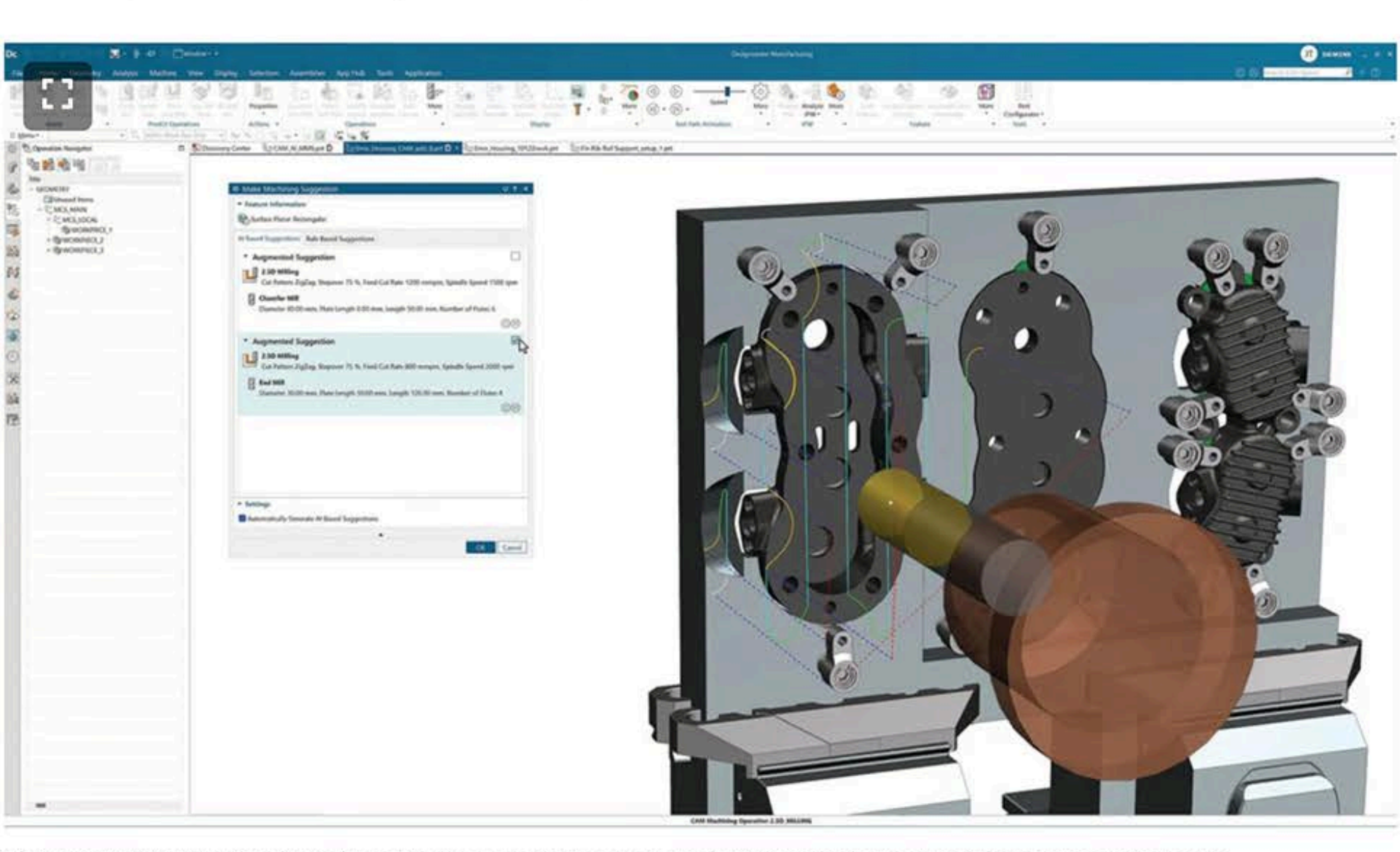
“We are not trying to change what makes machining special,” he continues. “We are just trying to take the strain out of the process and reduce the mental load. Artificial intelligence is a force multiplier for good judgment—it does not replace it.”

Making AI Work

For manufacturers, the key is to start small and go for quick wins, Davis advises. Target areas with measurable value, such as reducing machine downtime, improving on-time delivery or eliminating reporting bottlenecks. Once users see AI saving them time or helping them make better calls, he says, adoption snowballs.

“Manufacturers don't always know up front where AI will deliver the most value,” Davis says. “Sometimes the biggest wins show up in unexpected places, like smarter scrap management, improved quoting accuracy or predicting cash flow.

“The best way to discover opportunities is to start experimenting. Use AI to answer one or two business questions, see how it performs, then expand. Over time, AI becomes not just a tool, but a trusted partner in decision-making, helping manufacturers move faster, run leaner and stay competitive in an industry that never stops evolving.”



Siemens' NX CAM Copilot gives users access to an AI assistant to help them quickly program parts.
(Provided by Siemens)

Looking ahead to 2026, pilot projects will scale into full-scale production, Gilbert predicts. “As organizations come up their individual AI learning curves, the adoption of both physical AI and other AI technologies will continue to increase, though the pace will continue to be strategic and measured given the investment levels required in manufacturing settings,” he says.

“We'll continue to see companies focusing on a clear ROI, and applications that deliver tangible business value will be prioritized,” Gilbert continues. “Physical AI is ready to make manufacturing more agile, more competitive and more scalable.”

In a year, the broad conversation will have moved on from what's possible to what's practical and profitable, he asserts. “I hope we'll continue to see a mature and grounded approach to AI adoption, with a focus on real-world impact and sustainable value creation.”