AI Technologies Transform Industrial Control Automation

Smarter Manufacturing Processes Are Powered by AI

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Industry 4.0 Prompts New Trends in Manufacturing

AI-enabled industrial control automation creates fresh opportunities to innovate and adapt manufacturing processes, building on a foundation of digital transformation and network advances across the intelligent edge.

Industry 4.0 technologies are motivating manufacturers to transform their legacy processes: The global industrial automation market is anticipated to grow at a CAGR of 7.2% during 2019–2026.[1] Driving forces include wireless 5G networking, the emergence of the intelligent edge, AI-infused processors, AI-enabled automation, software-defined infrastructures, the Industrial Internet of Things (IIoT), and augmented and virtual reality. Improved efficiency is at the heart of many Industry 4.0 breakthroughs, but opportunities also arise from innovative technologies — for example, adaptive manufacturing enables companies to release products and solutions uniquely tailored to specific customer preferences, adjusting manufacturing processes on the fly.

In a March 2019 article, "Industry 4.0: 7 Real-World Examples of Digital Manufacturing in Action," Autonomous Manufacturing (AMFG) described the situation in these terms: "Industry 4.0 is signaling a change in the traditional manufacturing landscape. Also known as the Fourth Industrial Revolution, Industry 4.0 encompasses three technological trends driving this transformation: connectivity, intelligence, and flexible automation."[2]

Manufacturing industries have traditionally lagged behind other business sectors, clinging to outmoded legacy systems and missing the opportunities granted by automating traditional processes. But this attitude is changing at many companies, as leaders see the benefits.
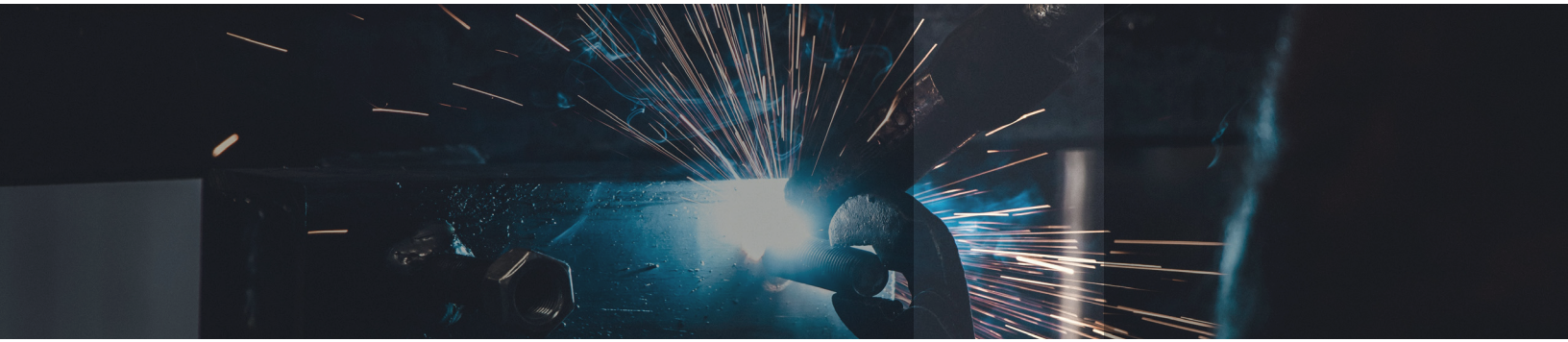
> "Some of our largest customers have global initiatives for Industry 4.0 adoption. Within the next five years, there's going to be a big focus on connectivity."[3]
>
> — **Chris Blanchette,** Executive Director for Global Accounts, FANUC America Corporation

$287.9B

Acumen Research and Consulting forecasts that the global industrial automation market will reach USD 287.9 billion by 2026.[4]

1 Acumen Research and Consulting: www.acumenresearchandconsulting.com/industrial-automation-market

2 AMFG, March 2019: amfg.ai/2019/03/28/industry-4-0-7-real-world-examples-of-digital-manufacturing-in-action

3 "Robotics in the Age of Industry 4.0," Assembly Magazine, May 2020: www.assemblymag.com/articles/95694-robotics-in-the-age-of-industry-40

4 Acumen Research and Consulting: www.acumenresearchandconsulting.com/industrial-automation-market

Machine learning alone has the potential to achieve huge leaps in productivity: Computers are now able to learn from experience, improving task performance and sharpening predictive accuracy. AI's role in the manufacturing sector has become more prominent and the milestone achievements more notable. Enabling technologies have matured and are better able to address current challenges.

MATURING AI MEANS RETHINKING INDUSTRIAL AUTOMATION

Some segments of the industrial sector have been hesitant to respond to the digital transformation wave sweeping through multiple industries. In a study of 1,600 industry executives worldwide, Deloitte found that manufacturing lagged behind most other industries (including IT, automotive, electronics, telco, and retail) in digital maturity, and that only one fifth of manufacturing organizations surveyed rated themselves "highly prepared" to take advantage of the benefits of Industry 4.0.[5] Deep investments in manufacturing equipment and uncertainty about the emerging technologies have led many senior decision-makers to sidestep digital transformation. Meanwhile the automotive, medical, and aerospace industries have reaped advantages in efficiency, productivity, and return on investment that provide proof points and success metrics to dispel doubts.

The complexities of large-scale digital transformation are significant, but in a competitive industry, the risks of falling behind are greater. Early adopters that have taken the leap have earned the benefits. Many organizations that have adopted AI and machine learning to improve automated processes are seeing substantial operational cost savings, improved agility in software development and deployment, and greater workflow efficiencies.

8.5%
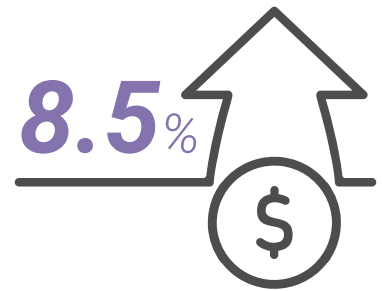
Research indicates that Industry 4.0 solutions can generate up to 8.5% in operational cost savings — a yearly savings of up to $600 per square meter for factories and industrial sites.[6]

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5   "Distinctive Traits of Digital Frontrunners in Manufacturing," Deloitte Insights, August 2018: www2.deloitte.com/us/en/insights/focus/industry-4-0/digital-leaders-in-manufacturing-fourth-industrial-revolution.html

6   "Industry 4.0 and AI Best Practices," Connected World, July 2020: connectedworld.com/industry-4-0-and-ai-best-practices

Success Stories in Industrial Automation Space

Examples of some of the ways AI-enabled industrial automation has positively impacted manufacturers include:

AUTOMATING MEDICAL PROCESSES

Leaders in the life-sciences industry are taking advantage of industrial automation technology to reduce development times for vaccines, treatments, and therapies. By combining cloud advances, virtualization tools, and batched software running in a controller, the medical sector can meet all regulatory requirements and still cut the time from gaining approval to activating production to as little as two months. The ability to perform virtual simulations of process automation elements is critical to this process. With viral diseases such as COVID-19, reducing time-to-market for vaccines can save countless lives.

IMPROVING MACHINE MANUFACTURING WITH SMART AUTOMATION

The machine manufacturing sector represents a large segment of industrial automation advances. Even small companies can double or triple production by implementing end-to-end factory automation. By keeping equipment running for longer periods of time, applying AI techniques to perform predictive maintenance, and using analytical tools to enhance production efficiency, companies can operate more profitably and compete successfully with firms around the world. For example, automated asset management and tracking can ensure that parts are in stock to keep the manufacturing line running. Shelf-fitting sensors and weighing devices can distribute inventory details to a warehouse management system, which can avoid overstocking or understocking

> "In today's turbulent business environment, adaptation is mandatory for ongoing survival. Smart companies know that having the ability to pivot quickly can often turn disruption into competitive advantage."[7]

— **Brent Dawkins,**
The Manufacturer

50%

A DHL distribution center in the Netherlands uses digital robots that rely on machine learning to perform pick-and-place operations. The company reports that this use of AI-enabled industrial automation reduces order cycle time by as much as 50% and can double productivity.[8]

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7   *DHL: www.dhl.com/nl-en/home/our-divisions/supply-chain/thought-leadership/brochures/picking-fully-autonomous-self-driving-robots.html*

8   *"The Case for Adaptive Manufacturing Enterprises in Disruptive Times," The Manufacturer, September 2020: www.themanufacturer.com/articles/the-case-for-adaptive-manufacturing-enterprises-in-disruptive-times*

of inventory. In another example, augmented-reality technology can provide instructions and guidance to workers performing maintenance and repair. A major U.S.-based jet engine maker uses this approach to boost productivity, minimize errors, and enhance product quality.

INNOVATING WITH ADAPTIVE MANUFACTURING

For decades, manufacturing production lines have been designed to produce one kind of part or complete one kind of assembly. Now that limitation is changing, with advances in AI and machine learning that make it possible to change the nature of a product being made while it is still in the production line. Feedback loops in the manufacturing process that link to automated measurement of key criteria in a part or assembly support AI-driven process control, which, in turn, can automatically perform corrective actions. Adaptive manufacturing guided by AI is becoming increasingly popular where precise tolerances and quality control are required, as in the aerospace, medical, transportation, energy, and consumer products industries.

USING SIMULATION TO DEVELOP SUCCESSFUL AUTOMATED PROCESSES

Successful design, development, and testing of automated industrial systems can be expensive and time-consuming, particularly when the control software, AI applications, and hardware components are all being developed in parallel. Simulation platforms such as Wind River® Simics® virtually replicate a physical hardware system, letting developers run code on hardware that is under design or being manufactured. This capability allows development teams to validate design decisions, anticipate problems in the process control flow, and improve the reliability and resilience of the overall solution design.

> "Part of what's unique about [adaptive] manufacturing is you're effectively building the material as you're processing the part, so material properties can vary substantially. Changing the parameters, such as laser power, scan speed, or hatch spacing, can have a significant impact on the part's properties."[9]
>
> — **Zach Simkin,**
> *President, Senvol*

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[9]   "*The Additive Manufacturing Industry Embraces AI,*" *The Additive Report, February 2020:*
       www.thefabricator.com/additivereport/article/additive/the-additive-manufacturing-industry-embraces-ai

Why Wind River

Wind River technology is backed by our unsurpassed legacy of delivering comprehensive safety offerings and certification expertise, with a focus on reducing program risk and enabling faster time-to-market for our customers.

VxWorks®, Wind River Linux, Wind River Simics, and Wind River Helix™ Virtualization Platform have been used in industrial environments across automotive, energy, aerospace, medical, and manufacturing sectors. When used in combination with platforms or infrastructure elements, these solutions can save time in meeting certification requirements: System architects and developers can build packaged solutions using components that already have certifications.

- **VxWorks:** The world's leading commercial real-time operating system (RTOS), VxWorks excels at high-performance industrial applications, including robotics, process control automation, and intelligent vehicle applications. To fully support industrial implementations, certifications are in place for IEC 61508 SIL 3, ISO 26262 ASIL D, and IEC 62304.

- **Wind River Linux:** With robust support for container technology, Wind River Linux delivers a rapid-fire means of loading and patching applications dynamically in an industrial automation system and across additive and adaptive manufacturing environments.

- **Wind River Simics:** This comprehensive system simulation environment streamlines design, development, and testing of complex intelligent industrial automation systems. Simics accommodates agile and DevSecOps software practices and enables teams to shorten development cycles and thoroughly test embedded system designs without physical hardware present.

- **Wind River Studio operator capabilities:** This single platform integrates cloud platform, orchestration, and analytics capabilities so operators can deploy and manage their intelligent 5G edge networks globally.

- **Wind River Helix Virtualization Platform:** This software platform supports virtualized frameworks in intelligent process control systems, spanning hybrid networks and multiple operating systems.

Solutions from Wind River help accelerate digital transformation, powering critical infrastructures and delivering the required technologies and expertise. Our customers rely on our deep industry experience to support edge computing and 5G, complementary technologies that are turning intelligent industrial automation into a reality.