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WHITE PAPER

AI in Manufacturing

Moving from Aspirations to Implementations

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Executive Summary

Artificial intelligence (AI) is transforming global manufacturing. It promises substantial business benefits for manufacturers: increased throughput, reduced costs, and improved product quality.

While AI represents maturity in what Industry 4.0 seeks to achieve, your organization's first steps into implementing AI don't need to feel overwhelming. Instead of trying to solve everything at once, you can—and should—use AI incrementally to solve the right problems at the right time for your business.

AI Fulfills the Promise of Industry 4.0

Industry 4.0 is sometimes seen as an overused buzzword, with many believing the phrase only aligns with new technology initiatives such as the Industrial Internet of Things (IIoT) or robotic automation. In reality, Industry 4.0 represents a more significant cultural shift: a move toward integrated technology solutions and using data for practical and real-time purposes.

While Industry 4.0 does encompass many new and useful technologies—IIoT, big data, the use of cloud services, and smart factories—AI is the accelerant that allows manufacturers to supercharge these investments.

Transforming Underutilized Data

Industry 4.0 represents a more significant cultural shift: a move toward integrated technology solutions

Factories today generate massive amounts of data. Unfortunately, over 90% of this data isn't utilized appropriately. To reap the rewards of capturing all of this data, manufacturers need to incorporate new AI technologies into their processes. AI has the power to transform underutilized data into an integrated and automated flow of information, insights, and business benefits.

AI in Manufacturing Roles

Any new technology needs to help people inside the organization get their jobs done more effectively. Without this direct impact, new technologies may be underutilized or may simply fail to generate a solid ROI. Fortunately, AI initiatives are a good fit for generating an impact throughout the organization, from the factory floor up to the executive suite. Below are a few examples of how AI can make an impact:

- Production engineers tasked with conducting preventative maintenance can benefit the most from AI's predictive failure and machine maintenance technology. AI algorithms can predict potential calibration, safety, or failure events—and can even recommend proactive maintenance. As a result, production engineers can harness AI to maximize uptime and prevent major financial impacts from unforeseen stoppages.
- Continuous improvement managers are constantly analyzing manufacturing processes, looking to see where there's room for improvement. AI technologies across the board— whether it's those that assist in supply chain optimization, cybersecurity, worker safety, machine maintenance, predictive failure, and more—will optimize throughput and factory logistics while saving money and improving accuracy.
- Quality control managers can use machine vision and specialized cameras to interact with AI-based software to check for defects and then take action depending on the results. Real-time AI defect analysis means quality inspections can be conducted more quickly, and with higher accuracy.

- Process engineers can use tracking solutions and machine vision to understand the holistic effects of throughput from end to end. Identifying bottlenecks within production through AI technologies allows process engineers to better recommend areas of improvement and improve workflows.
- Information technology specialists can now utilize AI-enabled cybersecurity solutions to ease their workload by reducing the time it takes to detect and respond to threats. Machine learning algorithms can be used to automatically detect and analyze security incidents, with some even automatically responding to threats.

AI: Aspirations Versus Implementations

The potential rewards of incorporating AI solutions into the manufacturing space are enormous. After implementing AI-based solutions, these manufacturers see fewer production challenges, have lower operational costs, less downtime, an optimized supply chain, and fewer injuries on factory floors.

Most manufacturers understand the benefits AI technology can have on their operations. 85% believe an AI-based production process is needed. Despite this, less than 30% of manufacturers have an AI-focused roadmap.

This gap between aspirations and implementations leaves many manufacturers struggling to see how AI solutions can fit into their operations. They agree that the prospect of AI sounds exciting; however, they are unsure of how to turn these aspirations into pragmatic solutions that generate a good ROI.

Here are just a few examples across a wide range of use cases that show how manufacturers have tapped into the power of AI-based solutions to help fill this gap.

Less than 30% of manufacturers have an AI-focused roadmap.

Predictive Failure + Maintenance

Predictive failure and maintenance uses algorithms to predict the next machine or system failure, then alerts employees so that they're able to prevent that failure from happening. AI can even go one step beyond avoidance to achieve proactive maintenance.

Defined as the "low hanging fruit" by Capgemini, intelligent maintenance of machinery and equipment is the most common use of AI in manufacturing.

AI for Component Failure: General Motors analyzes images from cameras mounted on assembly robots to identify indicators of failing robotic components. A pilot test of the system detected 72 instances of component failure across 7,000 robots, identifying the problem before it could result in unplanned outages.

AI for Large Datasets: Volvo uses a method called Early Warning System to analyze over a million events that occur during machine operations, such as temperature increases or abnormal pressure readings. These large-scale datasets allow Volvo to assess the impact these events are having on breakdown and failure rates.

AI for Predicting Failure: Thales SA, a leading supplier of electronic systems to a wide spectrum of industries, is using machine learning to predict preventative maintenance for high-speed rail lines throughout Europe. By collecting data on thousands of sensors, train parts, and more, they have developed an AI algorithm to predict potential problems and identify when specific parts need to be replaced.

Machine Vision + Quality Assurance and Inspections

Specialized cameras can interact with AI-based software to improve operations, check for quality, and take action depending on the results. Analyzing images in real-time to complete product quality inspections is critical to augment the workforce and stay in compliance with regulatory requirements.

AI for Image Recognition: Audi installed an image recognition system based on deep learning, in which several cameras capture images of pressed sheet metal. AI then analyzes these images to identify fine cracks on each sheet with high levels of precision, saving time and improving overall quality of the finished product.

AI for Inspections: The BMW Group uses an AI application that compares vehicle order data with a live image of the model. These model designations along with other identifying information are stored in the image database. If the live image and order data don't correspond, the final inspection team receives a notification so any necessary corrective action can be taken.

AI for Material Characteristics: Bridgestone, the Japanese tire manufacturer, introduced a new tire assembly system to improve the quality of its tires. During the rubber molding phase, AI uses sensors to measure rubber characteristics in great detail and then control the molding process in real time based on that data. As the malleability of rubber is highly variable with temperature, this system helps Bridgestone produce a more consistent product, resulting in a 15% improvement in uniformity and a doubling of overall productivity over their previous approach.

Supply Chain Optimization

AI can help companies anticipate and respond to changes in the market. To construct estimations of market demand, machine learning algorithms can detect buying patterns that trigger manufacturers to change production. This ability to predict buying behavior allows manufacturers to optimize inventory control, staffing, energy consumption, raw materials, and more.

AI for Cost Savings: Danone Group, a French multinational food product manufacturer, uses machine learning to predict demand variability and achieve its target inventory service levels. This system led to a 20% reduction in forecast error, a 30% reduction in lost sales, a 30% reduction in product obsolescence, and a 50% reduction in demand planners' workload.

AI for Predicting Demand: L'Oréal uses machine learning to predict demand based on a wide variety of data gathered from social media, weather, and financial markets, among other buying patterns. Using this technology allows L'Oréal to efficiently forecast inventory needs.

AI for Predicting Shipping Delays: Coyote, a subsidiary of UPS, uses AI to predict supply chain issues and dynamically optimize shipping routes. It uses a variety of tools, including machine learning and predictive analytics, to pair customer shipment information with outside data such as real-time traffic and weather. AI then helps Coyote make alternate plans so shipments arrive on time, avoiding major financial impacts from delays.

Generative Design

This AI technology helps organizations design new products or refine existing ones. Engineers first enter product design parameters such as materials, size, and cost into generative design algorithms. Then, these algorithms generate all possible design iterations for that product, giving engineers insight into solutions they may not have considered on their own. Machine learning can test selected iterations and improve upon them to reach a final design.

AI for Rapid Prototyping: General Motors adopted Autodesk generative design software to assist with their rapid prototyping. Designers first define functional requirements, materials, manufacturing methods, and other constraints. They optimize for weight and other key product criteria that are essential for the parts being designed to succeed. GM recently deployed this software to design a seat belt bracket part, resulting in a single-piece design that is 40% lighter and 20% stronger than the original eight-component design.

AI for Product Improvements: Airbus used generative design to reimagine an interior partition for its A320 aircraft and came up with an intricate design that ultimately shaved off 45% of the part's original weight. That weight decrease resulted in a significant reduction in jet fuel cost and greenhouse gas emissions.

Digital Twin and Simulations

A digital twin is a digital copy of a real manufacturing process using data from the process and the products that flow through it. Simulations can be performed on the digital twin to test process changes, allowing manufacturing teams to observe and refine their effects on production before implementing those changes in reality.

AI for Cutting Maintenance Costs: Chevron uses digital twins to predict maintenance problems in its oil fields and refineries. They expect to save millions of dollars in maintenance costs and are aiming to have sensors connected to most of their high-value equipment by 2024.

AI for Detecting Energy Loss: Ford develops seven digital twins for each model of vehicle it produces, with each twin covering a different aspect of production. Ford also uses digital models for the manufacturing process, production facilities, and customer experience. For their production facilities, the digital twin accurately detects energy losses and pinpoints areas where energy can be conserved and overall production line performance improved.

AI for Anticipating Potential Failure: Boeing uses digital twins to design aircraft. After creating a digital twin for a new plane, simulations are run that predict the performance of many different airline components over the lifecycle of the product. As a result, Boeing engineers can anticipate when products may fail.

Security and Networking

AI provides insights that help companies understand threats, reduce detection and response times, and protect manufacturing data. Machine learning algorithms in cybersecurity can automatically detect and analyze security incidents, with some even automatically responding to threats.

AI for Detecting Cyberattacks: Agricultural commodities merchant ED&F Man Holdings uses an AI-based threat detection and response platform called Cognito to collect and store network metadata. It uses this metadata—along with machine learning techniques—to detect and prioritize cyberattacks in real time.

AI for Identifying Unusual Behaviors: Energy Saving Trust uses Darktrace's Enterprise Immune System to model the behaviors of every device, user, and network to learn specific patterns. Darktrace automatically identifies any behavioral anomalies and alerts the company in real time.

AI for Mobile Anti-Malware Solutions: Google is using AI to analyze mobile endpoint threats. Organizations can use this analysis to protect the growing number of personal mobile devices. Zimperium and MobileIron have since collaborated to help organizations adopt mobile anti-malware solutions incorporating artificial intelligence.

Workplace Safety

AI has enabled a number of technologies that have the potential to keep workplaces safer through personal protective equipment (PPE) detection, safety zoning, equipment maintenance, and more.

For example, AI can improve workplace safety during the COVID-19 pandemic. High-resolution cameras and Internet of Things (IoT) devices can collect visuals and other types of data points and stream it to a machine learning-aware data lake. This data is processed and analyzed in real time to ensure workers are properly wearing their PPE and keeping 6 feet apart. Furthermore, thermal imaging can even test employees' temperatures throughout the day.

AI for Predicting Machine Repair: Schneider Electric developed Realift Rod Pump Control, a predictive IoT analytics solution based on Microsoft's Azure Machine Learning service and Azure IoT Edge. Oil and gas producers use it to pinpoint remote equipment that needs repair, increasing safety for workers and reducing environmental impacts. Additionally, engineering and maintenance teams now use the solution's predictive analytics to minimize their oil field visits, as safety rises with fewer trips to oil rigs.

AI for Ergonomics: Travelers is offering its business customers ergonomic assessments through AI-based technology that can analyze a smartphone video of a worker performing a task and identify movements or postures that could cause injury. The software then quantifies risk and produces a report that helps Travelers develop a safety plan for their customers.

Production Throughput Optimization

AI technologies utilizing tracking solutions, sensors, or machine vision can be deployed within factories to understand the holistic effects of production throughput from end to end. This allows production engineers to identify bottlenecks and recommend areas for improvement.

AI for Analyzing Productivity: Hitachi has been gathering and processing previously unused data through AI technologies, unlocking insights that were previously too time consuming to analyze. Now, they have improved abilities to analyze the productivity and output of its factories.

AI for Spotting Process Inconsistencies: Nokia launched a video application that uses machine learning to monitor assembly line processes in its factories in Finland. The technology alerts the operator of inconsistencies so that any issues can be corrected in real time.

AI for Improved Operations: Manufacturers like Nike, GE and Nissan are all using Sight Machine's AI-powered insights platform to optimize their manufacturing processes. The Sight Machine platform gathers information from multiple sources, analyzes it, creates a digital twin of a company's infrastructure, and then highlights areas where operations can be improved based on that information.

Warehouse and Logistics Optimization

With so many moving parts, warehouses constantly need to eliminate unnecessary steps, increase quality, and reduce overall costs. AI technology can optimize and streamline these environments, reducing waste and increasing throughput in the process.

AI for Forecasting Deliveries: Lineage Logistics, a company that keeps food cold for grocery stores and restaurants, uses AI to predict the path of its orders. The AI algorithm can forecast when orders will arrive and leave a warehouse, which means employees can put the pallets in the right positions, saving time and trip distance.

AI for Logistics Assistance: Amazon acquired Kiva Systems in 2012 and changed its name to Amazon Robotics in 2015. Today, Amazon has 200,000 robots working in their warehouses. In 26 of Amazon's 175 fulfillment centers, robots help humans pick, sort, transport, and stow packages.

AI for Streamlining Warehouse Operations: British online supermarket Ocado uses highly automated warehouses with robots that unpack inventory, plan and stack shelves, and move goods around the warehouses.

Get Started With Connection

As shown by the numerous examples above, AI initiatives are already positively impacting a wide range of manufacturers. Standing still and waiting "until next year" for your AI roadmap development, AI pilot projects, or broader AI initiatives is a mistake. Doing so will not only leave you behind your competitors, but it will put you at risk of producing products with more defects at a higher cost.

AI-based technologies are no longer an aspirational concept for the average factory. Additionally, by getting started today, you can ensure a move to AI-based solutions is a measured and gradual process instead of a rush to catch up to competitors or the broader market at a much later date.

Connection believes your AI transformation should be a phased, gradual process uniquely designed for your factory floor, customers, and business needs. We'll take a holistic approach to discover which technologies make the most sense to incorporate as part of your overall AI rollout. We'll listen to your challenges, offer a direct and practical consultation that cuts through the clutter, and empower you with the right solutions.

Whether you are looking for a technology solution that can offer predictive maintenance, improved quality assurance, improved worker safety, or are still unsure of which AI manufacturing technologies would make the most sense for you, Connection can help you navigate the landscape and set you up for AI success.

A Trusted Partner

As a leading National Technology Solutions Provider, we've been trusted for more than 35 years to connect people with technology that enhances growth, elevates productivity, and empowers innovation. Connection stands ready to deliver, install, and maintain technology nationwide by leveraging our internal professional services expertise and top-tier vendor partnerships.

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