What is Industry 4.0?

Synonymous with smart manufacturing, Industry 4.0 is the realization of the digital transformation of the field, delivering real-time decision making, enhanced productivity, flexibility and agility

Explore Industry 4.0 solutions →

Read industry news →

How Industry 4.0 technologies are changing manufacturing

Industry 4.0 is revolutionizing the way companies manufacture, improve and distribute their products. Manufacturers are integrating new technologies, including Internet of Things (IoT), cloud computing and analytics, and AI and machine learning into their production facilities and throughout their operations.

These smart factories are equipped with advanced sensors, embedded software and robotics that collect and analyze data and allow for better decision making. Even higher value is created when data from production operations is combined with operational data

from ERP, supply chain, customer service and other enterprise systems to create whole new levels of visibility and insight from previously siloed information.

This digital technologies lead to increased automation, predictive maintenance, self-optimization of process improvements and, above all, a new level of efficiencies and responsiveness to customers not previously possible.

Developing smart factories provides an incredible opportunity for the manufacturing industry to enter the fourth industrial revolution. Analyzing the large amounts of big data collected from sensors on the factory floor ensures real-time visibility of manufacturing assets and can provide tools for performing predictive maintenance in order to minimize equipment downtime.

Using high-tech IoT devices in smart factories leads to higher productivity and improved quality. Replacing manual inspection business models with AI-powered visual insights reduces manufacturing errors and saves money and time. With minimal investment, quality control personnel can set up a smartphone connected to the cloud to monitor manufacturing processes from virtually anywhere. By applying machine learning algorithms, manufacturers can detect errors immediately, rather than at later stages when repair work is more expensive.

Industry 4.0 concepts and technologies can be applied across all types of industrial companies, including discrete and process manufacturing, as well as oil and gas, mining and other industrial segments.

Read the blog post about Industry 4.0 and manufacturing →

From steam to sensor: historical context for Industry 4.0

First industrial revolution

Starting in the late 18th century in Britain, the first industrial revolution helped enable mass production by using water and steam power instead of purely human and animal power. Finished goods were built with machines rather than painstakingly produced by hand.

Second industrial revolution

A century later, the second industrial revolution introduced assembly lines and the use of oil, gas and electric power. These new power sources, along with more advanced communications via telephone and telegraph, brought mass production and some degree of automation to manufacturing processes.

Third industrial revolution

The third industrial revolution, which began in the middle of the 20th century, added computers, advanced telecommunications and data analysis to manufacturing processes. The digitization of factories began by embedding programmable logic controllers (PLCs) into machinery to help automate some processes and collect and share data.

Fourth industrial revolution

We are now in the fourth industrial revolution, also referred to as Industry 4.0. Characterized by increasing automation and the employment of smart machines and smart factories, informed data helps to produce goods more efficiently and productively across the value chain. Flexibility is improved so that manufacturers can better meet customer demands using mass customization—ultimately seeking to achieve efficiency with, in many cases, a lot size of one. By collecting more data from the factory floor and combining that with other enterprise operational data, a smart factory can achieve information transparency and better decisions.

Read the Frost & Sullivan whitepaper on why Industry 4.0 matters →

What technologies are driving Industry 4.0?

Internet of Things (IoT)

The Internet of Things (IoT) is a key component of smart factories. Machines on the factory floor are equipped with sensors that feature an IP address that allows the machines to connect with other web-enabled devices. This mechanization and connectivity make it possible for large amounts of valuable data to be collected, analyzed and exchanged.

Take advantage of connected devices and data →

Cloud computing

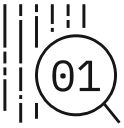
Cloud computing is a cornerstone of any Industry 4.0 strategy. Full realization of smart manufacturing demands connectivity and integration of engineering, supply chain, production, sales and distribution, and service. Cloud helps make that possible. In addition, the typically large amount of data being stored and analyzed can be processed more efficiently and cost-effectively with cloud. Cloud computing can also reduce startup costs for small- and medium-sized manufacturers who can right-size their needs and scale as their business grows.

Explore cloud capabilities →

AI and machine learning

AI and machine learning allow manufacturing companies to take full advantage of the volume of information generated not just on the factory floor, but across their business units, and even from partners and third-party sources. AI and machine learning can create insights providing visibility, predictability and automation of operations and business processes. For instance: Industrial machines are prone to breaking down during the production process. Using data collected from these assets can help businesses perform predictive maintenance based on machine learning algorithms, resulting in more uptime and higher efficiency.

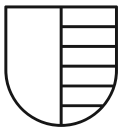
Learn how to do more with Watson® AI →



Edge computing

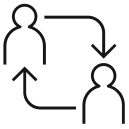
The demands of real-time production operations mean that some data analysis must be done at the “edge”—that is, where the data is created. This minimizes latency time from when data is produced to when a response is required. For instance, the detection of a safety or quality issue may require near-real-time action with the equipment. The time needed to send data to the enterprise cloud and then back to the factory floor may be too lengthy and depends on the reliability of the network. Using edge computing also means that data stays near its source, reducing security risks.

Act on your data at its source →



Cybersecurity

Manufacturing companies have not always considered the importance of cybersecurity or cyber-physical systems. However, the same connectivity of operational equipment in the factory or field (OT) that enables more efficient manufacturing processes also exposes new entry paths for malicious attacks and malware. When undergoing a digital transformation to Industry 4.0, it is essential to consider a cybersecurity approach that encompasses IT and OT equipment.



Digital twin

The digital transformation offered by Industry 4.0 has allowed manufacturers to create digital twins that are virtual replicas of processes, production lines, factories and supply chains. A digital twin is created by pulling data from IoT sensors, devices, PLCs and other objects connected to the internet. Manufacturers can use digital twins to help increase productivity, improve workflows and design new products. By simulating a production process, for example, manufacturers can test changes to the process to find ways to minimize downtime or improve capacity.

Learn about digital twin applications →

Characteristics of a smart factory

Data analysis for optimal decision making

Embedded sensors and interconnected machinery produce a significant amount of big data for manufacturing companies. Data analytics can help manufacturers investigate historical trends, identify patterns and make better decisions. Smart factories can also use data from other parts of the organization and their extended ecosystem of suppliers and distributors to create deeper insights. By looking at data from human resources, sales or warehousing, manufacturers can make production decisions based on sales margins and personnel. A complete digital representation of operations can be created as a "digital twin."

IT-OT integration

The smart factory’s network architecture depends on interconnectivity. Real-time data collected from sensors, devices and machines on the factory floor can be consumed and used immediately by other factory assets, as well as shared across other components in the enterprise software stack, including enterprise resource planning (ERP) and other business management software.

Custom manufacturing

Smart factories can produce customized goods that meet individual customers’ needs more cost-effectively. In fact, in many industry segments, manufacturers aspire to achieve a "lot size of one" in an economical way. By using advanced simulation software applications, new materials and technologies such as 3-D printing, manufacturers can easily create small batches of specialized items for particular customers. Whereas the first industrial revolution was about mass production, Industry 4.0 is about mass customization.

Supply chain

Industrial operations are dependent on a transparent, efficient supply chain, which must be integrated with production operations as part of a robust Industry 4.0 strategy. This transforms the way manufacturers resource their raw materials and deliver their finished products. By sharing some production data with suppliers, manufacturers can better schedule deliveries. If, for example, an assembly line is experiencing a disruption, deliveries can be rerouted or delayed in order to reduce wasted time or cost. Additionally,

by studying weather, transportation partner and retailer data, companies can use predictive shipping to send finished goods at just the right time to meet consumer demand. Blockchain is emerging as a key technology to enable transparency in supply chains.

Industry 4.0 and hybrid multicloud IT architecture

Building a hybrid multicloud IT infrastructure is a key component in digital transformation for manufacturers seeking to take advantage of Industry 4.0. Hybrid multicloud is when a company has two or more public and private clouds to manage their computing workloads. This gives them the ability to optimize their workloads across all their clouds, as some environments are better suited to or more cost-effective for certain workloads. Manufacturers looking for digital transformation and a secure, open environment can move their existing workloads from their on-premises location to the best possible cloud environment.

Explore digitally transformed manufacturing →

Industry 4.0 and IBM

AI visual insights lead to higher productivity

Augmenting manual inspections

AI-powered manufacturing

The digital transformation to Industry

Convergence of IT and OT is a cornerstone of Industry 4.0

Industry

Let's talk

and technical assistance with AI-powered automated inspections cuts down on product defects, improving efficiency and minimizing false positives. Typically, the deep learning model can be quickly trained with existing images and videos. After it is connected to a smartphone camera, the automated inspection model is ready to be added to the production line.

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4.0 starts with collecting data, then adds artificial intelligence to make sense of that data. Smart factories employ IoT devices that connect machines and computers to get a clear picture of the manufacturing facility with real-time data. Then AI and machine learning are used to pull actionable insights from the large quantities of data.

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4.0 is bringing about the convergence of information technology (IT) and operational technology (OT) systems, creating interconnectivity between autonomous manufacturing equipment and broader computer systems. OT data from sensors, PLCs and SCADA systems is being integrated with IT data from MES and ERP systems. Augmented by machine learning, this integration impacts the entire enterprise, from engineering to operations, sales and quality.

Related Solutions

Operations consulting services

Count on IBM specialists to help you model and deploy your vision of IoT-enabled, connected operations so you can reach new levels of agility and flexibility.

Learn more about operations consulting services →

IBM Maximo® Visual Inspection—enhance visual inspection with AI

Deploy AI and IoT computer vision technologies within your operating environment to monitor your assets and detect production issues faster.

Learn more about IBM Maximo Visual Inspection →

Modernize enterprise applications with SAP applications

Let IBM professionals help you make the most of your SAP data and transactions by improving manufacturing output and increasing supply chain visibility and asset uptime.

Learn more about SAP applications with industry solutions →

Let's talk

Improve manufacturing supply chain management and logistics

IBM Solutions can help you build a better supply chain and reduce complexity by employing automation through AI and deploying the Industrial Internet of Things (IIoT).

Learn about Industry 4.0 and supply chain management →

IBM Solutions for 5G and edge computing

Automate operations, improve experiences and enhance safety measures wherever they happen.

Learn about 5G and edge computing →

Intelligent asset management and maintenance

Enterprise asset management (EAM) is essential for keeping operations running. Manufacturers implementing Industry 4.0 technologies can easily have many thousands of IoT-connected devices in their smart factories. To meet the demands of Industry 4.0, each must have maximum uptime to ensure efficiency. Enterprise asset management drives operational resiliency and agility by allowing remote monitoring of equipment, offering functionality to extend asset lifecycles and providing analytics for predictive maintenance.

Read more →

Resources

The manufacturing side of digital transformation: smart factories

Fulfill the promise of Industry 4.0—transform your legacy production technologies by connecting IoT devices, collecting and analyzing real-time data and optimizing your manufacturing process.

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Securing the Internet of Things

Thirty-six percent of executives believe that securing their IoT platforms is a top challenge for their organizations.

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Why one company believes this workbench is the key to a smart factory

UK-based aerospace component manufacturer Meggitt embraces the potential of Industry 4.0 to ensure faultless delivery and zero defects.

→

How smart manufacturing can optimize your factories for the new era

Combine data gathered through the Industrial Internet of Things (IIoT) to develop predictive maintenance capabilities and drive collaboration between key manufacturing personnel.

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What is enterprise asset management (EAM)?

Let IBM experts help you manage your physical assets and equipment by leveraging IoT-enabled sensors and devices to enhance efficiencies and maximize resource investments.

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Industry 4.0 blog posts

Read blog posts that cover a range of Industry 4.0 topics, including AI-powered manufacturing, intelligent visual inspection and the Industrial Internet of Things.

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