What Is Industry 4.0?

Ever since the first Industrial Revolution effectively set the definition of "manufacture"—a term that literally means "to make by hand"— on its ear, new technologies, tools, and techniques have continued to alter the business landscape.

In the twenty-first century, companies find themselves at the cusp of a *fourth* industrial revolution: Industry 4.0. Driven by digital technologies, this revolution seeks to blur the line between the virtual and physical worlds by turning big data into big gains in productivity and profitability.

But embracing Industry 4.0 is about more than simply upgrading to the "latest and greatest" software and hardware for business and manufacturing.

It's a fundamental shift in how businesses integrate continuous improvement and digital transformation with production and internal process development across their entire organizations.

The Journey to Industry 4.0

Understanding the impact and importance of this new industrial revolution requires a working knowledge of those that came before, and how the changes they made to business and manufacturing led us here.

The First Industrial Revolution (Late 18th Century/Early 19th Century)

Prior to what was then simply called “The Industrial Revolution,” goods were typically made by hand, in a variety of ways that may or may not have been documented and standardized within the same town, let alone entire regions or countries.

For big projects, animal labor was added to human manual labor, again with basic but limited thought toward process optimization.

The First Industrial Revolution shifted production away from scattered craftspeople to manual labor aided by standardization and assistance from machines and tools using water and steam power.

Mass production became the norm rather than the exception as household goods and

The Second Industrial Revolution (Late 19th Century/Early 20th Century)

As steel production became more widespread and electricity became widely available for use not only in homes, but in factories, the Second Industrial Revolution was born.

Further efficiency and process improvements were introduced with steady power, more advanced mechanization, and the exploding transportation industry, which gave humans both trains and automobiles to carry materials and finished goods vast distances.

The concept of the assembly line evolved during this period, championed and perfected in large part by engineers working for automobile innovator Henry Ford in his Michigan-based manufacturing plant.

The Third Industrial Revolution (Mid-20th Century)

Integration of emerging electronic technologies, including the computer, with the

manufacturing process began to proliferate in the 1950s.

Analog and mechanical solutions remained important for a variety of tasks, but as computerization of labor and digitalization of data began to gain ground, companies seeking optimal performance and efficiency looked to replace as many legacy solutions as possible.

Software was of special import during this period, as it provided a shift in both concept and practice with regard to how both paperwork and actual production were accomplished.

With computers augmenting the already substantial abilities of machines to outperform humans in certain capacities (e.g., parts per minute of production/quality review/sorting, calculation of advanced sums, deep analysis of market trends to identify opportunities and challenges), this shift led to greater increases in productivity and efficiency as workers became the human element in an advanced labor system, rather than the sole source of both intellectual and physical labor for all tasks great and small.

The Fourth Industrial Revolution, AKA Industry 4.0 (Late 20th Century-21st Century)

With the 20th century drawing to a close, computers became even more prominent in, and essential to, all areas of business thanks to the Internet.

Providing real-time shared computing, digital document management, and 24/7 global communication, the Internet revolutionized the way the world did, and continues to do, business.

But while its virtual virtues are often the focus of discussions about its value to humanity, it’s the Internet’s ability to create interconnectivity between cyberspace and the real world that holds powerful value for Industry 4.0 applications.

Cloud computing decentralizes the office and further expands the concept of the “anytime, anywhere” execution of essential tasks. The Internet of Things (IoT) provides real-time data inputs from a wide variety of devices and software platforms, simplifying collaboration between staff, departments, companies, and the devices that support “the business of doing business” through advanced tools

like digital twins.

Centered firmly in digital transformation, Industry 4.0's revolutionary value lies in data management, deep analysis and insights supported by machine learning, mobile-friendly versatility of operations, and growth driven by continuous improvement and process optimization.

> *Depending on your business needs, it's possible you could regard business analytics as a subset of the larger business intelligence function—or vice-versa. If that sounds a little strange, remember that every business is different, and ultimately, both business intelligence and business analytics are both useful parts of a unified information management strategy.*

Industry 4.0: Key Concepts

To contextualize some of the ways in which Industry 4.0 is driving innovation and improvements within the manufacturing industry (and industry as a whole), it's important to know some of the core concepts.

- **Artificial Intelligence (AI):** The ability of a machine to perform tasks of varying complexity with a measure of intelligence formerly exclusive to humans. It excels at simple and repetitive tasks with clear contextual parameters, and can, over time, improve its own performance based on historical data, in effect "learning."
- **Augmented Reality (AR):** The integration of digital objects in physical spaces. While games such as *Pokemon Go* are the most frequently cited example of this tech, AR is valuable as a testing and prototyping tool in manufacturing. Companies like Amazon also use it to show customers what an item would look like in their home, for example.
- **Big Data:** Large sets of structured or unstructured data generated by a company's activities. Big data can be collected, stored, organized, manipulated, and analyzed to provide insights into performance, market trends, and productivity, as well as potential opportunities for growth.
- **Cloud computing:** Storing applications and data on, and accessing them from, multiple, interconnected remote servers. This redundancy allows for easier data backup and, in certain contexts, improved cybersecurity, as well as easier access from both local and mobile devices.

- **Cyber-Physical Systems (CPS):** Sometimes called *cyber manufacturing*, this manufacturing paradigm uses Industry 4.0 technologies to integrate real-time data management, improved procurement and supply chain efficiency and transparency, and automation-driven process improvement across not just production, but all of the company's business units.
- **Digitization:** Collecting and converting data into a digital format for greater ease of use and versatility. Also used in areas like 3D printing, where prototypes are created from real-world data in virtual environments and then produced on demand.
- **Digital Twin:** A virtual device or application mirroring a physical copy in the real world. Used to provide testing data useful in improving the performance of its more concrete twin, as well as predictive maintenance and prototyping new versions.
- **Ecosystem:** As in the physical world, a manufacturing ecosystem is the interconnected web of "organisms" within your company, including procurement, inventory, production, finance, marketing, customer service, and sales.
- **Enterprise Resource Planning (ERP):** Software tools used to manage process information across organizations.
- **Internet of Things (IoT):** The data sphere connecting physical objects and their users via the Internet.
- **Industrial Internet of Things (IIoT):** The data streams connecting devices and users within the context of manufacturing. For example, a sensor and its digital twin might both be connected to a company's systems. The physical sensor provides real-time feedback to the system, while the digital twin is subjected to different usage scenarios in order to gain insight into potential process improvements, hardware updates, and other performance factors before those changes are made in the physical world.
- **Machine-to-Machine (M2M):** Network communication between two linked devices.
- **Machine Learning:** Improvements and updates acquired by computers without explicit instruction, but through the use of artificial intelligence.
- **Real-Time Data Processing:** Using automation software and Internet-enabled computers and devices to collect, organize, and analyze data in real time (or nearly real time, AKA *near time*) for use in decision-making.
- **Smart Factory:** A manufacturing facility leveraging Industry 4.0 tech and

tools.

Adding Industry 4.0 to Your Business

From improving production processes to gleaning valuable insights on emerging trends in the manufacturing sector, making smart manufacturing part of your overall plan for success can benefit your company's ecosystem in a number of ways:

- **Improved competitive advantage.** The more optimized your supply chain, logistics, and internal controls, the more effectively your company can compete in the digital marketplace. The IIoT, AI, and real-time data management make it possible to connect and optimize all areas of your business to compete with "the big boys" in production, agility, and customer service.
- **Better collaboration and performance.** Full data transparency and leveled, secure access from multiple platforms and devices means your team is always on the same page, able to work more effectively toward shared goals. Automation streamlines workflows, takes tedious and repetitive tasks out of human hands, and removes roadblocks and errors from workflows while freeing your team to focus on tasks higher up the value chain. Powerful data analytics provide much more agile decision-making based on complete information.
- **Fewer headaches.** Using predictive analytics, automation, and IoT tools like digital twins shifts your business posture from *reactive* to Continuous improvement means inefficiencies are always under the microscope, and data tools make it easier to spot, and fix, potential maintenance, logistics, or materials problems before they have a chance to wreak havoc.
- **Higher profits and lower costs.** Industry 4.0 data management helps you make sense of the endless flow of information produced by doing business. Real-time data analytics simplify business intelligence and financial planning processes; automation and machine learning turn data into process improvements in your supply chain, vendor relationship management, and production workflows. These same tools can build further value when applied to the processes in customer service and marketing, too.

A Few Caveats

Few revolutions are painless, and when you're considering how to add Industry 4.0 upgrades into your workflows and corporate culture, it pays to ask, and answer, a few difficult questions:

- Is our corporate culture open to digital disruption? If not, how can we gain buy-in from the C-suite, management, and other stakeholders?
- What steps will be necessary to fund upgrades, and can we put the gains in productivity and efficiency they provide to immediate use?
- Do we have the staff, resources, and expertise required to accomplish large projects such as switching to a software-as-a-service (SaaS)-based office suite? What kind of organizational changes will such a change produce?
- Do we have the skillset and training required to put Industry 4.0 tools to use? If not, do we have a reliable source to obtain training and support?

If you can answer these questions with confidence, you're ready to leverage the potential of digital transformation for your business.

The Revolution Will Be Digitized

The future of manufacturing spans both the virtual and physical worlds.

By bringing together the lessons learned from traditional manufacturing with the power of machine learning, real-time data management, and other new technologies, companies can build significant value and position themselves for greater competitiveness, profitability, and performance.

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