



FACTORY OF THE FUTURE:

How Digital Technologies are Reshaping
the Manufacturing Industry





Introduction

We've been in the midst of a major, transformative technological event for years now, but the impact it's having on the workforce is only just beginning to become glaringly apparent. The manufacturing industry is undergoing change of an enormous scope. Factories as we once knew them—and the machines, tools, labor, processing and formulations used in industrial production—are transitioning into instruments of digitized creation. Everything is becoming “smart,” and manufacturing is no exception. With the rise of Industry 4.0, we are seeing machines, factories and people becoming connected in new ways.

From the late 18th century up until now, we've seen four industrial revolutions that have affected our world in unprecedented ways. With the First Industrial Revolution, from the late 18th to 19th centuries, came the inception of power generation, through water, steam and railroads. This signified the beginning of further monumental evolutions to take place in the manufacturing panorama. The Second Industrial Revolution ushered in electricity, division of labor and mass production, each of which contributed to a change in manufacturing that would forever dictate the path upon which the industry would progress. The Third and Fourth Industrial Revolutions heralded in the technological eras: the third, with electronics, IT and automated production, and the fourth—the current revolution, in which we are currently taking part, also known as Industry 4.0—with the blurring of reality and digital and the emergence of a new, hyper-connected and hyper-intelligent type of manufacturing.



TIMELINE OF INDUSTRIAL REVOLUTIONS

Late
18th - 19th
CENTURY



First Industrial Revolution -
Power Generation
Coal, iron, railroads,
textiles

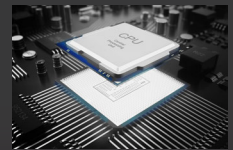
Beginning of
20th
CENTURY

Second Industrial Revolution -
Science & Mass Production
Electricity, petroleum, steel



**1970^s -
2000^s**

Third Industrial Revolution -
Electronic Automation
Digital technology



2010
and
BEYOND



Fourth Industrial Revolution -
Smart Automation &
Abundant Change



So what is smart manufacturing? The National Institute of Standards and Technology (NIST)¹ says that smart manufacturing entails systems that are “fully-integrated, collaborative systems that respond in real time to meet changing demands and conditions in the factory, in the supply network, and in customer needs.” Smart manufacturing is also defined by “the ability to solve existing and future problems via an open infrastructure that allows solutions to be implemented at the speed of business while creating advantaged value.” One of the defining characteristics of this type of manufacturing is an amalgam of the tangible and intangible, or the physical and digital.

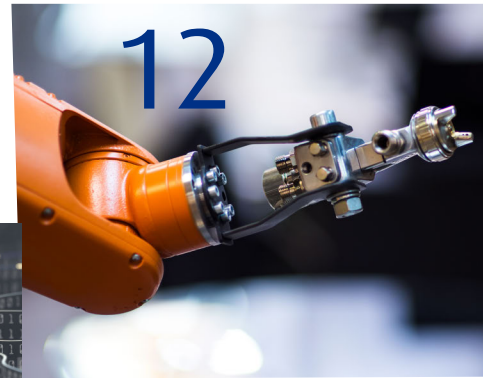
Evolving dynamics in the manufacturing industry have reshaped the structure and methods upon which factories operate—shifting from a focus on mass production to customized production.² With consumers today intently focused on the personalization component of companies, products and experiences, today’s factories are driven to implement technologies that are tailored to delivering products specifically

manufactured to meet the needs of individual consumers and their unique preferences, personas and demands.

In recent years, the manufacturing industry has suffered from decreasing jobs, but technological innovations like robotics, automation and AI have helped spur a revival. The productivity of factory workers has gone up 47 percent more² than what it was 20 years ago, and it’s occurring with less labor. The reasons behind this include the fact that older factory machines are being replaced with new, updated machines and technologies, and today’s factory workers are coming into their jobs with more skills and education—both of which are contributing to higher productivity and output. Likewise, with the Fourth Industrial Revolution, and Industry 4.0, the manufacturing segment is becoming more valuable. According to a market research report,³ the Industry 4.0 market was valued at \$66.67 billion in 2016 and is anticipated to grow to \$152.31 billion by 2022; even more compelling is that the economic impact of the Industrial Internet of Things (IIoT) is forecasted to reach \$11.1 trillion⁴ by the year 2025. The

increasing adoption of the industrial internet—which entails integrating and linking big data, analytical tools and wireless networks with physical and industrial equipment—and a stronger focus on efficiency and cost of production are the major drivers for the Industry 4.0 market. In a professional landscape that has relied on time-honored business standards, processes, equipment and operations, this new way of working is propelled by many important factors that are steering manufacturing toward a new, digitized industry.

The prime motivator for this transformative movement in manufacturing is comprised of a combination of increasing consumer expectations as well as the booming prevalence of connected devices and platforms. To fit the form of this new era, industries are continuously striving to utilize digitization in personalizing products and delivering them to the right people, at the right price.⁵ Market trends, new technologies and overall pressure on business are also prompting industrial machinery companies to change in order to increase revenue and profitability, as well as customer experiences.



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IoT connectivity among devices and manufacturing equipment in industrial transformation has made up more than \$178 billion in 2016²

Trends and Drivers in the Manufacturing Transformation

By 2020, 50 percent of the Global 2000 companies will rely on their ability to create digital experiences, services and products for dictating the future path of their business' success, according to IDC.⁶ These digital experiences are aligned with the following technology innovations and are primed to become more prevalent in the manufacturing industry.

IoT-Connected Equipment and M2M Communication

IoT connectivity among devices and manufacturing equipment in industrial transformation has made up more than \$178 billion in 2016² and acts as a business differentiator, providing a leg up on the competition. With IoT implemented in factories, it's possible to virtually monitor

processes, products and assets—providing business transparency and optimization. Deeper insights into the data regarding manufacturing operations and equipment allow workers and employers to automate processes and foresee possible issues, preventing problems before they occur and therefore maintaining operational efficiency. Likewise, IoT can provide real-time feedback and alert companies of defects and point out where potential issues and problems might lie. By placing factory machinery and other equipment online, some of the responsibilities of making operational decisions are moved into the hands of technology—therefore freeing up employees to utilize their manpower on more critical business tasks. With this industrial shift from mass production to mass customization comes the ability for

manufacturers to address customer demand and cater to the people who drive their business. Customers require intuitive products that are easy to interact with, so this also contributes to the pressure on factories to deliver goods that are software enabled and IoT connected. Instead of making long-term commitments to acquiring permanent equipment, manufacturers are taking advantage of the trend of pay-per-use business models for software, machines, equipment and digital services. Machine-to-machine (M2M) communication through IoT-enabled machinery increases automation of tasks and reduces the need for factory workers to manually resolve equipment failures, as machines can predict maintenance issues before they occur and remotely monitor assets.⁷



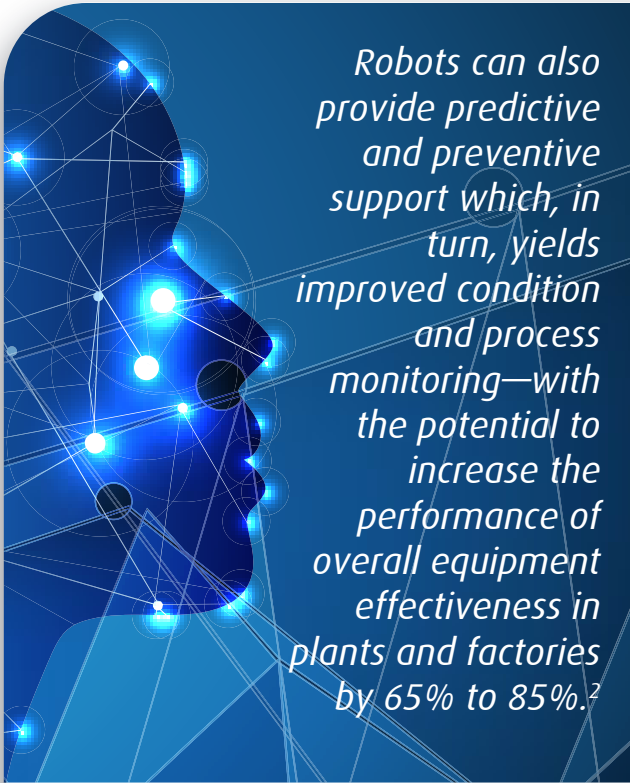
AI, Machine Learning and Cognitive Computing

Artificial intelligence often goes hand in hand with IoT connectivity and, in manufacturing, this is especially true. The ability for AI to record and transmit data through IoT-connected devices and equipment by way of sensors is another driving force of changes and trends in manufacturing. Machine-learning algorithms and AI can analyze and make note of inconsistencies and errors which may signify problematic or weakening assets. AI can also utilize data to determine whether it is advisable to implement a new process or not, allowing workers and employers to glimpse the possible future effects and outcomes. Generally speaking, advanced algorithms have the capability of totally altering and evolving the way that factories assemble information, interpret

data, predict customer behavior and perform manual, repetitive tasks. The oversight of quality is no longer a hindrance in considering AI and machine-learning implementations in factories, as this type of intelligent technology now demonstrates the ability to pinpoint components that affect quality and service.² With sensors available to perform certain tasks with nearly the same capacity and precision as humans, improving accuracy and therefore wasting less working time, manufacturers are experiencing the pressure to take advantage of these process improvements.

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Augmented/Virtual Reality and 3D Printing in Everyday Factory Operations

In manufacturing, both augmented reality and 3D printing are emerging as effective solutions and tools for many purposes, and this is prompting manufacturers to use them. More than just fun, high-tech virtual interactions, augmented reality can be applied to provide many benefits for factories and their overall business operations. Helmets or glasses enhanced

with augmented reality can provide workers with the opportunity to easily visualize and interpret data and information about machinery and processes. This can aid in boosting productivity and improve decision-making, as concrete facts and information are readily available, preventing employees from experiencing inefficiencies due to manually calculating and analyzing. Manufacturing field service is an area that can especially see benefits from augmented/virtual reality, as technicians can utilize these technologies to aid with repairs for specific products, environments, locations, etc. Additionally, the growing popularity of 3D printing is pushing manufacturers to explore this technology as a possible option to include in their factories. Incorporating 3D printing can allow businesses to save costs from full-scale production by printing out parts or other products at a lower volume; this also aids in product testing without significant investments and without excessive wasted materials.

Robotics

Generally, robotics have been used for simple, recurrent, repetitive tasks, but now they are able to emulate human qualities such as performing actions with “their own hands” and also memorizing processes and specific methods used to accomplish tasks. Attributes like these can make robotics an efficient choice to use in manufacturing, as this type of technology can provide safer working conditions by using robots as a replacement for performing certain tasks, to which humans were originally assigned. For example, in mining sites, self-controlled dump trucks can be operated remotely, erasing the need for human drivers and human intervention.² Robots equipped with sensors have the ability to increase speed and efficiency for many factory tasks, by accelerating the process of identifying and fixing issues. Robots can also provide predictive and preventive support which, in turn, yields improved condition and process monitoring—with the potential to increase the performance of overall equipment effectiveness in plants and factories by 65% to 85%.²



Data, Analytics and Cloud Technologies

Virtually everything we do leaves behind some type of footprint, and this is especially true with using the internet, mobile devices and other digital technologies. Data and information are stored in virtually limitless quantities, for an immeasurable amount of time. Factories have an especially unique situation with their equipment, machinery and digital processes. Trying to collect, organize, analyze and store unending product and customer data is a major challenge for manufacturers.

However, the digital era has provided the ability to migrate data to the cloud for storage as well as increase data visibility. Additionally, cloud technologies create more collaboration among multiple endpoints, such as the company, supply chain and customers. The cloud can connect multiple scattered global locations and also provide an opportunity for agile prototyping.⁷

Plug and Produce

The ability to simply plug in or connect a product and start employing it is what comprises the trend of “plug and produce,” and it’s applied to Industry 4.0 and manufacturing for ease of use, dismissing the need for specially trained technicians, experts or special tools to get these technologies up and running. Plug and produce is an easier and more efficient way for factories to integrate new technologies into their systems quickly while maintaining flexibility and increasing agility in factory operations.⁸

The majority of these manufacturing technological trends is centered on

addressing several points: catering to the customer, developing intelligent products and implementing the “smart” factory, increasing productivity and efficacy, as well as creating new business models that address the needs of the new digital era. In smart factories, technology has the ability to make higher-quality products and improve productivity among employees by reducing the amount of time they spend on routine tasks that are more adeptly conducted by AI, enabled by IoT. Likewise, smart factories in manufacturing can see a boost in energy efficiency,¹ overall safety and competitiveness when these technologies are implemented. Overall, adding the “smart” component to manufacturing has the capability to produce many benefits for businesses, empowering the factories of the future to thrive in this type of technological transformation.



Examples of Smart Manufacturing in Action

While many of these technological trends in manufacturing have yet to be implemented at a high capacity, many companies are already well into their journeys of digital transformation in the factory setting. For example, the American machinery and equipment company Caterpillar recently partnered with an industrial analytics company to gain more in-depth insights into the health and operational statuses of their equipment. They also utilize technologies to monitor and optimize their fleets, track fuel efficiency and work with a proactive mindset of stopping problems before they begin.

Another example of a manufacturer currently taking advantage of smart technologies in its factories is Airbus, a European aircraft company. Airbus not only utilizes IoT-enabled technologies with its products but also with its workers, in that workers on the factory floor use smart glasses or a tablet to find information on a task and then deliver that data and information to a robot—which ultimately completes the action.⁹

How Stefanini is Meeting the Manufacturing Needs of Today and the Future

The manufacturing industry is undergoing many changes at the hands of the Fourth Industrial Revolution and Industry 4.0, and it's becoming redefined by new trends, insights and technologies made easily accessible with digital solutions designed to streamline factory operations and drive efficiency. As a partner that is big enough to act globally—investing in an innovation ecosystem while taking customers through the digital journey—we are also small enough to be customer-centric and flexible to adapt to individual needs. With decades of technological and domain experience, Stefanini can transform your manufacturing business with unparalleled integration, digital expertise and big-picture vision.

Our dedication to long-term partnerships proves Stefanini's commitment to supporting your business every step of the way, ensuring that your digital transformation continues to perform, evolve and deliver long after initial

implementation of our technologies. We offer customized and seamless integration of Operational Technology (OT) and Informational Technology (IT) services while embracing IoT solutions, offering your business a comprehensive industrial automation solution. Our extensive experience serving manufacturing industries includes mining, metals, pulp and paper, food and beverage, fertilizer, cement and more.

By leveraging our robust digital experience and proven agile methodology framework, we also provide a seamless integration across various platforms including BPO, ITSM and field enablement. Our innovation begins with a rigorously tested four-pillar portfolio designed to effectively transform your business through planning, executing, sustaining and innovating. Starting with defining the project pipeline, we use a powerful methodology that incorporates multidisciplinary competencies aimed at achieving specific financial goals. With services and equipment supply, we execute the project accordingly, with the planned schedule. Sustaining continuous operation is performed through agile



<p>frameworks that support constant performance improvements. Transforming through innovation, we take advantage of digital opportunities wherever we see them to further enhance your business.</p>	<p>and data science through predictive maintenance, data science solutions, soft sensors, machine learning and image processing; we can also implement design thinking, innovation frameworks and autonomous decision-making for overall business enrichment.</p>	<p>management, controlling system integrity, condition-based monitoring and automated maintenance rounds.</p>
<p>By evaluating your factory's unique environment, we can provide custom OT and IT service integration, increased operational effectiveness, asset reliability, decreased O&M cost and reduced operational risk. Through integrating your OT and IT services, we will be able to proactively address issues before they happen and seamlessly transform your business to be more productive, effective and secure. We integrate instrumentation and infrastructure through IoT, electrical projects, electrical and automation panels and e-house supply. With automation and control, we can provide a multi-brand experience, robotization and augmented reality to implement into your manufacturing business for enhanced optimization. Our industrial IT services include MES, PIMS, LIMS, customized and off-the-shelf software. Your manufacturing business can also benefit from our analytics</p>	<p>By gaining these insights and digital innovations, we can elevate your business to achieve more. We will engage with every aspect of your unique manufacturing business to increase connectivity, receive and interpret invaluable data, as well as optimize your processes.</p> <p>Our methods of leveraging data for your factory include data historization, correlations, data analysis and modeling. For tracking production, we also provide warehouse/factory monitoring, aging monitoring and lifecycle management. We can also optimize your plants and maintain efficiency and reliability through advanced process control, energy monitoring, quality</p>	<p>Our world-class digital services are uniquely customizable to your specific business needs. As these technologies develop and continue to gain traction in the technological manufacturing landscape, many will become increasingly relevant and beneficial to your industry, if they haven't already. Our integrative offerings include simulating business processes for an in-depth look at the future of your business, as well as implementing robotics to take on all physical, dangerous, routine work in your plant or factory. We also see the value of VR and AR and ensure they are an established part of the working environment, in addition to fully automated production. Using our substantial AI capabilities, we process complex knowledge and decisions to standardize a clearer, less effortful way to work.</p>



Steel Producer

Context

- As a flat steel producer in Brazil, the company had a 7.7 million ton/year capacity to produce steel slabs and hot-rolled coils, and it had 4.5 thousand direct employees. The company wanted an energy model developed for the electric arc furnace natural gas burners in order to reduce the energy consumption and electrode consumption, as well as increase the productivity of the electric arc furnace.

Results

- 14% reduction in energy costs
- Optimized and reduced costs of the main raw material
- Reduced energy consumption

Main Deliverables

- Development of flexible, customized heating model
- Complete electrical and automation projects of an electric arc furnace; ladle furnace and dust removal system for steel mill; modernization of the entire plant; implementation of a new control system for electrodes placement, eccentric spout, burners, dust removal, power program and entrance of scrap yard inputs

Food Manufacturer

Context

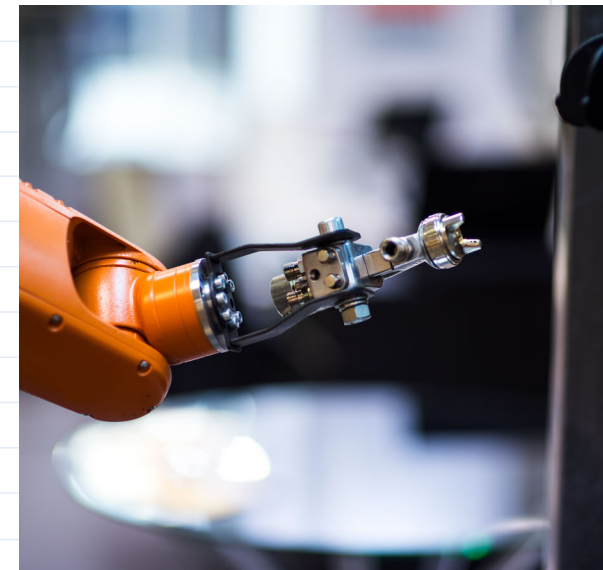
- The company's distribution center did not meet the continuously growing market demand. The conveyor belts were unidirectional, and stacker cranes operated at a constant speed. Operating at full capacity, the distribution center could not support the demand at peak times.

Results

- 30% increase in productivity (pallet storage and retrieval/hour), avoiding expending \$5.3M for a new warehouse
- Increased efficiency in pallet storage process
- Reliable traceability and visibility of the whole process
- Improved productivity
- Better utilization of the existing assets
- Reduced cost of maintenance

Main Deliverables

- Optimization of routes during peak times; rearrangement of cargo during idle times
- Predictive maintenance; intelligent cargo allocation and automatic inventory
- Tracking system completely integrated to control SAP systems
- Automation of the whole process, including all conveyor belts and stacker cranes
- Instrumentation, mechanical and electrical intervention on the stacker cranes and conveyor belts





What the Future Holds for Manufacturing

The future of the manufacturing industry is dependent upon a variety of elements, including obtaining a new mindset based on agility, collaboration and risk-taking. By implementing technologies including advanced analytics, robotics, AI and machine learning, IoT, AR and VR, the factories of the future have the potential to look completely different, demonstrating a type of high-performing, digital skillfulness and abundance of powerful output that has not previously been seen.

Through the automation of routine, repetitious tasks, factories will improve efficiency and re-allocate the time, energy and expertise of factory workers to roles of higher value, requiring more skills and a different set of competencies not found in technology. Deeper insights from big data

and analytics will also yield evidence-based decision-making, which previously took the shape of educated guessing by workers. Real-time contextual insights also deliver proactive and instantaneous problem-solving and even preventive actions. The new face of manufacturing will also demonstrate customized and personalized production at a high scale, with the optimization of behavior patterns and more engaged employees and end users.

As a business partner with the utmost experience in our field and dedicated, talented experts working with the common goal of delivering value through technology, Stefanini can support your manufacturing business' digital strategy with scale, fulfilling your company's value purpose. We can connect factories, plants and warehouses to all parts of an innovative ecosystem, utilizing

end-to-end capabilities to see your business through the entire process of digital transformation and beyond.

In an age driven by customization and technologies that are causing metamorphoses in all areas of life, we know there is not one standard way of tackling your industrial digital transformation needs, so we set the best strategy tailored to your company's unique purpose and technological goals. With our robust experience and technological background amplified by a big-picture vision and long-term support, we will ensure your business thrives in the era of digital disruption and help establish it as a factory of the future.



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