The Future of Manufacturing
The future of manufacturing will offer a world of opportunities, a transformation that will require substantial steps and boldness. The industry needs to be open to new insights instead of mentally closed by the existing ones.

Each industry has its own challenges, and digital disruption is everywhere. Organizations must be agile and build new momentum that respects the new reality of their industry. As organizations strive to remain relevant, they need to adapt to changes not only today, but also tomorrow. Change is the only constant. Constant change requires scenario-based thinking, exploring several paths and crafting a digital strategy based on preparing for the future. For businesses to stay relevant they need to explore the future and look at next generations.

No one can predict the future; organizations must actively explore various possible futures to anticipate what disruptions are coming. We believe that future winners in the digital economy will be those that can deliver on one key insight: put technology in the background, and focus on people first. Putting customers first does not diminish technology’s importance; rather, a deep customer understanding should help guide the choice of which technologies to incorporate in your business.

Cognizant can bring together digital strategy, deep industry knowledge, human sciences, experience design and technology expertise to help companies design, build and scale digital business solutions. Cognizant has both the expertise and experience with digital transformation. Together with clients we can explore tomorrow’s opportunities.
The future of manufacturing is human

An external perspective by futurist and trend-watcher Tony Bosma

The future is already here

New challenges and questions

Key take-aways

The Future of Manufacturing
Diane is at work, but her mind is on other things. Her wedding is next week, and she’s ticking off a mental checklist to make sure everything’s been taken care of. The customized place settings and guest favors have all been 3D-printed and shipped to the wedding venue. Her dress arrived yesterday, produced from recycled materials in her exact specifications. Her fiancée’s custom-made tuxedo arrived, dyed the perfect shade of blue: a color the designer never offered originally. The gifts for the wedding party – selected based on their social media profiles – were packaged and wrapped in personalized paper and delivered directly to their hotel rooms. Diane’s 3D-printer at home is creating the perfect stand for the wedding cake. The couple’s customized gifts, made to match the dimensions and measurements of their new apartment and their chosen color scheme, are being produced at a special made-per-order factory, and individual bills are off to the guests who’ve registered to give them.
The manufacturing sector has been invaluable during the COVID-19 crisis, from making and distributing everything from hand sanitizer to ventilators, this sector has pivoted to the production of essential goods that are making a real difference.

Post-COVID, these lessons in adaptability will prove essential as consumers look for an ever-increasing degree of personalization and one-off production of goods.

And the factory that created her home stereo is recycling the parts and reassembling them to give the system more power and less feedback.

She confirms a reminder for the day after the wedding, when a truck will arrive to take everything – from the glasses and plates to the chairs to Diane’s dress and her hubby’s tux – back to the factory, where they will be disassembled, recycled and reused for the next customer’s custom order.

Seems too good to be true? It’s not. This is the future of manufacturing. And for factories to remain relevant, they’ll have to embrace a whole new, made-on-demand mindset.

From assembly line to assembly circle

Today’s manufacturers enjoy a straightforward, transactional relationship with customers. The resellers’ orders come in, and human workers control machines that pump out the products. And while data can help estimate the amount of specific product that will get sold based on previous sales figures, it’s always a bit of a guessing game. And unused product and materials end up in a landfill, along with tons of manufacturing waste.

In recent years, manufacturers have looked to technology to optimize production and reduce waste. In an increasingly competitive market, lowering the cost of ownership in factories and logistics is a key differentiator. But as the sharing economy grows in popularity and customization becomes the norm, manufacturers must explore the potential of technology to truly shift the paradigm of how consumers use – and reuse – products.

Opening the loading dock doors

So, what does manufacturing look like when everything goes personal? First, customer interactions will be enhanced with intelligent voice-based assistants and IoT to make service, ordering, advice and self-diagnosis more agile, accurate and applicable. And as customers become more comfortable dealing directly with manufacturers, they’ll leave behind the retail middleman and work directly with manufacturers on their desired products.

Soon after, mass production will likely become a thing of the past. The next industrial revolution will be all about automated production of made-to-order goods. And production will just be one step in a circular process. Manufacturers will partner with retail, home supply and other producers to expand their capabilities, so that customers can get exactly what they want, in any color they want, at any time they want. And manufacturers will be responsible for a full array of product service after purchase – from repairs to recycling to reuse – so that waste is minimized, and products can be repurposed.
In the years to come, customers will demand far more personalized products.

Of course, no one can talk about Industry 4.0 without talking about robots. In Japan, the fully autonomous Fanuc plant uses robots to build other robots. While some fear that such developments will force humans out of a job, countless studies show that the most powerful team in manufacturing is still a human-machine interaction. The robots do the physically demanding, technically sophisticated work. The humans keep it all under control and ensure nothing goes wrong. In France, Kraaft.co is already using voice recognition and natural language processing to improve human-machine interface on the factory floor.

Disrupting the links in the chain

In the years to come, customers will demand far more personalized products, at the same level of speed and quality as today. So the coffeemaker they order on Amazon will still arrive the next day, but now, it will be the exact, customized color they specified. Clothing will be made to order, to exacting color and size specifications, and returned to the factory for recycling when it’s no longer in use. People will no longer buy products – they’ll borrow them.

For manufacturers, this means deep investment in technology. The shifting paradigm will affect every aspect of the work, from raw material acquisition to delivery and logistics. And with AI and machine learning, factories will become predictive and waste-free. The circular manufacturing process will not only eliminate waste; it will also possibly replenish the supply of materials that have already been depleted.

Several companies are already getting a head start on the new industrial revolution. In Slovenia, Origintrail uses blockchain technology to create trusted data sharing to global supply chains. And Deevio in Germany is automating visual inspections, using smart algorithms and image classification.

The future of manufacturing is human

These developments in manufacturing provide profound opportunities for new, up-and-coming manufacturers. While four or five major players currently dominate the market, in the future, those manufacturing giants will have a much steeper learning curve, and a much longer journey to optimization. In the meantime, smaller, more agile market players can shift quickly into providing the services that customers desire.

In the new era of manufacturing, even borders will be erased. There will be no need to ship product or materials overseas. A manufacturer will simply configure the dimensions and specifications for a product, and send a digital file to the country in question. Then, local producers can print and ship the product to its destination. Or better yet, the customer can print it herself.
On-demand and tech-driven

The manufacturer of the future will do much more than make products. High-value, on-demand services will create a circular relationship with customers. And these service-based models will be entirely human. No matter how many robots a factory installs, there will always be a need for a human intelligence to solve problems and orchestrate innovative solutions based on societal needs and technological possibilities.

The result? Dynamic manufacturing and customized, on-demand products, produced and shipped as quickly as needed. No waste and no warehouses. No surplus and no downtime. Human-machine interfaces that work together to produce just about anything people can imagine. So that next week, the same materials that made Diane’s wedding such a smashing success, will be reduced to their raw state and reused to make someone else’s vision a reality.
The Fourth Industrial Revolution (Industry 4.0) introduces many radical innovations and technological developments. While many of these advances will impact manufacturing, most are still in the pilot phase and haven’t been deployed at scale. However, new and increasingly intelligent technologies offer remarkable opportunities for manufacturers to gain competitive advantage, as well as much-needed change in an industry that, for the past few decades, has been slow to take fundamental steps toward a future that demands a shake-up of traditional processes and ways of working.

Now is the time to really rethink and reshape the industry. But while opportunities await, radical innovation requires not just speed but also vision, persistence and direction. To successfully execute on Industry 4.0 initiatives, the industry needs to stop focusing only on efficiencies and open its mind to how its processes, products and services can be reinvented in ways that benefit customers and society as a whole.

Tony Bosma (1973) is a futurist and trendwatcher. He is the founder of futuring and consultancy organization Extend Limits (www.extendlimits.nl). Extend Limits does not predict the future but helps organizations anticipate it. Do not ask yourself why things are happening. Ask yourself why hasn’t it happened yet? This is the mindset companies need to adopt in this era of change.

Tony Bosma is an authority in future thinking and trendwatching and was nominated in The Netherlands several times for trendwatcher of the year. He is an internationally renowned keynote speaker. He is known for his confronting, inspiring, visually attractive and surprising sessions about a wide variety of topics. He also works for a variety of companies and governments, helping them anticipate the future and, more important, challenge and question today’s world and mindset.

In collaboration with Cognizant, Tony Bosma did extensive research into near future trends across industries. Together with Cognizant, he made abstracts of the most dominant developments - not far fetched futuristic worldviews - but realistic developments which are seen right now. These are not only plausible future developments but also the challenges of technological developments.
The future of manufacturing is smart, interconnected and flexible. It’s technology-enabled but human-driven. To achieve this vision, the industry will need to adopt a fundamentally different mindset – from its current focus on “cheaper, faster and more efficient” toward “smarter, disruptive and more collaborative.”

Although change is happening in manufacturing, it’s also a very conservative industry when it comes to adopting new technologies. Manufacturers have historically focused on operational improvements. As a result of constrained resources and available factory capabilities, innovations have traditionally been required to have a clear ROI and minimal impact on existing business operations. Competition and a lack of in-house skills have also made it difficult to radically innovate and embrace change. According to McKinsey, more than 70% of industrial companies are still either at the start of their digital journeys or unable to move beyond the pilot stage, even as productivity growth seems to be decelerating in many Western economies.

When we look at the factory of the future, however, manufacturing will move beyond traditional automation and toward a fully intelligent and connected system, aided by 5G networks, smart sensors, artificial intelligence, robotics, smart materials, quantum computing, nanotechnology, biotechnology and 3D printing. But while extremely powerful, these new technologies are also much more difficult to deploy than previous technologies, as they require changes in the manufacturer’s organizational structure, culture and, above all, mindset.

“Nations who invest in exponential manufacturing technologies and innovation ecosystems will emerge to be more competitive than those who choose to compete on price alone. Higher value, advanced products, and processes that require excellent product quality and deliver greater margins are driving faster, permanent innovation.”

World Economic Forum
Beyond the four walls

So the question is: Will this new wave of technological developments really result in fundamental improvements, or is the manufacturing industry too far behind the needed change? What are the most fundamental technological trends and developments for the future of manufacturing, and how transformative will they be?

The factory of the future will not be limited by its physical walls and on-site machines. We will see growth in the industry when new technologies are implemented at scale across the value chain, shifting the supply chain from linear to interconnected ecosystems. This requires looking beyond the four walls of the factory and connecting manufacturing processes with the outer world of suppliers and customers.

Connectivity, integration and converging technologies will help manufacturers meet the growing demand for low-volume, more customized and more complex products. These are also the biggest challenges for the industry. Expanding beyond the factory walls requires not just strong collaboration among operations technology, industrial automation and information technology but also a change of mindset and trust in each other and technology.

Smart as the new normal
The merging of cyber and physical systems with the outer web will make the smart factory a reality. True power and progress for manufacturing lies in the creation, enhancement and real-time sharing of data and information throughout the value chain. Cognitive technologies like machine learning, computer vision, speech recognition, data analysis and AI will fuel this development, all working together to create a network of machines and technologies that use data to do the right things and do things right. Machinery and manufacturing equipment will no longer need to follow explicitly programmed instructions; instead, by being exposed to real-time data from the value chain, these networks will be able to self-optimize, improve processes and even reorganize processes based on demand in the value chain.

To accomplish this, data collection will become key. Smart sensors will monitor specific processes throughout the factory, and smart robots will continuously monitor material handling and adjust production if needed. Dynamic manufacturing will become a reality due to smart equipment enabling different production settings for lower-volume production, minimizing downtime for retooling and reprogramming factory equipment.

Merging worlds
Manufacturing will also transform from a reactive to a predictive approach. Traditionally, the most common way to get information about the complex and critical systems used in manufacturing was physical inspection by humans. With advanced technologies, however, we’ll see the rise of digital representations of machines, processes and products. By connecting the physical assets to the digital world and creating an identical digital representation, businesses will be able to create, test, build and service future products before they’re physically manufactured.

As such, the virtual world will become the ultimate playground for future products and services. Extreme flexibility will become a reality, as requirements and factory processes can first be tested virtually. By the time factories manufacture goods, everything will perform according to the desired requirements. Virtual representations will also be used to self-diagnose needed maintenance in real-time.

Autonomous machines on the horizon
Veterans of the manufacturing industry might remember the introduction of the Unimate 1900 series in 1961 by General Motors. It was the first official mass-produced robot arm for
factory automation. In 1966, Unimate became world-famous in its first television appearance on The Tonight Show in the U.S.

Now, manufacturing is about the combination of cyber and physical systems, blending the physical, digital and biological worlds. The network of all these different technologies will ultimately create so-called “lights-out” factories, where intelligent systems will execute processes that don’t require human dexterity or problem-solving skills. Autonomous systems will divide tasks like assemble, pick-up and hand-over. Robots will decide by themselves which tasks can best be handled autonomously and when. Although these advanced factories are still rare today, they will become the new normal.

The most well-known example of the autonomous factory is the Fanuc plant in Japan, where robots build other robots. The way toward this future is through the use of co-bots, or collaborative robotics, which work safely and harmoniously together with their human counterparts. Humans will go from planning and performing manufacturing tasks to problem solving and orchestrating innovative solutions based on societal needs and technological possibilities.
86% of the top 100 companies in R&D spending worldwide are from the manufacturing industry.

Deloitte, Council on Competitiveness and Singularity University
Imagine, one day...
By 2050, it’s possible to imagine factories operating without reliance on humans. In this scenario, human activities have all but disappeared from the factory grounds, while factories have become interconnected with customers, resulting in untapped levels of flexibility and customization.

Machine-to-machine communications prevent overproduction and wait times. Round-the-clock and flexible and scalable productivity are possible through highly intelligent robotics, ensuring a production process free from waste and defects. Manufacturing is fully circular and environmentally sustainable. Production even regenerates our natural environment, undoing the harm done by previous industrial revolutions. Much of the needed resources come from returned products or even from other planets. Maintenance is fully predictive, with no need for unnecessary transportation. There are even products being printed at the homes of consumers. The necessary movement of products from factories to customers is fully autonomous, and production has become location-independent.

The few humans who are necessary in the factory are completely free of repetitive and dangerous work. Manufacturing has become fully capable of adapting to the constantly changing needs and demands of society. The factory is able to fully self-optimize, reorganize and adapt to changing demands, and is able to autonomously run production processes without the need for human intervention. This does not result in factories without any people but in a balanced world of machines combined with human intelligence. The future factory still needs human intelligence to cooperate with machines.

This future scenario raises many questions. What does the future of manufacturing mean for the planet, safety, inequality and work? Can technology create real progress by fundamentally changing the manufacturing industry?

Manufacturing reinvented
New challenges and questions
We’ve faced the prospect of mass automation in factories for decades. Now this vision is becoming a reality. As the industry envisions Industry 4.0, in fact, technologists and futurists are already thinking about Industry 5.0. But with all the new digital opportunities, are we addressing the real challenges faced by the manufacturing industry? Will this new industrial revolution result in a world we want to live in?

Manufacturing is a potent force for improving the standard of living worldwide by creating a more human-centric, environmentally minded and sustainable world. This demands forward-thinking engagement from the industry and a changed mindset from “doing less bad” toward “doing only good” and from becoming sustainable to becoming circular and resilient.

Is the industry asking the right questions and doing the right things to create our future world? As machines redefine manufacturing, a new set of ethics and morals need to be adopted. Is everything that is technological possible also desirable? The manufacturing industry will be confronted with questions it had never considered before.

New technologies in manufacturing will change the concept of ownership, ethical production and what and how we consume. It will create borderless societies, affect the relation between organizations and consumers and change the balance between work and leisure.
Technology-driven ecosystems will be fueled by real-time consumer data. Wearable devices and smart assistants – already a part of our everyday lives – will be connected to suppliers and commercial organizations, which will use that data to predict individual consumer needs and adapt products and manufacturing processes accordingly. As products become more digitized, physical distribution will become less critical, as digital files will be sent and printed locally. This will disrupt taxation codes and change the concept of inter-country import and export. Ethics and transparency in manufacturing will also become more essential as consumers increasingly demand ethical production and manufacturing.

What will the future of factory work be? Do we need to shift power to machines – and do we want to? Even with increased automation, the intent of the Fourth Industrial Revolution is not to turn the human workforce into machines and cyborgs but to humanize work. The goal is to harness technology to differentiate us from machines, assigning inhuman tasks to machines and freeing human workers to utilize their unique skills and capabilities in production processes. To accomplish this, manufacturers will need to facilitate collaboration between technology and humans, which in turn will require upskilling the workforce to take on new responsibilities. Some have gone so far to say that human learning will be even more important than machine learning in the future of manufacturing.

The most vital question in this technology-driven industrial revolution is: How will we all benefit? Are we creating a new inequality between digitally rich and digitally poor individuals and countries? As we witness the rise of digital monopolies – and some companies becoming even more powerful than countries – will technology result in inequality between organizations? Even if all manufacturers increased their investments into new technologies, leading organizations would still reap all the benefits and gain enormous competitive advantage.

Those that avoid risk or have fewer opportunities to harness technology could quickly become irrelevant. Will the world of manufacturing transform toward only a few worldwide suppliers? A study by the Organisation for Economic Cooperation & Development concluded that the gap in performance between the best companies and the rest is widening. New monopolies within manufacturing are on the horizon, and we will see a significant reordering of manufacturing nations.

“More jobs will be created than are lost from the AI revolution.”

World Economic Forum

More jobs will be created than are lost from the AI revolution.

World Economic Forum
“Excessive automation at Tesla was a mistake... Humans are underrated.”

Elon Musk
The future is already here

While manufacturing will be dominated by new technologies, the changes we’ll experience will be led by humans. We’ll see the industry shift from a system based on physical activities in a limited and controlled environment, toward interconnected cyber-physical systems driven by predictive smart data. The future will bring flexible production processes facilitated by augmented humans, as well as borderless and location-independent physical production. Consumer needs will be monitored and automatically translated into future products. Every product will contribute to the health of the environment, with no negative impact on our natural world. Every manufacturing process will add value to society rather than extracting value and resources.

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Real-life cases

The cases below are inspirational and show how manufacturing is changing. Startups and innovative ideas can grow but also fail fast – that’s how innovation works at the frontiers of an industry. There is no business relationship between the following cases and Cognizant.

OriginTrail
OriginTrail uses blockchain technology to enable trusted data sharing in global supply chains. The OriginTrail Decentralized Network (ODN) is built for data integrity and validation in inter- organizational environments, based on globally recognized standards and powerful graph data structures.

www.origintrail.io

Deevio
Today, parts inspection processes are conducted by humans. However, Deevio makes it possible to automate visual inspections. The startup promises to automate quality control by using smart algorithms and image classification.

www.deevio.ai

German Bionic
German Bionic focuses on augmenting human factory workers with exoskeletons for Industry 4.0. To aid its research into intelligent human-machine and AI systems, the startup is developing an open software platform. Data gathered by the exoskeleton’s sensors will be made available for analysis and research.

www.germanbionic.com

Twaice
Twaice uses digital twins to capture battery performance and enable predictions of future developments. Using this information, the organization wants to realize precise predictions and extend battery life.

www.twaise.com
MachineMetrics
MachineMetrics has created an industrial Internet of Things (IIoT) analytics platform capable of monitoring production processes in real-time. With the data, it can produce visualizations of production data and, using predictive analytics, identify production bottlenecks. As such, the company is driving process improvements and manufacturing efficiency.
www.machinemetrics.com

Kinemic
Kinemic develops and sells systems for human-computer interaction. To enable hands-free input and gesture control in factories, the organization developed the Kinemic Band, which makes keyboards and touchscreens unnecessary.
www.kinemic.com/en

The future is human
Humans excel at being creative, at seeing, identifying and investing in opportunities and solving problems. So while technology will become highly intelligent, it will never match our human creativity. The greatest progress technology can offer us, our organizations and our institutions is to help us emphasize our most basic and strongest human skills by digitizing the activities machines are best at.

Let’s be curious about the future, not fearful. Let us, as a society, create and discover new varieties of rules and norms. The future is not about making the present more efficient but about reshaping it – something that only humans can, and will, do.

“Technology changes all the time; human nature, hardly ever”
Evgeny Morozov
1. Put customers in control of their own data, and enable them to utilize it their way.

2. Focus on creating/sharing borderless data with consumers and suppliers.

3. Prepare for “beyond four walls” execution and manufacture.

4. Move from assembly line to assembly ecosystem.

5. Embrace the circular mindset and ways of manufacturing.


8. Try to disrupt your own processes. If not, someone will do it for you.
ABOUT COGNIZANT
Cognizant (Nasdaq-100: CTSH) is one of the world’s leading professional services companies, transforming clients’ business, operating and technology models for the digital era. Our unique industry-based, consultative approach helps clients envision, build and run more innovative and efficient businesses. Headquartered in the U.S., Cognizant is ranked 193 on the Fortune 500 and is consistently listed among the most admired companies in the world.

Driven by a passion to help our clients build stronger, more agile and more innovative businesses, we enable global enterprises to address a dual mandate: to make their current operations as efficient and cost-effective as possible and to invest in innovation to unleash new potential across their organizations. What makes Cognizant unique is our ability to help clients meet both challenges. We help them enhance productivity by ensuring that vital business functions work faster, cheaper and better. And, our ability to conceptualize, architect and implement new and expanded capabilities allows clients to transform legacy models to take their business to the next level.

Learn how Cognizant helps clients lead with digital at

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