



The 7 Megatrends Shaping Manufacturing in 2021



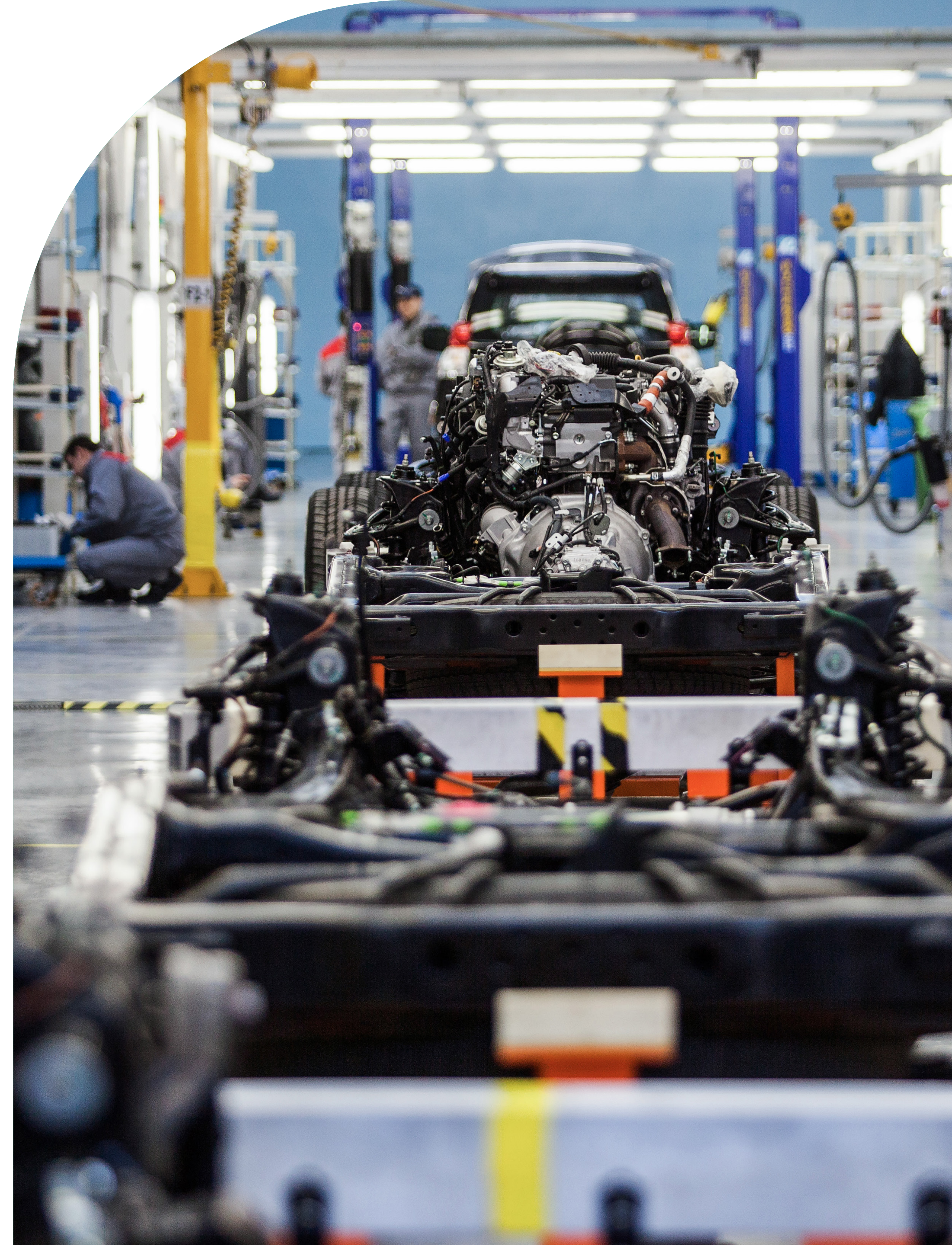
INTRO

The 7 Megatrends Shaping Manufacturing in 2021

We've all been hearing about smart manufacturing for quite some time now. But only with recent developments have manufacturers started to realize the smart factory's full potential and achieve a true digital transformation. This is due to a string of deeply interconnected phenomena, including technologies, trends, and conditions, that are finally coming together for 2021.

In this eBook, we explore the seven biggest megatrends transforming our lives and our industries. These trends are gaining traction fast, and those who ignore them run the risk of being left behind. On the other hand, if you strategically prepare for the changes that lie ahead, you'll be laying the groundwork for a smarter, more resilient, and more productive factory floor, paving the way toward a tremendous market advantage.

So let's get started.



TREND 01:

Cloud Computing

85% of companies worldwide have already made the transition to the cloud

Cloud adoption is on the rise everywhere. Already used by 85% of companies around the world, the public cloud services market is expected to reach \$257.9 billion this year. Let's take a look at how this affects manufacturing

In manufacturing, cloud services are gradually becoming an industry standard. The global cloud manufacturing market is set to reach \$111.90 billion by 2024, while the cloud market for automotive is forecasted to reach \$66.95 billion by 2022. As you may have anticipated, the COVID-19 pandemic has accelerated the demand for cloud services even further.

There are many compelling reasons why you should consider investing in cloud technology. The cloud frees you from your on-premises data centers, which are often expensive, outdated, and difficult to maintain. Instead, you can opt for flexible, secure, low-cost public cloud services that can scale up and down as needed to handle the influx of data produced by smart factories.

Freed from the constraints and limitations of your legacy systems, you can harness the cloud to gain key advantages:

REMOTE CONTROL :

When stored in the cloud, real-time data from the factory floor is highly available anytime and from any location. This not only supports remote work but also leads to greater visibility into processes and bottlenecks, speedier fixes, and elevated product quality.

ENHANCED COLLABORATION :

The cloud supports many collaborative tools that allow your employees to work on projects remotely while making simultaneous contributions in real time. This increases efficiency and shortens feedback loops.

ACCELERATED PRODUCT DEVELOPMENT :

The cloud provides compute power that can handle complex R&D tasks such as iterative design and product testing. This can help you achieve major breakthroughs faster. For example, Autodesk leveraged

the cloud's compute power to reduce the component mass of a motorcycle part by 15%.

The demand for cloud capabilities is growing stronger by the day, and one of the factors fueling this is the various trends in automotive today, such as connectivity and autonomous driving. AI chips for ADAS, for example, often consist of a staggering 1 trillion pure RC components, over 100 billion connected nodes, and up to 25 billion transistors. Designing these chips requires collaboration over intricate and massive data sets, requiring large-scale storage and compute resources. The cloud simplifies and speeds up this daunting task considerably.

The cloud can also be leveraged to tackle these trends in the automotive industry itself. Just take a look at Volkswagen. The German automaker invested in a cloud platform not to just enhance production but to also connect its vehicles, allowing it to provide in-car data and boost the customer experience.

Cloud migration is gaining momentum throughout the entire manufacturing ecosystem. Microsoft, BMW, ZF, Redhat and other key manufacturers and solution providers have created the Open Manufacturing Platform (OMP) initiative to provide manufacturers with an open-source infrastructure for data analytics in the cloud and NI is contributing to this effort.

Like many manufacturers, you may have been hesitant to migrate your sensitive data to the public cloud. But cloud adoption has been picking up speed in recent years as manufacturers realize that the cloud can actually enhance security. And this vote of confidence is justified. Cloud providers spend immense resources on cloud security to equip you with advanced built-in security measures, including firewalls, encryptions, and risk mitigation packages to safeguard your manufacturing data.***

So, if you haven't done so already, now is the time to focus on migrating workloads to get the most out of what the cloud has to offer.

TREND 02: 5G Technology

Expected to be 25 times faster than 4G networks, 5G is taking the smart factory to a whole new level.

5G is another budding trend that provides the technological infrastructure required to run a smart factory. Its high speed—expected to be 25 times faster than existing 4G networks—as well as high bandwidth and low latency allow manufacturers to connect multiple sensors, devices, and assets through a single, highly reliable, and near-instantaneous network. This wireless infrastructure promises considerable flexibility, allowing manufacturers to connect just about anything to anything else.

Leveraging these capabilities, you can take full advantage of AI to analyze production patterns in greater detail for enhanced supply-chain visibility, predictive maintenance, repurposing of tools, waste reduction, faulty-part identification, and more. Combined with cloud technology, these operations can all be highly automated and performed remotely in real time.

5G is expected to have a huge economic impact in the coming years, increasing GDP by \$3 trillion by 2035, and

implementing 5G networks in industrial IoT environments can unlock tremendous value. One German manufacturer of metal-bladed disks has already connected sensors to a 5G network to identify faulty parts in real time. This dramatically reduced its 25% error rate and prevented the shipping of faulty parts, resulting in considerable savings.

5G is already entering the public consciousness, with nearly two-thirds of manufacturers planning to roll out 5G infrastructure within two years once it becomes widely available. Ericsson is already using 5G to transmit location data to the cloud in real time, providing decision-makers complete transparency of any asset or machine. Although it could take a few years before 5G is fully implemented, you can start taking steps now to prepare for this shift.

Moving to a wireless environment naturally leads to some concern regarding data security. The U.S. and UK even went so far as to ban Huawei 5G equipment due to security concerns. This leads us to our next megatrend—cybersecurity.

Real-time high-capacity, low-latency applications

FEATURE	DESCRIPTION	WI-FI6	4G	5G
Latency	Delay between the sender and receiver of the data - the lower the latency, the more 'real time' the experience of the event	20 milliseconds (ms)	30-50 ms	1-10 ms
Reliability/availability	Source and destination without packet loss	99.99%	99.99%	99.99%
Throughput	Theoretical maximum amount of data moved from one place to another in a given period	9.6Gbps	300Mbps-1Gbps	10Gbps
Speed (project driven)	Expected practical speeds per user or device	1Gbps	20-50 Mbps	Up to 1Gbps
Connection density	Number of connected devices per unit area	8 per part	12 per part	100 per part
Energy	Comparative power consumption levels	Comparative power consumption levels	High	Medium

(5G outperforms other wireless options, Source: PwC report "5G in manufacturing")

TREND 03: Cybersecurity



Did you know that...

- Manufacturers are a prime cybersecurity target?
- Every year 120 million new forms of malware are developed?
- Companies typically experience thousands of cyberattacks a month?

Security threats are more prevalent than ever. According to a recent McKinsey report, every year, cybercriminals develop 120 million new forms of malware and several billion data sets are exposed to attacks. Many companies are subject to thousands of attacks a month, and if you're a manufacturer, you're considered a leading cybercrime target, putting your business at an even higher risk.

Compromised security is one of the hidden costs of a digital transformation. As factories become smarter and increasingly complex, it's much more challenging to track, assess, and mitigate risk. Let's take a closer look at why this is.

The connectivity of industry 4.0 devices, which can be so valuable on one level, also renders businesses more susceptible to attacks. Every connected device multiplies security vulnerabilities, ultimately creating billions of potential entry points for hackers. 5G technology exacerbates this problem even further because any point that is breached offers access to the entire 5G network.

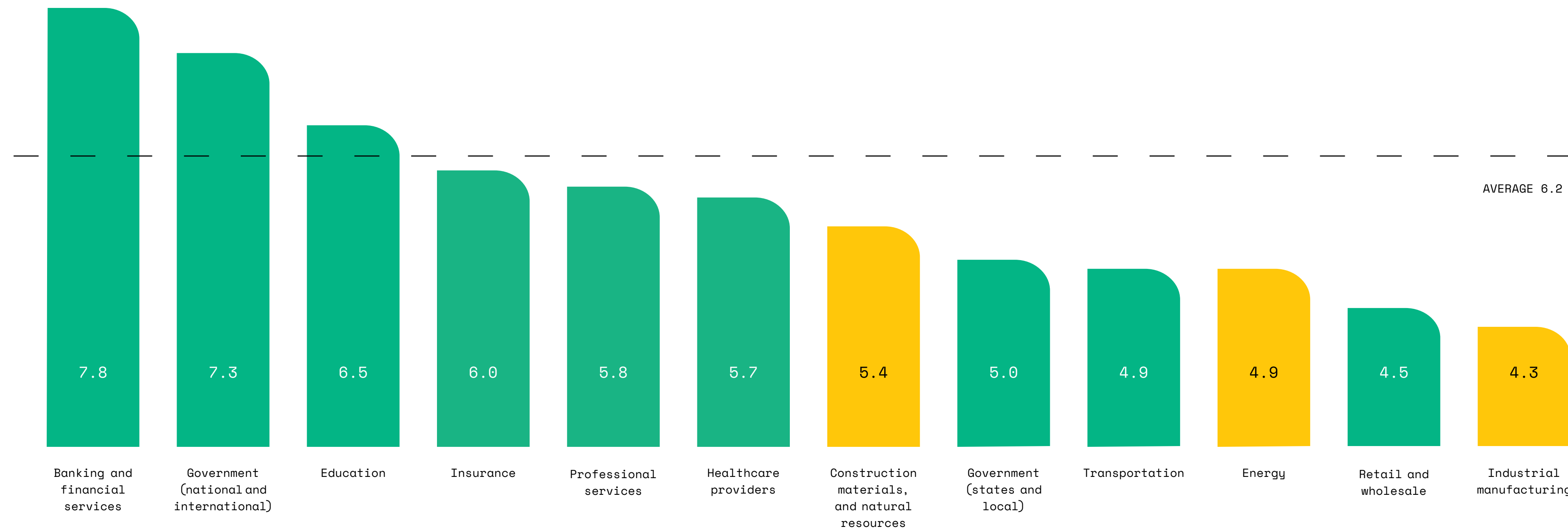
The stakes are very high for manufacturers. A hacker that gains access to a single entry point could potentially affect processes and systems across the entire network, disrupt operations, make unauthorized changes in safety and compliance regulations, steal intellectual property, and rob companies of their competitive edge.

To make matters worse, manufacturing is lagging behind when it comes to security. In a Deloitte study conducted in 2019, nearly half of manufacturers surveyed identified cybersecurity as one of the greatest threats to their smart factory initiatives. According to the same report, very few manufacturers have implemented sufficient monitoring in their OT environments, and less than half have conducted security assessments in the last six months. According to another report, industrial manufacturing was the sector that spent the least on IT security. The reality is that manufacturers are implementing new technologies faster than they are establishing the security measures needed to secure them.

TREND 03:

Heavy industrial companies lag behind most sectors in IT security spending.

IT security spending as a % of all IT spending, 2017



(Source: IT Key Metrics Data 2018: Key IT Security Measures: By Industry, Gartner.com, 2018)

It's not just manufacturing that's at stake- autonomous cars will also be prime targets for breaches and terrorist attacks. The FBI has voiced concerns that self-driving vehicles can serve as "lethal weapons." Navigational systems can be hacked to run cars off the road and hold passengers hostage, and evidence points to ISIS already looking into substituting self-driving cars for suicide bombers. Governments are beginning to address this

issue. The UK Department for Transport and the U.S House of Representatives have recently issued cybersecurity guidelines for the automotive sector and its supply chain. No matter which sector you operate in, measures should be taken today to ensure data is secured at its source, across operations, and all the way to the backend repository. This requires strategic thinking, including performing a thorough cybersecurity maturity

assessment and identifying which assets are the most valuable and in need of protection. The cloud can also play a significant role here, providing advanced built-in security capabilities developed by giants such as AWS, Google, and Microsoft.

TREND 04 : Sustainability

Sustainability is given a weight of 20% in Gartner's assessment of manufacturers Sustainable manufacturing practices can:

- BOOST ASSET EFFICIENCY BY 10-20%
- IMPROVE QUALITY BY 10-35%
- REDUCE COSTS BY 20-30%.

The world is failing to meet the Sustainable Development Goals set by the UN regarding energy and climate change. If things continue as they are, experts predict an increase in temperature of over two degrees by 2050. This will set off a chain of disastrous outcomes, such as mass human migration, acute water shortages, the spread of infectious diseases, and irreparable damage to the environment.

The industrial sector is a major consumer of energy and responsible for over one-quarter of global CO2 emissions—and it's starting to be held accountable. Sustainability is becoming an increasingly important benchmark in company evaluations; in Gartner's 2020 ranking of the leading 25 manufacturing companies, sustainability is given a weight of 20%.

Also, manufacturers are subject to increasingly strict regulations. In the automotive industry, for example, both the manufacturers and the vehicles

themselves are under scrutiny when it comes to carbon emissions. Even suppliers must provide certifications such as ISO 14001 attesting to their effective environmental management systems (EMS).

Finally, the COVID-19 pandemic is forcing factories to radically rethink their strategies for handling a scarcity of resources and supply-chain disruptions. This new way of thinking is paving the way toward more sustainable practices.

In light of these developments, manufacturers are becoming increasingly motivated to reduce their emissions and energy consumption. Many are beginning to market their products not just in terms of speed and quality, but also in terms of sustainability.



TREND 04:

Industry 4.0 can play an exciting role in digital lean manufacturing. Technologies such as IoT, artificial intelligence, and machine learning, coupled with the fast processing of 5G and cloud computing, can generate unprecedented insights to enhance sustainability. This combination can lead to:

- Heightened visibility into a system's behavior and usage, performance indicators, wasteful operations, and emissions throughout the product life cycle
- Increased agility through highly automated processes, swift real-time problem resolution, and adapting production according to forecasts for consumer demand and material availability
- Greater productivity at a lower cost with real-time insights that optimize processes, reduce waste, lower your carbon footprint, and ensure efficient energy use

This approach can thus have far-reaching effects on your business. In a recent report, Deloitte identified seven types of waste that can be eliminated through lean processes and claims that digital lean manufacturing can improve asset efficiency by 10-20%, improve quality by 10-35%, and reduce costs by 20-30%.

Deloitte's research makes one thing quite clear: The manufacturers that are set to succeed tomorrow are beginning to view sustainability not as a hindrance, but as a valuable business opportunity, and these companies are already taking steps toward greener and leaner manufacturing.

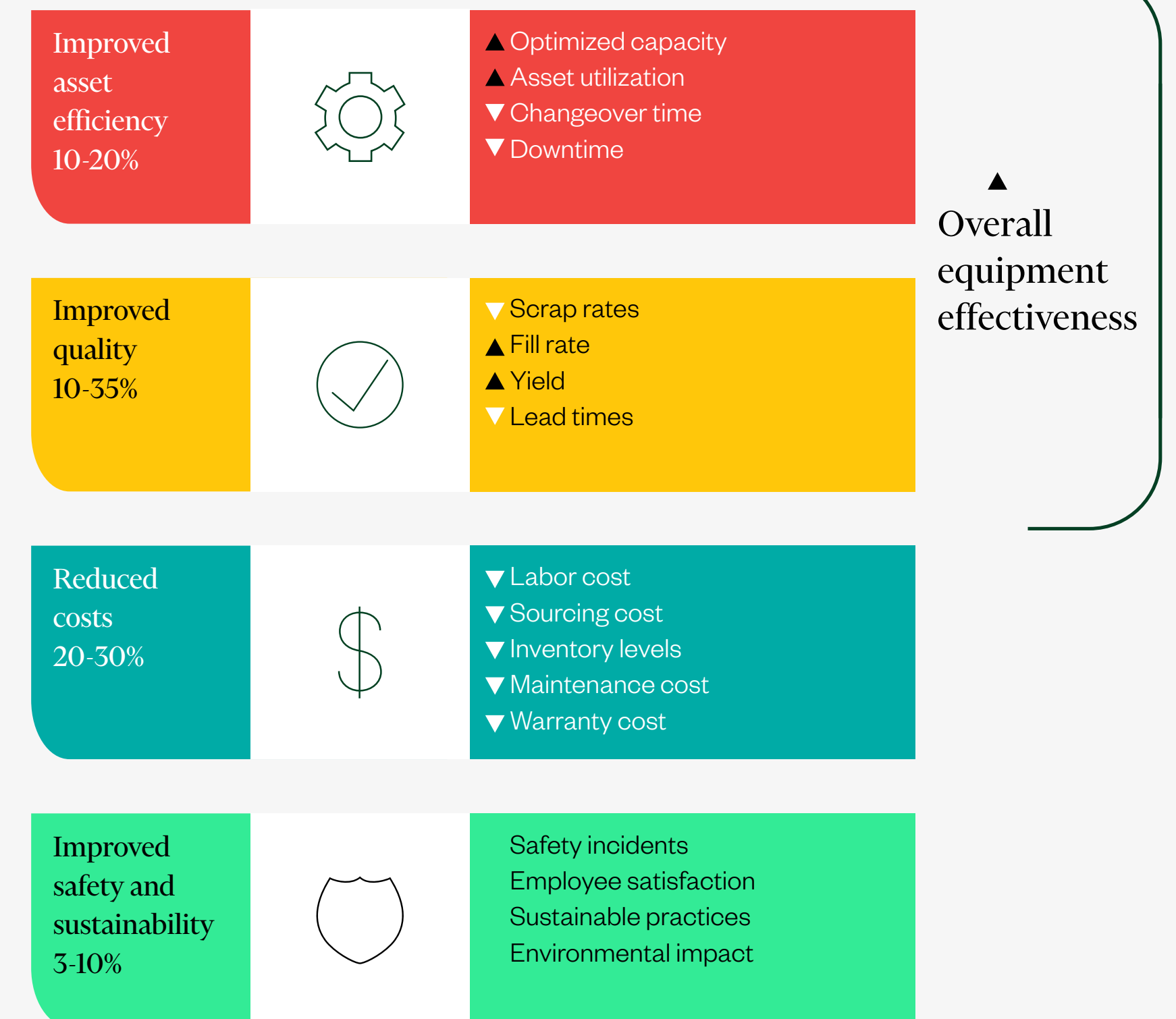
The seven kinds of waste

INVENTORY	Working capital and space used for raw materials, components, and work-in-progress and finished products
OVERPRODUCTION	Capacity utilized to produce goods that are not required
TRANSPORT	Transport of materials across the locations that adds zero value to the product
MOVEMENT	Movement of personnel or machinery that adds zero value to the product
WAITING	No-value-added time that increases lead time to fulfill customer demand
OVER PROCESSING	Unnecessary use of technologies, technical specifications, oversized equipment and resources
DEFECTS	Materials, labor, and time used to produce noncompliant products

(Source: Deloitte report "Digital lean manufacturing")

Digital lean business opportunity and value

Potential Benefits:

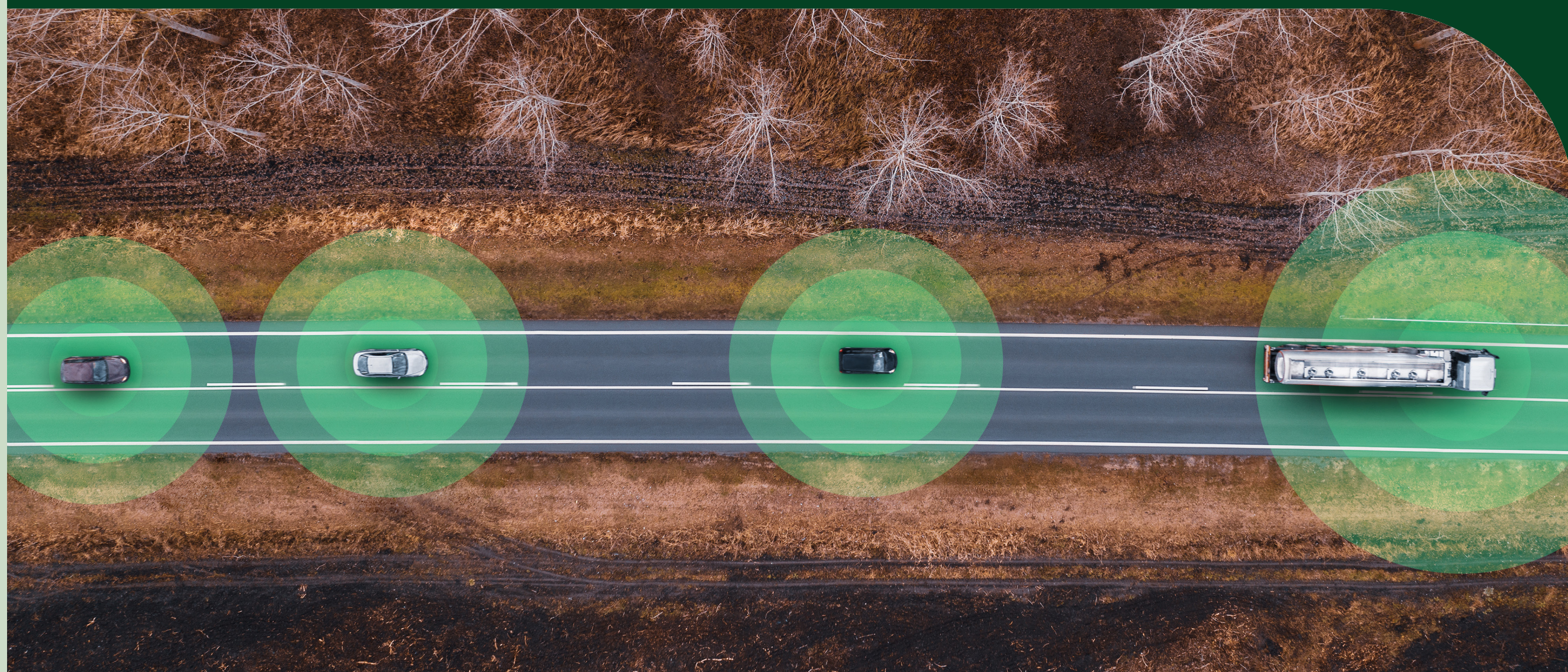


(Source: Deloitte analysis.)

TREND 05:

Electrification and Autonomous Driving

Electrification and autonomous driving are picking up speed, deeply affecting both the automotive and semiconductor industries



Electrification and autonomous driving are prospering, resulting in a huge impact on the automotive and semiconductor industries. They are also highly connected with the megatrends we've covered so far. Let's take a look at these trends in numbers.

Electrification is flourishing. Even in a post-COVID-19 reality, the market is expected to achieve a CAGR of 11.9%, hitting \$126 billion by 2025. The global autonomous driving market is also thriving. Valued at \$24.1 billion last year, it is projected to grow at a CAGR of 18.06% over the next five years.

ADAS is one of the fastest-growing trends in autonomous vehicles. It includes adaptive cruise control, lane assist, emergency braking, connected mobile apps, navigation, and infotainment. These technologies rely heavily on other megatrends: AI, 5G networks, and cloud-based services.

Autonomous driving is also having a big impact on semiconductor manufacturing. According to one estimate, the tech equipment required for autonomous vehicles will add a mind-boggling 200-300 extra pounds to each car, including billions of 5G electronic components that are interconnected and will need a lot of compute power. This has led to an explosion in demand, with semiconductors for mobility accruing an average annual investment of \$7.4 billion in 2019 vs. just \$0.8 in 2013. Of course, as mentioned in the cybersecurity section above, the increase in electronic components in vehicles is also rendering autonomous vehicles much more vulnerable to data breaches and security attacks.

Both electrification and autonomous driving play key roles in sustainability. Electrification lowers emissions, enhances fuel efficiency, and lowers vehicle weight. Connected vehicles and autonomous driving can reduce traffic and lead to smoother and less-wasteful driving. This trend thus not only supports smart cities but is also crucial from an environmental perspective, seeing as transportation currently accounts for 28% of greenhouse gas emissions in the U.S.

One obstacle in designing self-driving cars is that they use much more compute power, draining the electric battery. Ford says more than 50% of its electric battery will be drained by the compute power needed for its self-driving software. Despite these challenges, companies continue to break new ground every day and bring these innovations closer to everyday life. Mobileye, for example, has already been given the green light to test its autonomous vehicle on public roads.

So what can you do to prepare for this megatrend? There is still a lot of groundwork to be laid out in preparation for the coming wave of electric and autonomous vehicles. This megatrend requires both the semiconductor and automotive industries to prepare for an increase in demand for the 5G components and cloud technologies involved; this means they also have to prepare to secure vehicle data and implement an AI infrastructure to handle the increase in data and decisions made for a single vehicle.

TREND 06:

Remote Work

The COVID-19 pandemic has led to a radical shift toward remote factory management, made possible through AI, ML, IoT, and cloud technologies

The COVID-19 pandemic has radically changed the work landscape, putting pressure on companies to control operations remotely. TSMC, the largest contract chip manufacturer, was one of the first to launch a full-blown plan for remote work in March 2020.

To handle this new reality, you have to invest not just in Zoom meetings but also in infrastructure that allows you to perform maintenance, operate manufacturing floors, and perform R&D remotely with as much automation as possible. By harnessing IoT, AI, and an ML infrastructure, coupled with cloud technologies, the factory floor can be managed from afar, facilitating:

01

Remote monitoring:

Sensor data is aggregated, contextualized, and automatically analyzed by machine learning algorithms to track performance remotely. It also provides a more accurate and detailed picture of operations in real time.

02

Predictive maintenance:

Key KPIs are tracked, detecting and solving problems before performance is impacted.

03

Enhanced collaboration:

Traditional back-and-forth communication through email and messaging is replaced with digital collaboration tools that are linked directly to factory-floor data and process workflows. This allows employees to efficiently collaborate across geographies and functions, boosting productivity, decision-making, and KPIs, as well as speeding up root-cause analysis and product development.



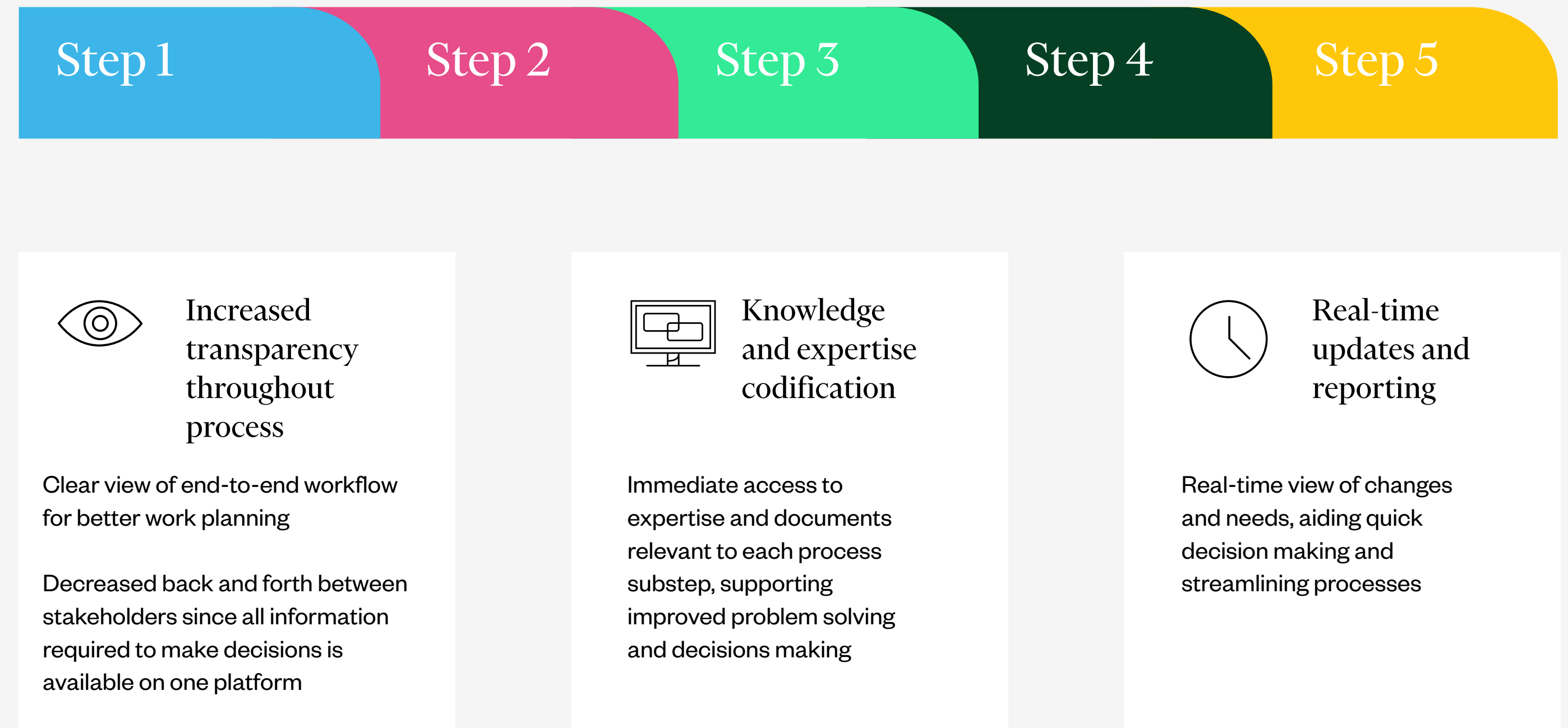
TREND 06:

Setting up infrastructure for remote work can have an overarching impact on your business. Remote collaboration, which is just one aspect of remote work, can boost productivity by 20-30% and unlock more than \$100 billion in value.

Gearing your business toward remote work is a huge business opportunity. Even if it's just a temporary situation, which it most likely is not, setting up an infrastructure for remote work goes hand in hand with an accelerated digital transformation and collaboration. It paves the road toward reliable operations that are highly automated and less dependent on workers on the factory floor.

Embedding digital collaboration in process workflows generates a wide range of benefits.

Core business process, eg, maintenance or inventory operations



(Source: McKinsey & Compayn's "Digital collaboration for a connected manufacturing workforce")

TREND 07:

Bringing AI to the Edge

AI is going as strong as ever. The majority of companies spent over \$50 million in 2020 on AI projects.

This megatrend started in our report last year and is still as relevant as ever. As we've seen, the six megatrends covered above are deeply interconnected and all rely heavily on AI technology. This is because AI offers a solution to the number one phenomenon flooding manufacturers at an alarming rate—data.

AI algorithms, which encompass technologies such as machine learning, machine vision, and deep learning, can ingest immense volumes of information and extract patterns, predictions, and insights from them. These powerful tools can be applied to just about anything measurable—from product design to shipping—and dramatically reduce costs, enhance product quality, and reduce time to market.

Countless companies have already applied AI to their operations, achieving milestones that were previously inconceivable. General Motors, for example, implemented machine learning technology in its design process and created a seatbelt part that is 40% lighter and 20% stronger. AI algorithms can also be trained to detect anomalies with extreme precision. For example, they can identify faulty parts up to 90% more accurately than humans. In the semiconductor industry, machine learning has been shown to improve yields by up to 30% and cut supply-chain forecasting errors by up to a half. These are just a few examples of the considerable effects AI can have on manufacturing.



TREND 07:

Impact of use cases across multiple industries

Realizing the immense business value at hand, enterprises have begun to invest heavily in these capabilities. In 2020 alone, nearly 65% of companies have each spent over \$50 million on projects dedicated to Big Data and AI. However, the same report revealed that only 14.6% of companies have actually deployed AI in production. This is because deploying AI at scale is often complex, slow, and difficult.

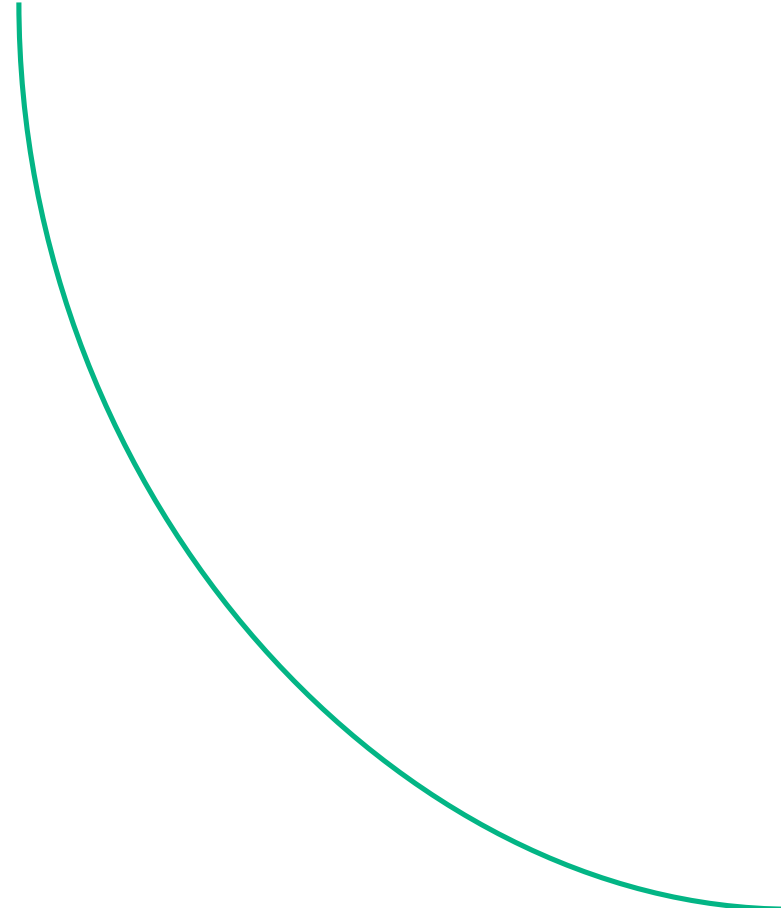
As we'll see in the following section, AI initiatives can be accelerated dramatically when using the right third-party tools. This is a necessary step for any company that wishes to thrive in the industry of tomorrow.

		INDUSTRY				
USE CASE		Aerospace	Automotive OEMs/ commercial vehicles	Automotive suppliers	Industrial equipment	Semi-conductors
Products and services	Autonomous vehicles	High	High	High	Medium	Low
	AI – enhanced predictive maintenance	Low	High	Low	High	Low
Manufacturing operations	Collaborative and context-aware robots	Low	Low	Low	High	Medium
	Yield enhancement in manufacturing	Medium	Medium	Medium	Low	High
	Automated quality testing	Low	Low	Medium	Low	Medium
Business processes	AI – enhanced supply chain management	Low	Low	High	High	Medium
	High performance R&D projects	Low	Low	Low	Medium	High
	Business support function automation	Medium	Low	Medium	Medium	Low

(Source: McKinsey & Company's "Smartening up with Artificial Intelligence (AI)")

CONCLUSION:

Riding the 2021 Megatrends with OptimalPlus



With OptimalPlus, you can implement AI at scale, tackle the biggest megatrends, and enter 2021 more prepared, more productive, and more profitable

There has been a buzz surrounding smart factories and digital transformation for quite some time. But 2021 promises to be the year the big puzzle pieces finally fall into place. The megatrends we've covered in this eBook are coming together to usher in a new wave of manufacturing.

The combination of 5G networks, cloud services, and cybersecurity are allowing AI and ML to work their magic on the factory floor. This shift is being further accelerated by the growing demand for electric and autonomous vehicles, pressure to operate factories remotely in a post-pandemic reality, and the urgency to meet sustainability goals.

Manufacturers that are quick to recognize these megatrends and prepare for them will stay ahead of the curve. This means moving away from next quarter's tactical objectives and focusing on longer-term strategic projects. Since all the megatrends mentioned above rely heavily on AI technology, the first step in preparing for 2021 is making sure you can implement AI at scale.

OptimalPlus provides you with a full-blown, end-to-end platform for AI and Big Data analytics that integrates directly into your systems on the production line and throughout your entire supply chain. The platform enables businesses to deploy machine learning infrastructure at the click of a button and instantly influence decisions that enhance product quality, automate inspection, increase yield, lower scrap rates, accelerate time to market, and

more. These benefits naturally lead to leaner manufacturing, creating a positive impact on sustainability.

In addition to providing machine learning infrastructure, our platform enhances the cybersecurity measures around sensitive product data and helps companies move to the cloud and manage their operations remotely. We also have a focused solution for the automotive industry, which helps accelerate innovation in the fields of electrification and autonomous driving. OptimalPlus is now a part of NI, joining its broad spectrum of product lifecycle analytics solutions to solve the world's most pressing problems.

At OptimalPlus we're focused on propelling your digital transformation journey at full speed, helping you make the most of the big trends coming up ahead. Leveraging our platform can serve as a powerful springboard for your organization to enter 2021 more prepared, more productive, and more profitable.