

# INDUSTRIAL IOT: A REALITY CHECK

AUGUST 2021



# INDEX

<a href="#">Executive summary</a>	<a href="#">4</a>
<a href="#">Introduction</a>	<a href="#">9</a>
<a href="#">The market size of Industrial IoT</a>	<a href="#">13</a>
<a href="#">Industrial IoT as the backbone of Industrie 4.0</a>	<a href="#">24</a>
<a href="#">Business improvements from Industrial IoT</a>	<a href="#">35</a>
<a href="#">Lessons learned on IoT for manufacturing and logistics</a>	<a href="#">47</a>
<a href="#">Market view and predictions about Industrial IoT from PAC (Teknowlogy Group)</a>	<a href="#">57</a>
<a href="#">Conclusions</a>	<a href="#">68</a>
<a href="#">Appendix</a>	<a href="#">71</a>



# EXECUTIVE SUMMARY

## **Along with cloud computing, the Internet of Things (IoT) is the leading technology driving innovation**

Since the start of the Covid-19 pandemic in 2020, many industries, notably healthcare, insurance and education, have increased their investment in IoT technologies as they discovered how it could help them overcome challenges. As we move into recovery, IoT looks set to play a crucial role, helping both businesses and governments achieve their aims.

In this Research, Reply explores two key areas that are pushing the growth of IoT within industry, or 'Industrial IoT' (IIoT): smart factories, and smart transport & logistics. Reply customers and partners share their experiences of the opportunities and challenges, and PAC (Teknowlogy Group) provides valuable new data and insights.

## **The growth of Industrial IoT**

The Research examines the main markets for smart factories and smart transport & logistics, grouped into two clusters: 'Europe-5' (Germany, Italy, France, Belgium and the Netherlands) and 'Big-5' (the USA, China, India, Brazil and the UK). Data is presented in

two segments, services and software & 'anything as a service', known as XaaS. These are further split into platforms, technology and applications.

Despite the tough economic climate of 2020, both clusters saw a small growth in investment in smart factories and significant further growth is predicted by 2025 with the USA expected to triple its smart factory market size. In the area of smart transport and logistics, the Big-5 has seen the stronger growth in 2020 but again, both clusters are predicted to grow by 2025.

China and the USA will be the two leaders for smart factory in the Big-5 cluster, with the platforms area growing fastest and high investment in predictive solutions and remote monitoring. Within smart transport & logistics, Brazil has lost most ground during the pandemic but is now recovering and the highest growth is expected in India.

Focusing on the Europe-5 cluster, the smart factory market will grow almost 3x in all nations, despite a skills shortage. Platforms will grow more than anything else, with companies investing to improve quality management and reduce costs. Looking at smart transport & logistics in the Europe-5 cluster, Germany will remain the leader but the other nations will still see significant growth.

## **Why Industrial IoT is becoming the backbone of Industrie 4.0**

Without Industrial IoT, Industrie 4.0 cannot exist. Data are the fuel for all 'smart' use cases in the industrial world, and Industrial IoT guarantees the infrastructure to collect them, transmit them to the cloud and manage the feedback post-analysis.

From data-driven design to augmented and virtual reality, Industrial IoT will bring a virtuous circle of benefits. Technology



is being used innovatively in factories and logistics centres, with Industrial IoT-enabled robots and drones progressing and driving efficiency whilst also taking on potentially dangerous tasks previously performed by humans.

However, no one involved in the realm of the Industrial IoT can remain unaware of the cyber-risks it brings, alongside the opportunities, and IoT cybersecurity is itself a huge growth market. In this Research, Reply identifies the biggest security considerations and some of the different solutions that are arising to meet them.

### **How Industrial IoT is improving business**

For those businesses leveraging its benefits, Industrial IoT is increasing factories' productivity whilst simultaneously improving quality of delivery. Its use in quality control is enabling not only adaptive or corrective decisions when problems are discovered, but also predictions for future production cycles. A particularly interesting area of improvement is additive manufacturing, in which AI and Industrial IoT working together are enabling reduced materials waste and lower energy consumption.

Industrial IoT is also challenging Supervisory Control and Data Acquisition (SCADA) to monitor factory equipment 24/7. Real-time monitoring is enabling predictive maintenance and reducing downtime caused by machine failure. This is also relevant to equipment manufacturers, who are evolving their own business models towards service-oriented contracts.

Supply chains and logistics have recently been in the news more than usual, with events such as the Suez Canal blockage highlighting the potential weaknesses in the system. IoT-based technologies can bring enormous benefits to the supply chain, from tighter monitoring of the movement of goods to better forecasting of demand.

Although most industrial managers want to adopt Industrial IoT and digitised processes, many struggle to progress beyond Proof of Concepts (PoC). In this Research, Reply shares its experience in this field, discussing the challenges and pitfalls organisations face in bringing PoCs to launch, providing valuable insight.

### **Lessons learned for manufacturing and logistics**

The Covid-19 lockdowns have accelerated companies' use of Industrial IoT technologies, aiming to make industrial workplaces safer and more productive. Real-time tracking and location systems have been widely used as social distancing tools and this market will continue to grow after the pandemic ends.

Businesses are also making progress on the challenges of operating existing equipment and new processes together. Translating the different languages used by different IoT devices remains a focus for IT specialists. Energy management is an area currently being transformed by Industrial IoT, with innovations constantly emerging.

The Research also offers a 'sneak peek' at a number of early-stage IoT companies which are being funded and supported by Reply's IoT incubator, Breed Reply.

### **Market view from PAC (Teknowlogy Group)**

In the 'first wave' of Industrial IoT, projects were generally driven by new technologies, new use cases, enthusiasm, and competitive threat. Companies followed a step-by-step approach from identification of potential use cases to outcome measurement, but often found they generated a lower ROI than expected.

PAC experts share some valuable insights from this first phase



and offer their view on the prospects for Industrial IoT in the near future. For example, the pandemic has not only revealed the vulnerability of supply chains, but also the potential for massive shifts in demand, requiring manufacturing companies to be prepared to produce different products at short notice.

This need for greater agility is driving investment in technologies such as IoT, AI and robotics. PAC (Teknowlogy Group) also predicts major investment in supply chain management systems, to protect against future external shocks such as Covid-19.

### **Conclusions**

Industrial IoT has a bright future, in which 5G and edge/cloud-powered architectures will enable an astonishing growth of connected devices. Personal and professional lives will be supported; workers will perform their roles more efficiently and innovative companies will have the tools they need to stay ahead of the competition.

However, reaching this future requires the traditional barriers among IT managers, OT managers and business experts to be overcome, and companies to reposition themselves in a world of connected products.

# INTRODUCTION

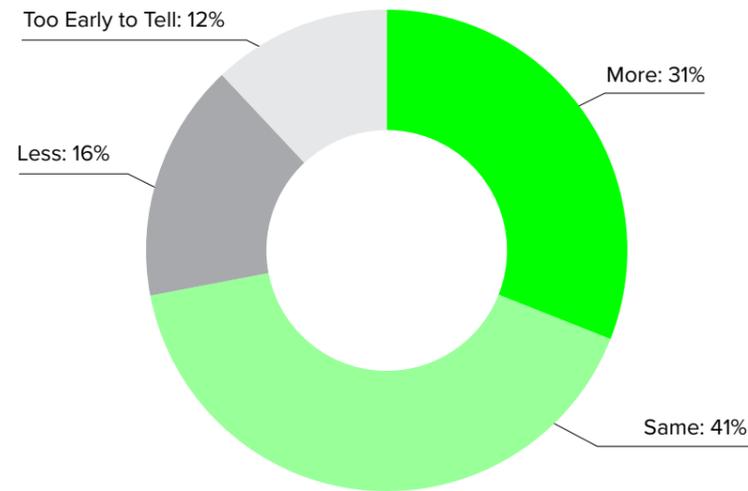
### **The Internet of Things and cloud computing are the guiding threads of major innovation areas**

During its first year of life, the Reply Market Research Hub often touched the world of the Internet of Things. While presenting 'Rebooting Longevity' Research, Reply revealed how smart home and medical IoT are clearly relevant technologies that can improve quality of life for everyone, not just for older adults. 'From Cloud to Edge' Research focused on how edge computing could accelerate companies' investments in Industrial IoT. 'New Interfaces, Zero Interfaces' Research mentioned a number of relevant interfaces powered by some kind of IoT, e.g. wearables or connected vehicles.

Along with the ubiquitous role of cloud computing as the new standard for software and services, IoT is today's other leading technology, completing cloud with new hardware flocking onto both consumer and industrial markets. 'IoT' has become a comprehensive label that includes all internet-connected physical objects able to collect and exchange data with systems, other devices, robots and humans too.



Source: [Microsoft, 2020] **Covid-19 impact on IoT Investments**



During the Covid-19 pandemic peaks in 2020, investment in IoT technologies suffered less than other market segments. Although some industries reduced investment in IoT during the pandemic, others, such as healthcare, insurance and education, increased their investment as they discovered new ways it could help them overcome challenges.

[Read more about Reply Trend Sonar](#)

We used our AI-powered Reply Trend Sonar technology to check millions of sources and find the most popular trends in different areas: the use of IoT for consumers, for companies and for public services/governments. Many of the fastest-growing topics were, as expected, in some way healthcare-related: disease monitoring, digital PPE and the Internet of Medical Things (IoMT) were in the top five growing trends, alongside connectivity infrastructure and smart shipping. Public (and private) debates were strongly conditioned by the Covid-19 situation and so attention on IoT also moved in this direction.

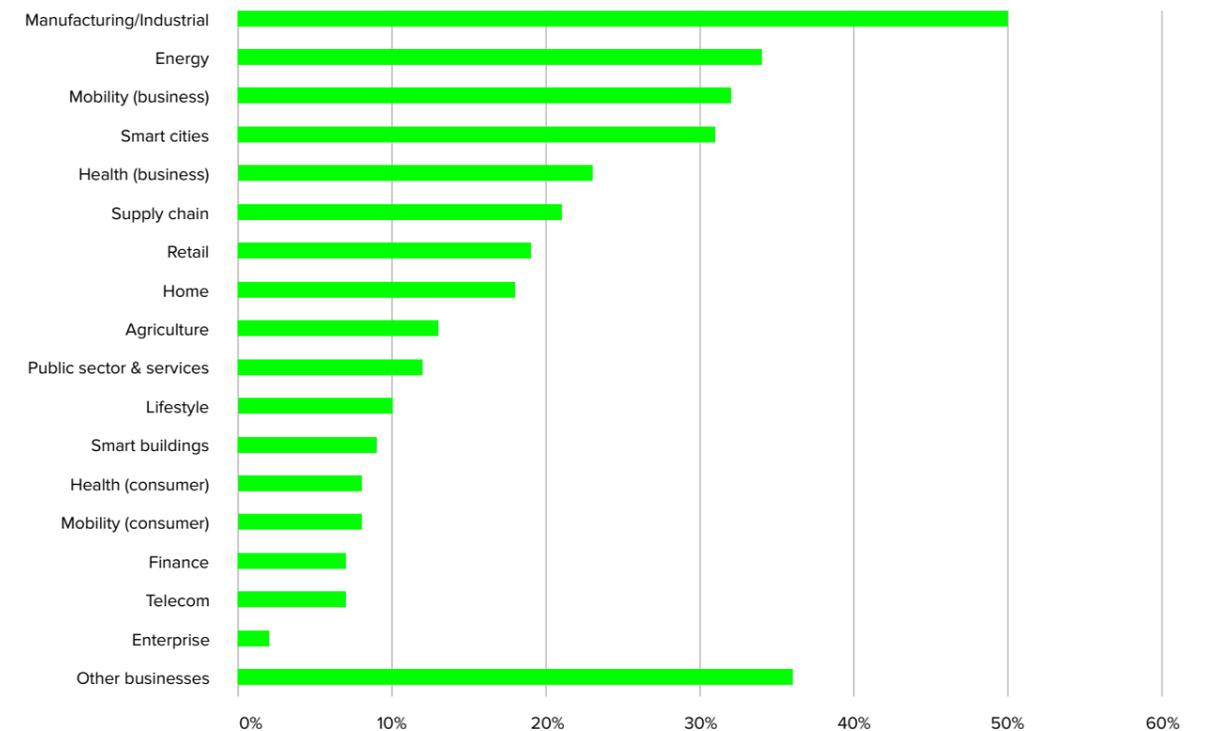
Reply Trend Sonar highlighted the 15.5% growth among IoT-related contents during the first 'pandemic' year (February 2020-January 2021) compared to the previous 12 months. The role of IoT was crucial during the pandemic and we now think it will be a pillar

for all recovery projects, for both companies and governments, but also for improving the quality of life of individuals.

### Focus on Industrial IoT

Share of Internet of Things platforms worldwide (% , multiple choices)

Source: [IoT Analytics, 2019]

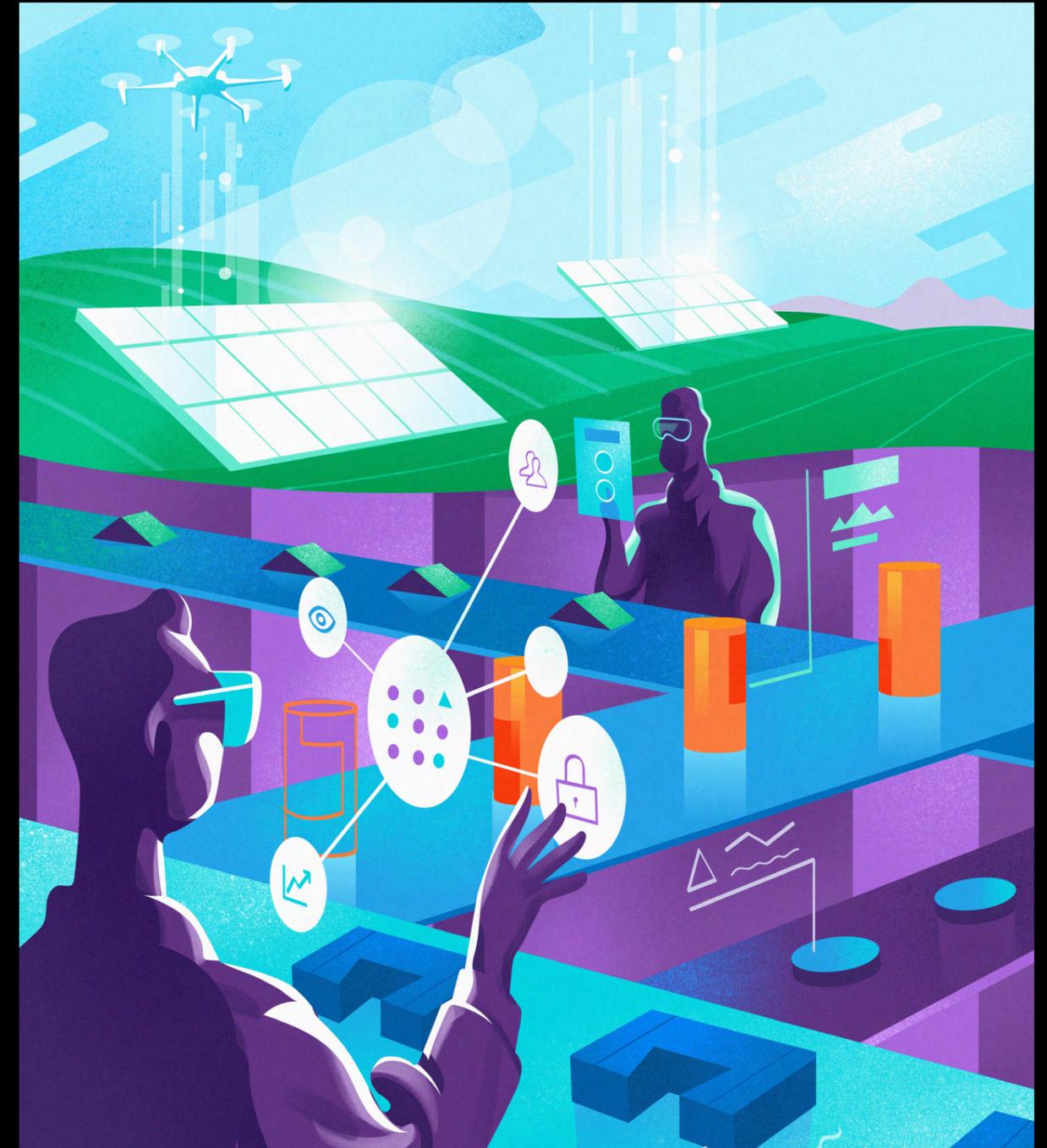


Looking at the platforms that are pushing the growth of the IoT market, the use of IoT in manufacturing is the most relevant segment. Combined with cloud computing and other industrial-related fields like energy management and supply chain, we think this is the most interesting field to explore, also thanks to its relatively long history of trials and implementations. Consumer-related use of IoT is being deeply influenced by the launch of connected products, with projects originating in the manufacturing context and evolving along supply chains and through retail markets.

The Industrial IoT is already a huge market, with consistent growth expected in the Asia-Pacific region and key countries like the USA and Germany. Even if the number of consumer-connected IoT devices is higher than industrial ones today, the expenditure on Industrial IoT is growing fast for both cross-industry solutions and devices designed for specific industries.

Markets like energy have adopted Industrial IoT as their de facto standard, investing in smart grids not just for electricity. Companies operating in logistics and transport are re-designing their whole business model, offering connected services to their business partners. Leading manufacturers in different industries, are experiencing strong adoption of several 'mature' use cases like production flow monitoring/scheduling, industrial automation and quality assurance.

Therefore, we decided to focus this Research on a 'reality check' of Industrial IoT, within two main areas: Smart Factory and Smart Transport & Logistics. It does not pretend to be exhaustive about the huge Industrial IoT world, but to share experiences from our customers' IT/OT Managers and Reply Partners around the challenges and the opportunities seen in designing and launching Industrial IoT initiatives. Furthermore, we involved PAC (Teknowlogy Group) to get a valuable opinion about best practice and perspectives on Industrial IoT, and share new data about relevant international markets.



## The market size of Industrial IoT

“ We’re seeing actually relatively strong demand for IoT factory projects. Because I think in the downturn, people are looking for efficiency and taking a dumb factory and making it smart ought to make it, most people would believe, 5%, 10%, 15% more efficient and across the level of spend that people have in their production processes, those are very big numbers. So IoT demand is good. ”

James E. Heppelmann, President and CEO at PTC [PTC, 2020]



### An overall view of main Industrial IoT markets

In collaboration with PAC (Teknowlogy Group), Reply defined Smart Factory and Smart Transport and Logistics as particularly relevant markets for Industrial IoT. We grouped market data in two clusters:

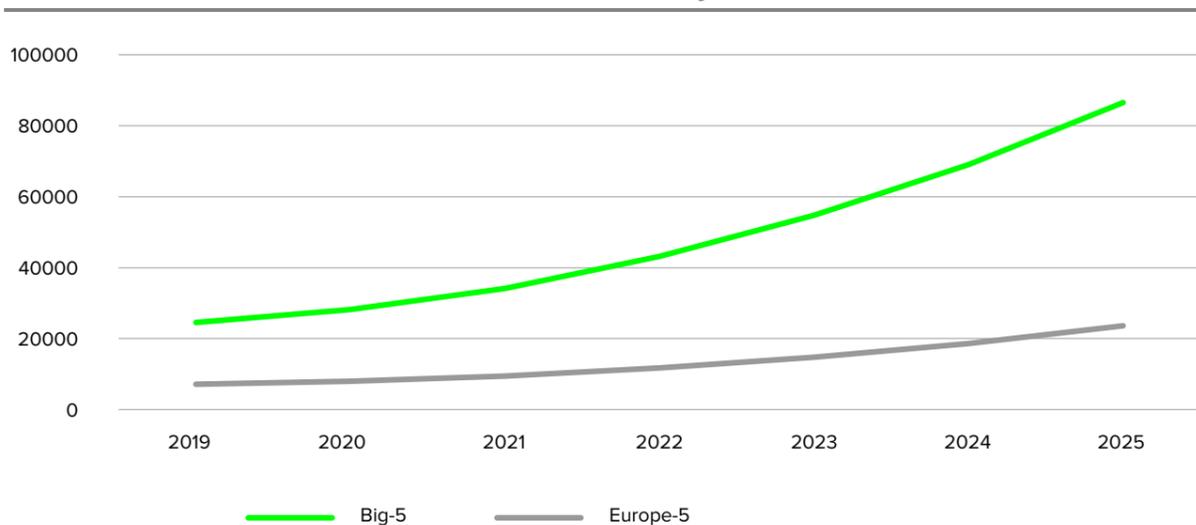
- ▶ Europe-5, which includes Germany, Italy, France, Belgium and the Netherlands
- ▶ Big-5, including the USA, China, India, Brazil and the UK

All data is presented in two segments, Services and Software & XaaS. They are furthermore split into:

- ▶ Platforms - this includes data & device management; both capabilities can be delivered via the cloud or directly at the edge; network & connectivity also belongs in this area
- ▶ Technology - this includes technologies like analytics, AI and data visualisation, but also OT security
- ▶ Applications - this covers all kinds of IoT applications, including firmware and embedded software on IoT devices

Source: Teknowlogy Group for Reply, 2021

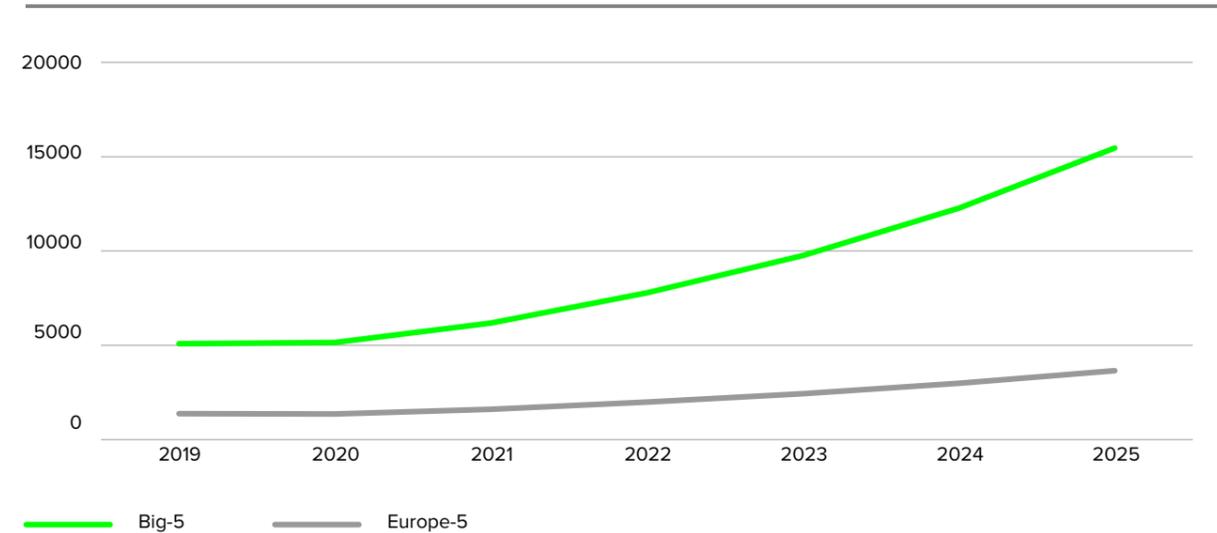
**Overall evolution of Smart Factory market**



Both the 'Europe-5' and 'Big-5' clusters saw a small growth (not a deep dive, as happened for some other IT markets) of Smart Factory investments during 2020's tough climate, even in troubled waters for both general economic context and the manufacturing sector. Both clusters are projected to grow up to 3x in 2025 vs. 2020, reaching more than 23 billion Euro for the Europe-5 cluster and more than 86 billion Euro for the Big-5 cluster.

Source: Teknowlogy Group for Reply, 2021

**Overall evolution of Smart Transport & Logistics**

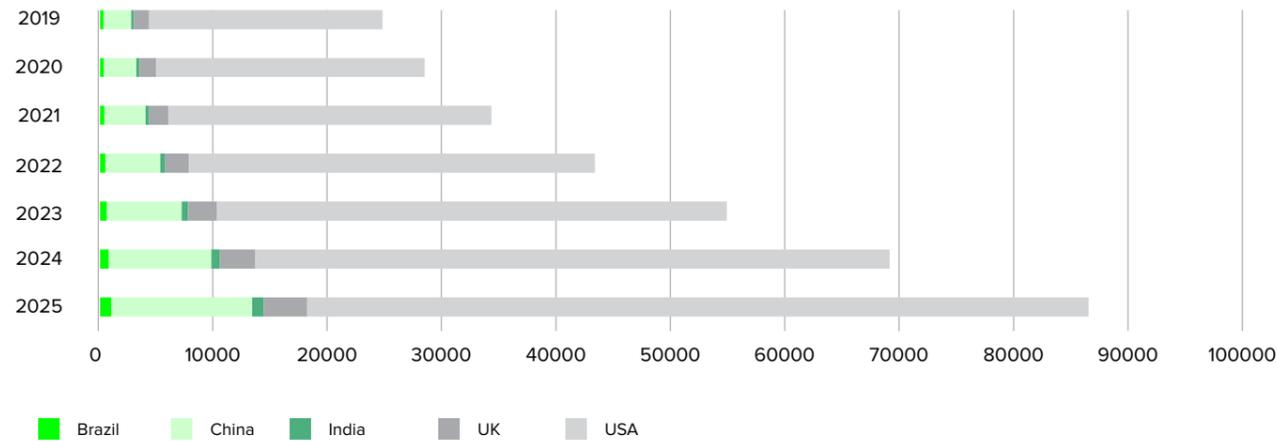


If Smart Factory in 2020 bumped against Covid-19 and reacted well, Smart Transport & Logistics suffered more. Although the Big-5 cluster substantially maintained volumes thanks to the fast recovery in China, the Europe-5 cluster saw a decrease of -2%. However, both clusters will grow fast until 2025: Big-5 will pass the 15 billion Euro mark (x3 compared to 2020), while Europe-5 will reach 3.6 billion Euro (compared to 1.4 billion Euro in 2020).



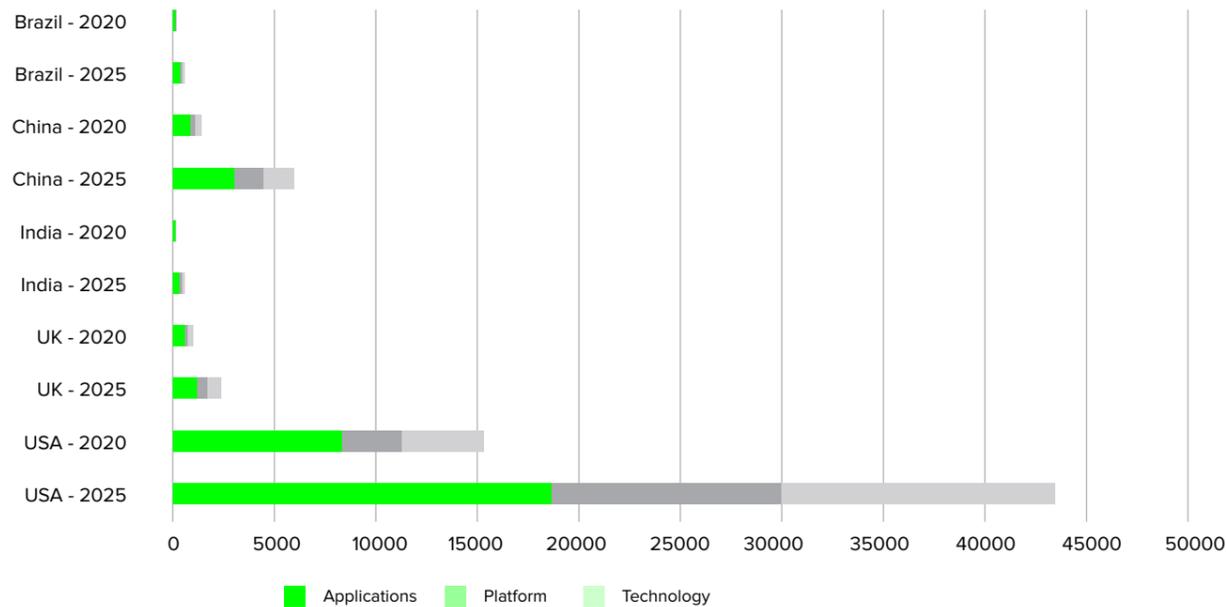
### Focus on Big-5 cluster (USA, UK, China, India and Brazil)

Source: Teknowlogy Group for Reply, 2021 **Big-5: evolution of Smart Factory market, by country**



China and the USA will be the two leaders of the Big-5 cluster for Smart Factory. The first will grow more than 4 times (2025 vs. 2020), reaching a size of more than 12 billion Euro. The USA, however, is already the worldwide leader in the Industrial IoT market and its Smart Factory market is expected to reach a staggering size of 68 billion Euro in 2025, tripling 2020's market size.

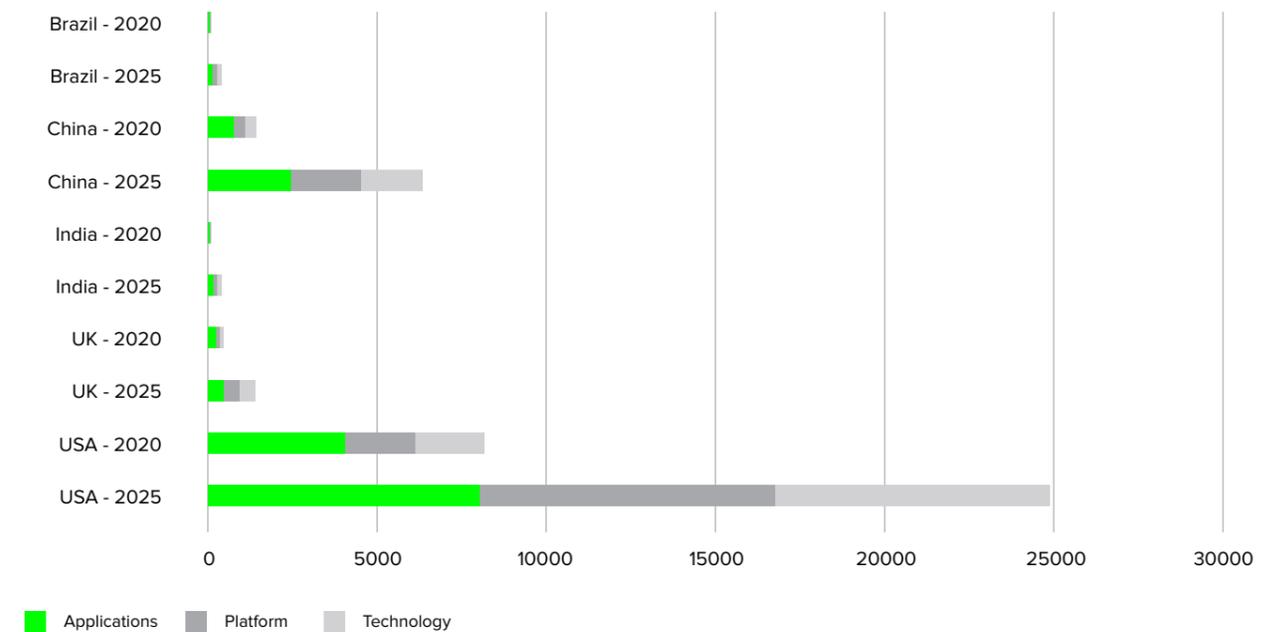
Source: Teknowlogy Group for Reply, 2021 **Big-5: evolution 2020-2025 for Services segment in Smart Factory market**



The focus of the market is on analytics, industrial automation and data management. In all Big-5 countries, the Platform area is the one growing faster, with a forecast of 5x in both China and India and 4x in Brazil. Apart from the 43 billion Euro market in the USA, the Service area will reach 2.4 billion Euro in the UK and almost 6 billion in China, while both India and Brazil will reach around 600 million Euro.

**Big-5: evolution 2020-2025 for Software & XaaS segment in Smart Factory market**

Source: Teknowlogy Group for Reply, 2021

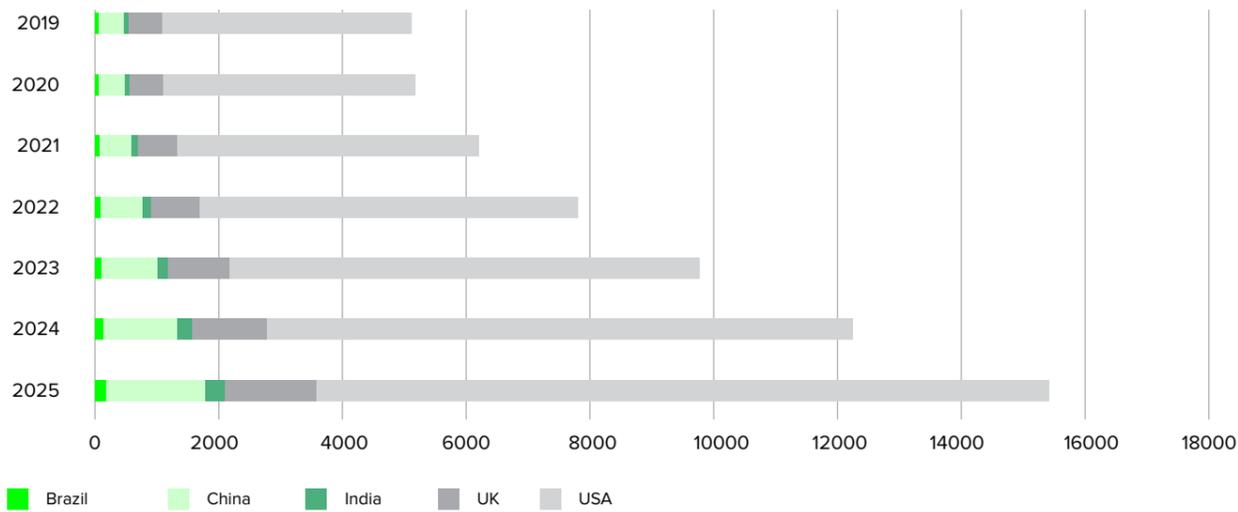


The market, especially in the USA (up to 25 billion Euro expected for Software & XaaS in 2025), is investing highly in predictive solutions and remote monitoring. The Software & XaaS segment will grow between 3x and 4x in all Big-5 countries, with faster growth in China (up to 6.4 billion Euro) and India (up to 420 million Euro).



Source: Teknowlogy Group for Reply, 2021

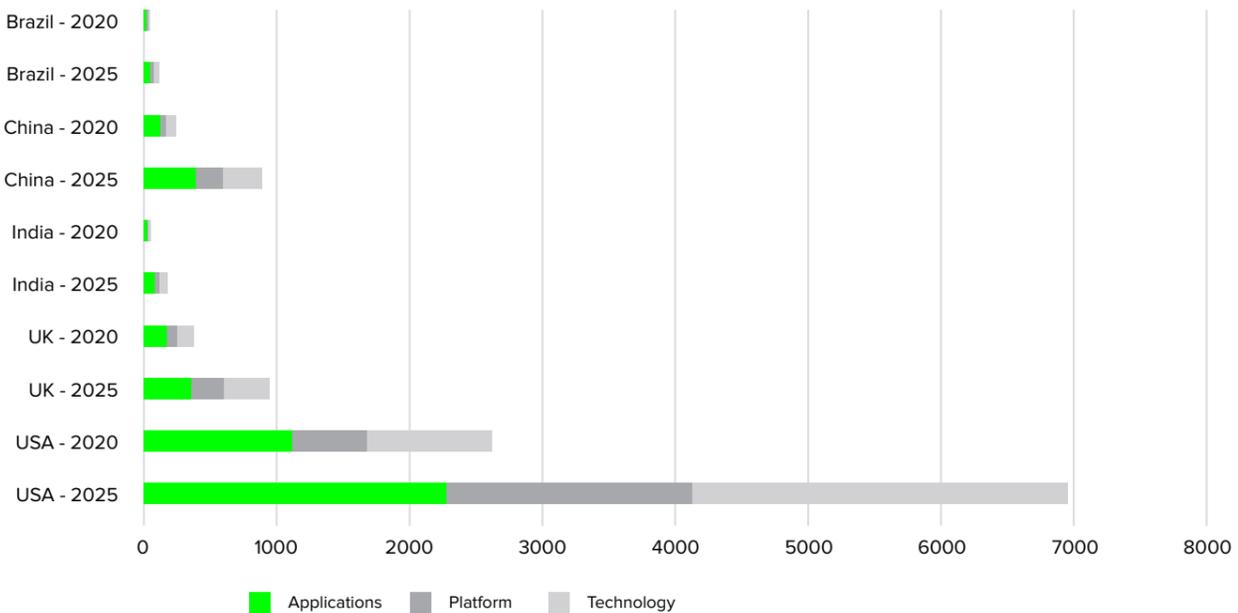
**Big-5: evolution of Smart Transport & Logistics market, by country**



Looking at Smart Transport & Logistics market for the Big-5 cluster, Brazil was the country suffering most in 2020 vs. 2019, with -4%; the Brazilian market, however, will grow fast in the coming years, up to 181 million Euro in 2025. The USA is the main market for Smart Transport & Logistics: their market will triple from 2020 to 2025, up to almost 12 billion Euro. The highest growth is expected in India, with a 4x growth up to 312 million Euro in 2025.

Source: Teknowlogy Group for Reply, 2021

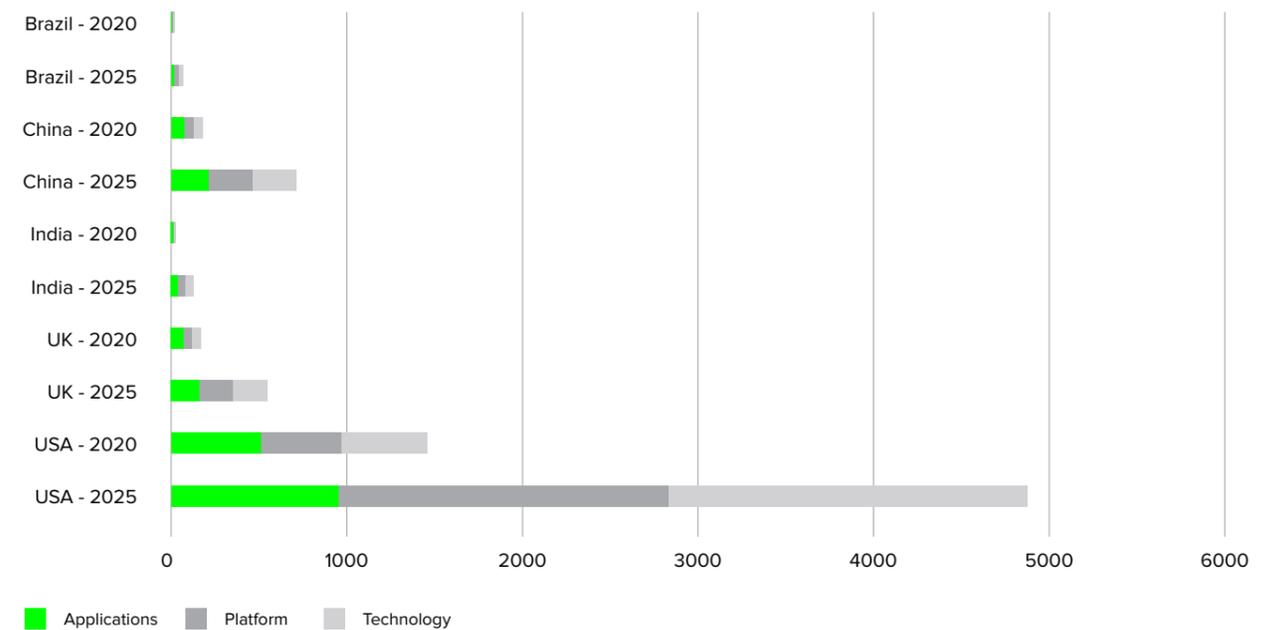
**Big-5: evolution 2020-2025 for Services segment in Smart Transport & Logistics market**



The Services segment will grow fast, particularly in China and India, where the Platform area already grew by 15% in 2020 vs. 2019, compensating for the decrease of volumes of Applications. Looking at the next five years, even if growth is less strong in the UK, Brazil and the USA, the market dynamics will be similar to the Chinese and Indian ones, with a relevant growth of Platforms in all markets and a minor increase in the Applications area. The Services market will remain bigger in the UK than in China.

**Big-5: evolution 2020-2025 for Software & XaaS segment in Smart Transport & Logistics market**

Source: Teknowlogy Group for Reply, 2021

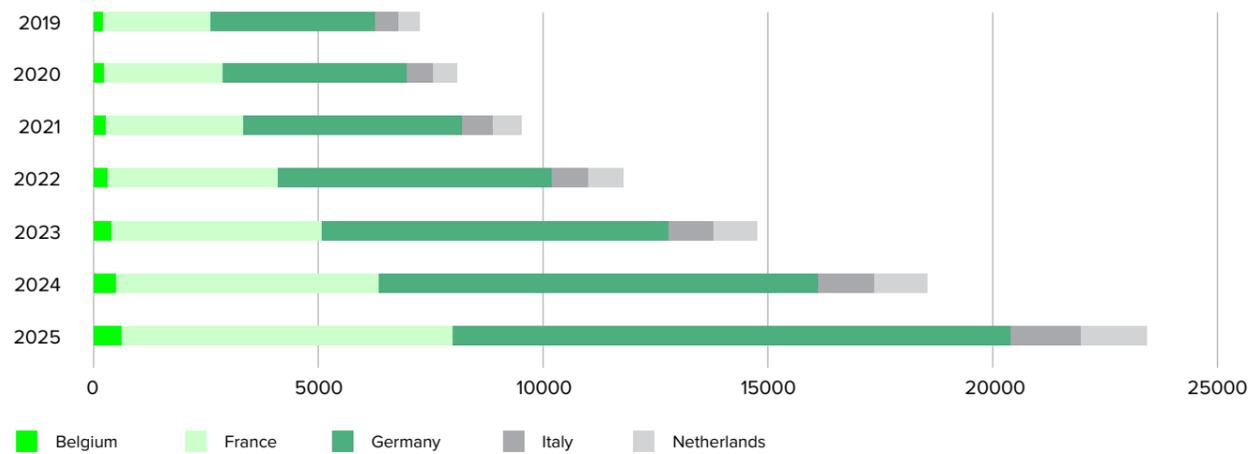


In the Software & XaaS segment for Smart Transport & Logistics, Platforms and Technologies will grow significantly (2025 vs. 2020): both will achieve a 4x growth in the USA, UK and Brazil, and almost a 5x growth in China. India will reach up to 6x growth, but with a market relatively small expected to reach 130 million Euro in 2025. The USA will maintain its leadership position with almost 5 billion Euro expected in 2025, followed by China with more than 700 million Euro.



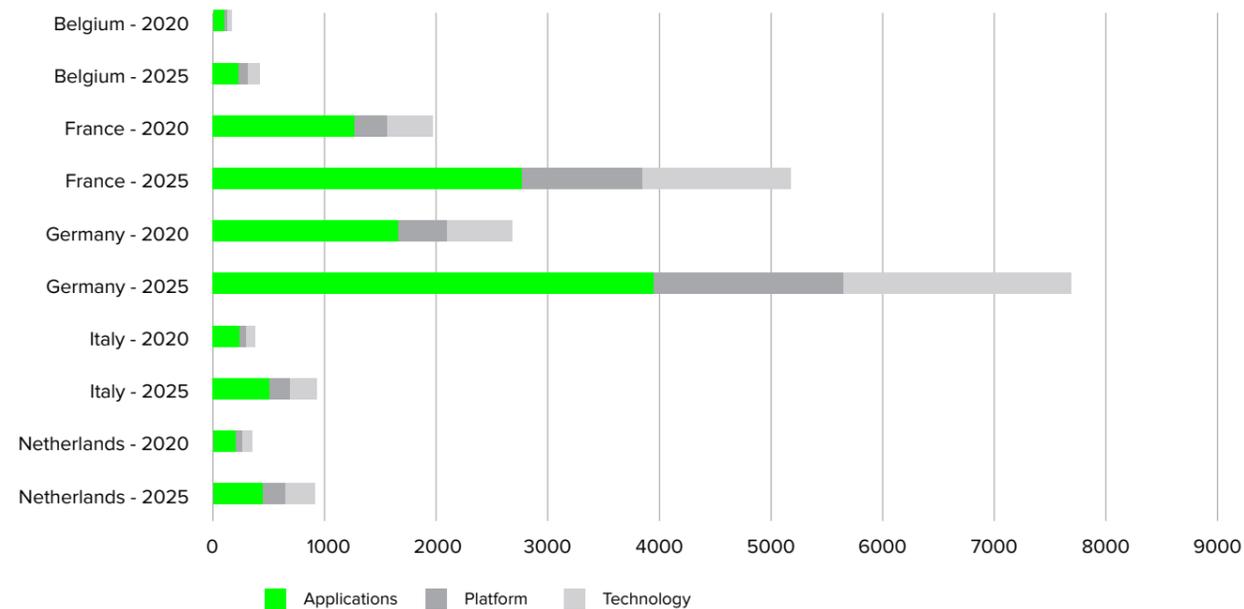
### Focus on Europe-5 cluster (Germany, France, Italy, Netherlands and Belgium)

Source: Teknowlogy Group for Reply, 2021 **Europe-5: evolution of Smart Factory market, by country**



Looking at the Europe-5 cluster, the Smart Factory market in Germany pre-Covid-19 was one time and half the Chinese one; however, by 2025 the size of the two countries will match, crossing the 12 billion Euro mark, and creating with the USA the triad leading the Smart Factory market, besides Japan and Korea. France is the second market in the cluster, with a 3x growth in 2025 vs. 2020, up to 7.3 billion Euro.

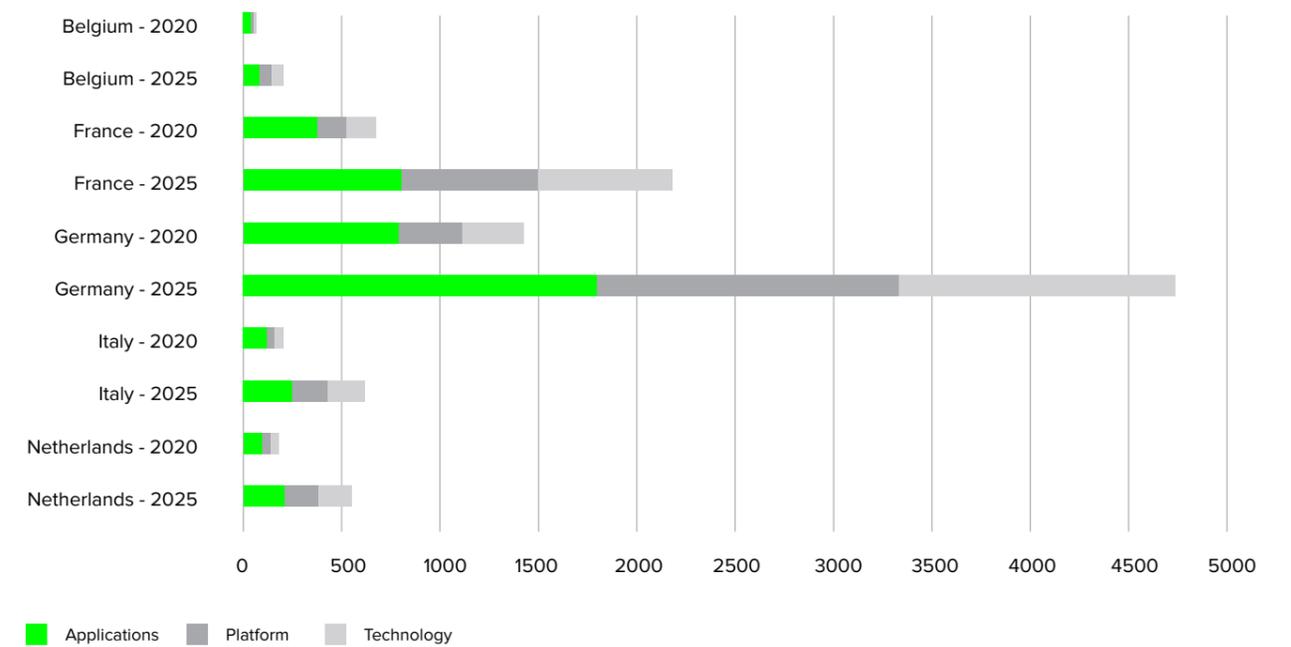
Source: Teknowlogy Group for Reply, 2021 **Europe-5: evolution 2020-2025 for Services segment in Smart Factory market**



All Europe-5 countries, especially Germany, are suffering a skills shortage. The Services market will grow between 2x and 3x in all nations, reaching almost 8 billion Euro in 2025 for Applications, 3 billion Euro for Platforms and 4 billion Euro for Technologies. Italy and Netherlands will reach a total Services market of 900 million Euro in 2025; France will cross the 5 billion mark and Germany will reach 7.7 billion Euro.

**Europe-5: evolution 2020-2025 for Software & XaaS segment in Smart Factory market**

Source: Teknowlogy Group for Reply, 2021

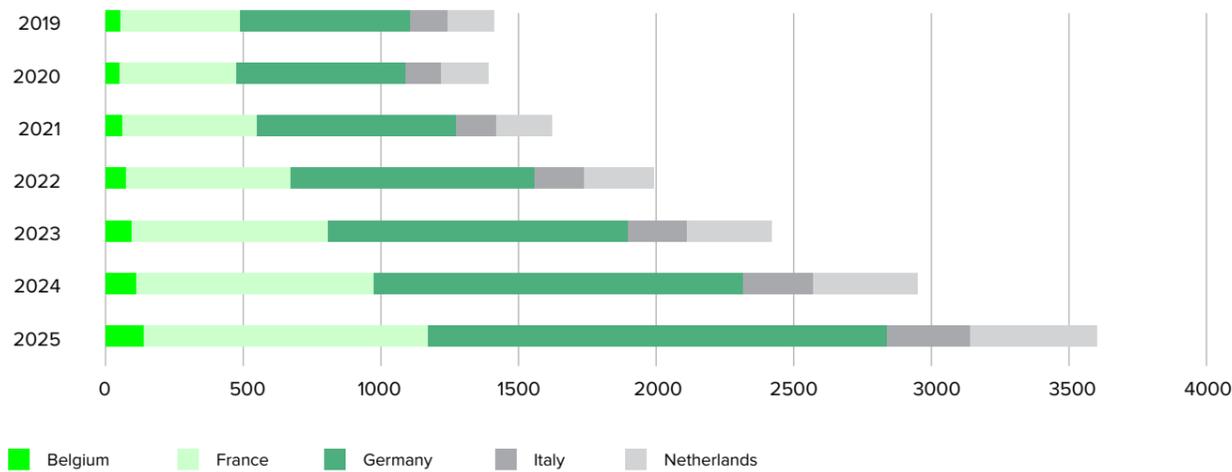


In the Software and XaaS segment, Italy will consolidate its third position, after Germany and France, also thanks to the new Industrie 4.0 programmes which continue the incentives of the last 5 years. In all countries, the Software and XaaS segment will reach at least a 3x growth in 2025 vs. 2020. Platforms will grow more than anything else, up to 4x in Germany and Netherlands. Companies in this cluster's nations, particularly French companies, are investing to improve quality management and reduce costs.



Source: Teknowlogy Group for Reply, 2021

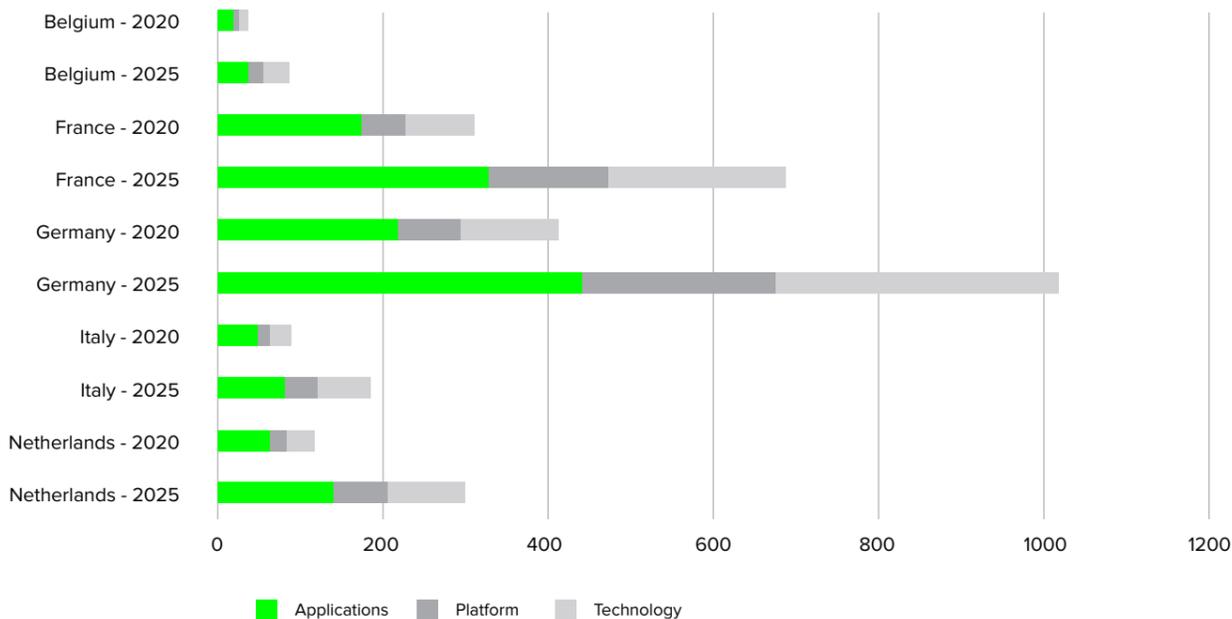
### Europe-5: evolution of Smart Transport & Logistics market, by country



Looking at Smart Transport & Logistics in the Europe-5 cluster, Germany's leadership is evident, with a projected market in 2025 up to 1.7 billion of Euro; France is expected to pass the 1 billion mark. The Netherlands, one of the first nations with a broad LoRa network coverage, will grow significantly from 170 million to more than 460 million Euro. After suffering from Covid-19 impacts in 2020, by 2025 Italy and Belgium will reach respectively more than 300 million and almost 140 million Euro.

Source: Teknowlogy Group for Reply, 2021

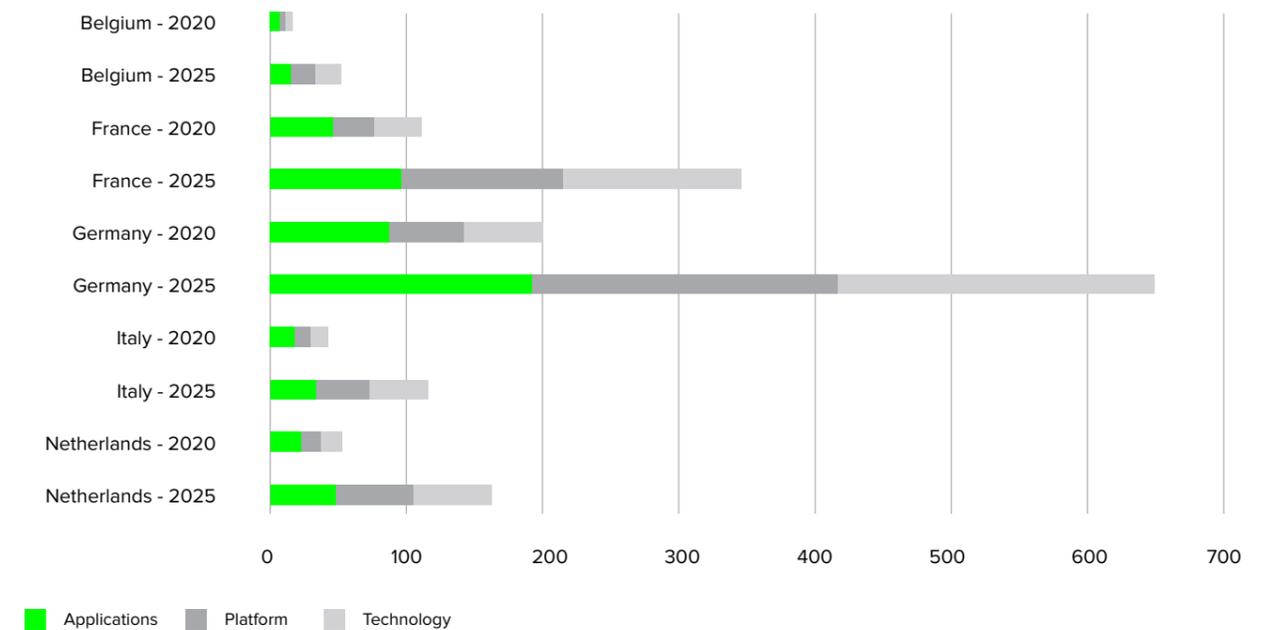
### Europe-5: evolution 2020-2025 for Services segment in Smart Transport & Logistics market



Looking at the Services segment, all the countries in the cluster saw a decline due to lockdowns and mobility halts in 2020 vs. 2019, from -3% of Netherlands to -9% of Italy. From 2020 to 2025, however, all the countries will at least double the size of this area, with significant growth of Platforms and a more modest increase in Applications. Germany is expected to pass the 1 billion mark, while France will get close to 700 million Euro.

### Europe-5: evolution 2020-2025 for Software & XaaS segment in Smart Transport & Logistics market

Source: Teknowlogy Group for Reply, 2021



The Software & XaaS for Smart Transport & Logistics kept growing in 2020 vs. 2019, despite Covid-19. Growth will be consistent for all countries from 2020 to 2025, up to 3x, meaning Germany will reach a 650 million Euro size and France 360 million. Both Platforms and Technologies will grow significantly up to 4x, in Germany, Netherlands, France and Belgium. Italy's growth will be slightly less intense in all three fields.



## Industrial IoT as the backbone of Industrie 4.0

“ We’re only in the beginning of the adoption of Industry 4.0 and IIoT, and many companies are running pilots and proof of concepts. It starts with planning, and the ability to sense demand changes and trigger fast, flexible execution on shop floor, logistics and asset management. Building an agile environment means being able to adapt processes for agility. ”

Franz Hero, Head of Development Digital Supply Chain at SAP [SAP, 2021]

### Edge computing and 5G will improve the role of Industrial IoT as the backbone of Industrie 4.0

In industrial/manufacturing contexts, the Internet of Things has become the backbone of Industrie 4.0 strategies, creating opportunities for further investments in cloud computing, artificial intelligence and cybersecurity. Comfortable devices are allowing mixed reality and 3D technologies to be bought by managers and adopted by workers. In fact, the new generation of mobile robotics is made of IoT-based devices too. Without Industrial IoT, Industrie 4.0 cannot exist.

Data are the fuel for all ‘smart’ use cases in the industrial world; Industrial IoT guarantees the infrastructure to collect them, transmit them to the cloud and manage the feedback post-analysis. In our ‘From Cloud to Edge’ Research, we analysed how the adoption of edge computing could improve and fasten this scenario, giving even more value to ‘local’ Industrial IoT thanks to elaboration of data in the factory and onboard smart transport, with a limited transmission of data to far location/data centres.

[Download the “From Cloud to Edge” Research](#)

This new approach could substantially improve the adoption of Industrial IoT, and therefore of Industrie 4.0 innovations, allowing faster improvements, compared to the actual use of data collected from Industrial IoT devices, often used at an organisational level rather than on the shopfloor. The adoption of low-cost sensors and 5G networks could further improve the diffusion of Industrial IoT.

Public 5G networks are under rollout in all major metropolitan areas, driven by heavy investments by Telco. Some benefits for Industrial IoT come from the protocol itself: for example, the possibility of defining multiple QoS, with different priorities in the use of the network, with possible offers dedicated by operators to industrial players. The concept of network slicing will allow these customisations of Telcos’ offerings natively.



Once public 5G networks are widely available across territories, industrial players will see great improvements in flexibility, e.g. in the arena of smart transport and logistics. However, infra-logistics inside the factory will also gain the benefit of operating models based on edge computing powered by 5G networks, e.g. thanks to the lower battery consumption of connected devices.

The improvement of communications among autonomous vehicles/robots, artificial intelligence, machinery, with lower bandwidth, increased computing power and very low latency will not just improve the efficiency of plants, but also improve their safety. Moreover, it will become possible for companies to elaborate and encrypt data locally, increasing compliance with different laws, e.g. privacy regulations and protection of intellectual/industrial property.

Sceptical managers used to the mediocre reliability of 3G/4G public networks will be satisfied thanks to another opportunity offered by 5G: the creation of private networks. Among their benefits, it will become possible to define very specific SLAs for industrial contexts, build networks in rural areas (e.g. factories in places normally not supported by public mobile networks), and reach peak data at rates up to 20x that of 4G.

High-density private networks will not only allow the deployment of Industrial IoT with lower latency and increased privacy, but also enable an amazing number of sensors, machinery, vehicles and robots to be connected (e.g. 10 devices/m<sup>2</sup>). This will lead to a further increase of data generation, and therefore to new opportunities from artificial intelligence and machine learning, but also to new AR/VR-based ways of supporting connected workers.

### **Industries will greatly benefit from new opportunities coming from data-driven design, augmented reality and virtual reality**

Every day, design is becoming more data-driven, in industrial contexts too. Artificial intelligence (AI) could already help design new products, services and processes, based on data collected by IoT and Industrial IoT devices. These improvements in the industrial arena could be expected on production lines and logistics optimisation, but also translate into the improvement of final B2B and B2C offerings.

So-called generative design allows product managers to evaluate different versions of the same product in a virtual way, letting operation managers project their production lines accordingly, but also enabling planning experts to optimise logistics and supply chains in each scenario. The joined efforts on preliminary design allow them to save enormously in the setup of new production/distribution lines, but also to project them from scratch in an Industrie 4.0-ready way.

Benefits of this new design come from the collection of data enabled by Industrial IoT, but also come back to Industrial IoT-based production/distribution platforms, with virtuous cycles of performance monitoring and the possibility of introducing new improvements to products, production lines and logistics aspects. Prototyping can be done virtually, with significant savings in terms of timing and budget.

Players like Nvidia are pushing the virtualisation of these activities, to virtual desktops able to deal with huge 3-D models and VR-based projects, reducing the upfront investments of manufacturers. Various benefits have emerged since the start of the pandemic, including the possibility of involving both designers and production managers from all around the world, accelerating the design cycles and the knowledge sharing



between plants, designers and business specialists.

Among expected benefits of AR/VR-based solutions in the industrial space, connected glasses are living a second youth thanks to the possibility for the worker to receive task guidance, scan barcodes and manage quality assurance checklists. Advanced uses include the ability to interact with other workers, with eventual sharing of wearer's sight. Moreover, with AR they can learn and crosscheck HSE topics and instructions about equipment, contextualising the information in their workplace.

Thanks to use by popular innovators like Tesla, digital twins are affirming themselves as the most promising technology in the quality assurance field. They are usually avatars of existing physical objects, often realised with Mixed Reality (MR) or Extended Reality (XR) technologies. They can be used both by operation managers focused on monitoring the equipment, and by maintenance workers who will fix arising problems.

The goal of digital twins is to digitally simulate and oversee operations and activities to detect potential anomalies or disruptions. Doing so enables specialists to distinguish and manage both so-called hot and cold data for more efficient management, in terms of the physical processes and the digital resources for monitoring such processes.

An increasingly popular use of AR and VR is in the training area, related to both the transmission of knowledge about the running activity and to safety procedures. Workers can access useful information and instructions through AR and train themselves safely in VR environments, where they can interact by a digital twin of the equipment, of the product, or of the environment/building where they are going to operate.

[Read more about Reply's IoT Digital Twin Experience](#)

Created thanks to a collaboration with the Microsoft Worldwide Customer Experience Team, Reply's IoT Digital Twin Experience

enables organisations to use digital representations, AI and telemetry data to more effectively manage remote locations and train first-line workers. These organisations are leveraging Extended Reality capabilities to digitally transform manual processes for faster, safer and more efficient business operations.

### **The use of robots and drones is producing a new 'Autonomy of Things'**

Robots are nothing particularly new on the shopfloor, where production and assembly lines use them intensively, with light supervision by humans. At the same time, robotics is supporting some of the more innovative use cases in both manufacturing and logistics. The main reason is that progress in artificial intelligence has led to a surge of autonomous mobile robots like drones, wheeled or legged robots.

Walking towards the 'software-defined' paradigm, industrial robots are re-configurable, mobile and flexible in their use. Their ability to collect data from the environment, elaborate it locally or through edge/cloud connections, and execute consequent actions is completed by the possibility of remote/digital control by humans, giving them the ability to deal with complex environments and production contexts.

An example is the use of robots and drones by building managers: they can improve their control on properties, their safety and their energy management thanks to the so-called Building Information Modelling (BIM). This can systematically track and manage the complicated systems that keep buildings functioning for all modern needs: smart HVAC, smart plumbing, smart lighting, smart heating, smart waste management and more.

BIM is advancing to the point where digital twins can measure processes in 6D, which adds cost factors and sustainability



metrics to regular 3D geometry and time. As more types of materials and units are able to be incorporated into the IoT universe, BIM can also monitor scaffolding, windows, structural integrity and a myriad of other factors that make up the overall BIM picture. Providers like HAKI BIM allow building planners to monitor the components of construction and maintenance in real-time and dynamically through VR and AR capabilities.

[Read more about Robots in Real Estate Operations](#)

Reply identified multiple possible use cases for intelligent real estate operations based on Boston Dynamics SPOT robot. The goal is to improve or eliminate pain points in operations, thanks to robots, and support technical managers in their daily work with essential tasks and routines. The robot is also able to conduct BIM and 3D scans to create digital twins accessible with mixed reality technology.

Robots and drones are new field workers that can assume potentially dangerous tasks previously performed by humans. They rely on autonomous technology that varies in its application field, sophistication and maturity. Autonomous mobile robots and collaborative robots can transmit useful information to central systems and eventually change their behaviour based on the consequent real-time analysis/prediction.

The whole scenario is moving from the ‘classic’ Internet of Things towards the so-called ‘Autonomy of Things’, which gets the best from both Industrial IoT and robotics evolution. Thanks to computer vision, and object and pattern recognition, autonomous vehicles are able to find their path while constantly collecting data with equipped sensors in any form: from cameras to microphones, GPS, thermometers, moisture sensors, gas or radiation detectors.

[Read more about Reply's view on Autonomous Mobile Robots](#)

Wireless connectivity (e.g. 5G and Wi-Fi 6) with an intelligent system architecture will allow leveraging on collected data with AI algorithms, enabling the device to take its own decisions on how best to perform a specific task. Autonomous robots and drones

will use machine learning to improve their performance and their 5G connection to improve their communication with other robots, connected workers and production/logistics managers.

**Industrial IoT is both a blessing and a source of risk for industrial cybersecurity**

**“ 61% of manufacturers said they experienced cybersecurity incident in their factory, while 75% of companies that have experienced an incident that caused a production outage. In addition, 43% of companies said that production activities had been suspended for more than four days as a result. These incidents are not uncommon and have a direct impact on production activities, leading to the importance of manufacturers to properly recognize the risks of cybersecurity in factories. ”**

Trend Micro, The State of Industrial Cybersecurity (USA, Germany, Japan) [Trend Micro, 2021]

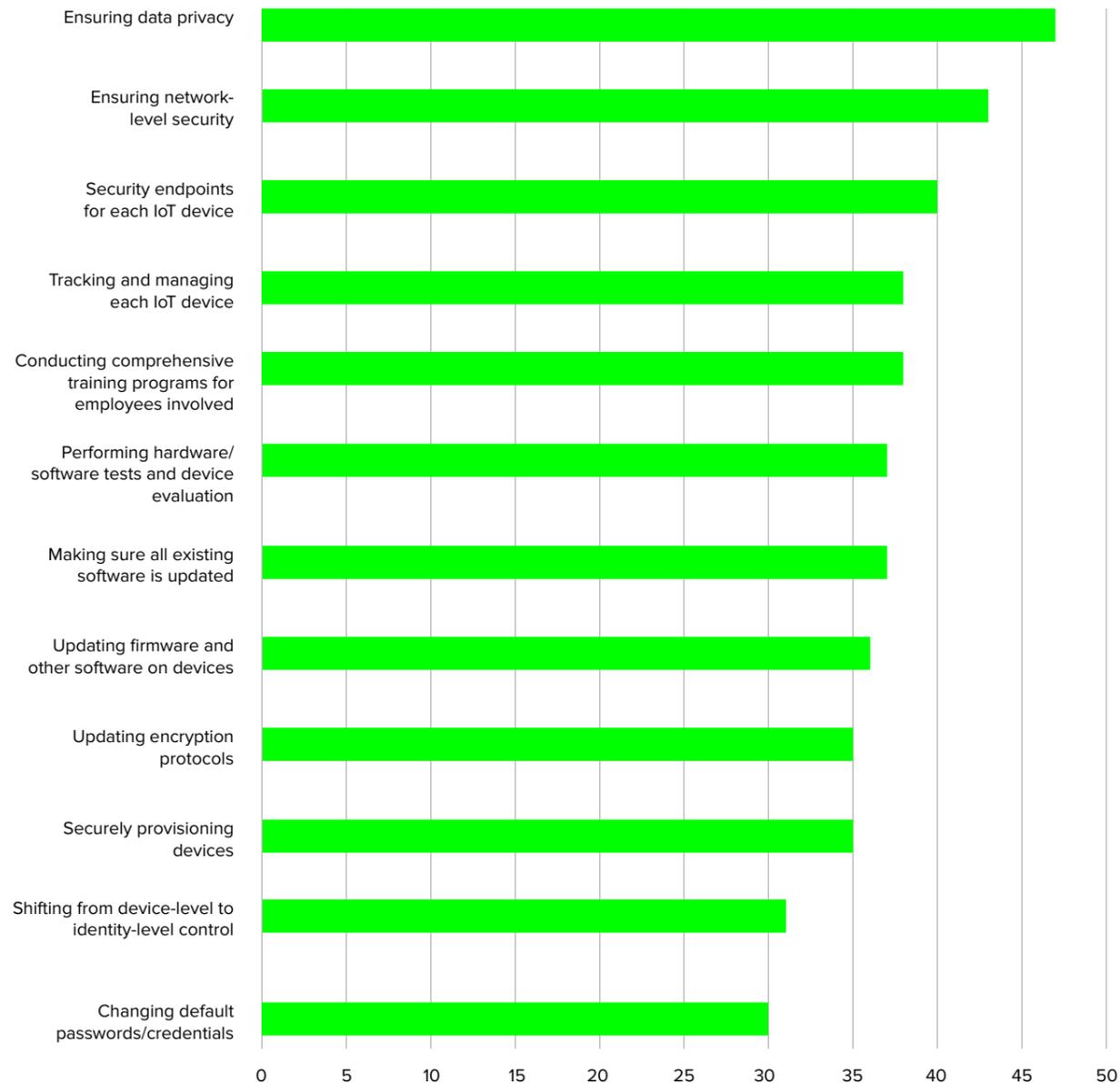
Interviewed managers mention cybersecurity and asset monitoring/management as crucial for the success of Industrie 4.0 strategies. Industrial IoT requires a better definition of responsibilities among IT managers, OT managers and security managers, in order to identify and fight the vast amount of possible threats affecting productive sites like denials of service, data tampering, identity spoofing, bad management of production data and their access privileges.

Cybersecurity for IoT is an enormous market that we estimate will grow up to 25 billion Euros in the next five years. The use of IoT in industrial contexts is a relevant part of this market: just one compromised device could cripple a whole local network, with implications for the overall functionality and security of factories and inventories. Gaining a dominant position in the local network



could even expose wider enterprise data and systems. The eventual connectivity of IoT solutions to mainframes amplifies these risks.

Source: [Microsoft, 2020] **Types of IoT security considerations**



In some cases, security is as simple as identifying and tracking units in the system, but at the more advanced levels, devices are becoming equipped with encrypted integrity verification protocols. Players like Sternum are collecting funding to secure IoT devices through a unique application of embedded integrity verification systems; Armis, instead, has developed a system to examine all assets in an Industrial IoT system in order to pinpoint weak spots, which helps to mitigate future vulnerabilities.

The steady growth of connected devices and their heterogeneity requires bold security management of the setup and maintenance policy of both devices and networks. Organisations are realising that it is not just a technological matter. Programmes to train employees in security standards using IoT-based systems are crucial, alongside a continuous study and test of any device tested on infrastructures (e.g. during PoCs) and then implemented on an enterprise scale.

Building reliable infrastructures not only allows operation managers to get benefits from Industrie 4.0 technologies but also permits a secure rollout of different devices connected to Industrial IoT, e.g. sensors and equipment. One of the main challenges is the safe collection and management of data, where systems need to translate information from hundreds or thousands of devices, prioritise relevant data and systematise the information for intelligent controls. All the while, the myriad of devices need to remain powered and secure from nefarious interventions.

Assuming that new solutions adopt a security-by-design approach, AI-based solutions can identify security threats in real-time across the production/logistics chain, reducing risks and improving the control of data flows inside the factory, through the logistics channels, and during the dialogue with external systems. Detection of threats can be improved through machine learning, based on data collected during initial PoC/stress tests and then

made reliable during effective production/distribution of goods.

The adoption of computer vision could also help security managers to improve physical security, identifying unauthorised actions, personnel or objects across the shopfloor. The integration of authentication methods based on biometrics of ‘connected workers’ is improving access management to restricted areas and improve the security of organisations’ sensitive sites.

Industrial managers need a holistic security architecture for the IoT/Industrial IoT and IT landscape that accommodates new attack types, technologies and methodologies, to improve the resilience capabilities of both their production and ICT environment. The visibility of assets and early detection of security issues will make them able to react fast to security issues and reduce the risk of production outages.

[Read more about Reply's approach to Industrial IoT Security](#)

Based on its experience, Reply believes that organisations need stable and maintained on-premises/cloud-based micro-segmented environments to react to traditional and new dangerous technologies/methods and reduce the probability of successful new types of attacks. The analysis of IoT architecture, industrial components and entire infrastructures will help companies to eliminate gaps, vulnerabilities and threats in advance.



## Business improvements from Industrial IoT

“ Covid-19 adds a new force shaping IoT maturity evolution as the companies have been forced to adjust their technology roadmaps in response to the crisis. It may further widen the divide between the two types of IoT adopters – determined advanced users and those who were struggling to understand ROI and monetize their IoT initiatives and to go beyond mere data collection. The second group will likely postpone their IoT investment, not seeing clear benefits in the near and long terms, and fall further behind, while others will leverage their IoT expertise focusing on the use cases that will help them secure a more advanced position in the next normal ”

Svetlana Khimina, IDC [IDC, 2020]



## Increasing the productivity of factories and the quality of delivery

Industrial IoT enables manufacturers to improve real-time production visibility, connecting machinery and tools. A popular goal of Industrial IoT has been the comparison between achieved capacity levels and pre-defined targets, with virtuous cycles of improvement. Real-time visibility of production data is enabling companies operating in different manufacturing fields to get the more effective use of resources, improving line efficiency.

On a global basis, major IT vendors and hyperscalers are designing platforms that combine industry-specific requirements and interaction with cloud-based and hybrid architectures. The huge amount of data coming out from Industrial IoT devices are the fuel for optimising production, thanks to machine learning algorithms and defect detection. The zero-defects approach requires the quality checking of every single manufactured item, instead of random samples, and Industrial IoT technologies, supported by AI algorithms, allow this.

Computer vision is proving itself effective for scanning items on conveyer belts to identify bad alignments, flaws, weld quality and other defects. Where something wrong is found, Industrial IoT-enabled routines can act differently: informing human workers, instructing robots, updating quality data and raising eventual alerts, placing orders for consumables and so on. The results can be adaptive or corrective decisions, but also predictive for future production cycles.

The possibility of intervening in real-time often requires an upfront investment in equipment and its connection to Industrial IoT platforms, but the minor costs and major productivity could return the investment in a short time. This is even more important when the whole company is adopting an 'agile' mentality and therefore needs to involve production in this faster capacity

to meet customer requirements/demand, whilst keeping costs under control.

An interesting area of improvement enabled by Industrial IoT and edge computing is the field known as additive manufacturing. Products can be created by adding materials layer-by-layer, on-demand, and customised based on the real-time needs of the line. The use of AI, connected to the equipment via Industrial IoT, enables lower materials wastage and consumption of energy.

**“ Artificial intelligence is the catalyst to release the disruptive power of additive manufacturing. Leveraging digital twins for real-time IoT will further standardise the additive manufacturing process chain, reduce costs and shorten delivery times. We strive to manufacture industrial components under high-quality series conditions with resilient processes and robust production ”**

Sebastian Blümer, Technology Manager Laser Additive Manufacturing at GKN

GKN's IDAM project shows how, by combining additive manufacturing with IoT, it is possible to make the production process smarter and more efficient, as well as producing superior quality components. Thanks to a digital twin, which runs on an IoT environment, it is possible to develop software that runs on a gateway and allows for the automation of several steps in the production process, as well as connecting several systems, storing and distributing information and data.

[Read more about GKN's IDAM case](#)

## Improving the predictive and conditioned maintenance of equipment

Through its different generations, SCADA was the solution favoured by industries for data acquisition on the shopfloor. In some contexts where connectivity with external is voluntarily reduced or avoided (e.g. nuclear-related plants), SCADA probably

remains a good choice; but for 'normal' factories and logistics centres, that are increasingly widely covered by connectivity (wired, wireless or mobile), the progression from SCADA to Industrial IoT seems a natural evolution.

Compared to SCADA, Industrial IoT offers the possibility of monitoring what is happening in the factory 24/7, even remotely and with minimum (or no) human involvement. Monitoring of different sites at once is easy and open to standardisation of processes and security/safety procedures. Moreover, control solutions based on Industrial IoT have proved to be sufficiently scalable to be less expensive for SME and potentially also for bigger industries than using traditional SCADA.

Lessons learned from the use of SCADA in modern implementations show that it does not have to be thrown away to embrace Industrial IoT platforms. On the contrary, providers are building layers that extract data from SCADA configurations, industrial control and telemetry, letting them leave the company towards the cloud. Moreover, these new possibilities enabled by Industrial IoT and edge/cloud computing often open up the possibility of better interfaces for users of those data or of the results of the elaborations by algorithms.

In recent years, many Industrial IoT projects aimed to improve the Overall Equipment Effectiveness (OEE) in factories. Actions like monitoring environmental/process control parameters (e.g. temperature, pressure) or controlling the efficiency of single devices (e.g. valves, conveyer belts, pumps) are now made significantly easier by Industrial IoT, compared to human intervention.

The control is in real-time, continuous and objective. It allows moving on from the 'if it ain't broke, don't fix it' mentality based on human experience, to anticipating the moment of detection of failure and therefore the interruption of production. Moreover,

data showing frequent failures of the same equipment/productive process can bring OT managers to introduce innovation against another bias, 'we have always done it this way'.

A relevant way of dealing with predictive maintenance is adopting sensors to monitor the performance of machine parts and assets, to anticipate fatigue and wear of the systems before it materialises into a problem that halts production entirely. Based on Reply experience, we can estimate that predictive maintenance could reduce machine downtimes by up to one third, at the same time extending the equipment's lifetime.

Instead of waiting for a component to break or disintegrate, systems engineers can monitor progress and attend to maintenance ahead of time, allowing production to operate more continuously. Heavy industries like steel production are using IoT to monitor the health of engines used for production, diagnostics and updates, enabling uninterrupted production of high-quality products and creating operations that are more efficient. Prescriptive analytics gives the insights to modify connected equipment to prevent future equipment failure.

Among the benefits of predictive maintenance, interviewed OT managers mention the reduction of halts in production and the increase of uptime of equipment. Over time, their trust grows in the machine learning algorithms necessary to predict faults, showing that effective Industrial IoT solutions need a reasonable time to prove themselves valuable, since the increasing amount of data collected can improve the results of predictive algorithms and potentially the algorithms themselves.

Experience shows that the training of machine learning solutions in industrial contexts improves when specialised workers are in the loop, contributing with feedback to the progress of fault detection based on statistical techniques. Effective predictive maintenance, on top of avoiding unplanned downtime and



outages, can also usually increase equipment life, giving more value to investments made.

Consequently, the business model of equipment manufacturers is also changing thanks to Industrial IoT. They are moving towards service-oriented contracts, often including predictive maintenance and remote monitoring of the equipment, with (where possible) remote intervention to resolve issues or prevent them through over-the-air updates of the machinery.

Moving from scheduled to predictive and/or conditioned maintenance can be a distinctive way for a manufacturer to evolve their own business model. Other services emerging in the maintenance area enabled by Industrial IoT are related to video, with telepresence and real-time streaming in high definition. Even if still not so frequent, this service model showed its value in last years for industrial sites in remote areas and, more recently, due to limitations to individual mobility caused by Covid-19.

[More info on Reply's Asset Monitoring and Predictive IoT Solution](#)

AMP, an asset monitoring and predictive IoT solution realised by Reply on AWS stack, showed itself capable of reducing maintenance costs by up to 50% and repair and overhaul time by up to 55%. The solutions, including re-configured industrial PCs for edge computing and sensor connectivity, pre-integrated sensor options (surface, temperature, vibration or liquid levels), and automation of monitoring equipment sensors, reduces unexpected failures by up to 55%. This improves operational transparency and visibility of assets, as well as reducing the staff required for routine inspections/call-outs.

## Automating and improving supply chains and logistics

**“ With IoT, you basically want to know where the thing is, and what it’s doing – and one is achieved by asset tracking and the other by remote monitoring. So tracking is one of the two main applications for IoT, and it’s one of the oldest. But it has tended to be limited to the high end, around either high-value items or high-value shipments, with lots in the same container. ”**

Phil Skipper, Head of Global IoT Development at Vodafone [Blackman, 2020]

The 2020-2021 period highlighted the frailty of global supply chains. From the outset, Covid-19 prompted many companies to cancel supply orders and halted global mobility. Then the first months of global recovery produced crazy conditions within chipsets and raw materials markets, while unexpected events (e.g. the Suez Canal obstruction) made evident the necessity of more effective ways to move goods and monitor their status. Interviewed managers forecast that uncertainty will last a long time and reported that they are working on improving their supply chains.

Years of ‘just in time’ manufacturing implied the necessity of real-time visibility of supply through the whole chain to avoid disruption of production. Industrial IoT-enabled solutions could not solve all the supply chain troubles by themselves, but they provided reliable solutions to manage asset tracking, inventory management/control, scheduling and ordering of supplies. In times of uncertainty, they can be particularly useful in improving demand sensing and transmitting relevant information across the supply chain and production lines.

Industrial IoT brings important benefits to the automation of the supply chain. IoT-based technologies allow operations managers



to monitor any event happening within a supply chain, down to the single item, piece of equipment or robot involved. Predictive analytics are helping companies to better forecast production's needs for supply, improving the capacity of organisations to react to external events and disruptions in near real-time.

Tags and sensors can be used to monitor inventory items across the supply chain. The result is the optimisation of provisioning, but also a real-time view of supplies availability. In the retail area, sensors are used to track the evolution of stocks in shops, deposits and logistics centres.

Some retail chains are working on adopting IoT technologies to extend to final consumers the benefits of tracking their goods before, during and after the purchase. During the pandemic, innovators in the retail area have been adopting IoT solutions for keeping their staff safe while optimising inventory and shelf-filling, guaranteeing surveillance and security of stores.

[More info about Reply's solution for Drones for the Warehouse Management](#)

Smart shelves, robots and collaborative robots (known as cobots) are becoming the protagonists of inventories. Warehouse management systems now dialogue with drones automating the process of stock checking without the need to stop production. Autonomous robots and drones can work all day and night, making possible a more frequent checking of the inventory and therefore better control of stocks. Their interaction with human staff is effective and the use of robots and drones reduces the risk of injury for people.

In smart logistics, each parcel and each pallet has its own smart tag. Solutions based on lasers and edge computing can optimise both its movement across the single inventory and across the whole distribution network. Autonomous robots move them across the inventory and cure the load of containers/trucks. Human mistakes are minimised and the flow of goods across the distribution chain is definitely accelerated.

As global trade and supply chains expand, and with increased demand for rapid delivery systems, the shipment industry has embraced Industrial IoT to facilitate inventory management, fleet protection, cargo monitoring and the automation of ports. Sensors on ships can help maintain the safety of products, while ships themselves are becoming autonomous vessels for remote management of fleets.

Higher expectations of customers, now used to the amazing delivery time from e-commerce giants, are revolutionising the whole logistics and transports industry. Distribution centres are now often geographically scattered and therefore a higher number of delivery transports move around: corporate fleets are growing and including a heterogeneous set of means, not just 'classic' trucks.

**“ For monitored faults, we've reduced diagnostic time 70% and repair time 25% when using SAS to process millions of records in real time, and point the agent to what needs to be done. That's a huge saving for customers who want to have a truck serviced quickly and accurately. ”**

Conal Deedy, Director of Connected Vehicle Services at Volvo Trucks North America [SAS, 2020]

Industrial IoT platforms are useful for collecting information for all different means and consolidating it in uniform dashboards. This is useful for both logistics managers and other stakeholders involved and interested in monitoring the real-time status of goods and trucks themselves. AI-enhanced algorithms are showing themselves as powerful for enhancing route design, consolidation of loads and optimisation of fleet use.

Reply designed an Industrial IoT platform to integrate connected transport means with enterprise systems and external sources. The solution facilitates complete control of costs through the

[Read more about Reply's Connectivity Platform for Fleet Management](#)



monitoring of vehicle performance and driver-related indicators, the monitoring of trips and an alarm system for detecting failures or problems.

The next step for smart transport is autonomous guided vehicles. Over the last few years, players like Daimler have invested in designing and testing solutions where trucks can drive themselves, escalating to the driver when needed. Full autonomous vehicles will take a longer time to become widely available, but Industrial IoT-enabled connected technology is also moving fast thanks to improvements in the autonomous car industry.

### Moving on from PoCs to launching connected products

**“ Data shows the majority of manufacturers get stuck in proof-of-concept (PoC) purgatory and developments rarely go into production. When projects encounter deeper complexities and challenges, companies lose sight of the value they originally aimed to deliver. The group championing the PoC has a small voice in keeping it alive. ”**

Accelerating Manufacturing Innovation at Scale, Open Manufacturing Platform [OMP, 2020]

Although 90% of interviewed industrial managers think that Industrial IoT and digitalisation of manufacturing and logistics processes are key to staying competitive, the majority of companies struggle to adopt these technologies at scale. Often, the disappointment from lapsed and costly PoCs block promising initiatives that could really change the face of the factories.

The world of Industrial IoT is accelerating rapidly, and without taking careful notice of the challenges for implementation, the scalability of the technology can end up being a curse for

practitioners rather than a blessing. Fortunately, the market is beginning to produce innovative solutions that can provide increased functionality, while keeping items secure and powered efficiently.

From experience gained in the field, Reply knows that although Industrial IoT promises substantial added value and nearly all industrial companies have implemented strategies and technical PoCs, only 5% of these customers can scale these solutions and realise their full business potential. The technological innovation cycle is considerably faster and easier than scaling the solution to an industrial setup.

To tackle this, Reply has created a new way for customers to identify use cases and scale Industrial IoT solutions, and generate substantial added value for their business. A tailor-made methodology/tool like Reply's Axulus Value Scaling Accelerator speeds up innovation and rollout in an industrial environment based on use cases and solution templates, as it allows clear workflows and scalable collaboration.

[Read more about Reply Axulus](#)

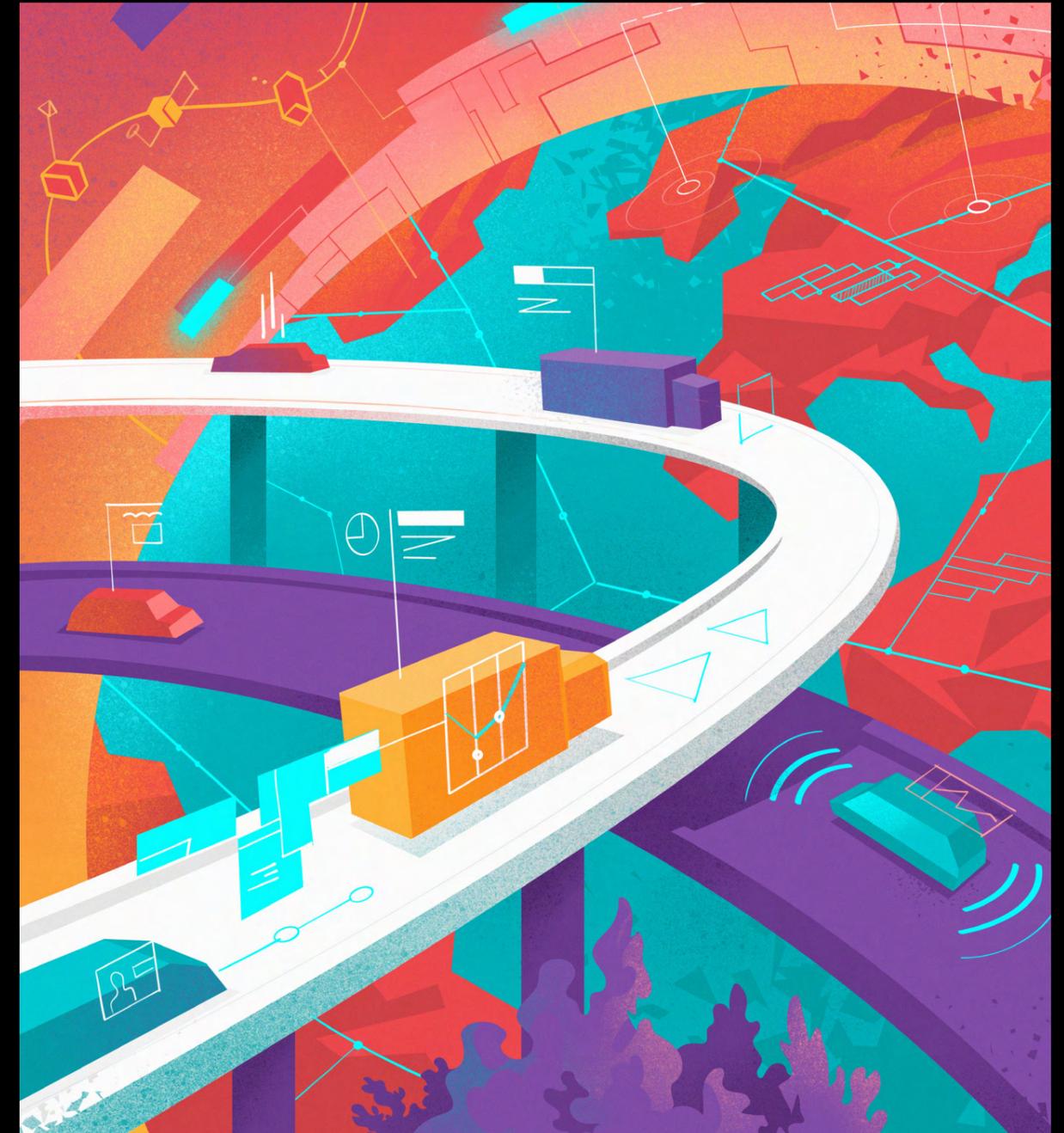
Until now, the attention of OT managers towards Industrial IoT was on the increase of efficiency and productivity. The general evolution of the IoT market, however, indicates that one of the most promising areas of innovation to show the value of Industrial IoT and move forward PoCs is that of connected products. It is a relevant cultural change that extends the interest towards Industrial IoT from the shopfloor to the rest of the organisation.

In fact, in the mid-term, the majority of products (both B2B and B2C) will be natively open to connection, thanks to cheap miniaturised chips/batteries and widely available 5G and optic fibre connections. More companies that are usually intermediated by retailers will experiment with 'direct to consumer' business models, leveraging the opportunity to enter into contact with customers through their devices, without intermediaries.

Leaving behind the PoC swamp and looking forward to new business models enabled by connected products brings benefits for the company, its customers and its suppliers. Data analytics from connected devices not only allow updates to be sent over the air, but also the redesign of physical products based on use. New performance-based levels of service, based on real data, can be defined for both the sold devices and the equipment used to make them.

To make this work, both manufacturing and logistics processes and tools will have to be re-designed and re-adapted. Interoperability, cybersecurity and time to market are the main areas where both manufacturers and IT providers must work to further extend the presence of IoT and the opportunities enabled from connected products. Hyperscalers are designing reliable platforms to support the whole path, from the factory to devices handed by the final customers.

A recent example of a connected product is the coffee machine Lavazza A Modo Mio Voicy. It enables end customers to customise their coffee through a simple voice interaction with Alexa, while collecting usage data anonymised and shared with Lavazza. The coffee manufacturer can use these data to improve the services offered to the end customer, but also their production, logistics and sales processes. A secure-by-design IoT platform powered by Microsoft Azure cloud enables interaction with all the parties involved.



## Lessons learned on IoT for manufacturing and logistics

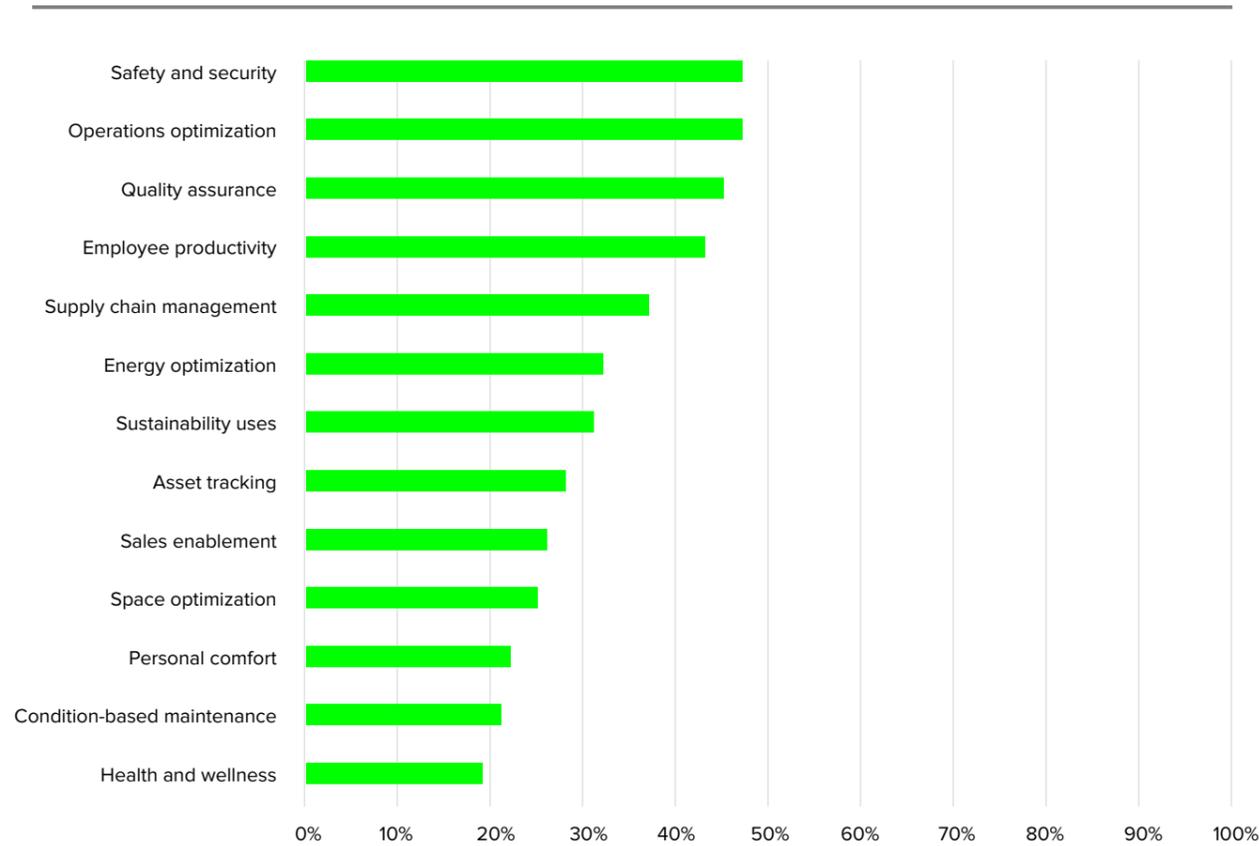
“ Not too long ago, executives from manufacturing and related industries would not consider running their IoT initiatives from a cloud. Now? It’s hard to find one who doesn’t enthusiastically embrace some role for the public cloud. Makers of Industrial IoT software platforms have undergone a similar change of heart, pivoting from making grand plans for multibillion-dollar global data center rollouts to wholeheartedly partnering with one or more of the hyperscale public clouds. ”

Paul Miller, Forrester [Miller, 2020]



## During the Covid-19 pandemic, organisations adopted IoT for enhancing safety and security

Source: [Microsoft, 2020] **Reasons for IoT adoption**



After Covid-19 lockdowns, companies adopted IoT technologies to be closer to their workforce returning to workplaces. The shared goal was to give them peace of mind about a safe environment, saving or even improving their productivity. Connected tools for monitoring workers' health became relevant for both employers and employees. Moreover, the adoption of IoT technologies also increased to create, manage and monitor a hands-free environment.

The pandemic motivated organisations to think differently about existing technologies too. IoT-powered wearables and gadgets, for example, are now used to monitor desk/workstation usage or to alert workers if they break the social distancing rules. Collaborative robots powered by IoT have been used to foster

collaboration among workers and teams while guaranteeing the social distancing and cleanliness of working environments.

Real-time tracking and location systems automatically identify and monitor the position of objects and personnel across indoor environments or facility entrances. These tools allow companies to track and monitor objects and employee movement, highlight high-risk areas and provide location-based services and contents. Throughout the pandemic, these systems have been applied as a social distancing tool, e.g. thanks to the adoption of an easy-to-wear badge holder.

[Read more about Reply Tracking and Location System](#)

The workforce tracking and location market will continue its growth after the end of pandemics. The introduction of 5G will enable these 'connected workers' to identify, in real-time, hazardous behaviours and either take steps to make themselves safer or transmit information to supervisors and colleagues to do so. IoT-enabled headsets/glasses can already warn the worker in real-time of possible hazards, preventing injuries and risks related to bad ergonomics.

## Extracting value from factories needs to involve old equipment and improve interoperability

It is difficult to imagine a 'greenfield' plant projected and implemented today without adequate connectivity, brand new connected equipment and sensors. However, a large part of production and logistics processes still happens in the so-called 'brownfield' plants, and therefore a large part of Industrial IoT projects is focused on how to extract value from existing setups.

The proliferation of Industrial IoT gateways goes in this direction. Their capacity to provide an Industrial IoT-driven increase of productivity gives the old equipment give a new value, since their depreciation is often already completed. The main feature



is to dialogue with the different PLC/existing protocols on a side and to be open to edge and cloud on the other side.

With so many start-ups in the Industrial IoT field, there are numerous different programming languages that individual machines use. Combined with different wireless connectivity applications and methods, the need to streamline the languages of different IoT devices so they can communicate effectively is a major challenge for IT specialists hoping to roll out wide-scale industrial solutions.

Middleware specifically developed to 'translate' the commands between objects and mitigate demands is essential for the future of IoT in industrial settings. Among proactive players, Ericsson has developed a system of semantic interoperability that allows various devices, designed with different operating languages, to communicate more effectively in an industrial setting.

As the world of IoT, especially in industrial contexts, accelerates into the future, the issue of interoperability is already presenting itself as a major roadblock to ubiquity. No matter how many IoT devices come to market, progress will continue to lag until they are able to communicate effectively and operate amongst each other. Hyperscalers are looking to assume a role as ecosystem orchestrators, as they have already done in the consumer market.

Managers often are worried about the difficulty of collecting data from older equipment to get the benefits of a comprehensive IoT adoption. They fear obsolescence, the integration between IoT technologies and legacy systems, possible halts coming from connectivity issues and cybersecurity. Furthermore, managers often encounter some resistance from employees, especially workers in factories.

Retrofitting is the process of upgrading and adapting existing industrial devices and systems into intelligent IoT systems.

Businesses that cannot afford to completely overhaul their systems with built-in IoT will use 'bolt-on' IoT to bring units into a network of smart sensors and operations that can dramatically enhance efficiencies. Solutions based on low-cost hardware like Raspberry Pi are emerging on the market as retrofitting enablers.

**“ Thanks to IoT and a ‘retrofitting’ approach we can now manage data and implement changes informed by data-based predictions that will be helpful to drive the performance of our plants to the next level ”**

Marian Kurc, EMEA Operational Excellence Director at Vertiv

Where needed, the 'retrofitting' approach allows companies to obtain strategic information from different-age pieces of machinery. An interesting case comes from Vertiv, which is obtaining strategic information from both old and new equipment, such as the usage of electric power, temperature and activity status, and using this information to manage production but also to set up predictive maintenance actions.

[Read more about the Vertiv case](#)

### **Energy management is becoming crucial, also thanks to new services from Utilities**

Energy management is already one of the main development areas for Industrial IoT and is transforming the whole Energy industry, from oil and gas production/extraction up to smart meters and sensors in homes, offices and factories. IoT is enabling new data-intensive, real-time processes and business models like smart grids, microgrids, energy communities and demand aggregation and management. These investments will be able to dynamically adapt supply and demand, thanks to IoT sensors distributed in both cities and rural areas.

Energy players and utilities are producing innovation on different



levels. Renewable generation optimisation and grid asset maintenance and automation are often the priority for players with a relevant role in the production and large distribution markets. However, smart metering, e-mobility, flexibility and advanced energy management are all business areas where utilities are designing new business models and services, thanks to the emergence of IoT.

To reduce its impact on climate change and to embrace renewable generation, electric cars, energy storage and all the innovations blossoming in this period, the entire industry is now investing strongly in transformation. A digital environment is linking up with the energy value chain to enable real-time interaction among stakeholders and continuous data exchange to optimise generation, usage, prices and operations at the market level.

Innovations in the IoT sphere are pioneering self-powered devices, whether by harnessing kinetic energy or micro solar cells that can be easily attached to small units. For example, EnOcean has developed kinetic energy harvesting cell units that can be connected to IoT systems and help power remote devices through the unique powering solution. Researchers at Uppsala University in Sweden have developed thin solar cells that can be attached to IoT devices for micro energy harvesting, powering different connected devices.

Thanks to Industrial IoT, utilities are creating new services for companies. Energy management today is an important topic for manufacturing and logistics managers, especially as internet bandwidth becomes increasingly able to manage larger scales of units in their systems. Connecting each device to the internet requires energy, to the extent that there can sometimes arise a trade-off between tracking efficiencies and energy resource efficiencies.

In the area of smart environment monitoring in industrial contexts, sensors can keep checking factories' conditions like humidity,

[Read more about Reply's IoT Energy Management system](#)

temperature and light. Alerts can be sent to managers and workers in order to restore the perfect production environment or to data analytics platforms to build up a consistent dataset useful for improving the environment quality periodically. Using an energy management system based on an IoT platform and sensors installed on equipment, companies can improve the area of energy and water optimisation.

### Innovation stories from the Reply IoT incubator

In 2014, Reply launched Breed Reply, an investor in early-stage IoT companies. Since its foundation, it has funded 24 IoT-related companies spanning fields such as manufacturing, health and wellbeing, smart buildings, smart cities and cybersecurity. Breed Reply supports these early-stage companies to go further faster, by avoiding common pitfalls and by using its robust governance and planning frameworks to achieve business readiness for sustainable growth.

[Read more about Breed Reply](#)

Using IoT in a corporate context is an important focus area in the Reply IoT incubator's portfolio. Here we introduce the innovations brought to the market from the start-ups and scaleups portfolio, with a focus on industrial and logistics contexts. In collaboration with Breed Reply, we selected and presented some IoT companies from its portfolio.

#### **Bodytrak**

Bodytrak is a brand from iNova Design, a company specialising in the design, development and commercialisation of novel body sensing solutions to optimise performance (e.g. in manufacturing contexts) and prevent illness. Bodytrak offers the measurement of all vital physiological parameters along with motion monitoring in a single miniature ear-based device, which is non-invasive and provides continuous real-time data wirelessly to the end-user.

[More info on Bodytrak](#)



## Metron

[More info on Metron](#)

The digitalisation of industries and the development of fully distributed energy systems foster the emergence of the Internet of Energy. French company Metron opens the way for this new paradigm by helping industrial clients leverage untapped industrial data and connect to decentralised energy resources. Metron Energy Virtual Assistant analyses data generated by industrial systems in real-time and offers a deep understanding of complex energy patterns. Factories become energy transparent: advanced optimisations are operated directly by the platform according to the context and tangible energy savings ensure robust paybacks in all industries.

## Senseye

[More info on Senseye](#)

Senseye has developed a cloud-based solution that helps manufacturers avoid downtime and reduce maintenance costs. By automatically identifying machine failure through predictive machine learning algorithms, the Senseye platform revolutionises predictive maintenance through non-invasive integration into sensor data from existing DCS, PLC and SCADA systems. This extends usage across any machine from any manufacturer, with user dashboards providing an automated diagnosis of potential failures up to months in advance.

## We Predict

[More info on We Predict](#)

We Predict is already a global leader in predictive analytics as a service turning big data into actionable insights for some of the world's largest companies. We Predict's predictive analytics is initially targeting the automotive and heavy machinery industries, predicting the failure rates of individual components used in a vehicle a year or more before the manufacturer would identify the same issues. This enables subscribers to better quantify and prioritise their potential warranty liabilities, and to improve their resource allocation and customer satisfaction for their quality assurance operations. Indico is a proprietary software solution that analyses current and historical data, without integration

or operational disruption, and unlocks valuable insights to better manage quality risks, and drive increased efficiency and profitability.

## Tag Sensors

[More info on Tag Sensors](#)

Huge losses of frozen and chilled food products globally are primarily due to inadequate facilities, improper food handling and insufficient training of cold chain personnel. The Norwegian company Tag Sensors has developed the first low-cost, full visibility solution that ensures and proves that temperature-sensitive foods and pharmaceutical products have been stored and transported within the temperature limits, from production to consumption. Through optimal monitoring, data analysis and management of temperatures and other variables of perishable goods during transportation, Tag Sensors enables food and pharmaceutical corporations to improve quality control and better prevent spoilage.

## RazorSecure

[More info on Razorsecure](#)

RazorSecure is a specialist in rail cyber security, providing cyber security solutions for rolling stock and signalling environments. The company offers a flexible, hybrid network and host-based approach to railway cyber security, powered by machine learning and designed to protect rolling stock, signalling and infrastructure systems. RazorSecure works with the most significant brands across the railway industry, providing visibility and insight into networking equipment and advising on security best practices and risk.

## Canard Drones

[More info on Canard Drones](#)

Spanish company Canard Drones provides real-time inspection and calibration of Navigational Aids for airports, by using sensor-equipped RPAs (Remote Piloted Aircraft, or drones). By law, airport navigation systems and lights need to be periodically inspected and calibrated from the air; Canard performs zero-emissions satellite-precise positioning flight inspections, which

is an alternative to expensive, inaccurate and highly disruptive traditional solutions based on the use of specialised inspection aircraft and personnel.

### Ubirch

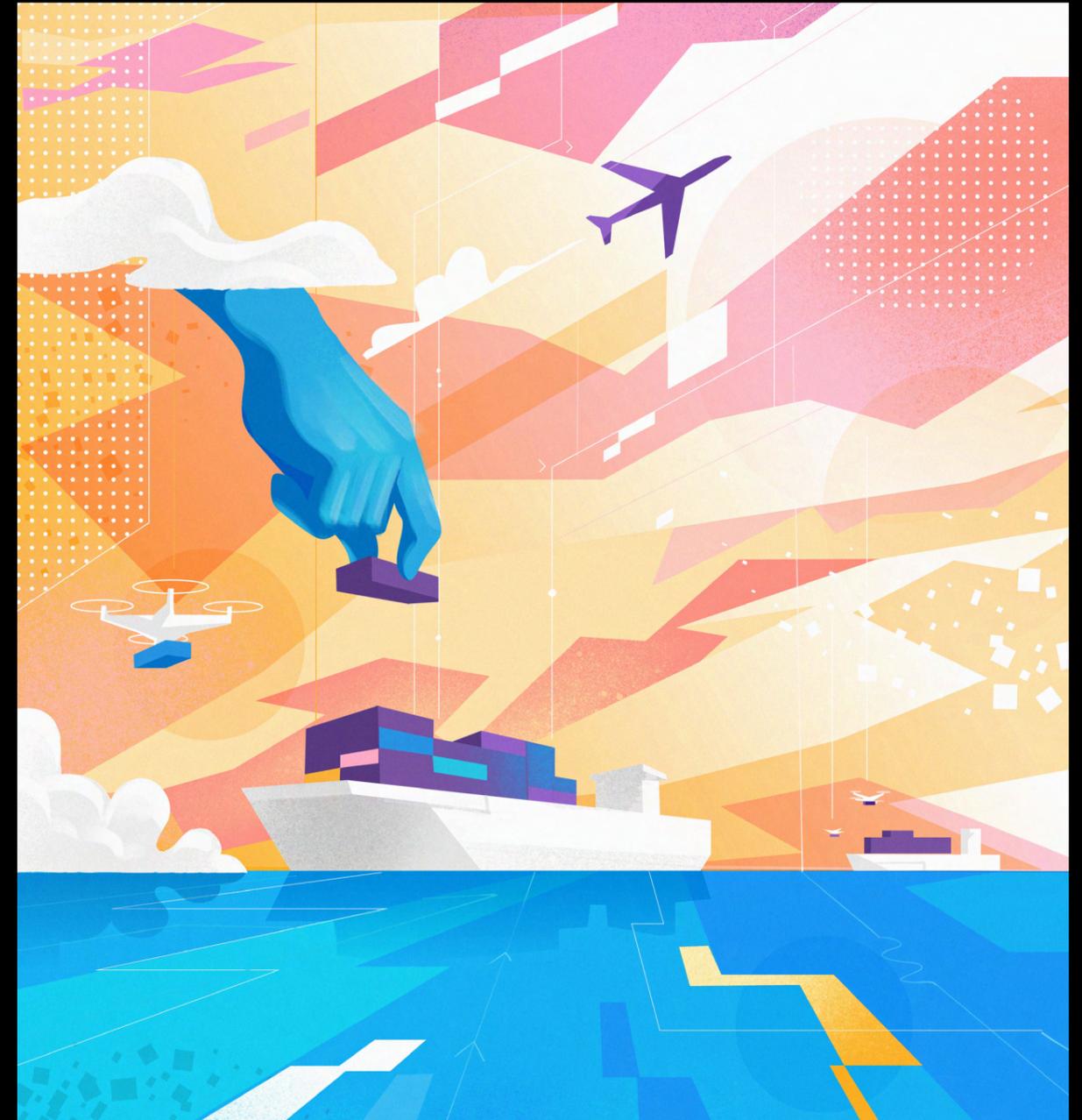
[More info on Ubirch](#)

The German company Ubirch has built a process that enables a continuous chain of security and confidentiality for the collection, handling and storage of data. This chain begins with an extreme lightweight blockchain client that can be operated on any IoT sensor, even on batteries. Each sensor that runs this protocol has a private key that generates a digital signature for every measurement that is being transmitted, thus both the identity and integrity of the IoT data can be verified by anyone on the receiver side. The solution, which is hardware agnostic, enables a wide range of IoT applications for infrastructures, buildings, machines and devices with clients in the insurance, telecoms and manufacturing industries.

### Zeetta Networks

[More info on Zeetta Networks](#)

Zeetta Networks breaks vendor-lock-ins using a unique open networking platform based on industry-standard ICT hardware and powerful orchestration software - named NetOS - which manages, automates and monitors the whole network while significantly reducing its operating costs. Examples of NetOS use are the 'Bristol Is Open' award-winning smart city, with a complex ecosystem of networks, technologies and systems, or their deployment at Ashton Gate Stadium, the largest stadium in South-West England with a 27,000 capacity, to improve network agility and efficiency.



## Market view and predictions about industrial IoT from PAC (Teknowlogy Group)

“ In a high-speed world, no individual application creates a lasting competitive advantage – it is the ability to move faster on a large scale that makes the difference. This is also true for the digital factory. There is a clear need to develop, scale and manage industrial IoT applications more agile and efficient. ”

Arnold Vogt, Head of Digital CX & IoT at PAC (Teknowlogy Group)

## Companies' approach during the 'first wave of Industrial IoT projects'

Before Covid-19 hit the world, many projects were initiated and driven forward to take the level of digitisation in factories across the world to the next stage. We can categorise these projects as the 'first wave of Industrial IoT projects'. This first wave of projects was generally driven by the following four factors:

- ▶ Many new technologies emerged close to IoT, such as AI, augmented reality, 3D printing, 5G, cobots, cloud, and edge computing. Each individual technology, as well as the potential value of combining them, attracted a lot of awareness in the market.
- ▶ Based on the technologies mentioned above, many new use cases (e.g. remote machine monitoring, fleet management, predictive maintenance, connected workers and digital quality control) became a subject of public discussion, promising significant value creation potential through efficiency gains in the production environment and around industrial field services.
- ▶ Enthusiasm among innovators and industrial pioneers, who predicted that even more use cases would be possible based on these new technologies and, in addition, these new use cases could potentially create even more value. This led to huge expectations across the industrial world, especially on all management levels. There was a common perception that digitisation projects in the factory would lead to efficiency gains in the double-digit range.
- ▶ The above-mentioned enthusiasm among digital leaders put a lot of pressure on all other players in the market to follow suit. These followers felt a significant competitive risk of falling behind by doing nothing, or just by moving too slowly.

Ultimately, new technologies, new use cases, enthusiasm, and competitive threat led to a 'high sense of urgency' for digital factory projects. Driven by these factors, common patterns emerged across companies in the manufacturing industry in their approach to initiating and driving these digital factory projects as fast as possible.

Companies followed this five-step approach:

1. Start bottom-up in the organisation and identify many different potential use cases
2. Prioritise these use cases based on attractiveness (value and time to market)
3. Initiate PoCs to check the technical feasibility of the most highly prioritised use cases
4. Broader deployment of successful PoCs across the company
5. Measure the outcome and draw lessons for the next cycle in the process.

Some companies went through the list of initially identified and prioritised use cases and tried to push them through the process, step by step. Other companies repeatedly started from the beginning, aiming to continually identify new use cases. They were constantly looking for new, high-value use cases – ideally, a real 'killer app' that would produce dramatic improvements.

While going through this process, many companies learned quite similar lessons. First, many potential use cases can be identified. Second, technology is not typically the main problem: many use cases are technically feasible. While this finding may not have come as a big surprise, the third lesson learned was definitely more interesting, but in a negative way. They often realised that individual use cases generated a more limited return on investment than expected.



Digitalisation projects often do create value, but not necessarily enough to live up to high expectations. This created a level of disappointment and disillusion on the user side of the market. Excessive expectations in terms of fast market growth based on new technologies were of course also a challenge on the provider side of the market. There was a real chance that early movers would become successful digital leaders in the industrial world. In reality, however, their ambitions and investments turned out to be based on excessive expectations as to how fast the market would accelerate.

In summary, we are in a good position today to see some valuable insights from the first phase of digital factory projects in the market.

- ▶ There is no 'killer app' on the horizon that enables significant (double-digit) efficiency enhancements. Instead, many different use cases allow step-by-step improvements for industrial companies. We expect further use cases to emerge in the future, but we do not expect to see a killer app.
- ▶ To overcome the bottleneck described above, manufacturing companies need an efficient approach (e.g. low code) to develop simple new applications for new use cases at a fast pace.
- ▶ The digital factory needs efficient scalability (simple and fast) to transfer successful PoCs of newly developed applications to many different machines, production lines and factories.
- ▶ Agile application development and agile scalability have to be combined with agile application management to handle updates (new functions, security) as efficiently as possible.

In short, there is a need for an agile DevOps approach to managing the digital factory as efficiently as possible.

## The impacts of Covid-19 on Industrial IoT

Of course, Covid-19 represents the key challenge for the manufacturing industry today. However, there is a clear expectation among manufacturing companies that business will return to normal during 2021 and local IT budgets will grow in comparison to 2020. PAC (Teknowlogy Group) agrees with this forecast.

It is remarkable to see that even during the pandemic in 2020, the local IT budgets of some (one in four) manufacturing companies increased slightly: this was mainly driven by larger companies. It is no surprise that large manufacturing companies with more than 1,000 employees have bigger investment plans in new digital technologies in general. They not only have higher budgets, but they also have the advantage of being able to scale new digital technologies much better.

From a regional perspective, it is interesting to observe that manufacturing companies in the US see the current crisis as an opportunity more often than companies from the rest of the world. This is underscored by the fact that more US-based manufacturing companies increased their local IT budgets considerably or strongly than in any other region of the world.

The construction industry has been facing more IT challenges than other sub-industries within manufacturing, which is why construction firms more often increased their local IT budgets significantly to overcome these challenges. The automotive, aerospace and defence sectors are expected to increase their investments in digital technologies going forward.

The hype around AI, BI & Analytics is slowing down and the focus among manufacturing companies shifted more to short-term goals during the pandemic in 2020. Nevertheless, the topic is highly important, and a major share of investments goes into data



preparation, self-service BI tools, overcoming data silos and data infrastructure software for collecting, storing and retrieving data.

To overcome the challenge of Covid-19, increasing investments are expected in CRM and customer experience management. In addition, AR/VR is a newly emerging investment area for manufacturing companies as it enables remote expert support. Track and trace seems to be experiencing a revival – currently important to increase the resilience and transparency of supply chains and help to better deal with global crises in the future.

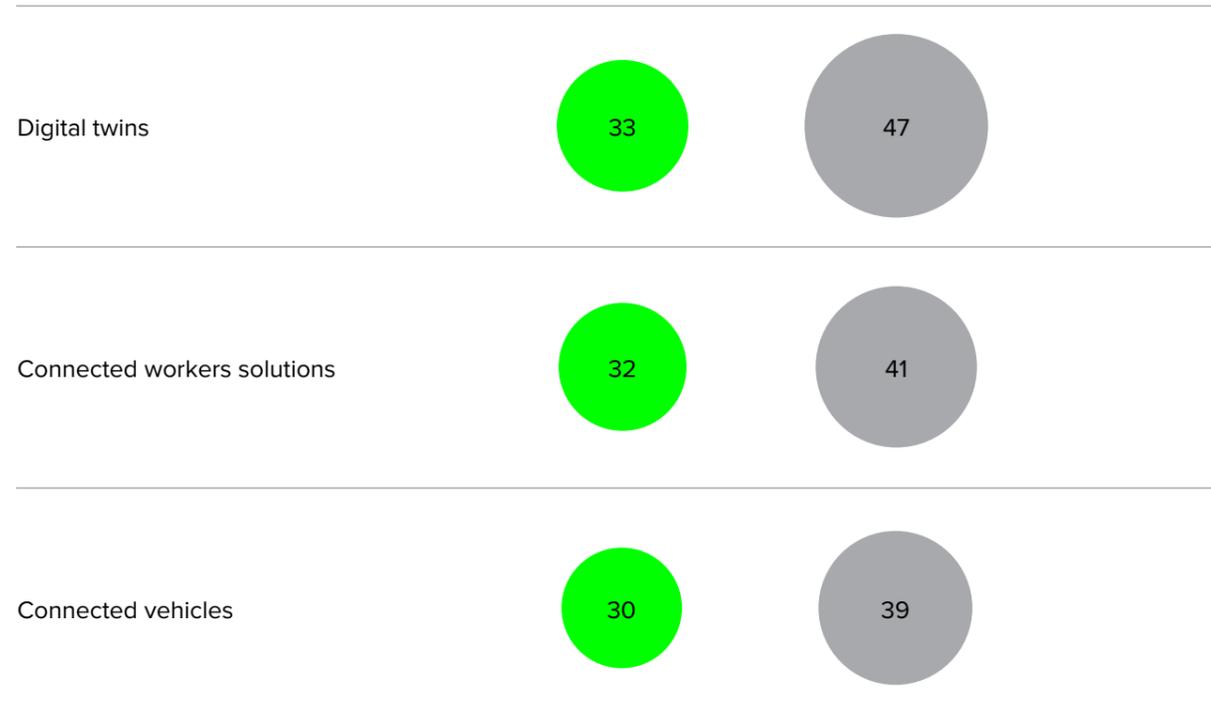
Creating direct value for the business is becoming more relevant for the IT departments of manufacturing companies, and services around applications get more attention than infrastructure-related services. Applications and application-related services that create superior business value by combining new technologies (e.g. AI/ML, IoT, AR/VR) have become a top priority for many IT departments at manufacturing companies.

### Insights from PAC (Teknowlogy Group)'s CxO Survey

The trend towards the cloud is unbroken. More manufacturing companies moved in the last 12 months from the 'planned' to the 'already realised' stage. The public cloud also increased in relevance, in comparison to other deployment models. According to PAC (Teknowlogy Group) CxO survey, AWS is the public IaaS/PaaS leader among manufacturers worldwide, closely followed by Microsoft Azure. Microsoft Azure IoT was able to take over the leadership position from AWS IoT in the field of IoT platforms.

### Actual use of an IoT platform and plans for investments according to PAC (Teknowlogy Group)'s CxO Survey (%)



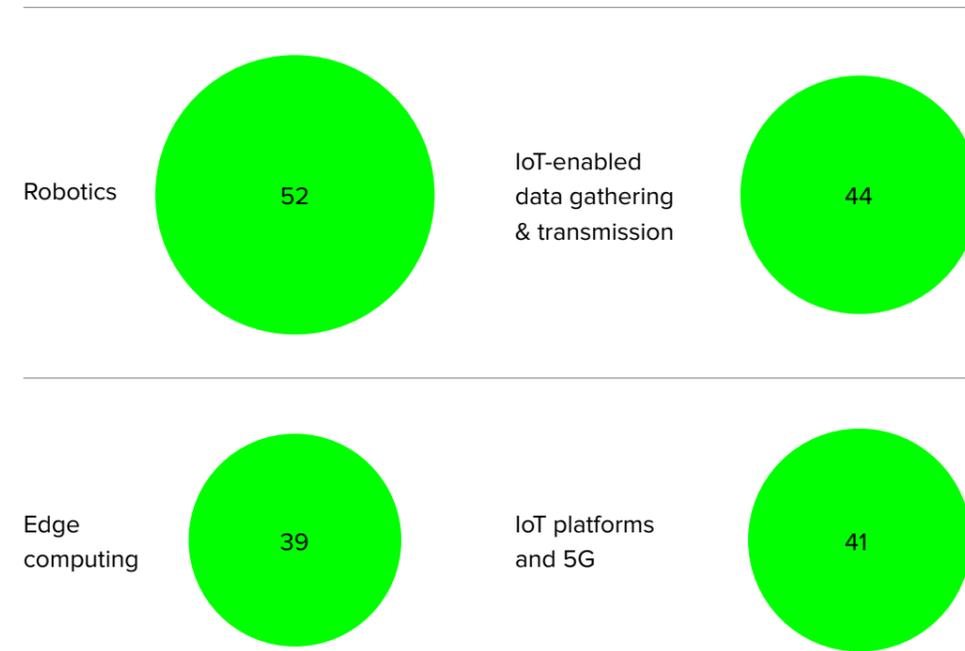


When asked which of the following approaches does or would your organisation prefer when using an IoT platform:

- ▶ 52% of the surveyed companies reported that they prefer an independent, edge-centric concept (data management and applications run predominantly at the edge)
- ▶ 48% prefer a highly scalable, cloud-centric concept (data management and applications run predominantly in the cloud).

IoT-related investment plans around energy management have increased. This is an indication that reducing carbon footprints is attracting increasing attention in the industry.

Investment plans in the next 2 years for IoT solutions and technologies according to PAC (Teknowlogy Group)'s CxO Survey (%)



Connected industrial robots and cobots are expected to be a key investment area in the next two years. Robots/cobots will play an increasingly important role in very different areas of the manufacturing industry.

The relevance of cybersecurity and analytics is unchanged. Both topics will remain the top investment areas for manufacturing companies over the next two years. Cyber-attacks are an unsolved problem for many manufacturing companies. The greatest cybersecurity threat comes from employees themselves. Application and data security are an area in which the largest share of respondents to the CxO Survey is planning to invest significantly.

### PAC (Teknowlogy Group)'s predictions about Industrial IoT

The pandemic has not only revealed the vulnerability of supply chains, but also of factory operations. Suddenly, massive shifts

in demand triggered by events like Covid-19 are a realistic scenario. This means that manufacturing companies even have to be prepared to shift their production capacities to totally different products that would normally be outside their scope – for example, from alcoholic beverages to hand sanitiser, fashion to face masks, or washing machines to ventilators.

Covid-19 has triggered a shift in mindset in factory automation. In addition to production efficiency, agility is becoming much more relevant. In 2021/22, this will lead to more investments into agility-enabling technologies such as IoT, AI, robotics, edge computing, AR and 5G. An example is digital platforms that allow the efficient and agile sharing of programming code between different IoT-connected machines (e.g. machine tools). This gives factories more agility and efficiency, and a shared, cross-company industrial cloud can even be used to exchange applications across company boundaries.

Leveraging AI to avoid the complex reprogramming of robots is another topic. This enables robots to learn much faster from workers' gestures, or completely self-driven, by setting specific targets (e.g. grabbing or packaging) without complex programming of motion control. Connected worker solutions (e.g. based on AR and smart glasses) are another efficient way to give shopfloor workers more digitally enabled agility through digital work instructions, self-driven learning and remote expert support. Digital quality control via image-based analytics allows for automated adaption of machines to ensure production quality.

Companies have worked hard over the past few years to optimise their supply chains. They have done everything to minimise costs, reduce inventories and remove buffers. Efficiency has been king: everything has to be delivered just in time, and this approach has worked well for many years. In 2020, Covid-19 made obvious the fact that many global supply chains only work well in a 'perfect world' without major disruptions.

Previously, companies did not tend to see the need to balance the efficiency and resiliency of their supply chains as equally important topics. This changed dramatically during the pandemic when factories and borders were closed and e-commerce boomed. Companies have come to realise that major external shocks are no longer theoretical; our highly connected and globalised world is much more vulnerable and fragile than many thought.

This is why, in the current and next year, we will see investments made by companies to adjust their supply chains accordingly. Their focus now is on balancing efficiency and resiliency much better than in the past. In concrete terms, this means investments in four areas to improve and modernise their supply chain management systems:

1. Improving overall visibility by establishing an integrated logistics control tower to achieve real-time visibility
2. Increasing transparency of goods delivery conditions (e.g. cooling) by leveraging IoT and analytics technology to predict in-time delivery
3. Evaluating supply chain scenarios by running simulations to predict when and where bottlenecks are likely to occur
4. Based on these simulations, increasing the delivery flexibility of the current supplier network.

More options have to be available to overcome future crises, and the merging of logistics data in a shared, cross-company industrial cloud is a promising approach.



# CONCLUSIONS

**“ Manufacturers today face challenges on many fronts: increasingly demanding customer expectations, higher costs, sustainability concerns, and disruption—most recently and dramatically due to the global Covid-19 pandemic. But data can help companies navigate their way through the obstacle course of modern manufacturing. Manufacturing generates petabytes of useful data that can improve production yields, avert problems and spot opportunities. But this data is only as useful as their ability to analyze and use it to make decisions. ”**

Dominik Wee, Managing Director Global Automotive, Manufacturing and Energy at Google Cloud [Wee, 2021]

## IoT has a bright future, both in industrial and consumer fields

Today companies, consumers and governments are already interested in adopting IoT technologies, with their differing size of investment: each is checking the cost/opportunity ratio in their own field. Looking forward to future use cases of IoT lets

us imagine an amazing flourishing of different contexts where connected products and services will support both our personal and professional lives.

Products (and relative ecosystems) that as yet did not involve the whole mass market, like connected vehicles, white goods and personal assistance robots, are expected to grow significantly in the next ten years, to become common within daily use. Industries like logistics, retail and insurance are showing they can obtain significant benefits by pushing IoT solutions on different stakeholders, either internal or external.

We estimate that an astonishing growth of connected devices will be achieved thanks to new use cases enabled by 5G networks and edge/cloud-powered architectures, creating a global total spend on IoT that could grow up to 1,200 billion Euros in the next five years. Besides benefits for end-users, real-time monitoring and analysis of data through IoT will deliver several benefits to organisations, leading to potential cost cuts and increased profits.

Industrial IoT already offers a wide range of ways for companies to get ahead of the competition, from enabling potentially dangerous tasks to be performed by drones rather than humans, to allowing zero-defects models of quality control rather than random sampling, to predicting maintenance issues before they arise. IoT is also proving to be a game-changer in optimising inventory, managing buildings and supporting plants' energy management.

Introducing Industrial IoT technologies is definitively one of the best ways to challenge old, expensive legacy systems. Leading proof of concepts on different fields and defining reliable business models can identify the areas where it makes the most sense to introduce new equipment with built-in IoT features, or at least adopt solutions that make 'smart' what is already there and cannot be moved. Then, a structured approach will allow



organisations to scale those proofs of concept in reliable changes to the everyday life of workers and organisations.

Organisations will have to invest in training and reskilling of existing workers and hire new staff, transforming manufacturers' and logistics players' workforce from pure handlers of equipment and goods to knowledge workers, able to interact with autonomous robots and artificial intelligence. The remote working tornado that involved offices during lockdowns will partially involve factories too, with an increase of remote control and digital maintenance of equipment.

Traditional barriers among IT managers, OT managers and business experts must be broken to allow the company to think about how to position itself in a world of connected products. Adopting an IoT-based approach throughout supply chains is significantly changing business models, enabling new products and services, and enabling investment in Industrial IoT to prove its value.

# APPENDIX

## References

- ▶ [\[Blackman, 2020\] James Blackman, Digital Industry Solutions Report Series: Asset Tracking and the March Towards Massive IoT, Enterprise IoT Insights](#)
- ▶ [\[IDC, 2020\] IDC, Worldwide Spending on the Internet of Things Will Slow in 2020 Then Return to Double-Digit Growth, According to a New IDC Spending Guide, 2020](#)
- ▶ [\[IoT Analytics, 2019\] IoT Analytics, Share of Internet of Things \(IoT\) platforms worldwide as of December 2019, by industry, 2019](#)
- ▶ [\[Microsoft, 2020\] Microsoft/Hypotesis, IoT Signals - Edition 2, 2020](#)
- ▶ [\[Miller, 2020\] Paul Miller, Make Room For Public Clouds In Your Industrial IoT Strategy, Forrester, 2020](#)
- ▶ [\[OMP, 2020\] Open Manufacturing Platform, Accelerating Manufacturing Innovation at Scale: Solving mutual challenges through open collaboration, 2020](#)



- ▶ [\[PTC, 2020\] PTC Inc \(PTC\) Q1 2020 Earnings Call Transcript, The Motley Fool, 2020](#)
  
- ▶ [\[SAP, 2021\] Franz Hero, Industry 4.0: A Key Enabler Of Resilient Supply Chains, SAP, 2020](#)
  
- ▶ [\[SAS, 2020\] SAS, Accelerate and improve business outcomes with AIoT, 2020](#)
  
- ▶ [\[Trend Micro, 2021\] Trend Micro, The State of Industrial Cybersecurity, 2021](#)
  
- ▶ [\[Wee, 2021\] Dominik Wee, Building the digital factory with SAP on Google Cloud, 2021](#)



### **Reply Disclaimer**

Mentioned trademarks and logos of customers belong to them.

Reply has been authorised by Reply customers' Managers to report their quotes. Such quotes are personal and do not necessarily represent the Managers' companies nor Reply's positions.

This Research is for disseminative and informative purposes and is not aiming to exhaust the panorama of information available on the topic.

This Research is based on information also collected from third party sources, which Reply considers updated and accurate. However, Reply cannot guarantee the adequacy, accuracy, completeness or correctness of such information, nor can guarantee or represent that the Research is in every respect complete.

Reply therefore expressly declines any liability related to the use of the information provided, and makes no warranty of any kind concerning the information provided, including, but not limited to, warranties of merchantability or fitness for a particular purpose.

Reply also does not warrant that the quality of the information obtained by readers through this Research will meet their expectations.

The contents not specifically attributed to third parties have been developed and/or processed by Reply and Reply is the source.

### **Teknowlogy Group Disclaimer**

All the market data mentioned in the document belong to the Teknowlogy Group. For more information, please visit <http://www.sitsi.com>.

The contributions of the Teknowlogy Group to this Research were compiled with the greatest possible care. However, no liability for their accuracy can be assumed. Analyses and evaluations reflect the state of Teknowlogy Group's knowledge in July 2021 and may change at any time. This applies in particular, but not exclusively, to statements made about the future.

The contributions of the Teknowlogy Group to this Research are protected by copyright. Any reproduction or dissemination to third parties, including in part, requires the prior explicit authorisation of the ordering party. The publication or dissemination of data, tables, graphics, etc. in other publications also requires prior authorisation.

The chapter 'Market View and Predictions About Industrial IoT From PAC (Teknowlogy Group)' was produced by Pierre Audoin Consultants (PAC) - a Teknowlogy Group company. Reply had no influence over the analysis of the data and the production of the chapter.



REPLY specialises in the design and implementation of solutions based on digital media and new communication channels. Through its network of highly specialised companies, Reply partners with major European corporations in the telecoms and media, industry and services, banking and insurance, and public administration sectors, to devise and develop business models built on the new paradigms of big data, cloud computing, digital media and the Internet of Things. Reply's services include: Consulting, Systems Integration and Digital Services. [www.reply.com](http://www.reply.com)