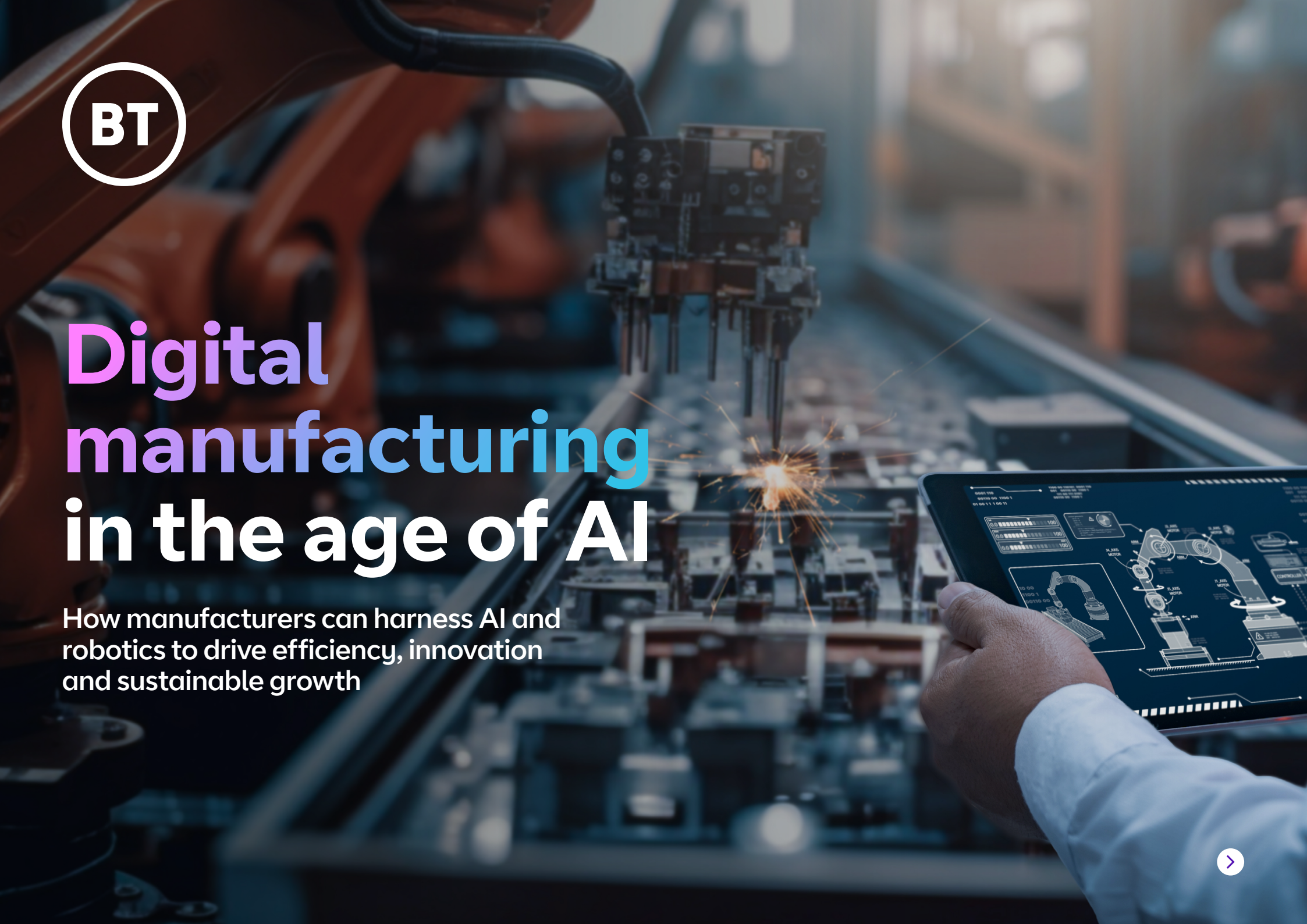


Digital manufacturing in the age of AI

How manufacturers can harness AI and robotics to drive efficiency, innovation and sustainable growth

Foreword

AI is at an inflection point, with billions of dollars flowing into AI infrastructure. In 2025, Global 2000 organisations will allocate over 40% of their core IT spend to AI-related initiatives. In manufacturing, this spend is reflected in AI and robotics integrating rapidly into the digital ecosystem, from data centres to the edge.

But here's the game-changer: The network is the AI, and the AI is the network. Just as neurons and synapses form an integral part of the brain, the network is an intrinsic part of AI and robotics. Intelligent networks provide the secure, robust, scalable, multi-cloud connectivity at ultra-low latency that AI and robotics demand.

Imagine a factory floor where robots seamlessly communicate, collaborate and adapt in real-time, driven by AI. This vision becomes a reality with a network that evolves alongside digital advancements.

As a global business, we collaborate with industry leaders worldwide, including many companies like yours. By combining our global insights with your deep expertise, we can pave the way to industry-leading AI and robotics solutions.

This whitepaper offers a comprehensive overview of the key considerations for a successful AI and robotics journey in manufacturing.

Ready to explore the possibilities? Get in touch with us today.

Contents

The vast opportunities of AI in manufacturing

The manufacturing industry is on the cusp of a significant transformation driven by AI and robotics. This transformation has massive potential for companies to increase their competitive advantage and profitability.

Here, we outline the most exciting opportunities.

The economic benefits from AI and automation are projected to add up to

$15.7 trillion

to the global economy by

2030.

Unlock an AI-driven productivity boost

AI is the most exciting opportunity because it's a golden thread that runs through manufacturing's future, enabling so many other possibilities; 'AI-powered' will become a familiar phrase. Fundamentally, its rapid, accurate data analysis is transformative, enabling near-instant decision-making by humans or automated systems.

Imagine if all physical assets were interconnected and the data collated into a single accurate view. By channelling this visibility into a digital twin, manufacturers can simulate different production scenarios to identify potential frictions, improve efficiency and test new processes virtually. This data-driven decision-making can empower dynamic scheduling to reduce bottlenecks, improve production planning and optimise real-time processes.

AI can also analyse demand patterns, supplier performance and logistics data inventory levels to reduce material shortages, optimise supply chains and support a just-in-time production model.

At a factory level, AI's continuous production line monitoring can adjust parameters like temperature to maximise efficiency and minimise defects. Then, adding AI-powered computer vision can detect even the most minor defects in real time for a higher-quality output with fewer rejects. This will result in greater accuracy, improved resource efficiency and lower waste levels to further optimise energy consumption, reducing costs and environmental impact.

Benefit from predictive maintenance

AI-powered machine learning models transform production-line functionality by analysing real-time sensor data to predict equipment failures before they happen. This allows engineers to schedule maintenance to prevent such failures from causing an expensive and disruptive unplanned shutdown. Planning ahead means the correct parts are ready and waiting, avoiding high express delivery charges.

Predictive maintenance also allows manufacturers to reduce their costs by reducing their reliance on reactive maintenance and unnecessary routine servicing.

Plus, when machines are kept in optimal order, they run at maximum efficiency, reducing wear and tear and increasing lifespan. What's more, constantly monitoring machine performance can identify inefficient machines that consume excess energy. Engineers can then make adjustments that will lower energy costs.

In addition, when AI capabilities run across the factory environment, hazardous conditions can be identified early, reducing the risk of accidents caused by faulty or failing equipment and improving worker safety.

AI-driven predictive maintenance can reduce maintenance costs by up to 30% and decrease unplanned downtime by 45%.

Take humans out of the equation with robotic systems

AI-driven autonomous robots and collaborative robots (cobots) have enormous potential to eliminate human fallibility in the production line. Robotic Process Automation (RPA) systems don't lose concentration or tire and can work day and night with the same high levels of precision and consistency. Adding AI-powered robotic vision systems delivers efficient quality control that detects defects faster than humans, ensuring greater accuracy and reduced waste.

AI can drive reprogrammable robotic arms, enhancing flexibility by rapidly adapting to production changes without incurring significant reconfiguration costs. This enables mass customisation and small-batch manufacturing.

And when robots handle hazardous tasks such as welding and heavy lifting, the risk of workplace injuries is reduced. Importantly, robots can fill labour gaps, ensuring consistent production.

Longer term, humanoid robots may be the most significant technological revolution ever. This new workforce will be reprogrammable, and eventually, we'll see a manufacturing world where robots build other robots.

React quickly with flexible automation

Flexible automation integrates AI, robotics, IoT and machine learning to enable dynamic adjustments based on production demands. This ability to pivot quickly supports greater agility, efficiency and adaptability in production.

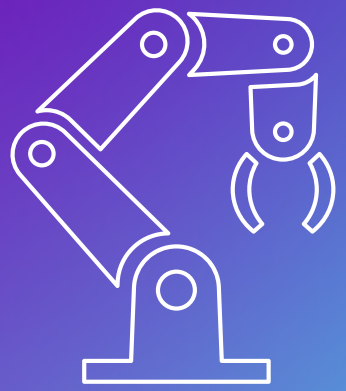
On the factory floor, flexible automation allows manufacturers to reconfigure and rapidly adapt production processes seamlessly, with minimal manual intervention. This scalability means they can respond faster to market changes by handling varying personalised product designs, batch sizes and workflows without significant retooling or downtime. Any changeover between configurations can be automated, reducing downtime while switching occurs. Plus, flexible automation's responsiveness can reduce production costs and waste.

Robotic systems are estimated to boost productivity by up to

30%

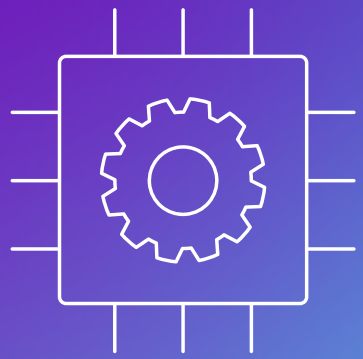
and reduce workplace accidents by up to

70%.



64%

of manufacturers report that flexible automation is a key factor for their future growth.



“Generative AI has the potential to revolutionise nearly every industry. It’s one of the most exciting and powerful technologies of our time, but it also presents new challenges and risks that we need to address thoughtfully and proactively.”

Sam Altman, co-founder and CEO of OpenAI

The challenges manufacturers must overcome

Despite the promising opportunities, implementing AI and robotics in manufacturing presents several challenges. Here, we outline what manufacturers should consider to achieve a successful digital future.

Data integration issues

Creating a holistic, single and accurate view is essential to underpinning successful AI because it's only possible to improve what can be measured. However, it's important to note that not all business-critical data points are readily available for collection. To ensure comprehensive data integration, actions such as machine retrofitting and sensor addition must come first. The following step can be challenging, too, as every data-generating point must be captured with frequency and granularity and integrated into the system. This process requires incorporating numerous devices, machines, sensors and processors from the production line and across the entire plant.

The next challenging step is to enable a seamless data flow across the various systems and elements. By operationalising this data, decision-makers can access a broad range of efficiencies.

However, legacy systems and data silos often don't integrate well with modern AI-driven analytics and IoT platforms, making it challenging to achieve data integration and a unified view without costly, customised solutions. AI depends on ontologised platforms derived from structured, clean and well-labelled data, but many legacy systems generate inconsistent or unstructured data. Also, different machines, software and sensors generate data in various formats, leading to incompatibility issues.

54%

of manufacturers report AI development is hampered by data integration issues.

AI-related risks

As manufacturing becomes more digitally connected and reliant on real-time data exchange, sensitive production and operational data become vulnerable to cyber threats, hacking and data breaches.

Intellectual property (IP) theft is a significant concern when AI systems are connected to cloud networks that store sensitive manufacturing data, as are hacks that affect robotic systems and make them go dangerously rogue. Then, compliance with data privacy regulations (e.g., GDPR, ISO 27001) adds complexity to AI deployment.

Over-reliance on AI can lead to serious issues. If trained on poor-quality or unrepresentative data, AI models can produce biased or inaccurate predictions. And if manufacturers cut back on human oversight, this can also lead to errors. Plus, AI-based predictive maintenance models may fail to detect anomalies if environmental conditions change.

And if robust AI model governance isn't in place, software updates and model retraining can lead to costly operational mistakes.

36%

of companies express concerns about AI-related risks, including data privacy and security issues.

Difficulties integrating new technology into legacy systems

Machines using older types of industrial automation technology were not designed to connect with modern digital technologies. Firstly, legacy systems often store data in isolated formats, making it hard to create a unified data pipeline for AI-driven analytics. Then, in some cases, hardware limitations mean legacy machines can't support IoT sensors or cloud connectivity without expensive modifications. In other cases, proprietary software used in legacy systems lacks APIs and integration capabilities, making data exchange difficult.

Should a manufacturer consider retrofitting legacy equipment with AI, automation and IoT capabilities, it can be expensive and may require hardware replacements.

Older systems also lack modern security protocols, making them vulnerable to cyber attacks and data breaches. But, further than that, AI demands that legacy equipment be connected to the internet, introducing new security vulnerabilities that need advanced threat protection.

In addition, integrating and testing new technology into legacy systems is complex and requires system downtime, affecting production schedules and output.

64%

of organisations still rely on over

25%

of business systems, applications and networks on legacy platforms, with many unable to connect to AI tools.

Problems with robot maintenance and repair

Although robotic systems remove human fallibility from production, they also have drawbacks.

Unplanned downtime due to robotic malfunctions disrupts production schedules and reduces efficiency. Yet, fixing them can be difficult. Complex robotic systems require specialised technicians and costly repairs when components fail, and these trained technicians and engineers can be hard to find. Repairs can be challenging, too, as robot components such as motors, actuators, sensors and AI chips are costly and have long lead times.

Robotic systems have vulnerabilities. Robots operating in extreme temperatures, dust, moisture or corrosive environments experience faster mechanical degradation. And heavy-duty robots require frequent recalibration and part replacements. Then some robotic systems may become obsolete due to rapid technological advancements, making long-term maintenance planning difficult.

Expensive mistakes can happen during the software updates and patches necessary for security, leading to robotic malfunctions. Plus, legacy system integration with robotic AI can create new security gaps if old protocols are not updated.

Manufacturing robotic downtime can cost up to

$10,000

a minute.

Solutions to unlock the potential of AI and robotics

We offer a comprehensive ecosystem of solutions to address the challenges manufacturers typically face when adopting digital transformation initiatives such as AI and robotics. Here, we highlight some of our core solutions:

Global Fabric

BT Global Fabric provides a scalable, cloud-centric networking solution designed to handle the increased data traffic and computational demands of innovative technologies such as AI and robotic systems. It's the key to improving productivity by avoiding application downtime, removing network friction and maintaining resilient connectivity.

This revolutionary network simplifies the orchestration of networks, clouds and infrastructures – regardless of provider. It efficiently supports the seamless integration and consistent deployment of solutions across different regions, cloud providers and partners. Global Fabric adjusts configurations worldwide in minutes rather than weeks so manufacturers can alter power, capacity, location and service requirements in real time. It also offers clear routes to optimising cloud and network costs with a pay-for-what-you-use structure and minimising public cloud egress charges.

Edge technology orchestration and computing capability

Our expertise in field area networks, including private / hybrid mobile networks and Wi-Fi, ensures robust and flexible connectivity solutions tailored to specific manufacturing needs.

Combined with edge computing solutions, we enable real-time data processing and analytics at the source, reducing latency, enhancing decision-making capabilities and improving agility. This is crucial for predictive maintenance, real-time monitoring of robotic systems and extended reality solutions for immersive training, simulation and remote collaboration.

Intelligently managing AI-driven analytics, IoT sensors and connected machinery at the edge ensures that critical decisions can be made instantly on the factory floor. From this intelligence, edge computing generates strategic maintenance insights so manufacturers can respond instantly to potential equipment failures, optimise production lines, manage natural and human resources efficiently and reduce downtime.

Edge computing also supports optimised workload distribution allowing manufacturers to streamline operations while reducing the burden on centralised cloud systems.

Industrial IoT and IT / OT convergence

We support the integration of Industrial IoT (IIoT) with IT/OT convergence by delivering secure, high-performance connectivity, intelligent automation and advanced cyber security solutions tailored for manufacturing environments. Using the mix of private 5G, SD-WAN and edge computing appropriate for the manufacturer, we seamlessly and securely connect OT systems - such as industrial sensors, robotics and control systems - with IT applications, including cloud platforms and AI-driven analytics, for streamlined, real-time data exchange.

Additionally, our Zero Trust security framework and encrypted data flows safeguard IIoT deployments, ensuring resilient and cyber-secure IT / OT convergence for smart manufacturing.

Operational efficiency

With real-time performance metrics, software-defined routing and a secure, high-capacity core, we optimise maintenance costs and reduce unplanned downtime, aligning with the operational benefits of AI-driven predictive maintenance and robotic systems.

This enables manufacturers to operate more efficiently and respond proactively to potential disruptions. Plus, by integrating encrypted data flows, resilient connectivity and intelligent automation, our solutions prioritise latency-sensitive processes, such as robotic assembly lines and remote machine monitoring, keeping production agile and efficient.

A high-capacity core also supports large-scale data transmission from multiple manufacturing sites, allowing manufacturers to centralise operational insights and optimise production planning more accurately.

Cost-effective scalability

Global Fabric's pay-as-you-use model is a cost-effective route to scaling AI and robotics initiatives without incurring prohibitive costs. With many manufacturers reporting scalability issues, they welcome rapid orchestration, real-time on-demand network access and the ability to avoid investing in slow-to-install hardware.

This means that AI-driven automation, machine learning and IoT applications can be deployed and expanded with fewer financial constraints, and manufacturers can swiftly adapt to changing production demands. Dynamic bandwidth allocation and intelligent traffic management also optimise resource usage and reduce operational costs while maintaining high performance.

Security and reliability

Advanced end-to-end encryption and support for Zero Trust security frameworks ensure critical industrial operations are secured and protected. Real-time threat intelligence and monitoring, plus AI-driven cyber security solutions such as DDoS mitigation, help manufacturers detect and mitigate cyber risks before they impact operations.

Robust security is critical as manufacturing evolves because essential data moves beyond the plant. Manufacturers are open to intellectual property theft and ransomware without secured information exchange between multiple plants, data centres, offices and third-parties. Security is a fundamental requirement because 71% of all ransomware incidents between July and September 2024 were in the manufacturing sector.

We deliver this essential security and ultra-reliable data transfer using a mix of private 5G, SD-WAN, secure cloud solutions and our global network to ensure the resilient, high-performance connectivity crucial for deploying AI and robotics across a global supply chain.

Sustainability

All our solutions are designed with sustainability in mind to support manufacturers' environmental goals. They focus on reducing carbon footprints and resource waste with energy-efficient network solutions, optimised connectivity and intelligent digital technologies that reduce reliance on energy-intensive on-premise infrastructure.

Our solutions help to reduce emissions and provide tools to monitor and track energy consumption, optimise production efficiency and minimise waste in real time. To support this, our services - powered by green energy, an efficient infrastructure and adaptive algorithms - optimise manufacturing and corporate environments reducing natural resource consumption.

Our sustainability tools deliver a real-time, in-depth view of total energy consumption and carbon footprint data of any IT services manufacturers buy. They can also drill down to identify carbon-intensive devices and system inefficiencies.

Extended Reality (XR)

Our extended reality solutions offer immersive training, simulation and remote collaboration capabilities to help the workforce keep up with digital manufacturing's rapid advances. XR can enhance workforce training by providing realistic, hands-on experiences without the need for physical prototypes or environments. This technology also supports the training of new joiners and remote maintenance and repair. XR allows experts to guide on-site technicians through complex procedures in real time, reducing downtime and improving efficiency.

Alongside XR applications, digital voice and collaboration solutions are integral to efficient workforce communication worldwide, enhancing how manufacturers use advanced digital solutions.

Lead your market

Change is happening in the manufacturing sector and we're ready to help you lead this transformation.

Our ambition is to become the world's most trusted connector of people, devices and machines, and we've channelled this into solutions to help manufacturers fully realise the transformative potential of innovative technologies such as AI and robotics in their operations.

Visit our dedicated webpage for more information or contact your account manager to explore the possibilities.

June 2025