

A photograph of several white industrial robotic arms in a factory setting. Two of the robots have "5G" printed in blue on their joints. The background is slightly blurred, showing workers in white uniforms. A thick red diagonal line cuts across the bottom right of the image.

How 5G is Transforming Manufacturing

MACH Takes the Complexity Out
of 5G for the Manufacturing Industry

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What 5G Offers the Manufacturing Industry

5G technology is transforming manufacturing by enabling faster, more reliable, and more flexible connectivity, which leads to increased efficiency, productivity, and safety. This is achieved through several key features: high bandwidth, low latency, and massive machine-to-machine communications. These advancements allow for real-time data processing, advanced automation, and the development of digital twins, ultimately paving the way for smart factories and Industry 4.0.

5G in manufacturing refers to the application of the fifth generation of wireless communication technology in the manufacturing industry. It is a key enabler for the digital transformation of manufacturing processes, providing faster, more reliable, and low-latency connectivity compared to previous generations of wireless technology.

What does 5G offer the manufacturing industry?

Enhanced mobile broadband (eMBB)

5G offers significantly faster data transfer speeds (up to 100 times faster than 4G) and higher network capacity, allowing for the transfer of large amounts of data in real time.

Ultra-reliable low-latency communication (URLLC)

5G provides extremely low latency (less than 1 millisecond) and high reliability, enabling real-time control of machines and processes, essential for mission-critical manufacturing applications.

Massive machine-type communication (mMTC)

5G is designed to support the connection of a vast number of devices simultaneously (up to 1 million devices per square kilometer), facilitating seamless communication between sensors, machines, and other IoT devices in a manufacturing environment.



Enhanced Connectivity and Communication

5G enhances connectivity and communication in manufacturing by providing faster data transfer rates, ultra-low latency, and greater reliability. It also enables real-time data processing and control and facilitates the connection of numerous devices. This results in more efficient production processes, increased productivity, and the ability to implement advanced applications like predictive maintenance and digital twins.

High Bandwidth

5G's high bandwidth allows for quickly transferring large amounts of data, enabling real-time data analytics and decision-making. This is achieved using higher frequencies or wider channels, which can carry more information per unit of time. In the context of 5G, high bandwidth translates to faster data transfer speeds and improved overall network performance.

Low Latency

Low latency, or minimal delay in data transmission, is crucial for applications like remote control of robots and automated guided vehicles (AGVs). Low latency, often measured in milliseconds (ms), is vital for applications requiring near-instantaneous interaction, such as real-time gaming, virtual reality, and autonomous vehicle control. 5G networks are designed to achieve ultra-low latency, potentially down to 1ms or even lower.

Massive Machine-Type Communication (mMTC)

Massive Machine-Type Communication (mMTC) is a 5G technology designed to connect massive numbers of devices (up to 1 million per square kilometer) with low data rate and energy consumption requirements. 5G's ability to connect these devices simultaneously facilitates seamless communication between sensors, machines, and other IoT devices in a manufacturing environment. It's a key part of the 5G system, enabling efficient communication between a large scale of IoT devices.



Increased Efficiency and Productivity

5G significantly enhances manufacturing efficiency and productivity through features like ultra-low latency, high bandwidth, and massive connectivity. These enable real-time data processing, advanced automation, and remote control of equipment. This leads to quicker decision-making, predictive maintenance, and improved quality control, ultimately boosting output and reducing downtime.

Real-time Data Analytics

5G enables real-time data collection and analysis, allowing manufacturers to optimize processes, identify bottlenecks, and make proactive decisions. Real-time data analytics involves processing and analyzing data as it's generated, enabling instant insights and decisions. This is crucial for applications like 5G network optimization, where low latency and high-speed connectivity are essential for real-time data processing and analysis. In 5G, the Network Data Analytics Function (NWDAF) provides machine intelligence and a centralized, predictive analytics platform for the core network. According to 5G Hub Technologies, Inc., NWDAF is critical for achieving the performance needed for more complex 5G network slices.

Advanced Automation:

5G's high speed and reliability support advanced automation, including robotics, AGVs, and automated inspection systems. Advanced automation in manufacturing refers to implementing technology to streamline production processes and reduce human labor. It's a broad term encompassing various technologies, including robotics, AI, and IoT, to automate tasks, improve efficiency, and optimize operations.

Predictive Maintenance:

5G enables predictive maintenance by continuously monitoring equipment performance, reducing downtime and maintenance costs. Predictive maintenance is a proactive approach that uses data analysis and advanced technologies to predict when equipment is likely to fail, allowing for timely maintenance and preventing costly breakdowns. It involves monitoring equipment, analyzing collected data, and taking action to prevent failures before they occur.



Smart Manufacturing and Industry 4.0

5G plays a crucial role in both smart manufacturing and Industry 4.0 by enabling real-time connectivity, low latency communication, and high data transfer speeds. These are essential for implementing advanced technologies like the Internet of Things (IoT), Artificial Intelligence (AI), and Robotics. This allows for more efficient, automated, and interconnected manufacturing processes.

Digital Twins

5G enables the development and deployment of digital twins, virtual replicas of physical assets and processes, which can be used for simulation, analysis, and optimization. Digital twins play a crucial role in Industry 4.0, acting as virtual representations of physical assets, processes, and systems. They enable real-time data integration, predictive analysis, and optimization across various manufacturing areas, from product development to factory floor management. By mirroring real-world operations, digital twins facilitate improved efficiency, enhanced decision-making, and better overall performance.

Enhanced Security

5G provides robust security features, ensuring the integrity and confidentiality of data transmitted across the network. 5G networks offer enhanced security for industrial deployments through features like network slicing, end-to-end encryption, and mutual authentication. These capabilities help protect industrial data, devices, and infrastructure from various cyber threats, including unauthorized access, eavesdropping, and denial-of-service attacks.

Remote Monitoring and Control

5G enables remote monitoring and control of manufacturing processes, allowing for greater flexibility and efficiency. 5G technology offers advantages like enhanced efficiency, safety, and cost reduction. It facilitates predictive maintenance, remote diagnostics, and data-driven decision-making, transforming how industries operate.



Specific Use Cases

5G technology offers several specific use cases within manufacturing, including robotics, remote monitoring and maintenance, augmented reality, and improved supply chain management.

Robotics – AVGs and AMRs

5G technology is revolutionizing industrial robotics, particularly for applications like AGVs (Automatic Guided Vehicles) and AMRs (Autonomous Mobile Robots), by providing higher bandwidth, lower latency, and enhanced connectivity for smoother operation and real-time data exchange. This allows for more efficient and reliable automation, improved safety, and enhanced operational efficiency across various industrial settings.

Remote Maintenance and Repairs

5G allows for remote troubleshooting, maintenance, and repairs of automated tools and equipment, reducing disruptions to the manufacturing process. Remote maintenance is the usual maintenance or repair work that a specialist carries out. However, unlike the traditional on-site visit, the work takes place from any location. This means monitoring, configuring, and controlling the required systems is possible from anywhere, at any time.

Augmented Reality (AR) for Training and Repairs

5G supports AR applications for training and maintenance, allowing technicians to guide operators or visualize complex procedures remotely. Augmented Reality (AR) is transforming training and maintenance in manufacturing by overlaying digital information onto the real world, enhancing learning and repair processes. This technology provides real-time guidance, improving efficiency, reducing errors, and boosting employee productivity.

Supply Chain Management

5G technology is revolutionizing supply chain management by enabling faster data transfer, real-time communication, and improved visibility across all stages of the supply chain. This leads to enhanced efficiency, reduced costs, and more informed decision-making.



Benefits for Manufacturers

5G offers manufacturers several economic and operational benefits. Below are just a few examples.

Increased Efficiency and Productivity

5G can significantly improve efficiency and productivity, with some reports suggesting up to 30% improvements.

Reduced Downtime

By enabling predictive maintenance and remote monitoring, 5G can reduce unplanned downtime.

Improved Quality Control

Real-time data analysis and automated inspection systems can help manufacturers improve quality control and reduce defects.

Enhanced Safety

5G supports robust safety measures like real-time equipment monitoring and automated safety protocols.

Reduced Costs

By improving efficiency, reducing downtime, and enabling predictive maintenance, 5G can lead to significant cost savings.

The benefits of 5G are changing the way manufacturing will operate. 5G has created a paradigm shift across several industries, but few will be more impacted than manufacturing.
