NATIONAL ASSOCIATION OF Manufacturers | ctia

How 5G Is Modernizing Manufacturing

America's manufacturing industry is foundational to our nation's long history of global economic leadership. American innovators built the equipment and systems that birthed U.S. factories, providing economic opportunities outside of farming. Factory jobs helped build American cities and suburbs, propelling the country out of the Great Depression, through two world wars, and into multiple eras of sustained dominance on the world stage.

Today, manufacturers are re-embracing domestic production and seeking to create more jobs, make more products in the U.S., and build a more resilient, secure, prosperous country.

Advanced manufacturing, including the Manufacturing 4.0 movement, is a critical part of this work and integral to our nation's competitiveness, economic growth, and quality of life. 5G is essential to the success of smart manufacturing, helping U.S. factories springboard into a future of safety, sustainability, productivity, and innovation.

A U.S. electronics manufacturer with a 200,000 m^2 smart factory powered by private networks and related Industry 4.0 technologies is expected to see

$1.05 BILLION

in operational cost savings after five years.[1]

– ABI Research

"5G is vital to the Manufacturing 4.0 movement that's propelling America to be the global hub for smart, modern manufacturing. Manufacturers are harnessing 5G to make workplaces safer, boost efficiency and strengthen resilience across our operations. By enabling real-time actions and supporting new technologies like AI, 5G is giving manufacturers more tools to sharpen our competitive edge, support more people and secure America's leadership in the global economy."

– Jay Timmons, President and CEO, National Manufacturers Association

5G helps manufacturers:

+ Leverage AI to evaluate large datasets and identify solutions to encourage efficiencies
+ Enhance factory safety via systems of sensors and alerts
+ Improve employee training opportunities with augmented reality/virtual reality headsets and applications
+ Monitor production processes in real time and predict equipment maintenance
+ Implement factory modularity and enhance flexibility through digitizing and automating factory equipment
+ Track and manage the pieces of their supply chain, both upstream and downstream
+ Apply energy, raw materials, and other resources precisely to improve factory efficiency and productivity

"The wireless industry is proud to partner with manufacturers to drive American innovation, productivity, and global leadership.

To support the wireless data needs of manufacturers and other leading U.S. industries, it is imperative that policymakers continue to take action to ensure additional mid-band spectrum is available for 5G."

– Ajit Pai, CEO, CTIA

The manufacturing and wireless industries both know the power and pressure of global competition and how it shapes our sectors and our nation. The success of U.S. manufacturing and U.S. wireless leadership are key to keeping our economy competitive on a global scale.

To continue our rich history of innovation, production, and global leadership, America needs a robust 5G strategy. Policymakers must ensure that we have enough licensed spectrum allocated and available to support manufacturers' ever-expanding use of 5G.

Read on for more on how the manufacturing and wireless industries are working together to connect every element of the factory floor, enhancing the modernization, productivity, flexibility, and safety of U.S. manufacturing.

According to the NAM's Manufacturing Leadership Council more than half of manufacturers already use AI in their operations, with 61% expecting investment in AI will increase by 2027.

5G-Enabled Analytics Inform Decision Making

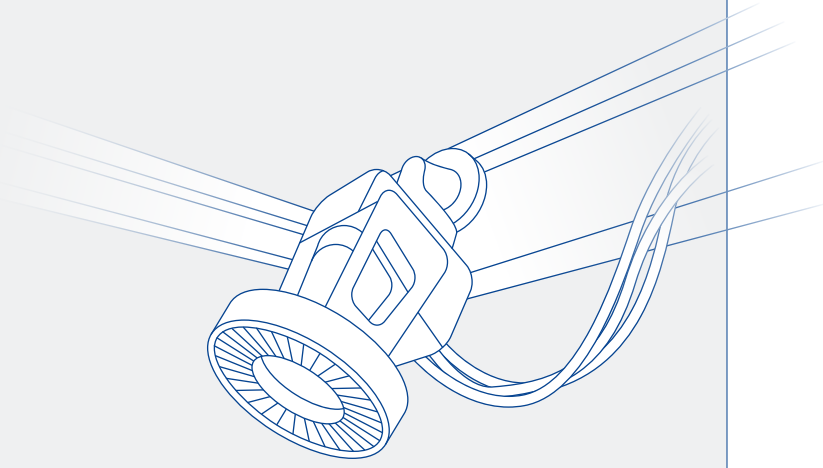
Manufacturers are applying 5G connectivity to everything on their production line and throughout their supply chains to collect data, then using AI tools to process this data and react to it, to make their operations more efficient.

+ Real-time data flows can ease supply-chain issues by letting manufacturers know the exact location of an input or output
+ Data analysis of facility machinery can help manufacturers predict when maintenance is due
+ Data flows about a manufacturing process can provide more visibility into the productivity and efficiency of a shop floor
+ Real-time information can assist workers with quality control efforts

5G networks have dramatically increased capacity compared to their 4G predecessors, with the ability to support millions more devices simultaneously. The speed and low latency of 5G networks facilitate real-time data sharing from all these devices, to provide manufacturers with the information they need to quickly make choices that will improve factory safety, efficiency, and the bottom line.

Private 5G Helps Hitachi Improve Defect Detection

Hitachi worked with Ericsson and other partners to install a private 5G network at its **Astemo Americas plant in Berea, Kentucky**. With the primary purpose of improving defect detection, the network supports a real-time high-definition video feed of the factory line. This feed, combined with machine learning capabilities, can simultaneously inspect 24 assembly elements and identify a defect at a sub-millimeter level.



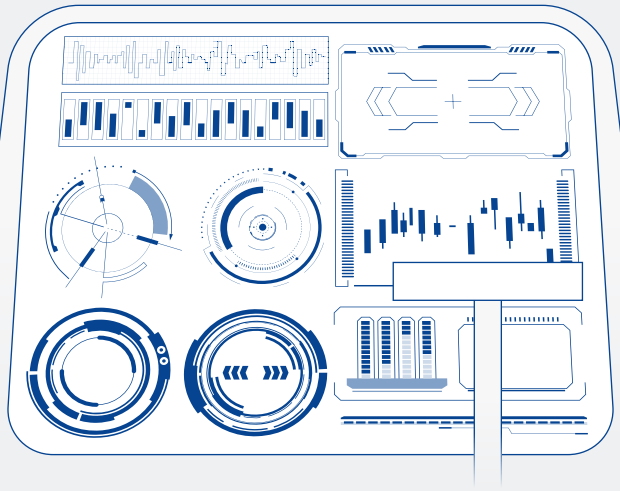
Deloitte Tests Predictive Analytics

At **Wichita State University's Innovation Campus**, Deloitte worked with AT&T to deploy a smart factory experience. A private 5G network provides students, faculty, and partner companies with a test ground to try out use cases, including the use of predictive analytics to determine the source of factory downtime issues and to identify product defects, improving the quality assurance process.

The smart factory also operates a live product line where STEM circuit kits are created for donation to local schools. At **Verizon's customer technology center in Richardson, Texas**, Deloitte worked with Verizon to build another smart factory setting. This one uses sensors, edge computing, and the power of 5G to detect and predict product issues and pass alerts on to employees in real time.

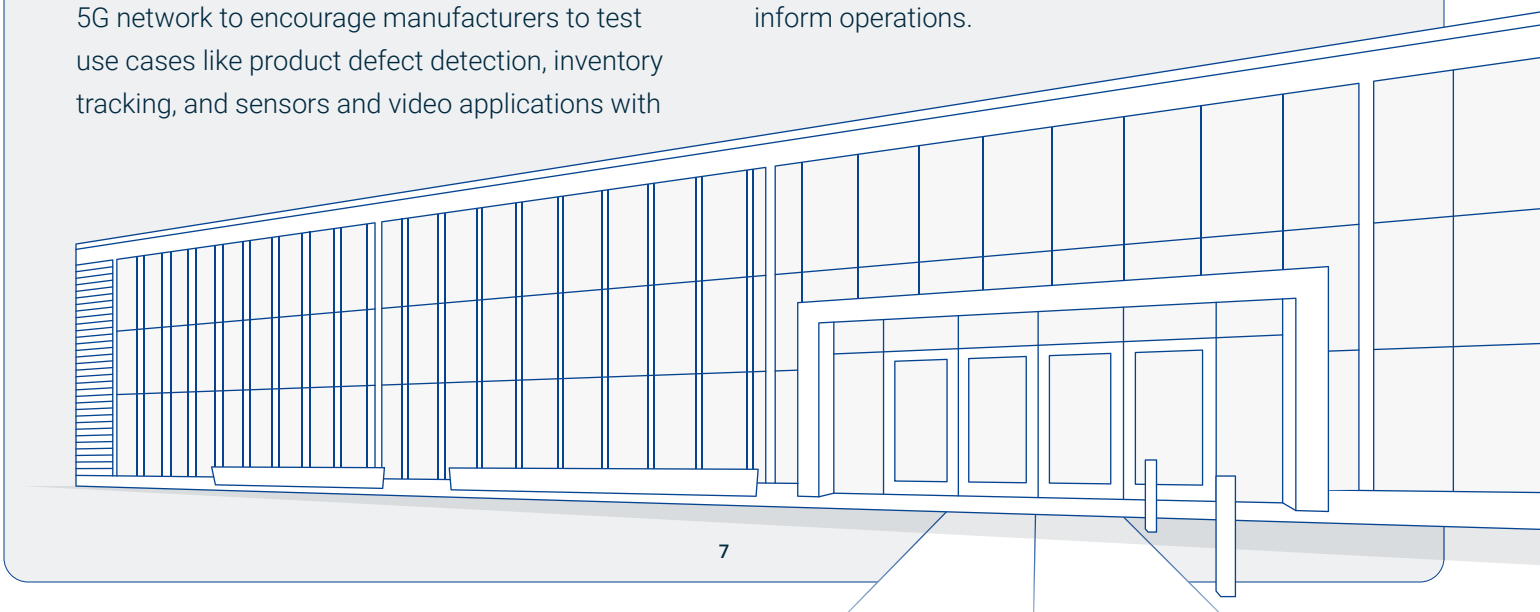
Rockwell Automation Uses 5G Analytics to Implement Instant Information Flows

Rockwell Automation and UScellular worked together to bring a private 5G network to Rockwell's Connected Enterprise Lab in Mayfield Heights, Ohio. Rockwell is using the network to test what 5G's low latency and speeds can offer the manufacturing industry. This includes using sensors and technology to manage real-time information and controls for conveyors, temperature settings, robots, and other machinery.

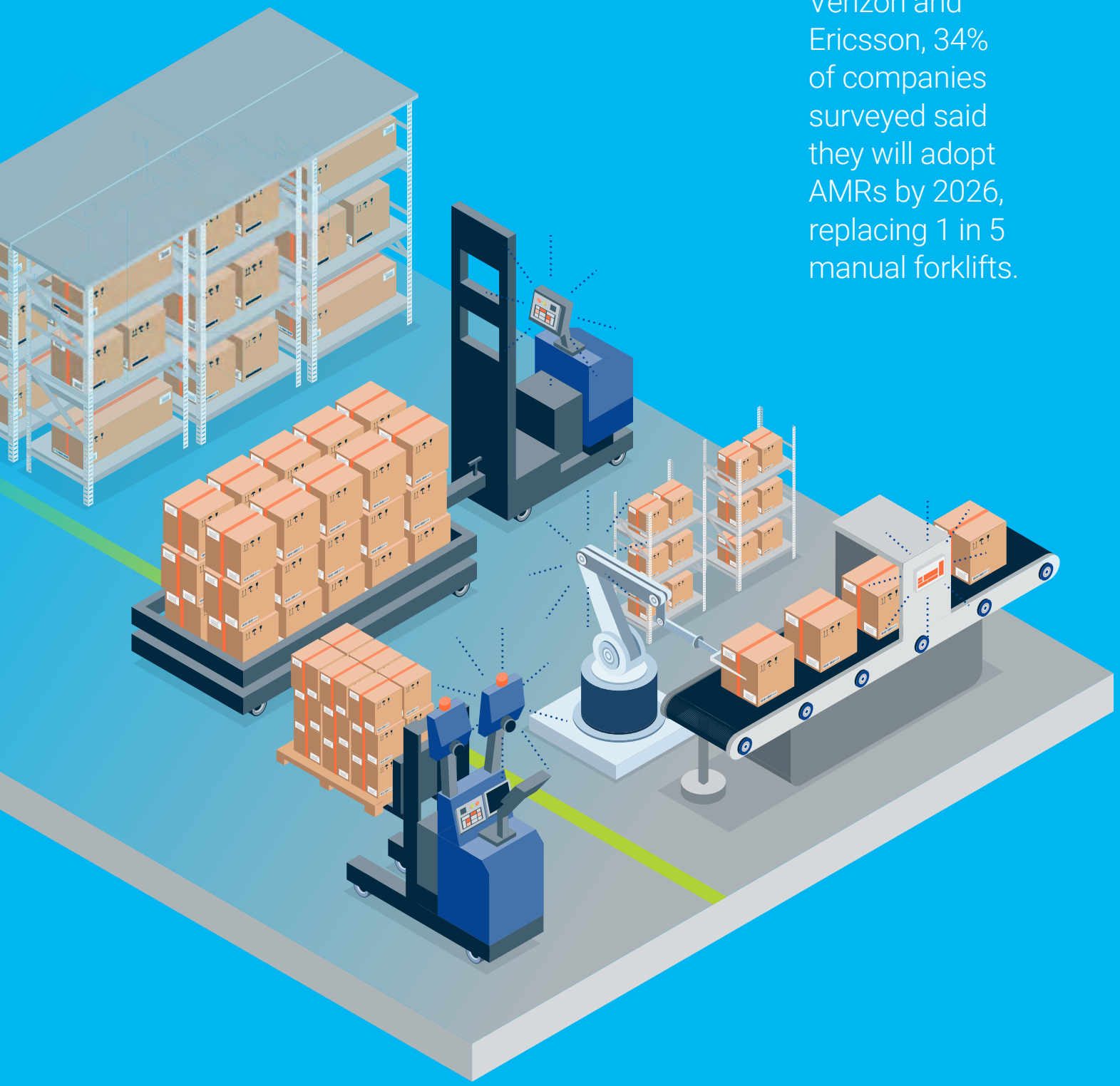


Manufacturing x Digital's Research Factory Tests Operations Use Cases

At a 22,000-square foot research factory in Chicago, Illinois, Manufacturing x Digital uses an AT&T private 5G network to encourage manufacturers to test use cases like product defect detection, inventory tracking, and sensors and video applications with 5G's edge computing capabilities, to see how 5G can help provide real-time information to inform operations.



In a study from Incisiv with Verizon and Ericsson, 34% of companies surveyed said they will adopt AMRs by 2026, replacing 1 in 5 manual forklifts.



5G Powers Robotics to Improve Factory Safety

Some of the most visible 5G-powered technologies to hit the factory floor are automated guided vehicles (AGVs) and next-generation autonomous mobile robots (AMRs). These self-moving robots allow manufacturers to perform set tasks and automate the delivery of goods and supplies around their facilities.

These robotic vehicles move slowly—AGVs on a designated path and AMRs by reacting to their environment—making them a safe means of transporting supplies across a busy factory floor. They also perform menial, dangerous, and fatiguing tasks, protecting employees' safety and physical wellbeing and allowing them to focus on more important work.

AI tools like machine vision can help here as well. Machines using 5G connectivity can be programmed to "see" their environment, and AI-powered data collection and processing can allow these robots to respond to what's happening around them.

These capabilities are key for factory floor safety—alerting workers to machinery that might be about to turn the corner, for example. They also support quality control efforts, such as AI-powered robots that can quickly locate defects that might otherwise be challenging to detect.

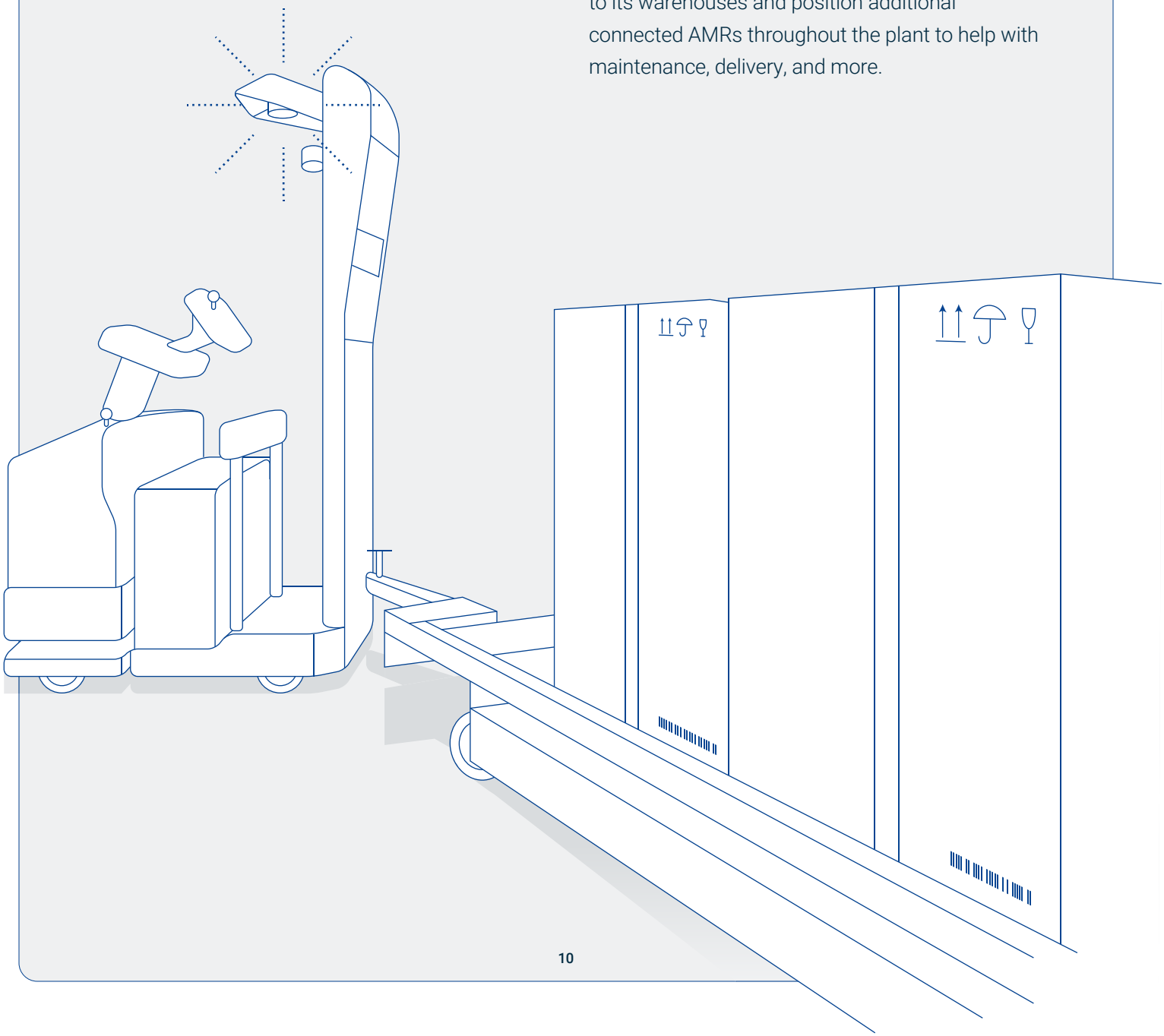
Increased automation also helps manufacturers realize the productivity improvements needed to onshore operations and keep manufacturing facilities in the U.S. For example, Ericsson's Smart Factory has seen output per employee increase 120% thanks to automation and efficiency gains from 5G. These productivity-enhancing 5G tools are key to modernizing manufacturing and keeping America competitive globally.

Whirlpool Corporation and Seegrid: AMRs Navigate the Shop Floor

Whirlpool makes appliances like washers, dryers, refrigerators, and ovens, and Seegrid AMRs deliver heavy appliance parts through Whirlpool's manufacturing facilities. At Whirlpool's factory in Clyde, Ohio, the manufacturer worked with AT&T to install a private 5G network to support the real-time information sharing Seegrid's AMRs need to operate.

Before the installation of the 5G private network, the AMRs would suddenly stop due to poor signals or signal interruption from metal and equipment. **Now the 5G network, covering 200,000 square feet, helps power over 80% of the Clyde factory's AMRs.**

Whirlpool expects to expand 5G connectivity to its warehouses and position additional connected AMRs throughout the plant to help with maintenance, delivery, and more.



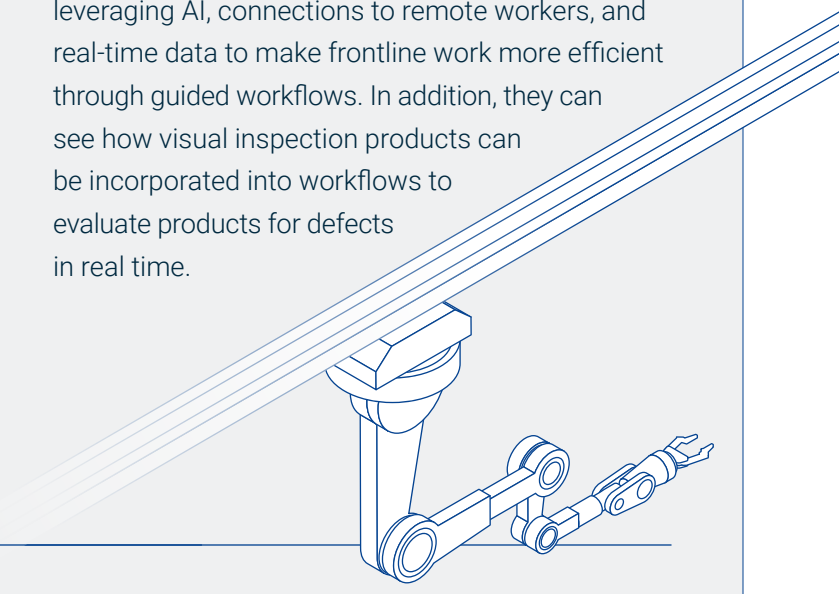
IBM Deploys 5G to Develop Robotic Innovations

IBM and AT&T partnered in three locations—IBM's Thomas J. Watson Research Center in Yorktown, NY, IBM's Bethesda Lab in Bethesda, MD, and AT&T's 5G Innovation Studio in Plano, TX—to test shared manufacturing solutions, such as **enhanced production line functionality via automation and robotics and the use of video intelligence** to improve inventory management and send out safety alerts—for example, when something comes into or leaves a predetermined zone.

IBM and Verizon have also created a 5G testbed at IBM's Industry Solution Lab in Coppell, Texas, to work on manufacturing use cases including robotics, automatic guided vehicles, and more.

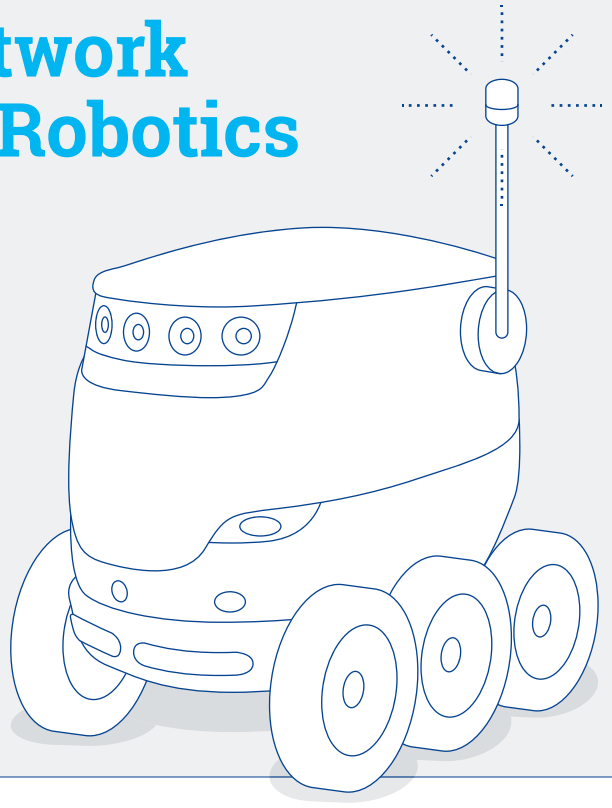
Using IBM's software, companies can see how ultrasonic technology can help them predict and avoid issues from machinery breakdowns.

Manufacturers can also try out solutions for leveraging AI, connections to remote workers, and real-time data to make frontline work more efficient through guided workflows. In addition, they can see how visual inspection products can be incorporated into workflows to evaluate products for defects in real time.



KPMG's Private Network Demonstrates 5G's Robotics Capabilities

KPMG partnered with UScellular to deploy a private 5G network at KPMG's Ignition Center in Chicago to highlight how 5G's low latency and data speeds can transform the manufacturing industry. At the 30,000-square foot facility, KPMG customers can **test out autonomous robots on a real-world network**, along with machine learning capabilities, AI, sensor systems, AR/VR, and more.



88% of manufacturers indicate 5G connectivity will allow engineers to troubleshoot remotely.[2]

– The Manufacturing Institute

5G Enhances Employee Training & Creates Upskill Opportunities

5G is creating hands-on opportunities for learning and upskilling, for employees to practice proficiencies and move into new roles.

Augmented reality (AR) and virtual reality (VR) applications use 5G connectivity to provide helpful information and experiences that overlay users' natural surroundings and respond to their movements. For frontline workers, AR/VR headsets are a game-changer, enabling them to remotely perform tasks and machine maintenance, virtually view service checklists, receive immersive and hands-on training, and bring experts to the factory floor without travel or wait times.

5G's lack of lag time makes AR/VR applications feel realistic, allowing for real-time data sharing so the virtual environment can keep up with the user's surroundings and actions. 5G makes AR/VR more effective and powerful.

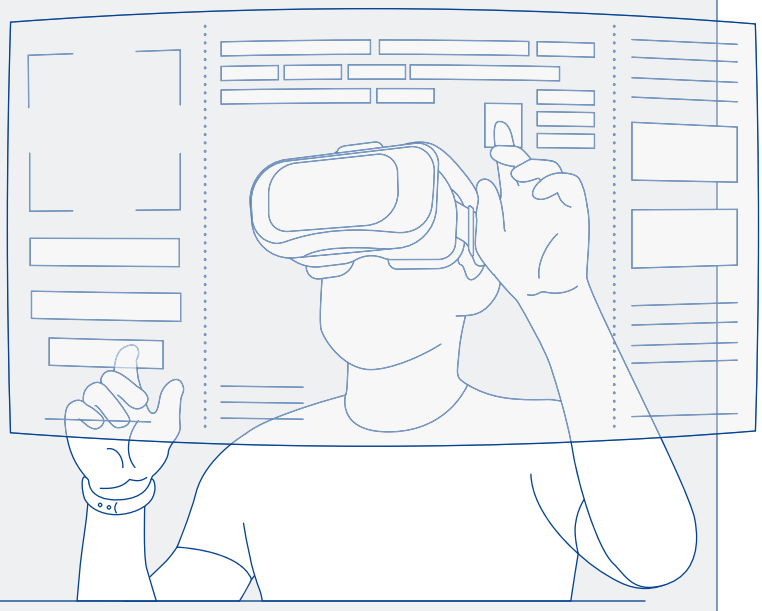
5G-enabled applications not only help employees perform their jobs, but they also provide training on how to perform additional tasks or new roles. Such immersive environments provide the practical experience employees require to feel confident in taking on new opportunities.

Finally, 5G-enabled research centers are training students and community members on how to use these latest technologies—providing upskilling opportunities that help them grow their careers.

AI, enabled by 5G's always-on connectivity, is another asset for manufacturing workers when it comes to upskilling. Employees can use AI tools to perform repetitive work, making their jobs easier, and AI enables them to take on more complex, innovative, or future-looking tasks, making their jobs more fulfilling.

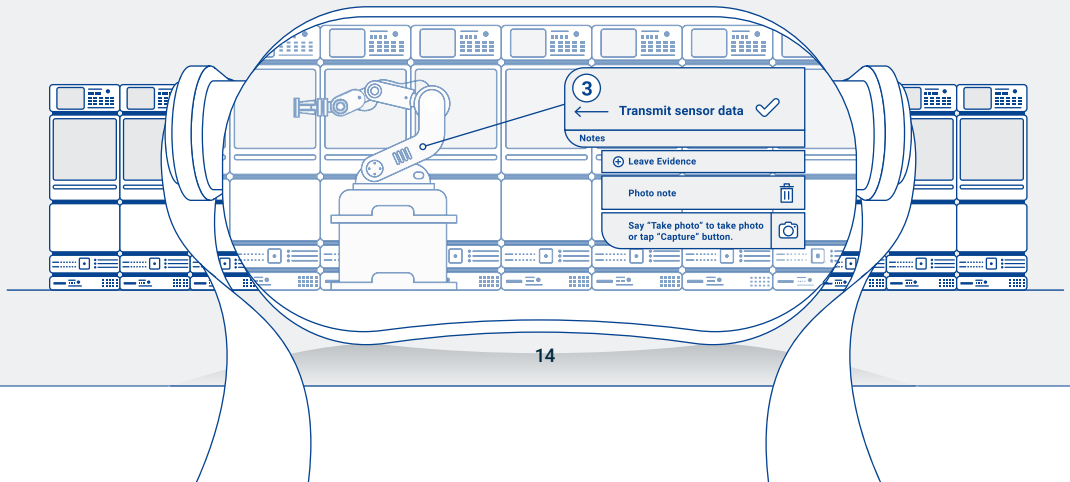
Taqtile and VictoryXR Bring 5G-Powered AR to Worker Training

Manufacturers can train their workers more efficiently with 5G-powered AR headsets from VictoryXR and Taqtile—two startups which are partnering with T-Mobile. 5G's low latency and high capacity allow for **immersive training that takes fewer hours and costs less** than traditional training methods. The hands-on learning aspect of AR /VR also helps with information retention, which can have additional productivity and safety benefits for manufacturers.



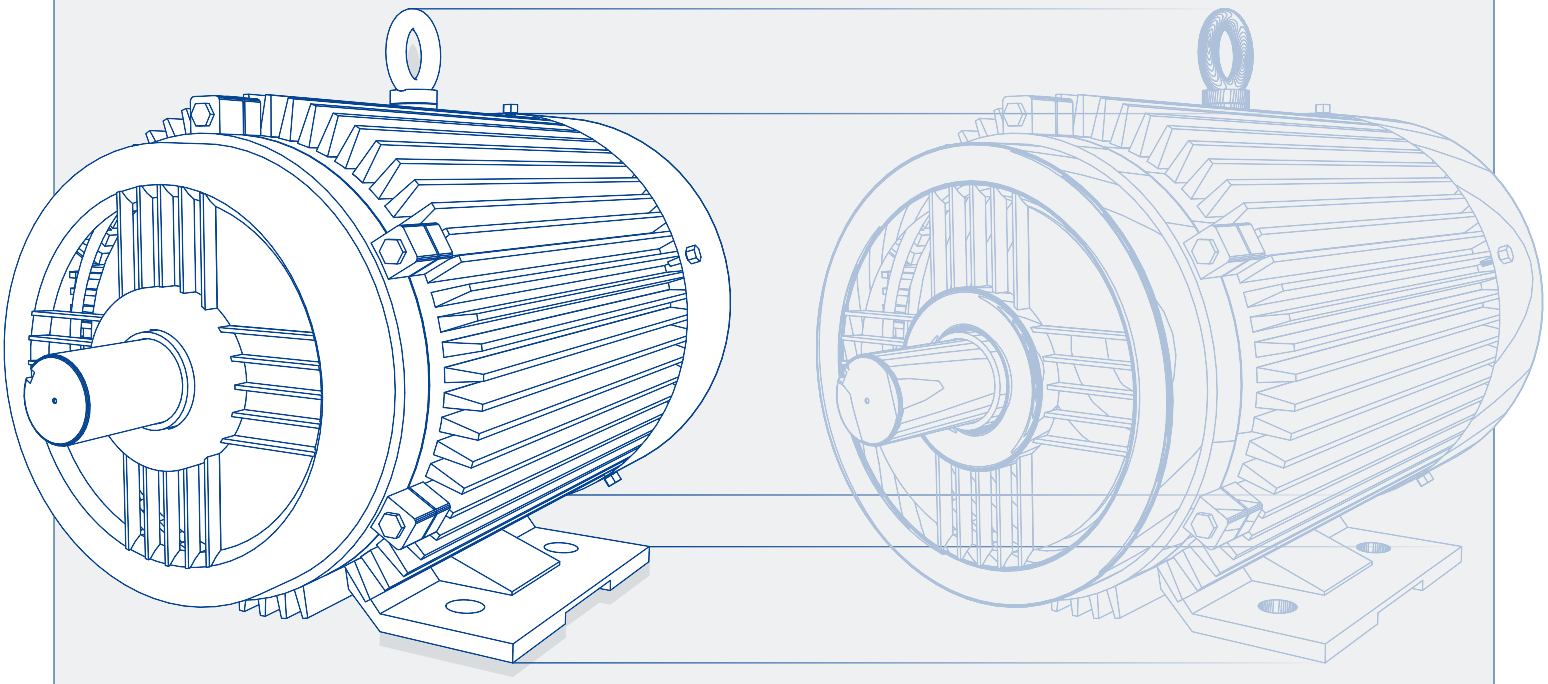
Samsung's 5G Innovation Zone Tests AR/VR for Training

AT&T worked with Samsung to deploy a private 5G network at Samsung's Austin, TX, semiconductor manufacturing plant. At this 5G Innovation Zone, manufacturing technologies are being tested, including AR for training purposes, that improve factory efficiency. The 5G Innovation Zone is also using private 5G to power health and environmental sensors and transmit video and sensor data for better facility management.



The University of Wisconsin-Milwaukee Uses Private 5G for Workforce Upskilling

UScellular provided a 5G private network to the University of Wisconsin-Milwaukee's Connected Systems Institute (CSI) to help the manufacturing research center leverage the power of 5G to test IoT sensors and controls. At CSI, students, faculty, and industry partners design and test manufacturing use cases such as digital twins, or computer models of a real-world process. Digital twin technology shows the effect of different designs or changes and requires the processing of huge amounts of data, making 5G the ideal connection. Training students and community members on how to leverage digital twins and other 5G-enabled technology is a key mission of CSI as it seeks to help upskill Wisconsin's workforce.

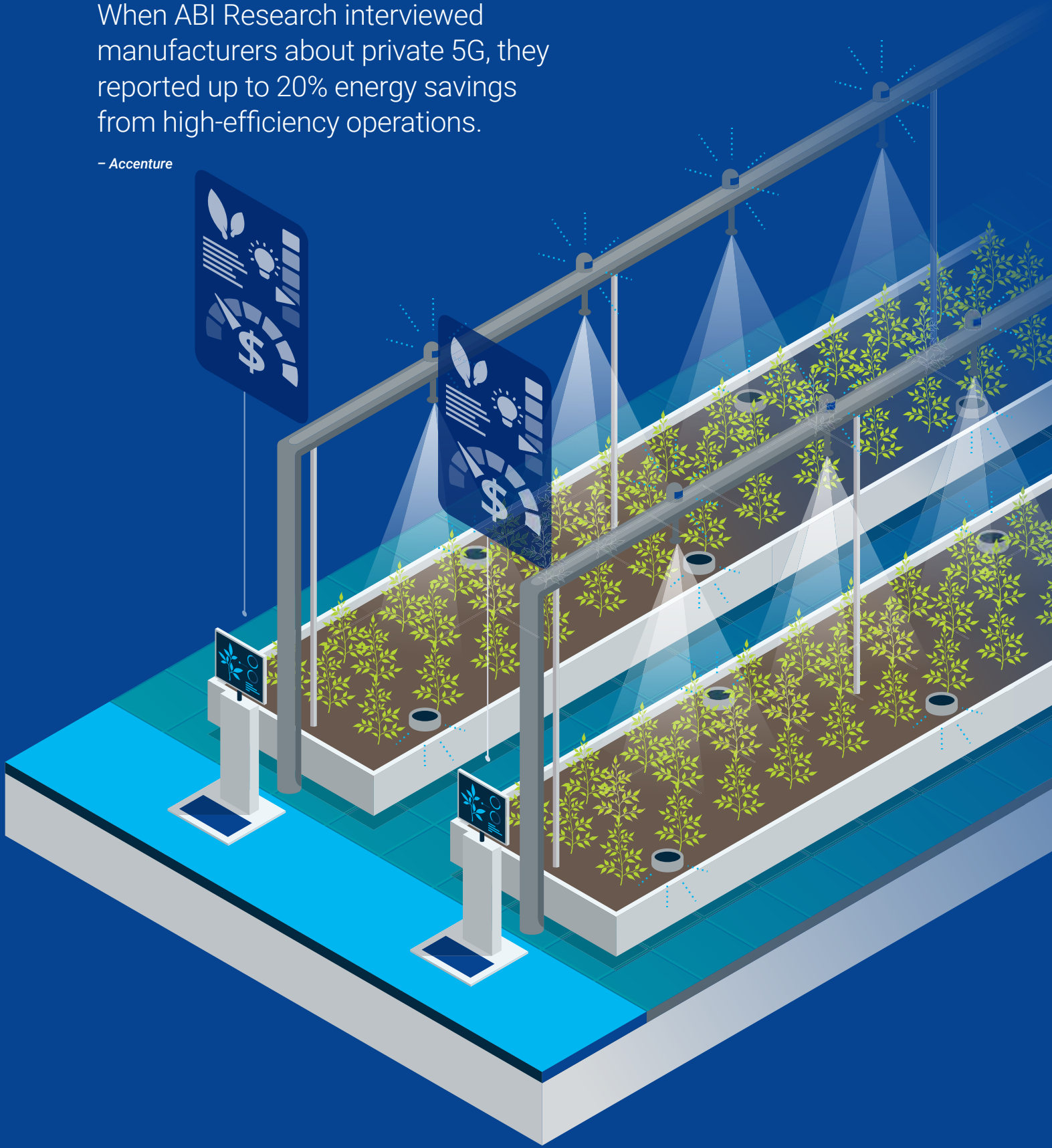


"CSI plays a critical role in Wisconsin and beyond to accelerate innovation, develop a highly-skilled workforce, and drive economic growth. UScellular's technology and investment in CSI allow us to advance research and business use cases while helping our students develop skillsets needed for Industry 4.0."

– Mark Mone, Chancellor, University of Wisconsin-Milwaukee

When ABI Research interviewed manufacturers about private 5G, they reported up to 20% energy savings from high-efficiency operations.

– Accenture



5G Enables Efficient Resource Use and Employee Safety

5G-powered sensors and the data they produce can also help manufacturers most efficiently use their resources.

This includes using sensors to better understand the precise amount of energy or water needed to perform a certain task.

5G-powered technology can turn certain parts of a facility or production line on or off, depending on use and scheduling.

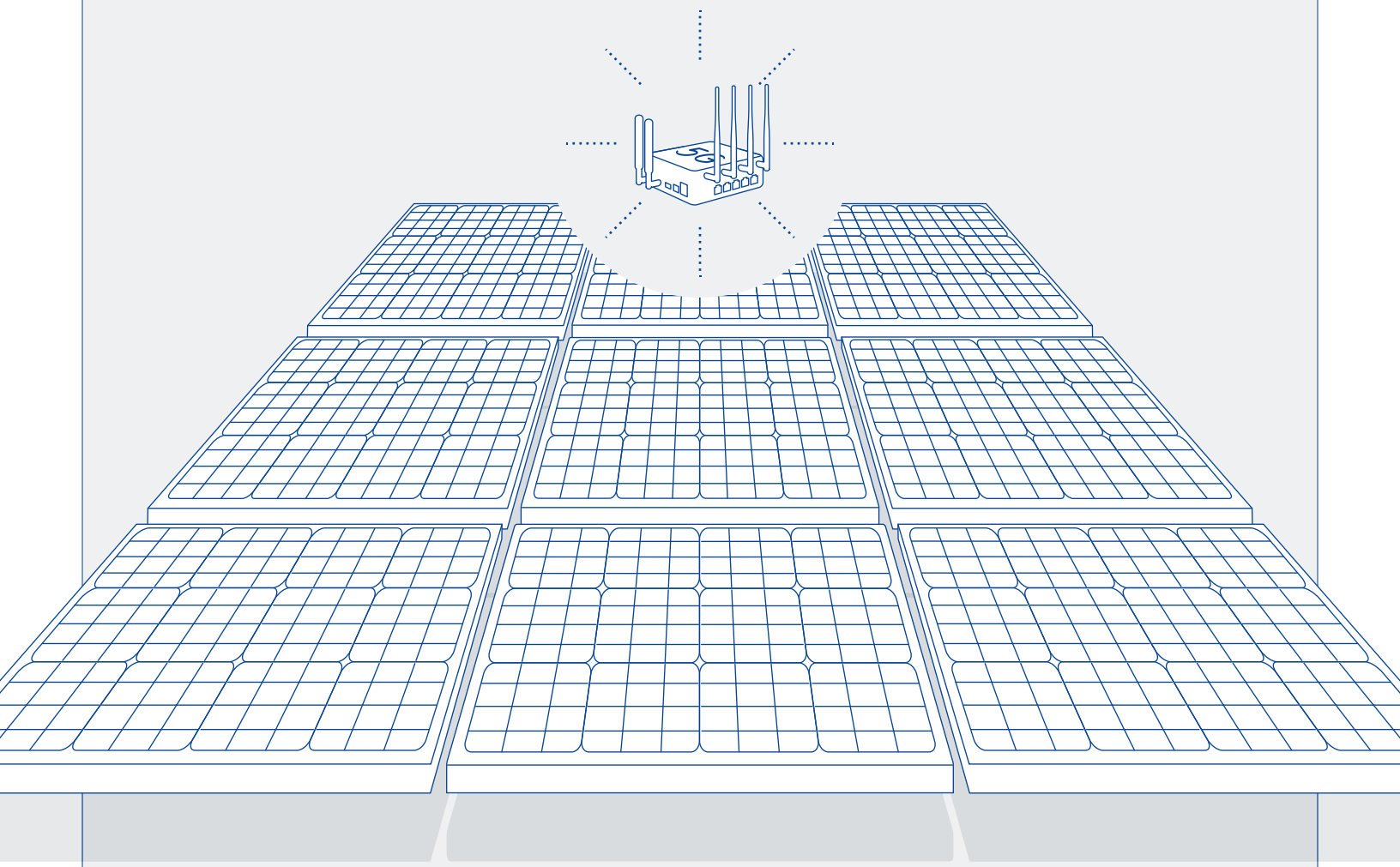
Sensors can monitor for chemical levels, temperatures, and other indicators of abnormalities—and automatically make needed adjustments.

5G can also enable a system of sensors and safety alerts to protect employees from issues with equipment, chemicals, unauthorized access, and more.

The tremendous capacity, speed, and low latency of 5G supports effective deployment of these sensors, enabling them to provide data and respond to it in real time.

Ericsson's Smart Factory Uses 5G to Monitor the Environment and Send Employee Alerts

Ericsson uses a private 5G network at its USA Smart Factory in Lewisville, Texas, to improve its own performance and efficiency manufacturing advanced 5G radios and basebands. The private network supports a variety of use cases such as autonomous mobile robots (AMRs) and building sensors around the factory. The 5G network is used to connect thousands of sensors that enable monitoring of environmental conditions, including temperature, humidity, and power consumed. The network automatically notifies operators if those conditions are out of range. This information has maximized production quality, especially first-pass yield. The autonomous robots move and handle electronic materials down the assembly line. For example, the AMRs provide material—electric components on reels—to the assembly line, and they move boards from assembly to testing, as well as to shipping.

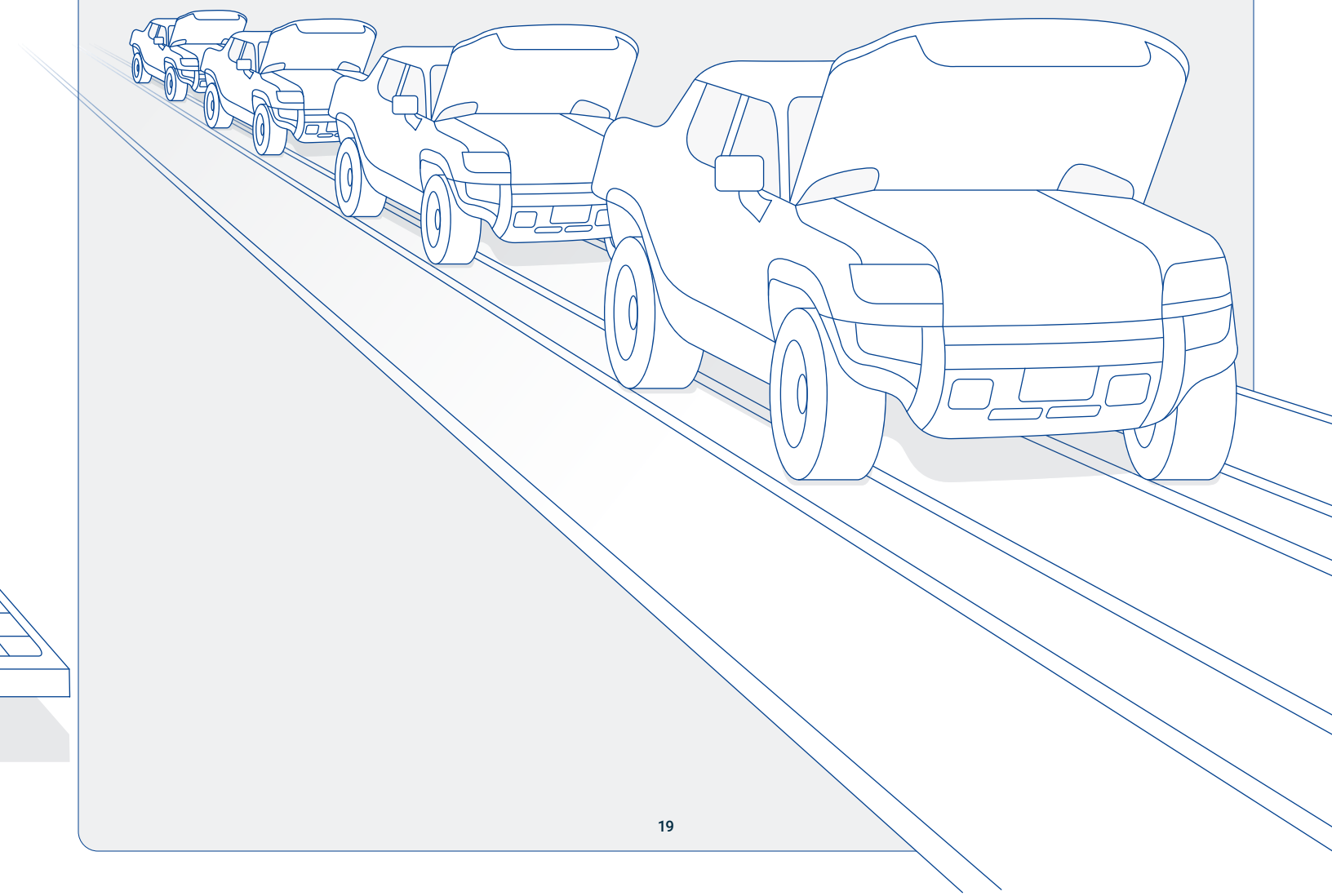


5G Helps General Motors Enhance Employee Safety and Facility Productivity

General Motors worked with Verizon to bring private 5G to GM's Factory ZERO Detroit-Hamtramck facility.

5G enables faster network speeds, scalability, and reliability and provides more overlap in the factory's communications and internal infrastructure, helping improve Factory ZERO's safety and limit its downtime.

5G also makes it easier for employees to shift workstations, use robotics like AGVs to deliver goods around the factory floor, and more.



ABI Research and the Digital Manufacturing and Cybersecurity Institute found that security improvements were the number one reason U.S. manufacturers set up a private 5G network.

5G Protects Manufacturers' Assets

Private 5G networks give manufacturers control over the information that powers their facilities, allowing access to equipment and systems within a certain perimeter or from a set of predetermined devices and enabling the utmost security over proprietary data and processes.

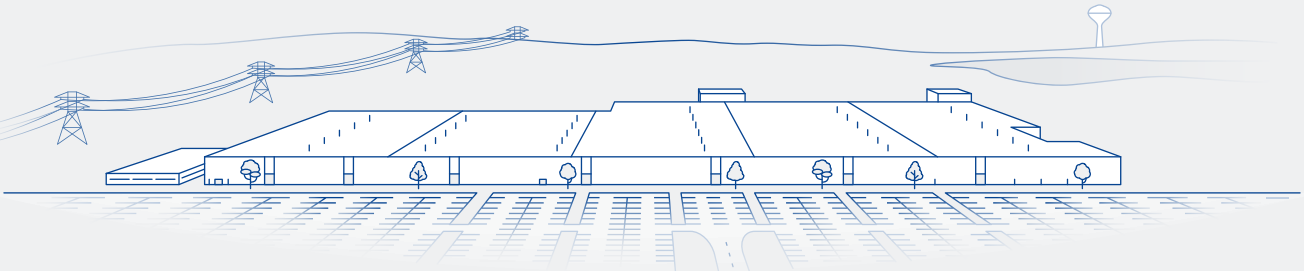
With a private 5G network devoted to a certain factory or campus, manufacturers can also ensure the network is always on to support their needs and not subject to congestion or other factors.

In addition, 5G's fast speeds and the ability to customize security updates enable the network to always keep up with changing security requirements.

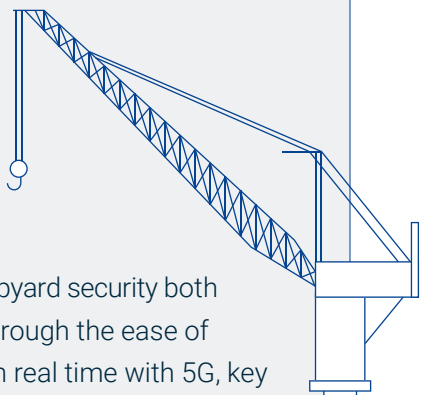
Private 5G Helps Cummins Keep Proprietary Applications Secure

At the Jamestown Engine Plant in Lakewood, New York, a private 5G network Cummins built with Verizon provides widespread connectivity across the manufacturer's 1 million square feet of industrial space and 1 million square feet of outdoor space. This helps keep the truck-engine manufacturer's 1,500 on-site employees connected so they can efficiently build **500 engines each day**.

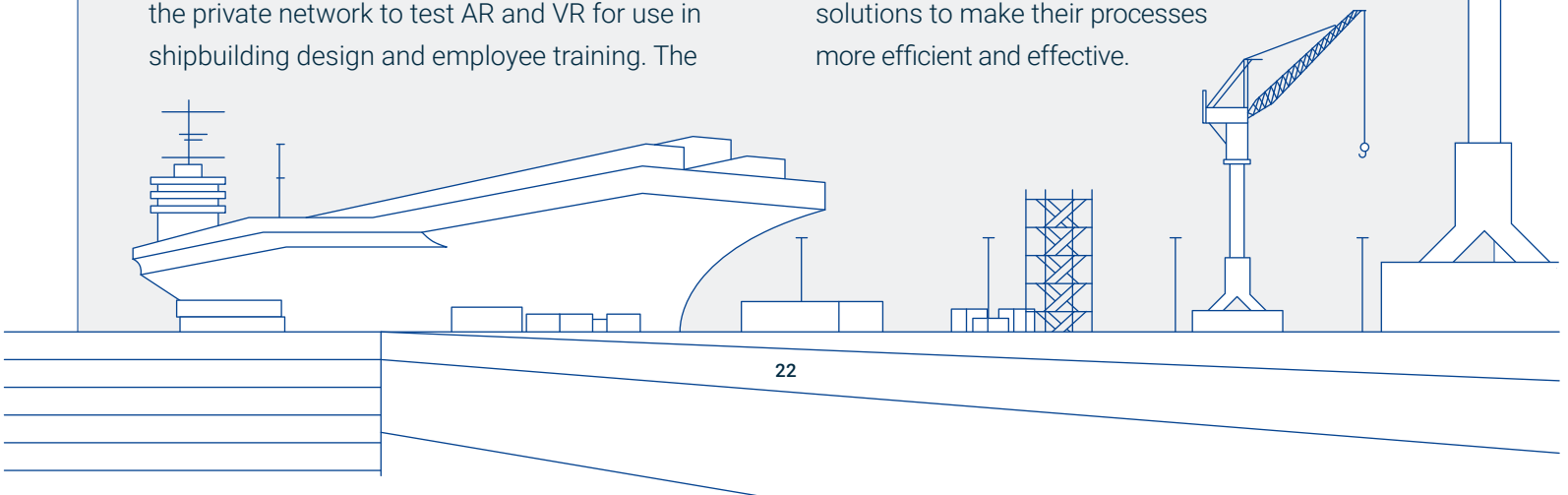
The network powers AMRs that bring materials around the facility, product defect detection technologies, AR/VR applications for training employees and troubleshooting issues, and equipment-monitoring sensors, Cummins also uses the private 5G network to run proprietary programs securely on site, protecting the company's intellectual property.



NNS Installs Private 5G to Secure and Improve Shipbuilding Design



Verizon deployed a 5G network at Newport News Shipbuilding (NNS), a division of Huntington Ingalls Industries that makes aircraft carriers and submarines for the U.S. Navy and is the largest industrial employer in Virginia and the biggest shipbuilding company in the country. NNS is using the private network to test AR and VR for use in shipbuilding design and employee training. The private network enhances shipyard security both through its exclusivity and through the ease of deploying security updates in real time with 5G, key in a business that relies on classified information. NNS also seeks to use the network for autonomous robots, machine learning tools, and other AR/VR solutions to make their processes more efficient and effective.



Endnotes

1 https://www.abiresearch.com/blogs/2024/06/07/5g-for-smart-manufacturing/

2 https://www.themanufacturinginstitute.org/wp-content/uploads/2021/03/Manufacturing-Institute-5G-study.pdf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