Manufacturing in the age of Industry 4.NOW

How the rapidly changing business environment is impacting the market.

Today, manufacturing companies are challenged to increase productivity, operational efficiency, product quality and overall safety. All of this in a dynamic environment filled with trade tensions, regulatory changes and constant disruptions affecting supply chains on a local and global scale.

The forces acting on your company range from the massive to the mundane. They range from the global and long-term impacts of COVID-19 to the daily challenges of detecting defects, managing resources, and controlling your critical production assets to optimize costs, avoid downtime and improve overall performance.

To meet these objectives, there is an increasing focus on understanding in near real-time what is happening in the last mile of operations. Increased visibility and insights through automation can help you adjust processes on the fly, accelerating corrective actions and measurably improving overall business performance. On the shop floor, this means predicting and optimizing routine maintenance, increasing asset performance and return, understanding root-causes of defect and quality issues ahead of time, and deploying automation in parallel with retraining and upskilling programs.

To support the digitalization of industrial production, intelligent enterprises need an agile, next-generation network that leverages a distributed infrastructure to securely capture, analyze and action massive amounts of data on premise and in the cloud. This, while also providing visibility and predictability across all enterprise operations and supply chains.

Information must flow seamlessly from and across all sources, including your Internet of Things (IoT) and Industrial IoT (IIoT) connected devices, multi-cloud environments, complex data lakes and modern industrial and networking architectures that underpin advanced analytics, machine learning and artificial intelligence. It will only be with this transparency that companies will be able to fully leverage the potential of the fourth industrial revolution (aka Industry 4.0), from 3-D printing and automated video analytics to augmented / virtual reality and autonomous guided vehicles.

Industry 4.0 is not some future concept. Companies today are turning challenges into opportunities, prioritizing defined use cases that leverage both technology innovations and the deep-domain expertise of a strong partner ecosystem. This will only accelerate as advanced infrastructures become more readily available over the next few years.

5G and Edge computing are accelerating Industry 4.0 to Industry 4.NOW.

The era of instantaneous information has already started. Direct machine-to-machine (M2M) automation is replacing human intervention for core business processes. Artificial intelligence and machine learning could offer users actionable business intelligence, predictive analytics and insights on quality improvements and cost optimization - all in less than a second.

But we can get even faster. Edge computing and 5G are now shortening the data loop by bringing the processing to where the machines and operators are working. This means that there is ultra-low latency between events, decisions and actions. The last mile of operations is brought to life in real-time.

Edge computing: extending your infrastructure.

The "edge" is a network architectural model that brings technology resources (including compute and related infrastructure) closer to the end user and automated devices where the data is generated and consumed. It's a decentralized extension of cellular networks where the data is processed and stored at the edge, and only certain workloads are transmitted to centralized networks (like the cloud).

According to Forrester, edge compute addresses a number of cloud-related challenges, including:

- An increasing need for low latency and high reliability
- Rapid expansion of IoT & IIoT connected devices
- An increasingly mobile and distributed workforce
- Bandwidth and connectivity limitations
- The high cost of data transit and storage
- Evolving data privacy requirements

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Distributing compute between cloud and edge also enables intelligent enterprises to operate with a very thin client, significantly lowering costs while keeping sensitive information at point of use.

5G + Edge = Multi-access Computing (MEC)

In 2020, it's estimated that over 20 billion devices are already connected to the internet. But 5G is expected to be able to support up to one million devices per square kilometer, likely spurring a radical increase in the number of connected devices and systems. The advent of Massive IoT (MIoT) is expected to grow the number of connected devices to 55 billion by 2025. This will include everything from manufacturing equipment and logistics assets to fully embedded smart cities - all requiring extensive, agile and flexible bandwidth.
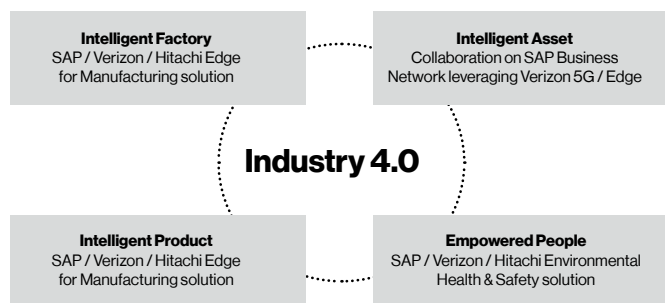
Ultra-low latency, 5G-enabled MEC will help enable the real-time connectivity, analytics and applications needed to widely implement technologies like autonomous vehicles, or provide immersive experiences through virtual, mixed and extended reality.

Verizon, SAP and Hitachi innovating for Industry 4.0

SAP's Industry 4.0 approach orchestrates the ecosystem of: machine / equipment builders, technology / application providers, and systems, and combines three priorities into one leading strategy:

- Connect people, machines and business processes to flow data, accelerate insight and propel automation
- Reinvent production using intelligent assets that dynamically adapt to changing conditions and priorities
- Accelerate supply chain collaboration with an ultimate focus on customer experience

Together, Verizon, SAP and Hitachi are collaborating on digital manufacturing solutions across all Industry 4.0 pillars by merging Verizon's 5G and Edge Intelligence, SAP's edge analytics and business applications, and Hitachi's 20+ years of digital manufacturing expertise and operating technologies.

Intelligent Factory SAP / Verizon / Hitachi Edge for Manufacturing solution	**Intelligent Asset** Collaboration on SAP Business Network leveraging Verizon 5G / Edge
Industry 4.0	
Intelligent Product SAP / Verizon / Hitachi Edge for Manufacturing solution	**Empowered People** SAP / Verizon / Hitachi Environmental Health & Safety solution

Verizon, SAP and Hitachi extend the Intelligent Enterprise to the edge.

Reliable high-speed connectivity is a core requirement for edge compute. Verizon's advanced networking and business collaboration portfolio, along with the agility, security and flexibility of fiber, 4G LTE and 5G integrated coverage, helps empower the critical data gathering, storage and analytics necessary for real-time insights.

The integration of intelligent enterprise and intelligent network also relies on seamless connectivity between business processes, employees, machines, business partners and customers. Verizon's software-defined and intelligent networks are helping enable the SAP Intelligent Enterprise today, and we are collaborating on new opportunities across multiple enterprises for tomorrow's SAP Business Network. We envision innovative industry solutions built on the SAP S/4HANA cloud platform and integrated into the Verizon MEC, running on the cloud infrastructure of hyperscale partners, with an elastic and replicable architecture framework across industries.

The Verizon / SAP collaboration will bring the near real-time capabilities of MEC to SAP industry solutions, enabling a wide variety of new use cases. Customers can access any end-to-end processes from all SAP cloud-based industry applications and services (such as Digital Manufacturing Suite or Critical Asset Repository for retail), down to the sensors on a single reference architecture.

New trends driving positive business outcomes. The reality of Digital Manufacturing today.

As Verizon and SAP work to significantly increase the speed, availability and density of connected devices, there are multiple areas that we see as ripe for development over the next 18 months:

Product research and development

New digital platforms could democratize research and development talent and propel collaboration on joint design throughout the entire supply chain. AI can accelerate materials science through more cost-effective digital simulation and testing environments, while augmented/virtual reality (AR/VR) becomes the drafting board of tomorrow.

Resource planning and sourcing

On-demand, decentralized manufacturing leveraging just-in-time ordering and logistics could reduce overall complexities while increasing compliance and accountability across the integrated supply chain.

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Machine monitoring and performance optimization

Edge connectivity and AI empower the "Factory of the Future" with increased operational visibility in near real-time. As events occur on the shop floor, rapid insights allow human and automated actions that prevent performance degradation, maintenance issues and operational downtime.

Labor management and augmentation

AR, wearable devices and exoskeletons promise to augment human effectiveness (speed, strength, knowledge) on the manufacturing floor.

Machining, production and assembly

Modular equipment, adaptive production lines and 3-D printing can respond quickly to new consumer demands.

Quality assurance

Computer vision will help automate inspections on the production line and improve aftermarket customer services. Complex root-cause analysis can be quickly executed through AI insights, with distributed software and blockchain helping accelerate targeted recalls where necessary.

Warehousing

Autonomously guided and less guided vehicles can be monitored and coordinated as they perform complex operations and interact with humans and other assets across the patio, production floor and warehouse. Fully automated "lights-out warehouses" are enabled, tracking and optimizing moving parts in real-time 24/7.

Transportation and supply chain control towers

Telematics and 4G LTE / 5G connectivity will keep trucks, containers and pallets 100% visible outside the factory gates - whether on the road, tracks or ocean. Truck systems are tracked in real-time to optimize maintenance and increase fleet ROI, while environmental conditions for sensitive goods are continuously monitored door-to-door to help ensure product quality. Manufacturers transporting raw materials and delivering finished products will have granular control over schedules and routing, improving overall efficiency.

Addressing disruptions such as the COVID-19 pandemic.

The transformative outcomes of Industry 4.0 can help make the Intelligent Enterprise an Agile Enterprise as well.

Ongoing environmental, social and economic disruptions have underlined the need for manufacturers to find new ways to address rapid and unforeseen changes, whether they are occurring locally, impacting specific industry segments, or globally affecting populations and markets.

For example, many companies have experienced major supply chain disruptions in 2020 - often with little notice - because partners and suppliers were directly affected by the pandemic. An impact on one supplier propagates down the chain, forcing companies to quickly change strategies and seek new vendors to keep up with demand. COVID-19 has also forced companies to rapidly adjust their workforce management policies in order to maintain operations, empowering a surge of remote office workers while struggling to also keep essential on site personnel safe and healthy.

Together, Verizon, SAP and Hitachi have been providing clients with workforce solutions that help protect workers and their families. These range from remote temperature sensing as employees arrive at the plant, to applications and hardware that help reinforce social distancing and monitor population density in areas of the facility.

Verizon 5G and MEC can also help optimize operations while maintaining a minimum workforce on premise, increasing the capacity to sense and react to potential issues as they occur. Remote workers are empowered to immediately intervene, either directly with the devices or through AR hardware in the hands of an on site colleague.

Pandemic effects
The state of the industry before and during COVID-19

Before Smart Factory projects focusing on:	**During** Smart Workflow projects focusing on:
• Autonomous guided vehicles	• Vision systems for social distancing and thermal imaging
• Warehouse automation (integrated systems)	• Improving / creating supply chain visibility into Tier 1 and Tier 2 suppliers
• Vision systems for defect reduction	• Real-time inventory visibility
• Real-time inventory visibility	• Material location / separation to include employees
• Process automation enhancements (analytics)	• COVID hot spot modeling to avoid supply chain disruption
• Finished product visibility	

Companies that didn't have work-from-home policies suddenly had to enable it, which solved for in-office employees but not in-plant personnel. Supply chains relying on single geographies are being reconsidered, along with project priorities. Emphasis has shifted to efficiency and automation improvements while others are scaled back to cut cost and resource commitments.

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Verizon, SAP and Hitachi are working together on proven use cases.

Beyond the workforce, Verizon, SAP and Hitachi are aiming to revolutionize the factory floor in three areas:

Predictive quality

- Near real-time monitoring and control of machines and processes using 5G, MEC and computer vision
- Using AI/ML to overlay complex models on actual products to continually optimize performance and quality
- Digital twin (DT) training models using AR/VR to improve operations efficiency
- Root-cause analysis in near real-time to reduce scrap, labor overage, resource consumption and recalls

Predictive maintenance

- Instant edge analytics and insights leveraging data at its source
- Using vibration and sound analysis to create predictions and maintenance alerts before production is affected
- Leveraging time-series models, Fast Fourier Transforms, and ML at the edge
- Predict and optimize maintenance to help boost efficiency, reduce costs and parts inventory
- Reduce unplanned operational downtime
- Safeguard critical operational assets and expensive machinery

AGV monitoring and optimization

- Connect and monitor autonomous vehicles and robots in near real-time, and increase visibility and control of autonomous operations
- Eliminate Wi-Fi shadow areas and improve location tracking
- Instantly predict issues, identify abnormal operations and model outcomes affecting production quality and maintenance operations
- Analyze performance and optimize robotic automation algorithms to increase efficiencies

Application to Supply Chain and Asset Management

Individually, these three use cases can bring incredible value to the manufacturing industry. When data is properly orchestrated and combined across systems, processes and people we'd expect to see a positive business impact across the entire value (and supply) chain.

One example: for some manufacturers, AGVs are reducing labor costs and increasing safety across shop floors. However, having management visibility into AGVs (like any other asset) should be part of running an efficient operation. Is this AGV performing well? If not, why not and how can I fix it? What is the contribution of this robot to the manufacturing process?

When used for material handling (load, unload, select, pack, move, palletize, etc.), not only does an effective Predictive Maintenance program become even more crucial but the value of the AGV increases due to the availability of near real-time data on the movement of goods. As products are finished and pass quality inspection, the AGV is deployed to move them into the loading dock to palletize and load. This information could then be sent upstream to the transportation company to indicate which loading bay the goods will be at and at what time to show up.

When the shipment leaves the facility, alerts are sent to the distribution center and/or sorting facilities which will reserve a bay to unload. This chain continues down to the delivery to the end customer, and (when used with IoT) could provide real-time data about the physical status of goods in transit. This is the end-to-end visibility we've been talking about for decades, and that Industry 4.0 now delivers through Verizon, SAP and Hitachi.

Conclusion

Industry 4.NOW is here. There are no more barriers preventing information, decisions and actions from running at the speed of thought. Verizon and SAP, in partnership with Hitachi Vantara, are bringing solutions to market that turn data into actionable insights and automated actions at the edge, from the factory floor, where things are happening right now.

Contact us to learn more about we can help you expand your Intelligent Enterprise.

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