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# A Lenovo NVIDIA® eBook: Powering a manufacturing revolution with edge AI

An eBook on how edge AI technology drives agility, intelligence, and sustainability in smart manufacturing, supply chain & transportation, and industrial field services, leading to improved operational efficiency, enhanced product quality, and reduced costs.

# Introduction

The manufacturing sector has battled against a mounting wave of challenges over recent decades. Amidst the whirlwind of globalization, heightened competition, complex supply chains, stringent regulatory compliance, escalating operating costs, and increasing cybersecurity threats, innovative and sustainable practices have become critical. In a climate characterized by a global skills shortage, the COVID-19 pandemic, inflationary pressures, and a perpetual quest for production optimization, there is a silver lining — the transformative power of Industry 4.0 technology, notably automation, robotics, IoT (Internet of Things), and machine learning. Consequently, despite the challenges, the industry has proved resilient, and the outlook is positive,<sup>1</sup> with manufacturing sectors such as automotive, aerospace & defense, food & beverage, and IT (information technology) capitalizing on this technological revolution through edge computing and edge AI (artificial intelligence).

Seeking agility, intelligence, and sustainability, 78% of global manufacturers have plans to or have implemented edge AI, with 50% of manufacturers at the mature stage of incorporating edge AI into factories, logistics, and warehouses.<sup>2</sup> This seismic shift toward data-driven environments is reshaping smart manufacturing, supply chains & transportation, and industrial field services, with over half of manufacturers looking to expand their use of IoT applications, automation, inventory management, and predictive maintenance in the coming years.<sup>3</sup>

In contrast to cloud computing, edge AI utilizes local data collection and processing to enable swift insights directly on the factory floor. This process promotes live interventions such as defect identification, hazard detection, and predictive machine maintenance, elevating manufacturing to unprecedented levels of efficiency. Real-time optimization, AI data analysis, and cognitive computing improve operational safety, boost productivity, and provide the workforce with actionable insights for decision-making. In a manufacturing setting, edge AI brings cost optimization, enhanced product quality, and advanced inventory management to the fore, carving a pathway to sustainability by mitigating cloud traffic and energy consumption — a significant step toward a greener future.

Combating the increasing complexities and demands of the evolving industry, edge AI emerges as a powerful solution, offering a new era of manufacturing prowess and a significant leap forward for the sector.

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<sup>1</sup> IndustryWeek, 2022, NAM Outlook Survey: Manufacturers Stay Positive Despite Recession Concerns

<sup>2</sup> AT&T Cybersecurity Insights™ Report, 2022, Securing the Edge: Focus on Manufacturing

<sup>3</sup> IDC, 2021, Edge Computing: Services for Manufacturing



# Resilience in revolution:

## Adapting to a new era of manufacturing

The global manufacturing sector, a critical cog in the world's economy, is navigating an increasingly complex landscape. Decades of globalization have amplified competition and expanded compliance and regulation.<sup>4</sup> Macroeconomic challenges have disrupted the industry, with soaring operating expenses fueled by rising material prices, energy rates, and labor costs. Despite a record number of new hires, job openings remain at an all-time high.<sup>5</sup> A worldwide skills shortage sees labor retention cited as a challenge for 75% of manufacturers, with 1 in 3 executives stating that retaining high-performing employees is a strategic priority for 2023 and beyond.<sup>6</sup>

The rise of sustainable practices and environmental stewardship has been a catalyst, nudging manufacturers to critically evaluate and fine-tune their processes and supply chains to curtail their ecological footprint. Manufacturers are making meaningful strides toward fulfilling their EHS (Environment, Health and Safety) and ESG (Environmental, Social, and Governance) commitments through extensive operational improvements across their value chains.<sup>4</sup> This transformation necessitates the deployment of advanced technologies and significant investment in digital safety and green manufacturing practices, fostering an efficient and responsible manufacturing landscape.

Challenges exist around technology implementation, management, and maintenance. Manufacturers are under pressure to minimize costly downtime, harness the power of AI, and use technology to improve workplace safety and experiences. The increasing dependency of manufacturing on technology has brought the industry to the attention of malevolent entities. With the transition from Industry 3.0 to 4.0, the quantity and depth of data processed have elevated the manufacturing sector's appeal and intensified its cybersecurity risk profile. Studies show that the three most common security concerns involve attacks against users, ransomware, and attacks against network servers.<sup>2</sup>

Despite these considerable challenges, the sector's future is full of opportunities. According to the World Economic Forum, the most successful companies will leverage their investments in advanced manufacturing to optimize operating models and unlock new business models that create and deliver new value to all stakeholders.<sup>7</sup>

Manufacturers consistently demonstrate resilience and adaptability, continually seeking avenues for strategic innovation, exceptional customer experiences, and operational excellence. Navigating these hurdles will demand a forward-thinking, proactive approach, crucial for advancing into a new era of efficient, sustainable manufacturing.

## Navigating through challenges in manufacturing

The AI manufacturing market size was US\$1.82 billion in 2019 and is projected to reach US\$9.89 billion by 2027, at a CAGR of 24.2%.<sup>8</sup>

A 2022 study by PwC<sup>9</sup> found that 89% of manufacturers have implemented or are rolling out AI and analytics. Similarly, 73% of the surveyed manufacturers have implemented or are rolling out smart technology.

IDC<sup>10</sup> predicts that from 2023 more than 50% of new enterprise IT infrastructure deployed will be at the edge rather than in corporate data centers. Their recent survey revealed the majority of manufacturers are investing in multiple AI technologies<sup>11</sup>:

- 59%** of manufacturers plan to increase investment in digital AI quality and compliance.
- 56%** of manufacturers plan to increase investment in autonomous AI factory operations.
- 54%** of manufacturers plan to increase investment in advanced AI digital simulation.

## Smart manufacturing

Technological integration poses a significant challenge in smart manufacturing, particularly reconciling legacy systems with new Industry 4.0 technologies, managing data overload, and aligning AI models with operational needs. Cybersecurity threats persist, making the protection of IT infrastructure and data integrity paramount. Smart manufacturing continues to battle workforce issues, including skills shortages and the need for retraining as automation increases. At the same time, maintaining product quality and achieving regulatory compliance remains crucial, particularly as production processes become increasingly technical and complex.

## Supply chain and transportation

The recent global uncertainties have underlined the critical role of resilient supply chains in the manufacturing industry. Ensuring supply chain resilience amidst global instability and managing dependencies on suppliers have emerged as top challenges. Logistically, manufacturers must balance cost, speed, and reliability, an act made even more complex by unpredictable events.

## Industrial field services

Field services, an integral part of the manufacturing industry, are not immune to the sector's broader challenges. Delivering high service levels while managing customer satisfaction is a constant struggle. Workforce issues are particularly pronounced, with a shortage of skilled technicians for advanced field equipment and an imperative to ensure field worker safety.

<sup>2</sup> AT&T Cybersecurity Insights™ Report, 2022, Securing the Edge: Focus on Manufacturing

<sup>4</sup> Deloitte, 2021, Sustainable manufacturing: From vision to action

<sup>5</sup> U.S. Bureau of Labor Statistics, Job Openings and Labor Turnover Survey

<sup>6</sup> Deloitte, 2023 manufacturing industry outlook

<sup>7</sup> World Economic Forum, 2022, Unlocking Business Model Innovation through Advanced Manufacturing

<sup>8</sup> Fortune Business Insights, 2020, Automation: Artificial Intelligence (AI) in Manufacturing Market

<sup>9</sup> PwC, 2022, PwC Digital Factory Transformation Survey 2022

<sup>10</sup> MIT Technology Review, Edge Computing: Powering the Future of Manufacturing

<sup>11</sup> SAS, 2022, AI in Manufacturing: Enabling Business-driven Factory Innovations

# The rise of edge computing in manufacturing

The investment in OT and IT is relentless as manufacturers seek to improve product and service quality, customer experience, and power operational efficiency.<sup>10</sup> IDC forecasts worldwide vendor revenue from AI hardware, software, and services will reach \$718 billion in 2025.<sup>12</sup> Manufacturers are harnessing the power and potential of real-time data processing at the edge more than ever,<sup>13</sup> driving higher productivity and creating more resilient supply chains.

The adoption of edge AI and related technologies are not just trends but vital components in the roadmap to Industry 4.0. A recent study found that 61% of manufacturers are partnering with specialized technology companies to drive smarter manufacturing, with 6% acquiring strategic partners to develop in-house skills and expertise.<sup>6</sup> The manufacturing industry, guided by this technological compass, is steering toward an era of unprecedented innovation and efficiency.

## The transformative impact of edge AI on modern manufacturing



### 1. Smart Manufacturing

#### Quality Assurance and Control

- Real-Time Quality Control
- Process Optimization

#### Production Optimization

- Material Requirements Planning (MRP)
- Energy Efficiency Management
- Process Automation
- OT and IT Integration
- Remote Management

#### Predictive Maintenance (PdM)

- Production Optimization

#### Worker Safety Monitoring

- Digital Safety and EHS and ESG Compliance
- Advanced Warning Technology

#### Real-Time Equipment Monitoring

- Intelligent Robotics Integration
- AI-Powered Analysis



### 2. Supply Chain & Transportation

#### Inventory and Logistics

- Demand Forecasting
- Inventory Management
- Product Availability Management
- Asset Tracking

#### Transportation and Routing

- Real-Time Logistics Optimization
- Route Optimization



### 3. Industrial Field Services

#### Service Optimization

- Infrastructure Management
- Work Order Optimization
- Field Technician Routing Optimization

#### Maintenance and Sustainability

- Predictive Maintenance
- Improved Sustainability Practices

#### Workforce and Customer Experience

- Empowered Workforce through Real-Time and After-Time Data
- Customer Experience Improvement
- Health and Safety Compliance

#### Analytics

- Remote Asset Monitoring
- Real-Time Service Analytics

<sup>10</sup> MIT Technology Review, Edge Computing: Powering the Future of Manufacturing

<sup>12</sup> IDC, 2022, Increasing Intelligence at the Edge with AI

<sup>13</sup> Research and Markets, 2022, Logistics Automation Market by Component, By Application, By Organization, By End-Use Industry: Global Opportunity Analysis and Industry Forecast, 2020-2030

<sup>6</sup> Deloitte, 2023 manufacturing industry outlook

# Industry 4.0: The integral role of edge AI in every manufacturing sector



**Aerospace & defense:** Edge AI in aerospace and defense helps streamline real-time data analysis for superior operational efficiency. It enhances predictive maintenance, optimizes asset management, and significantly boosts security by leveraging real-time threat detection capabilities.



**Auto:** In the automotive sector, edge AI enables autonomous vehicle decision-making and real-time quality control. It fosters advancements in autonomous driving, intelligent traffic management, and predictive maintenance, ultimately propelling the sector toward the era of smart mobility.



**Food & beverage:** Edge AI in the food and beverage industry offers real-time monitoring and predictive analytics for improved quality control and supply chain efficiency. It assists in maintaining optimal storage conditions, enhancing food safety, and ensuring consistency in production lines.



**Industrial:** Edge AI plays a pivotal role in the industrial sector by facilitating real-time decision-making and predictive maintenance. It significantly improves safety, productivity, efficiency, and workforce experience while reducing downtime in manufacturing processes.



**Information technology (IT):** Edge AI offers real-time analytics and cybersecurity protection for the IT sector. It enhances network efficiency, reduces latency, and boosts decision-making in data-driven environments.



**Pharmaceuticals:** Edge AI accelerates drug discovery in the pharmaceutical industry and ensures precise quality control. Providing real-time analytics enhances process efficiency and accuracy, helping to maintain compliance with regulatory standards.



**Semiconductor & electronics:** Edge AI in the semiconductor and electronics industry fosters quality control, predictive maintenance, and production efficiency. It facilitates the management of complex manufacturing processes by analyzing real-time data to improve yield rates, quality, and production speed.



**Supply chain:** In supply chain management, edge AI optimizes inventory control, streamlines logistics, and improves real-time decision-making. It facilitates tracking and tracing capabilities, improving transparency, reducing inefficiencies, and ensuring seamless operation across the supply chain network.



**Transportation:** Edge AI in transport significantly enhances efficiency, safety, and reliability. It drives innovations in autonomous vehicles, smart traffic control, and predictive maintenance, enabling a more connected, intelligent, and sustainable transportation ecosystem.

## Edge AI supports manufacturers with:

### Operational efficiency and quality control:

Edge AI enhances manufacturing efficiency by enabling real-time production optimization and equipment effectiveness. It promotes automation, improving product quality and reducing manufacturing process errors.

### Maintenance and predictive management:

With predictive maintenance powered by edge AI, manufacturers can forecast machinery issues before they occur. This reduces downtime, lowers repair costs, and extends equipment lifespan, resulting in superior operational efficiency and cost-effectiveness.

**Health and safety compliance:** Edge AI fosters a safer manufacturing environment by monitoring human actions and identifying potential safety risks. It ensures adherence to health and safety regulations, minimizing accidents and safeguarding the well-being of employees.

**Supply chain and inventory management:** Edge AI revolutionizes supply chain processes, providing real-time insights into production, demand, and supply. It optimizes inventory management, enabling manufacturers to plan and make informed decisions, avoiding delays and waste.

**Energy management and sustainability:** Using edge AI in manufacturing facilities improves energy efficiency by identifying and addressing abnormal consumption patterns. This leads to significant cost savings, supports sustainability goals, and reduces the environmental footprint of manufacturing operations.

# The cutting edge in a competitive industry

Edge computing is transforming manufacturing, dramatically improving operational agility, offering decision-making intelligence, and driving sustainability. By taking data processing to the edge, manufacturers can work locally without relying on a centralized data center or cloud solution.

Edge AI enables real-time and after-time analysis, leading to faster decision-making. Leveraging AI at the edge, organizations can rapidly process and analyze data where it originates, with predictive analytics and an array of benefits for smart manufacturing, supply chain and transportation, and industrial field services. Edge AI allows for live interventions like defect identification, hazard detection, and predictive machine maintenance, elevating the manufacturing landscape to new levels of efficiency. Real-time optimization and AI data analysis empower the workforce with actionable insights, enhancing operational safety and boosting productivity.

Edge AI uses machine learning and relies on powerful Graphics Processing Units (GPUs) for visual recognition, natural language processing, audio analysis, cognitive computing, robotics control, and other advanced applications.

Through edge computing, IoT device deployment benefits from improved speed, availability, and security, as data never leaves the localized environment during analysis.

## The edge advantage: Realizing the benefits of edge AI

### 1. Agility

With edge computing and AI, manufacturers gain the agility necessary to thrive in the fast-paced, increasingly unpredictable global market. Edge AI enables rapid response to customer demands and unexpected supply chain disruptions, minimizing downtime and financial losses. Manufacturers benefit from accelerated product design and prototyping, fostering a dynamic environment perfect for innovation and a short time-to-market.

### 2. Intelligence

Edge AI enables high-precision manufacturing at lower costs and with greater throughput. By using cognitive computing to analyze data in real time at its origin, manufacturers can detect and correct defects immediately, optimizing product quality. This level of precision, combined with the cost-efficiency of localized data processing, facilitates high-volume production without compromise. Edge AI real-time insights equip the workforce with the necessary information for intelligent decisions, driving productivity and operational excellence.

### 3. Sustainability

An edge AI implementation promotes environmentally conscious and sustainable practices. Edge computing reduces the need for constant data transmission to central servers, significantly lowering energy consumption and carbon emissions. By enabling predictive maintenance, edge AI prevents unforeseen equipment failures and emergency callouts, while real-time monitoring and control of manufacturing processes optimize production, minimize wastage, and support EHS and ESG compliance.



# Elevating the manufacturing process to new levels of efficiency

To excel in today's competitive landscape, manufacturers must consistently mitigate supply chain disruption and meet customer, market, and regulatory demands. Edge AI is unlocking the next level of performance for the manufacturing sector.



## Enhancing smart manufacturing

**Intelligent manufacturing:** Use IoT to capture data to drive efficiencies and optimize operational processes and Material Requirements Planning (MRP) with AI data analysis in real time and after-time.

**Factory planning:** Use cognitive computing to support factory planning, digital twinning, and continuous improvement of operations and worker experiences.

**Improved quality:** Use computer vision and deep learning to detect and prevent defects throughout manufacturing, from component assembly to shipment.

**Increased productivity:** Optimize equipment effectiveness and production, aided by real-time Intelligent Video Analysis (IVA) on assembly lines.

**Cost optimization:** Analyze operational patterns, integrate OT and IT, and drive decision-making to enable optimization and cost reduction.

**Enhanced customer experiences:** Provide customers with real-time information on inventory and live communication throughout production and delivery.

**Advanced robotics:** Enhance service quality, worker experiences, and efficiency by automating manufacturing processes such as production line work.

**Predictive maintenance:** Predict machine failure and schedule maintenance to prevent costly breakdowns and production disruptions.

**Energy efficiency:** Monitor and adjust operations to identify abnormal energy consumption patterns for sustainability and significant cost savings.

**Operational safety:** Enhance EHS compliance using IVA to monitor human actions on manufacturing assembly lines.

**Upgraded connectivity and security:** Enable faster and secure data processing with localized data hosting to reduce reliance on latency and bandwidth.

## Powering the supply chain and transportation

**Decision-making:** Power logistics and resource allocation decisions with real-time and after-time facility management data and analysis to drive decision-making.

**Inventory management:** Identify inventory shortages and surpluses to enable proactive replenishment, management, and supply chain performance.

**Product availability:** Use AI forecasting to anticipate consumer demand and eliminate product delays, ensuring availability.

**Warehouse robotics:** Boost efficiency and reduce manual workload with advanced robotics, automating warehouse processes such as picking and packing.

**Proactive inspections:** Use IVA to identify broken packages, damaged containers, inspect warehouses and rail routes to catch issues before they escalate.

**Route optimization:** Use edge AI to optimize routes in real time based on traffic, weather, and other factors.

## Enabling excellence in industrial field services

**Deep learning:** Analyze large data sets with deep learning to capture insights and functional information for decision-making.

**Federated learning:** Facilitate machine learning among devices without data transfer, enhancing performance, ensuring data privacy, optimizing bandwidth, and contributing to sustainability through reduced cloud traffic and energy consumption.

**Infrastructure management:** Build valuable manufacturing models, proactively monitor and repair infrastructure, preempting breakpoints to reduce costs and increase service availability.

**Empowered workforce:** Equip workers with powerful technology, including IVA, collect real-time data to boost performance and effective workload management.

**Customer service:** Improve customer service through real-time information and analytics, predictive maintenance, reduced latency, better data security, and personalized service delivery.

**Work order optimization:** For field service technicians, optimize work order scheduling and routing to increase efficiency and reduce travel times.

**Improved sustainability:** Promote ESG and a green future by reducing cloud traffic, energy consumption, and carbon emissions with edge AI and local data processing.

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# Edge AI solutions

When deploying manufacturing edge infrastructure, stakeholders must consider the long-term cost implications and return on investment rather than taking a short-sighted approach of focusing on upfront costs. A smart investment in reliable components with longer lifecycles can pay off by reducing total ownership expenses — ensuring stable performance and minimizing manual and equipment interventions that prove costly over time.

## Edge computing infrastructure

**IoT edge devices:** Edge devices capture and process user input, sensor, or camera-generated data. Edge devices can operate independently or in a connected state with cloud resources.

**Edge computing:** Edge computing brings data processing to the network's edge, reducing latency and enabling faster decision-making.

**Edge storage:** Edge storage allows users to store data locally, securely, and reliably at the network's edge.

**Edge servers:** Edge servers can store, process, and analyze data quickly and efficiently. Edge servers can also manage traffic loads, providing additional performance optimizations.

## A Lenovo and NVIDIA solution

**Computing:** Lenovo offers a breadth of purpose-built and edge computing solutions to power industry-leading performance, security, and manageability.

**Servers and storage:** Lenovo ThinkEdge and ThinkSystem servers provide a full range of ruggedized, industry-leading solutions, delivering performance, security, and scalability at the core, near edge, and far edge, backed by enterprise-grade support. Lenovo's easy-to-manage storage offers compact flexibility and manageability, explicitly designed for edge environments.

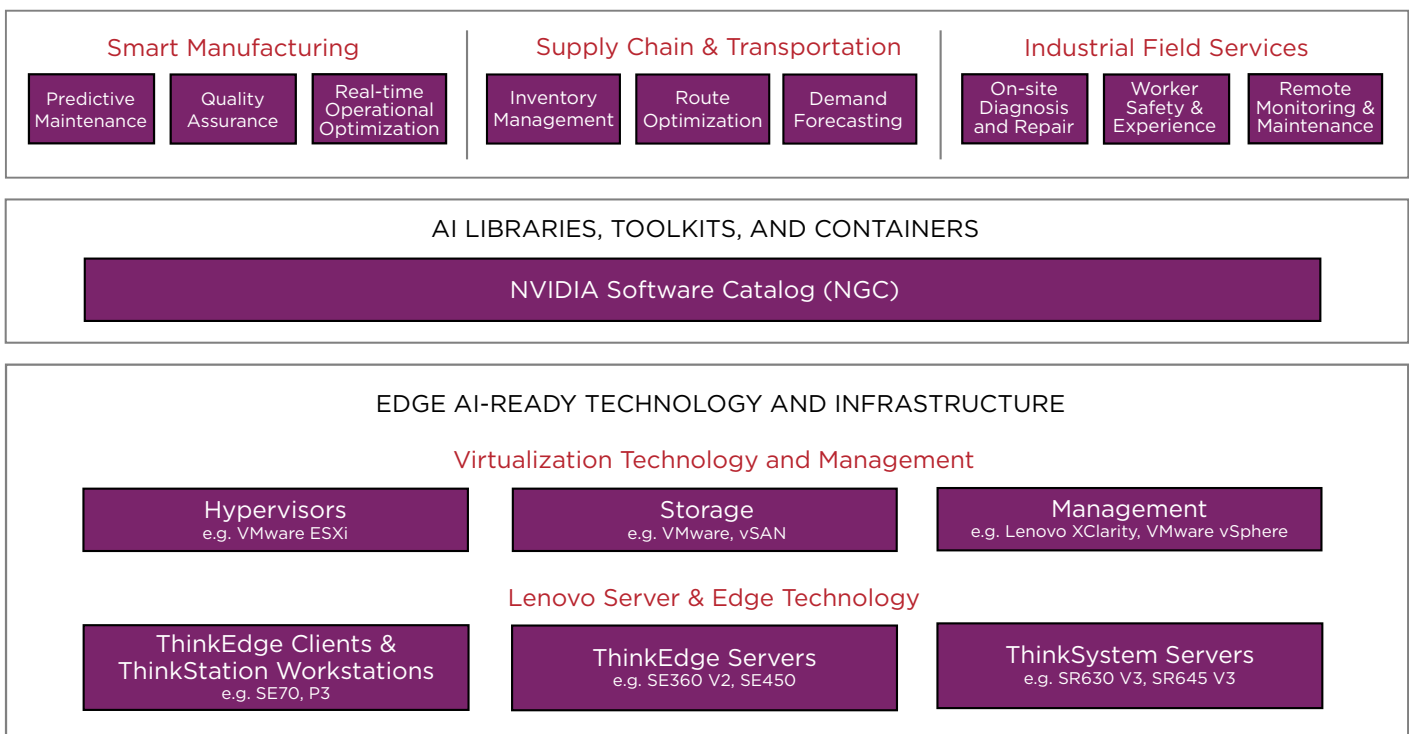
**Kubernetes:** Lenovo and NVIDIA offer a leading purpose-built solution for deploying, managing, and monitoring applications at the edge. The NVIDIA GPU Operator and NVIDIA Network Operator standardize and automate the deployment of all components for provisioning Kubernetes clusters.

**NGC software catalog:** The NVIDIA NGC software catalog is the hub for performance-optimized deep learning and machine learning applications. NGC simplifies building, sharing, and deploying software, allowing manufacturers to gather insights faster and deliver value sooner.

## NVIDIA AI Enterprise

NVIDIA AI Enterprise is an end-to-end, cloud-native suite of AI and data analytics software, optimized for every organization to excel at AI, certified to deploy on Lenovo NVIDIA-Certified Systems, and includes global enterprise support so AI projects stay on track, allowing organizations to focus on harnessing the business value of AI.

### EDGE AI SOLUTIONS FOR MANUFACTURERS





# The Lenovo advantage powered by NVIDIA

Lenovo's edge portfolio offers a one-stop shop and a complete end-to-end edge deployment solution for all enterprise organizations. The portfolio includes:



**Lenovo ThinkEdge SE70:** Provides enterprise-changing AI and ComputerVision applications constrained only by imagination. With best-in-class engineering, reliability, and scalability, the SE70 transforms existing camera infrastructure into intelligent automated environments ideal for every industry.



**Lenovo ThinkStation P3 Ultra Workstation:** Features a revolutionary form factor that delivers superior performance and flexibility in a chassis less than four liters in total volume. With up to NVIDIA RTX™ A5500 mobile graphics, ultrafast DDR5 5600MHz memory, and dual M.2 NVMe PCIe Gen4 SSD storage, this workstation is redefining the power of small.



**Lenovo ThinkEdge SE360 V2:** Offers AI-enabled server performance and business security for almost every environment. With ruggedized versatility, impressive resilience, and a proprietary design that mitigates the audible signature and maintains optimal cooling, the SE360 V2 supports edge AI and AI inferencing wherever needed.



**Lenovo ThinkEdge SE450:** Is an advanced processor-based server with a 2U height and short depth case that can go almost anywhere. It can be hung on a wall, stacked on a shelf, or mounted in a rack. This rugged technology can handle continuous operating temperatures from 5°C to 45°C, with designs configured to meet NEBS Level-3 and ETSI requirements for 96-hour operating excursions from -5°C to 55°C as well as tolerance for locations with high dust and vibration.

Lenovo edge servers are rugged and secure with physical tamper-proofing, data encryption, and the ability to withstand conditions of all kinds.

**A hybrid multi-cloud brings flexibility:**

The Lenovo edge ecosystem is open and flexible, and it integrates with all key cloud providers offering end-to-end, ongoing management.

**Extend cloud performance with a resilient edge:**

Get integrated, cost-effective, and resilient edge solutions that are easy to deploy, simple to operate, and maximize edge workload performance.

**Improve data management and access:**

Enjoy better data management with the widest choice of products, services, and, most importantly — guidance available for advanced hybrid infrastructure.



# Lenovo ThinkEdge solutions enabling AI

Lenovo delivers NVIDIA-Certified high-performance AI servers, digital twin-ready infrastructure, and ruggedized edge servers as the foundation to edge AI solutions for all industries.



Ruggedized, resilient Lenovo ThinkEdge servers (such as the SE360 V2) offer AI-enabled performance and robust security for the most challenging environments. With a minimal acoustic footprint and optimal cooling, ThinkEdge servers drive agility, intelligence, and sustainability at the edge.

Lenovo Open Cloud Automation (LOC-A) helps customers simplify and accelerate edge deployments for any number of locations at once — quickly, consistently, and automatically. LOC-A and enhanced XClarity management functionality expand device management capabilities with a minimal footprint — but with a scalable architecture, from far edge to core:

**Diverse portfolio:** from ultra-compact gateways to data center-grade products

**Highest performance:** CPU- and GPU-rich systems for ultimate performance

**Flexible deployment:** in harsh environments with ruggedized devices and unique cooling capabilities

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# Edge AI in action

## Analyzing data at the edge to keep production lines rolling

### Background

BOSCH VHIT (Vacuum & Oil Pump Products Italy) is a leading producer of vacuum and oil pumps for the automotive sector. Headquartered in Offanengo and a subsidiary of Robert Bosch GmbH, a multinational German engineering and technology company, BOSCH VHIT was acquired by one of the top 30 auto parts companies in China.

BOSCH VHIT must run its manufacturing lines at peak efficiency to keep just-in-time automotive supply chains equipped with crucial components. Avoiding manufacturing errors and equipment malfunctions are key goals, as they can delay client deliveries, lead to missed sales opportunities, and damage business relationships.

To reduce the risk of downtime, BOSCH VHIT depends on data. Corrado La Forgia, CEO at BOSCH VHIT, explains: "We use programmable logic controllers (PLCs) and a manufacturing execution system (MES) to help control and automate key workflows on the factory floor."

The organization faced considerable challenges in managing and maintaining its IT estate. Its numerous standalone traditional PCs were not designed for the typical manufacturing environment of continuous operation, high temperature, and vibrations. Disruptions included unplanned operating costs and monitoring and control system downtime.

"The factory is a harsh environment with significant dust, heat, and vibration — so we wanted platforms that were highly resilient," recalls La Forgia. "The Lenovo edge solutions deliver exactly what we were looking for: rugged devices able to run both modern and legacy applications at different levels, spanning from a small industrial PC footprint to a high-density compute server with GPU-class performance in just a 1U half-rack."

"The edge solutions from Lenovo send machine-learning insights directly to our MES — allowing our employees to make better-informed decisions, faster."

Corrado La Forgia, CEO BOSCH VHIT

## A high-performance solution for harsh environments

Lenovo developed two distinct edge solutions to address several different scenarios.

**Lenovo ThinkSystem SE350 edge servers**, equipped with NVIDIA® T4 GPUs, enabled BOSCH VHIT to consolidate the data from several production lines and apply advanced machine learning algorithms at the edge.

**Lenovo ThinkEdge SE50 hardware and LYNX MOSA.ic** for industrial software securely orchestrated the virtualization of the PLC, video inspection, and quality control application, with analytics models developed by BOSCH VHIT. This solution delivered modern industrial PC reliability and computational capacity on the production line, replacing poorly connected, fragmented, and aging subsystem controllers.

### Reliable operations and expedited, informed decisions

- Enabled machine learning at the edge
- Minimized operations downtime
- Reduced IT operational costs

By implementing robust industrial solutions, BOSCH VHIT has boosted the reliability of its production systems, improving availability. The company is also driving a double-digit percentage improvement in IT management efficiency, significantly reducing operational costs.

Thanks to these solutions, BOSCH VHIT can analyze video footage from cameras on the factory floor in real time, apply advanced machine learning algorithms at the edge, and alert employees to irregularities in materials or equipment, enabling them to take prompt action to resolve issues and avoid downstream delays.

Most importantly, the new solutions help the company to identify potential manufacturing issues faster, reducing the risk of costly delays to its production lines.

"Our automotive clients depend on us to keep their own manufacturing processes moving smoothly, so it's critical that we can deliver high-quality products on time, every time. Thanks to our IT platforms from Lenovo and NVIDIA, and our mission-critical virtualization software solution from Lynx, we can ensure maximum levels of availability for our mission-critical manufacturing assets," Corrado La Forgia.

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# Edge AI deployment considerations

As technology reshapes the manufacturing industry, strategic partnerships with reliable technology providers become increasingly prevalent. Strategic alliances arm organizations with critical knowledge and technology to make the investments successful. When implementing edge solutions, decision-makers must consider multiple factors to maximize success.

**Functionality:** Edge AI applications typically involve an amalgamation of sensors, cameras, human inputs, and other AI-based technologies. Manufacturers must collaborate with a technology provider to strategize their application planning and hardware requirements, considering the hardware's suitability, scalability, and flexibility for specific software, applications, and custom developments.

**Interoperability:** Ensuring the chosen edge computing solution can seamlessly integrate with devices and systems from various vendors is crucial. Compatibility with different operating systems, programming languages, and communication protocols maintains flexibility for future infrastructure changes or upgrades.

**Space/footprint requirement:** Organizations need to consider the physical footprint of edge technology during the planning stage, ensuring the technology's size and shape suit the available space and operate effectively within the desired environment.

**Environmental factors:** Energy efficiency, sound management, heat management, and dust resistance are essential considerations for edge AI deployment. Edge solutions often prioritize low noise production, with options for fanless and sound-optimized devices. For environments with high heat sources, thermal solutions without ventilation are available. Also, ruggedness and resistance to dust and humidity are significant factors in high-dust or high-humidity environments.

**Latency:** Reducing data processing and response latency is a key motivation behind edge computing. For applications demanding real-time decision-making, latency tolerances should be evaluated to ensure that chosen edge solutions can meet these demands.

**Scalability:** The system's scalability is another vital factor. Manufacturers must ensure their edge computing solutions can accommodate an increasing workload or expanded capacity to manage more devices, process more data, or handle more complex AI models.



**Cost:** The total lifetime cost of technology, rather than just the initial investment, is a crucial consideration for edge computing. This lifetime cost includes development, maintenance, technical support, and equipment replacement, which could significantly outweigh the initial investment over time.

**Privacy and security:** Edge solutions often manage sensitive data, warranting stringent privacy and security measures. Compliance with industry regulations and data protection policies is essential to mitigate risks associated with data breaches.

**Data governance:** Edge computing's distributed data processing and storage can pose data management and governance challenges. Manufacturers should choose edge solutions that help maintain control and visibility over their data, ensuring data quality and integrity, and compliance with data governance regulations.

**Maintenance:** The anticipated maintenance protocols for edge solutions should be thoroughly researched. Considerations include the frequency of necessary updates and hardware servicing, the support system for system faults, and the associated costs of these services.

**Integration:** The convergence of information technology (IT) and operational technology (OT) systems is crucial for successful edge solutions. Edge computing should enable seamless two-way communication and data sharing, improving usability, automation, data-driven decision-making, and operational performance while reducing data breach risks.

**Reliability and robustness:** Considering the critical nature of many edge computing applications, the reliability and robustness of solutions are paramount. Factors such as handling hardware failures, network disruptions, or power outages without significantly impacting the application are key.

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# Reimagining sustainability with Lenovo

Smarter is building a more sustainable future. Lenovo is committed to supporting our customers' efforts to reduce their environmental footprint. Lenovo is dedicated to being a leader in developing technologies that minimize the use of the world's precious resources.

Sustainability begins in the early stages of product design. From the composition of the materials in the technology to innovations in eco-friendly packaging, Lenovo not only delivers world-class solutions; we deliver sustainability for your organization.

## **Committed to the environment from acquisition to disposal, Lenovo:**

- Has introduced the use of ocean-bound plastic into our server bags, composed of 30% abandoned plastic waste once at risk of landing in the ocean.
- Uses high recycled content or material made of 65% pre-consumer recycled content.
- Ensures all packaging materials, including cardboard, foam cushion, and plastics, are 100% recyclable.
- Produces server products using post-consumer content (PCC) and closed-loop post-consumer content.
- Employs innovative, energy-saving components like Neptune™ liquid cooling and energy control software.

## Lenovo and NVIDIA

In partnership with NVIDIA, Lenovo is developing world-changing technologies to create a more efficient, connected, and digital society. By designing, engineering, and building the world's most complete portfolio of innovative, edge AI-ready devices and infrastructure, Lenovo and NVIDIA are leading an Intelligent Transformation — to create better experiences and opportunities for millions of customers worldwide.

Accelerating AI relies on GPUs, and NVIDIA delivers GPU acceleration everywhere needed — to data centers, desktops, laptops, and the world's fastest supercomputers. As companies are increasingly data-driven, the demand for AI technology grows. From speech recognition to recommender systems and supply chain management, AI technology gives enterprise teams the power, tools, and algorithms to work effectively.

AI is changing how organizations do business in industries from manufacturing to retail, healthcare to finance. Nearly half of enterprises have started their AI journey, but many still face moving from research to reality. According to a recent article published by Gartner, the intersection of edge computing and AI offers potential for augmented, real-time decision-making and many innovative use cases. Technology innovation leaders need to create a cohesive edge AI strategy to harness the full potential of industry innovations while mitigating challenges and risks.

Lenovo and NVIDIA bring innovative solutions and intelligent infrastructures to solve the most significant challenges of today and tomorrow. Together, we equip data-centered researchers, pioneers, and visionaries across all industries with the tools to help them evolve, transform, and implement enterprise AI solutions to deliver Smarter Technology for All.

To find out more, visit <https://www.lenovo.com/nvidia-edge-ai/>.