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Why Lenovo Smart Manufacturing Solutions Are Ready to Drive AI-enabled Transformation

AUTHORS

Ron Westfall
Research Director | The Futurum Group

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Introduction: Driving the Smart Manufacturing Journey

Integrating Generative AI (GenAI) into business operations is a complex endeavor, with pilots and do-it-yourself (DIY) approaches often taking many months to reach productivity, while numerous pilots remain in stall mode. This complexity stems from several factors, including the lack of clear business objectives, data quality issues, and the overestimation of AI capabilities.

Manufacturing AI initiatives are increasingly demanding specialized solutions tailored to the industry's distinct challenges and opportunities. These purpose-built AI systems are designed to integrate into existing manufacturing processes, offering plug-and-play capabilities that minimize disruption and accelerate adoption. Unlike generic AI platforms, these solutions address the unique needs of manufacturers, such as real-time quality control, predictive maintenance, supply chain optimization, and adaptive production scheduling.

By providing out-of-the-box functionality specifically engineered for manufacturing environments, these AI initiatives enable companies to quickly leverage advanced technologies without extensive customization or lengthy implementation periods. This approach not only enhances operational efficiency but also ensures that manufacturers can remain competitive in an increasingly technology-driven marketplace, where agility and innovation are paramount.

On-premises private clouds offer greater control over data security, compliance, and sovereignty, enabling organizations to safeguard sensitive information and adhere to strict regulatory requirements. Additionally, private clouds provide better cost efficiency for consistent AI workloads, improved performance with lower latency, and enhanced regulatory compliance capabilities. Taking advantage of private clouds aligns with our finding that most organizations (71%) plan to reevaluate their cloud workloads in 2025, focusing on optimizing placement between private and public clouds. Top drivers for workload changes include improved control and security at 55% and compliance or regulatory requirements at 20% .[1]

In this paper, we explore what organizations need to consider for evaluating today's smart manufacturing solutions. To address the top challenges, select solutions that take a holistic approach in fulfilling the topmost demands of integrating GenAI solutions into the manufacturing organization.

1 Futurum Intelligence: CIO Insights Survey for Q1 2025

Overview of the Top Challenges in Adopting AI-Infused Smart Manufacturing Solutions

Manufacturing organizations are increasingly shifting their AI workloads to on-premises private cloud environments due to critical factors such as data gravity and data sovereignty. The exponential growth of enterprise data creation, with most of this data expected to be created outside of public clouds, highlights the significance of data gravity.

The integration process demands specialized skills in AI, machine learning, and data science, which are often in short supply. The transition from pilots to production is frequently impeded by insufficient IT infrastructure, as GenAI models require substantial computational resources that many existing systems cannot support. Also, cultural resistance and change management issues also pose significant barriers with digital transformation efforts failing or underperforming due to organizational pushbacks. These multifaceted challenges contribute to the extended timelines and frequent stalling of GenAI pilot projects. Accordingly, the primary goals of AI adoption include automation at 96%, productivity improvements at 77%, and enhancing customer experiences at 69%[2], aligning with the strategic objectives of manufacturing organizations to directly address such challenges.

Many organizations are hesitant to fully embrace public cloud services due to data protection, governance requirements, and hidden costs. Public clouds, being shared environments, are particularly vulnerable to data breaches and require careful implementation of security measures such as encryption and multifactor authentication. Additionally, data governance in the cloud presents challenges related to information classification, management policies, and compliance with regulations. Hidden costs also deter organizations from public cloud adoption. These can include unexpected data transfer fees, storage costs, network usage charges, and support expenses.

2 Futurum Intelligence: CIO Insights Survey for Q1 2025

Adopting smart manufacturing presents several challenges for organizations. From our view, these include unknowns of implementing and scaling new technologies and difficulties in integrating legacy systems with new smart capabilities. Also, workforce resistance to changes in key areas such as operations and potential skills gaps are among the top challenges we identify below.

Absence of a Unified Corporate Strategy:
Many manufacturers lack a comprehensive strategy for implementing digital technologies and data-driven processes, impeding the rate of adoption.

Adoption Uncerttainties:
Manufacturing organizations struggle to fully understand how emerging technologies can be incorporated into existing workflows and what their long-term financial benefits might be. This lack of clarity often results in hesitation and postponement of technology implementation initiatives.

Awareness and Perception:
Numerous manufacturing organizations are reluctant to embrace smart manufacturing technologies because they are unaware of the concrete benefits and perceive significant financial and technical obstacles.

Traditional Infrastructure:
Outdated system infrastructure can impede the adoption of advanced smart manufacturing technologies. Older machines often feature complex proprietary interfaces or may not have any digital interfaces at all, making integration challenging.

Perceived Complexity and Cost:
Implementing smart manufacturing technology presents new cost and intricacy unknowns, frequently necessitating specialized expertise and extended trials.

Workforce Resistance:
Employees might feel insecure about evolving roles and job stability, highlighting the need for transparency and active involvement during the implementation process.

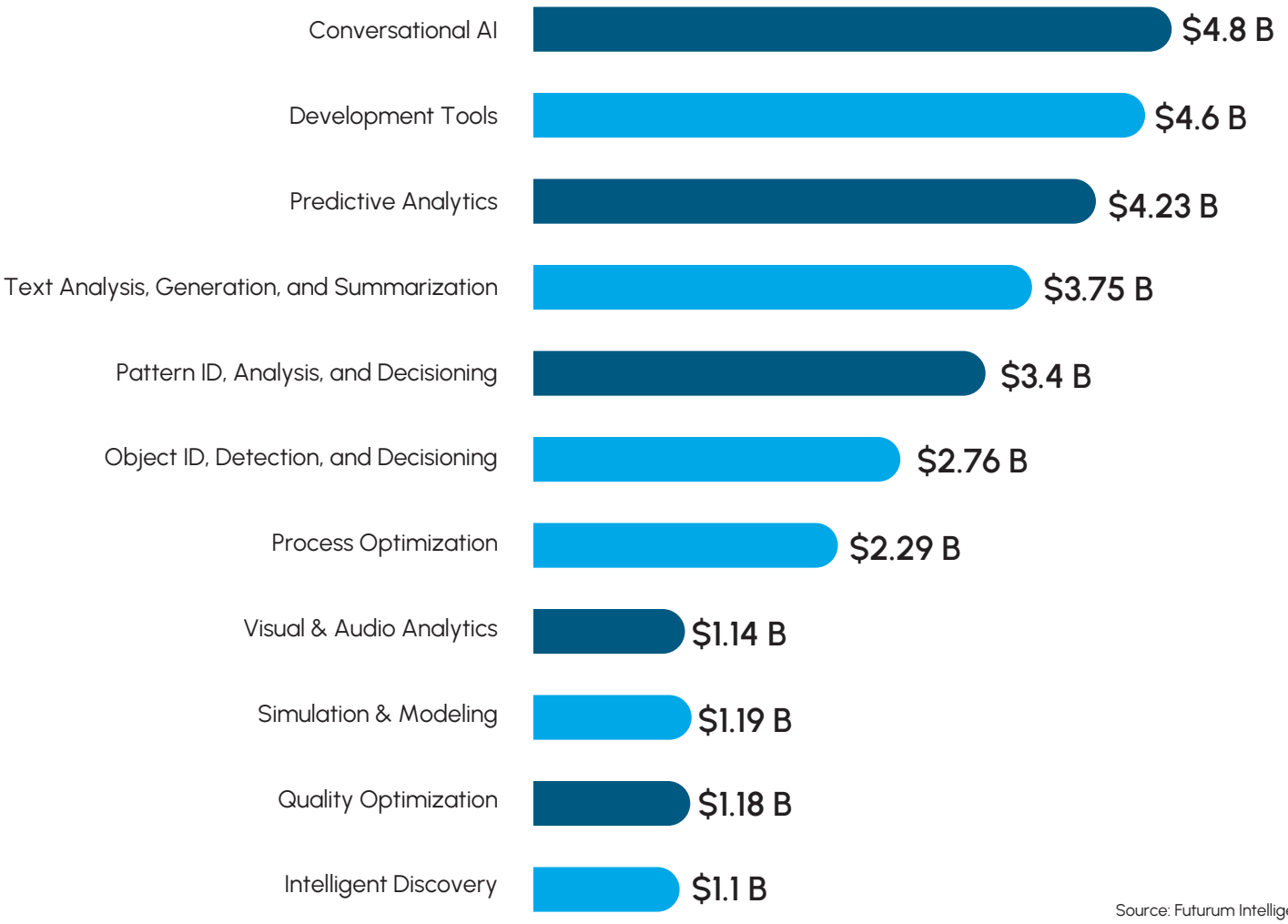
Skills Gap:
A primary obstacle to adoption is the lack of a skilled workforce that can adapt to the growing demands of data-driven and automated work processes.

Cybersecurity Threats:
Smart manufacturing environments face multiple cyber threats, including malware infections, ransomware, denial-of-service (DoS) attacks, and supply chain attacks.

To address these challenges, we find Lenovo offering consulting services, implementation support, and training to help manufacturers navigate the transition to smart manufacturing. Lenovo's own successful implementation of AI-powered solutions in its manufacturing processes serves as a compelling case study for potential adopters.

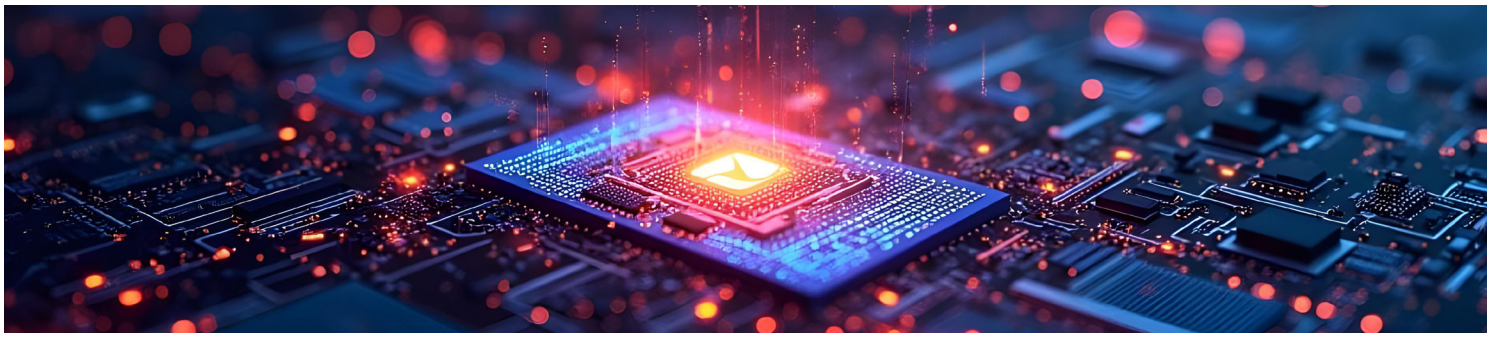
This includes enabling manufacturing organizations to take advantage of the top emerging AI use cases, such as Conversation AI and Development Tools, which fully align with their strategic goals of improving operational efficiencies and business processes.

Figure 1. Q2 2024 Revenue by Use Case (USD)



Source: Futurum Intelligence

The Conversation AI use category led Q2 2024 across all use cases, generating $4.7 billion, which accounted for approximately 15.7% of the global AI software/tools market. The Development Tools and Predictive Analytics use cases followed closely with market values of $4.5B and $4.1B, respectively. These results demonstrate why rapidly growing AI use cases have direct bearing on the manufacturing segment as manufacturing organizations prioritize taking advantage of GenAI capabilities such as conversational AI and predictive analytics.



Section 1: The Smart Manufacturing Advantage

Smart manufacturing solutions offer significant advantages in today's competitive landscape. By leveraging AI-powered technologies, smart manufacturing provides instant productivity gains while balancing supply chain resiliency, operational efficiency, and innovation needs. We see Smart Manufacturing gaining momentum into the foreseeable future as the AI in manufacturing market segment is projected to reach $16.3 billion by 2027, growing at a CAGR of 47.9% from 2022 to 2027.

These improvements not only enhance operational efficiency but also foster innovation and talent retention by automating routine tasks and allowing employees to focus on higher-value activities. As a result, the smart manufacturing approach enables companies to adapt quickly to market changes, optimize resources, and maintain a competitive edge in an increasingly demanding global market. It also enables manufacturing organizations to overcome key adoption obstacles such as reducing adoption uncertainties by demonstrating improved business value outcomes and lowering potential workforce resistance by boosting employee experience.

Implementing GenAI solutions can entail expertise in AI, machine learning, and data management, creating a potential skills bottleneck for organizations. Moreover, the journey from experimental AI pilots to full-scale production is frequently stalled by inadequate IT infrastructure, as these advanced models necessitate extensive computational capabilities that surpass the capacities of many current enterprise technology ecosystems. As such, we see that most organizations (79%) start with discrete AI pilots, while 71% have a well-formed plan for AI implementation, signaling a balanced approach to experimentation and regulation[3]. In response, we find that Lenovo Smart Manufacturing delivers accessible and affordable solutions through its modular and scalable architecture, which enhances production line agility alongside supporting predictive maintenance, enabling businesses to tailor solutions to their specific needs. By integrating advanced technologies such as AI, data management, and IoT, Lenovo ensures that its manufacturing options remain reliable, providing real-time monitoring and automation that improve efficiency and reduce costs for manufacturers of all sizes.

Moreover, the company's Advanced Planning and Scheduling (APS) technology has increased production line capacity by 24%, production volumes by 19%, and on-time deliveries by 3.5X, while reducing production schedule planning time from two hours to just two minutes. Such capabilities underpin Lenovo's ability to boost the workforce experience and fulfill strategic business objectives.

From our point of view, these portfolio-wide capabilities show how Lenovo is addressing the key challenge of many manufacturers struggling with the absence of a well-defined strategy. Also, the demonstrated cost reduction benefits answer upfront cost concerns related to adopting smart manufacturing solutions. Lenovo Smart Manufacturing provides the blueprint needed to integrate digital technologies and data-driven processes, which result in accelerated adoption curves and delivering innovations at a faster pace.

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The Key Role of Data Unification in Smart Manufacturing

Across manufacturing environments, data silos have produced isolated pockets of information across departments and systems, preventing a comprehensive view of organizational data. This fragmentation hinders GenAI's ability to access and use the entire range of available data, limiting its effectiveness in generating accurate insights and predictions.

As such, smart manufacturing solutions must be built to unify access to all data by leveraging AI and digital transformation technologies. This encompasses integrating previously siloed operational systems into a central platform, including intelligent supply and demand planning, procurement, manufacturing quality management, fulfillment, and logistics. The comprehensive approach allows for real-time analysis of data to identify and resolve potential issues. Moreover, this approach can ensure operational efficiency gains by solving manual, painful tasks through unified data underpinned by more implementation of automation.

By committing to digital transformation and exploring AI's full potential, Lenovo has achieved significant improvements in production line capacity, scheduling efficiency, and on-time deliveries. The implementation of these solutions requires a willingness to embrace AI-driven innovation, as evidenced by Lenovo's use of digital twin technology, APS systems, and AI-powered inspection platforms such as Lenovo DaystarCloud XP that assures data privacy; deployed on-premises, designed for hybrid; flexible and modular with cloud technologies, economical, and scalable.

Lenovo Intel Partnership Key to Driving Ecosystem-wide Smart Manufacturing Innovation

The strategic relationship with Intel across the manufacturing industry capitalizes on Intel technologies that have helped accelerate design solutions and improve operations. The partnership directly addresses edge security challenges and provides comprehensive solutions for industrial environments. Their collaboration uses Intel's advanced hardware and software capabilities, including Intel Edge Insights for Industrial, to enable real-time data processing and analytics at the edge, significantly enhancing Lenovo products in meeting worker safety issues, reducing unplanned downtime, improving product quality, and increasing productivity in industrial settings.

Lenovo's vision of Smart Factory and "build anything, anywhere" approach provides great flexibility in addressing manufacturing shifts due to geopolitical factors by leveraging AI-powered solutions and advanced planning systems. Intel technology-based solutions are deployed on premises and in the cloud, offering access to accelerated AI resources for a variety of applications and business needs. Moreover, the relationship enables Lenovo to ease integration of legacy infrastructure as organizations begin or advance their smart manufacturing journey.

By delivering manufacturing-specific confidence and control, Lenovo assures implementing AI-powered solutions that boost productivity and customer satisfaction, such as optimizing production scheduling through APS technology. The company also prioritizes revenue and profit growth through its hybrid AI strategy and significant R&D investments, resulting in double-digit growth across its client device, data center, and solutions businesses, while protecting and future-proofing the organization through enhanced supply chain security and manufacturing efficiency.

Section 2: Holistic Approach Essential to Smart Manufacturing and Overcoming Obstacles

Smart manufacturing requires a holistic, end-to-end (E2E) approach that includes supply chain management to maximize efficiency and innovation. This holistic view enables real-time monitoring and data-driven decision-making, key principles of Smart Manufacturing in key areas such as supply chain management. By integrating AI and real-time data alongside GenAI-enabled chatbots into its logistics system, holistic smart manufacturing solutions can quickly respond to supply chain risks and meet customer demands for on-time delivery.

The holistic approach is vital to successful implementations, especially as it positions smart manufacturing organizations to take advantage of the AI software/tools market, which is projected to reach a value of $238B by 2029 with a compound annual growth rate (CAGR) of 13.4%[4]. Such robust growth is fueled by advancements in GenAI technology, autonomous systems, and predictive analytics, fully aligning with fulfilling topmost smart manufacturing demands.

We anticipate that the robust growth in the AI software/tools segment will fully align with the distinct requirements of smart manufacturing. Specifically, use cases for development tools and text analysis & generation forecast are expected to post high CAGRs of 14.3% and 13.7%, respectively, driven by the high demand for tools that enable the development of multimodal AI solutions (integrating text, images, and audio), as well as those with MLOps capabilities that streamline model deployment, monitoring, and life cycle management for enterprises[5].

Lenovo's E2E approach and SCI capabilities directly speak to the top challenge that many manufacturing organizations lack a well-rounded strategy for adopting digital technologies and data-driven processes, which hinders the pace of their implementation. Additionally, it directly answers supporting organizations to better understand how emerging AI-driven smart technologies can be integrated into their current workflows and potential long-term financial advantages.

Lenovo's supply chain expertise, for instance, delivers comprehensive benefits such as the SCI system's ability to unify supply chain management and transaction systems, providing end-to-end visibility across the entire supply chain. SCI technology continuously analyzes data to identify potential issues and resolve them in real time, enabling the company to adapt resiliently to geopolitical changes and maintain a resilient, globally distributed manufacturing network.

Through offering a comprehensive suite of solutions tailored for manufacturing and engineering, Lenovo's solutions can enable an iterative loop of concept testing and refinement in the early stages of product development. Lenovo's high-performance ThinkPad and ThinkStation P Series workstations, powered by the latest Intel processors backed by "Get Started with Intel

4 Futurum Intelligence Q2 2024 AI Software/Tools Market Report

5 Futurum Intelligence Q2 2024 AI Software/Tools Market Report

AI in Manufacturing" expertise, are specifically designed for demanding tasks such as modeling, 3D imaging, and complex simulations.

These portfolio assets allow engineers to run sophisticated Computer-Aided Engineering (CAE) software for real-time data analysis and faster deployment of actionable insights. Lenovo workstations are ISV-certified, ensuring compatibility with industry-standard applications. Additionally, Lenovo provides supporting peripheral solutions such as high-resolution displays and docking stations, creating a complete ecosystem that enhances productivity and enables faster iteration in the design and manufacturing process.

Why Augmented Intelligence and Industry 4.0 Principles Elevate Smart Manufacturing

Augmented intelligence is a key asset for Smart Manufacturing due to its focus on optimizing human-machine experiences, which differs from traditional AI approaches. This approach enhances human capabilities rather than replacing them, leading to key advantages in manufacturing alongside reducing adoption uncertainties and complexity concerns for customers. Accordingly, Lenovo's augmented intelligence systems provide enhanced decision-making by providing tools and information to help humans make better decisions, improving efficiency and productivity in the manufacturing processes. Plus, through emphasizing collaboration between humans and machines, Lenovo's approach enables more effective problem-solving in complex manufacturing environments.

Smart Manufacturing embodies the core principles of Industry 4.0 by focusing on interconnectivity and IT/OT convergence, which are critical for driving awareness and realization of Industry 4.0 benefits. Lenovo's approach to smart manufacturing leverages advanced Industry 4.0 technologies to create a highly connected ecosystem consisting of intelligent shopfloor solutions that fuse cutting-edge technologies for operational excellence. In addition, the implementation of Industrial Internet of Things (IIoT) devices is enabling real-time data exchange between field devices alongside deployment of edge cloud technologies for seamless connectivity across the manufacturing environment.

Section 3: Hybrid AI Produces AI Business Strengths

The hybrid AI approach brings significant advantages to public, enterprise, and personal data, accelerating AI adoption and intelligent transformation across manufacturing sites of all sizes. Manufacturing organizations need to establish a unified corporate strategy, including unified data management across hybrid environments, to advance their implementation of the digital technologies and data-driven processes as key to optimizing AI/GenAI applications.

This hybrid approach ensures AI can be deployed flexibly across the continuum of multiple environments – on-premises, in the cloud, or at the edge – enabling manufacturers and organizations engaged in manufacturing to optimize their AI strategy and choose the most appropriate deployment model for their needs.

To ensure such advantages, the Lenovo Hybrid AI Advantage can empower manufacturers to turn data and intelligence into business outcomes faster and more efficiently by combining Lenovo's full-stack capabilities and AI Library with NVIDIA's AI software, accelerated computing, and networking.

Lenovo's comprehensive AI portfolio, including AI-optimized devices, enterprise solutions, and cloud-based technologies, delivers personalized experiences, enhances productivity, and provides data protection for work, learning, and home life. Through bridging the gaps between private and public data securely, Lenovo's hybrid AI unlocks new potential for individuals and enterprises alike, delivering Smarter AI for All.

Answering Demand for the Data Privacy and Security Integral to Safeguarding Smart Manufacturing

Smart manufacturing environments encounter various cyber threats, such as malware infections, ransomware, DoS attacks, and supply chain vulnerabilities. Plus, data privacy safeguards are assigned top priority to protect personal information from unauthorized access, reducing the risk of identity theft and other malicious activities. The interconnected nature of these systems poses risks that can potentially disrupt the entire production chains. Lenovo's solutions ensure that cyber threats do not undermine confidence in adopting and scaling smart manufacturing.

Lenovo's data privacy and security portfolio offers robust capabilities to ensure data remains private and secure through on-premises solutions and multi-layered controls. The ThinkShield security portfolio, powered by the Intel vPro platform, is designed to safeguard devices throughout their entire life cycle, implementing layered protections for comprehensive security. This includes Intel vPro safeguards below the operating system (OS), and OS to cloud protection.

The Intel security features can help build trust in the smart manufacturing infrastructure with built-in security and compliance from supply chain to the processors, integrated Lenovo and Intel security features, data protection and responsible AI approach. This includes the use of AI to help protect endpoint devices from advanced cyberattacks. Intel Threat Detection Technology (Intel TDT) augments endpoint security software with AI to uncover cyberattacks that evade traditional detection methods. As such, users gain high-performing experience with AI and memory scanning offloaded from the CPU to the integrated GPU and NPU.

Lenovo's approach includes hardware-based security features such as the Trusted Platform Module chips and full-disk encryption, as well as software solutions for remote management and wiping capabilities. The company's Cyber Resiliency as a Service (CRaaS) integrates AI-powered protection, detection, response, and recovery across digital estates and devices, providing greater visibility and control.

Lenovo AI Transforms Manufacturing Workforce Experience

Lenovo leverages AI throughout its SCM to enhance workforce experience and deliver significant manufacturing benefits. The company's (SCI) solution, an AI-powered platform, analyzes over 800 data sources daily to identify potential issues and propose real-time solutions. This has led to a 60% reduction in decision-making cycle times and a 20% decrease in manufacturing and logistics costs. Such results help Lenovo to overcome cost concerns related to adopting and scaling smart manufacturing solutions.

The AI-driven approach extends to production scheduling, where the company developed an in-house APS solution that slashed schedule creation time from two hours to just two minutes, with 75% of the process now automated. These innovations boost efficiency alongside improving employee satisfaction by enabling workers to focus on more critical tasks.

Open-Source Collaborations Optimize AI

Lenovo's comprehensive AI ecosystem offers a broad portfolio of AI-ready infrastructure solutions, including over 70 products and 150+ turnkey solutions, that are scalable, pre-validated, and optimized for diverse AI workloads, enabling organizations to flexibly experiment with and deploy AI projects.

Moreover, Lenovo collaborates with open-source partners including Intel developers who work directly with both ISVs and the open-source community to optimize applications for performance advances on Intel architecture and technologies. Accordingly, manufacturing organizations can deploy AI faster and easier with Intel's OpenVINO, an open-source toolkit designed to simplify the development and integration of deep learning solutions.

Lenovo works with Red Hat to deliver solutions such as Red Hat Enterprise Linux AI (RHEL AI) on Lenovo ThinkSystem servers, enabling customers to develop, test, and run AI and GenAI models on a trusted foundation built on an AI-optimized operating system.

Lenovo's AI Services help technology and business partners and customers strategically navigate the AI ecosystem by offering a comprehensive suite of solutions, including AI Discover workshops, tailored advisory services, rapid deployment options, and ongoing managed support. This enables manufacturing organizations to identify, implement, and scale AI solutions that align with their specific business goals and readiness levels.

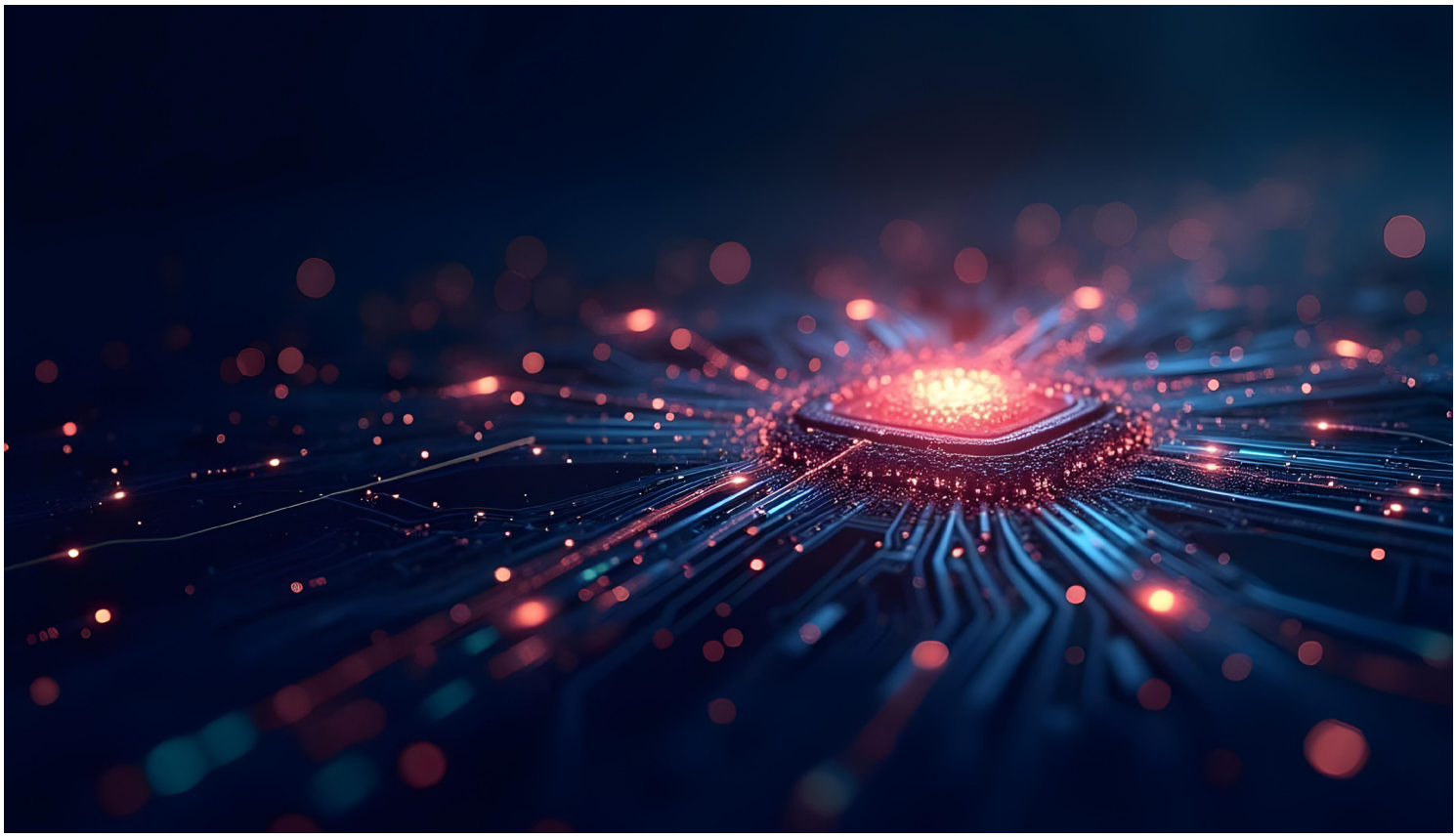
Lenovo's Own Manufacturing Prowess is Key Differentiator

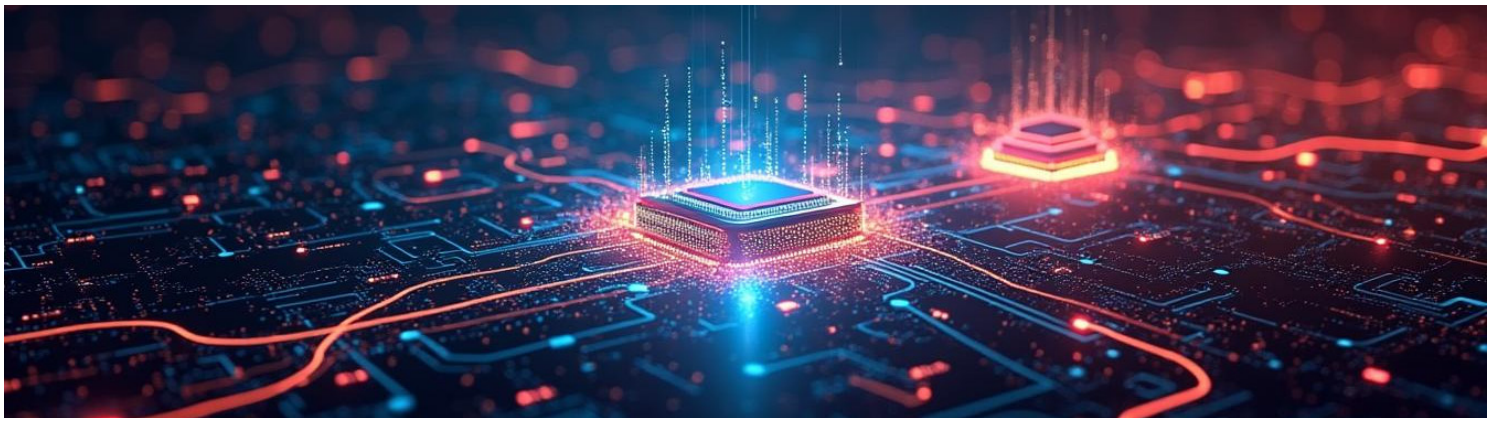
Lenovo's position as a top-tier manufacturer is reinforced by its practice of "eating its own food" – using its own products and technologies internally. As such, Lenovo gains a sharp competitive advantage in meeting the unique requirements across the manufacturing segment. This approach is particularly evident in Lenovo's AI-enhanced data management and device intelligence solutions. The company leverages its heritage of using internal data models to enhance product reliability and performance. Lenovo Device Intelligence, a SaaS tool, utilizes proprietary machine-learned models that run both locally on PCs and in the cloud to analyze telemetry data, pre-emptively identifying potential issues.

This proactive approach helps minimize failure rates, boosts predictive maintenance capabilities, and advances safety-first features across Lenovo's product lines. By applying AI-driven predictive analytics to its own fleet management, Lenovo not only improves its products but also offers these advanced solutions to customers, demonstrating a commitment to data-driven innovation and product excellence.

Delivering Intelligent Sustainability

Lenovo's sustainability priorities encompass the entire manufacturing product life cycle, from using recycled materials in manufacturing and packaging to implementing energy-efficient processes and offering take-back programs. The Lenovo ESG Navigator leverages over 30 AI models for energy efficiency and conservation scenarios, resulting in energy savings exceeding 15% while maintaining user comfort. All of which align with and support the company's overarching sustainability objectives, including its commitment to achieving net-zero greenhouse gas emissions by 2050.





Section 4: Unique Lenovo Advantages

Bringing extensive experience in developing workstation solutions offers significant advantages for the manufacturing industry, enabling the reliable creation of lean and sellable products. Lenovo ThinkPad and ThinkStation P Series workstations, powered by the latest Intel processors, provide breakthrough productivity and performance for demanding manufacturing tasks.

By offering powerful workstations and comprehensive solutions tailored for manufacturing, Lenovo enables faster simulation, visualization, and iterative testing of early-stage concepts, thereby accelerating product development and enhancing the design-to-manufacturing workflow. In taking advantage of chatbot technology, Lenovo is shifting its focus toward training all customer-facing employees to engage in value-driven conversations, moving beyond product-centric or service-centric approaches to better address client needs.

These systems support manufacturing critical technologies such as IoT, AI, cloud, data optimization, and analytics, facilitating the rise of smart factories and enabling real-time data collection and analysis. Lenovo takes advantage of powerful Intel processors that drive Lenovo ThinkEdge clients for advantageous AI performance and efficiency across edge devices and servers.

The ThinkEdge portfolio delivers up to 56% more AI performance for advanced manufacturing edge workloads. The compact yet high-performance Intel powered Lenovo ThinkEdge clients and servers with Lenovo XClarity management software alongside Intel Tiber Edge Platform for development, deployment, management, and scaling of manufacturing applications on standard hardware bring cloud-like agility. As a result, manufacturing organizations can gain competitive advantage through faster productivity and innovation through Lenovo and Intel AI infrastructure solutions, ecosystem, and services.

Through its portfolio, Lenovo meets head-on the key challenge organizations confront in navigating the perceived adoption uncertainties related to migrating over to smart manufacturing capabilities. This consists of better understanding how existing technologies, such as edge computing, IoT, and storage, can be integrated into smart manufacturing workflows and business processes. This reduces the uncertainty that leads to reluctance and delays in initiating technology implementation projects.

By leveraging these integrated hardware and software solutions, manufacturers can streamline their processes, improve product quality, and respond more quickly to market demands, ultimately creating leaner and more competitive products. Lenovo TruScale and its Device as a Service (DaaS) offering demonstrate a comprehensive approach to delivering architecture rather than just point products, showcasing the company's breadth and diversity of solutions support.

TruScale Answers Demand for Private Cloud Assurances

The company's storage solutions and TruScale AI at the Edge provide scalable and cost-effective options for managing and analyzing large volumes of manufacturing data. Additionally, Lenovo's Professional Services have helped companies such as BWT implement smart factory solutions, resulting in a 30% boost in operational efficiency and a 20% reduction in labor costs.

Lenovo's TruScale private cloud capabilities answer the demand for on-premises private clouds to provide organizations with enhanced control over data security, compliance, and sovereignty, allowing them to protect sensitive information and meet stringent regulatory standards. Furthermore, these private clouds offer improved cost efficiency for consistent AI workloads, superior performance with reduced latency, and strengthened capabilities for regulatory compliance.

Ecosystem-wide Partnership Prowess Matters

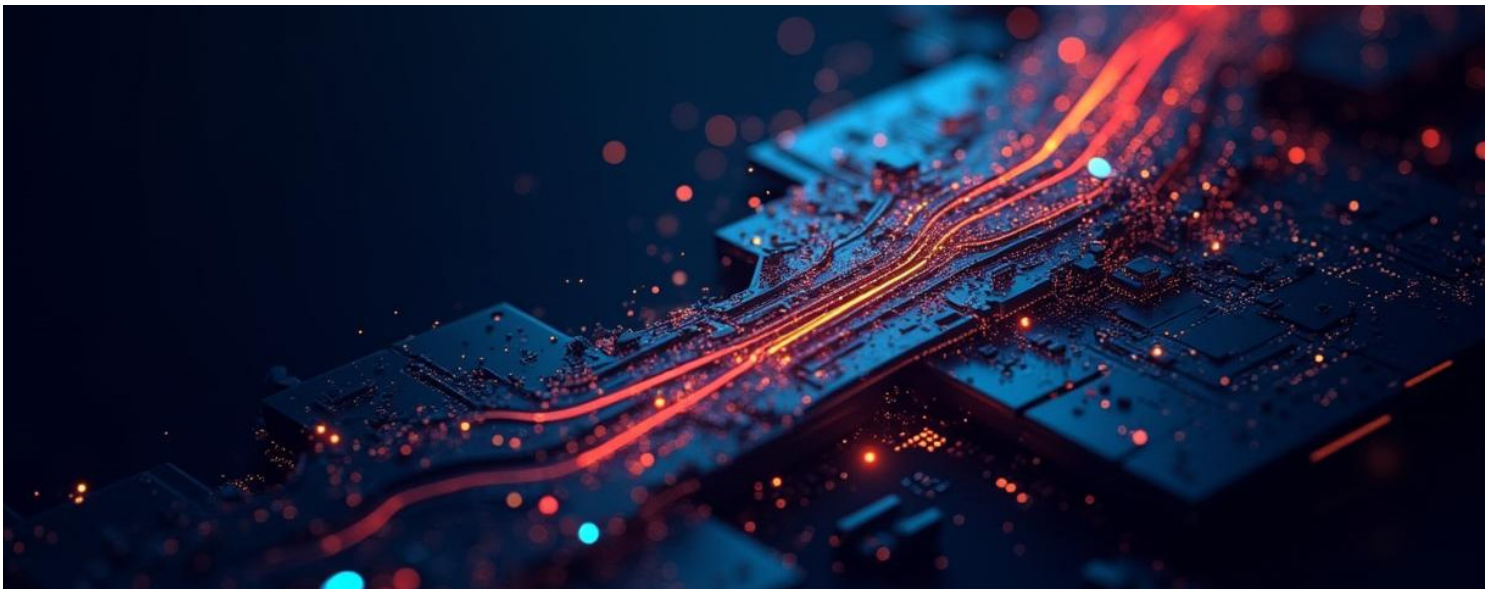
Akin to open-source collaboration being critical to optimizing AI solutions for smart manufacturing, overall partner prowess is vital to advancing overall AI capabilities. Integrated circuit (IC) supplier partners, for instance, need to leverage generative design and AI workflows to transform product development. This integration enables engineers to create the lightest and strongest products by optimizing designs based on predefined engineering criteria. The process uses AI and machine learning to generate multiple design options that meet specific performance goals while minimizing material usage.

These AI-driven workflows can be applied to various manufacturing methods, including injection molding, ensuring that the resulting designs are not only optimized but also manufacturable. By incorporating generative design into daily design processes, Lenovo and its partners are enhancing design integrity and efficiency, allowing for rapid iteration and validation of complex geometries. This approach not only reduces component weights and manufacturing costs but also enables greater customization and improved performance across industries such as automotive, aerospace, and consumer goods.

In our view, Lenovo offers the portfolio range and ecosystem support that are key to providing a competitive edge in CAD and engineering documentation for visualization. For instance, Lenovo's ThinkStation P Series are equipped with high-performance Intel processors and NVIDIA RTX GPUs, enabling efficient creation and rendering of complex 3D models.

Additionally, the integration of Lenovo ThinkReality and TechViz software enables switching between CAD desktop applications and 1:1 scale 3D representation in augmented reality and mixed reality, streamlining the design review process. This holistic approach allows engineers and designers to leverage advanced capabilities such as generative AI, digital twins, and XR technologies, significantly improving productivity and innovation in CAD workflows.

We find that Lenovo offers best-in-class smart manufacturing solutions by leveraging cutting-edge technologies and proven methodologies from its partners across its global operations. The company's Intelligent Transformation journey incorporates intelligent data, AI, and IoT across its 30+ manufacturing sites, resulting in significant improvements in efficiency and output.



Section 5: Conclusions & Recommendations

Overall, Lenovo's Smart Manufacturing portfolio continues to drive digital transformation through its innovative solutions in AI, hybrid cloud, and mission-critical workloads. The company's AI-powered APS technology has a proven track record in significantly improved manufacturing efficiency alongside the focus on AI-driven insights driving the development of technologies such as SCI.

Additionally, Lenovo's commitment to sustainability and security in its manufacturing processes, including the implementation of a zero-trust supply chain and ThinkShield security features, further solidifies its position as a leader in driving the industry's AI-powered transformation. By taking a holistic approach to smart manufacturing, Lenovo not only improves its own operations but also sets a benchmark for the industry, driving innovation and sustainability in the manufacturing sector.

Call to Action:

- Manufacturing organization decision-makers should consider Lenovo Smart Manufacturing across all manufacturing and critical workload environments, achieving a secure, AI-native network, purpose-developed with AI and for AI.
- For the evaluation of the Lenovo Smart Manufacturing portfolio, directly factor in how Intel AI hardware and software help achieve market-leading performance per dollar and power efficiency that can lower the total cost of ownership.

Important Information About this Report

CONTRIBUTORS

Ron Westfall
Research Director | The Futurum Group

PUBLISHER

Daniel Newman
CEO | The Futurum Group

INQUIRIES

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Lenovo is a global leader in PC manufacturing, known for delivering innovative and reliable computers for a wide range of users. Renowned for their ThinkPad series, which is a favorite among professionals, and the versatile Yoga line of 2-in-1 laptops, Lenovo combines cutting-edge technology with durable designs. Whether for gaming, productivity, or everyday use, Lenovo's PCs stand out for their performance, sleek aesthetics, and user-centric features. With a strong focus on sustainability and innovation, Lenovo continues to push the boundaries of computing technology.

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CONTACT INFORMATION

The Futurum Group LLC | futurumgroup.com | (833) 722-5337 |