AI in Manufacturing

Solutions for Addressing Unique Requirements

OMDIA

Introduction

Artificial Intelligence (AI) is revolutionizing the manufacturing sector, offering unprecedented opportunities for efficiency, innovation, and competitive advantage. This e-book explores the current state of AI adoption in manufacturing, delves into the unique challenges faced by industrial AI implementations, and provides strategic insights for successful integration and scaling of AI technologies in manufacturing environments.

AI Adoption and Market Overview in Manufacturing

Examine the global trends and regional disparities in AI deployment.

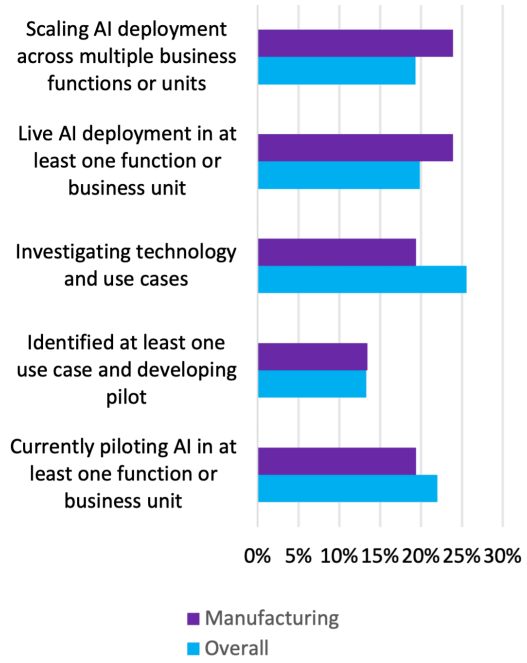
AI adoption in the manufacturing sector is outpacing other industries, particularly among companies with over $1 billion in revenue.

Global adoption trends

- Key drivers include the need for greater efficiency, flexibility, profitability, and addressing skilled worker shortages.
- Large manufacturers are leading the charge in AI implementation.

Current deployment

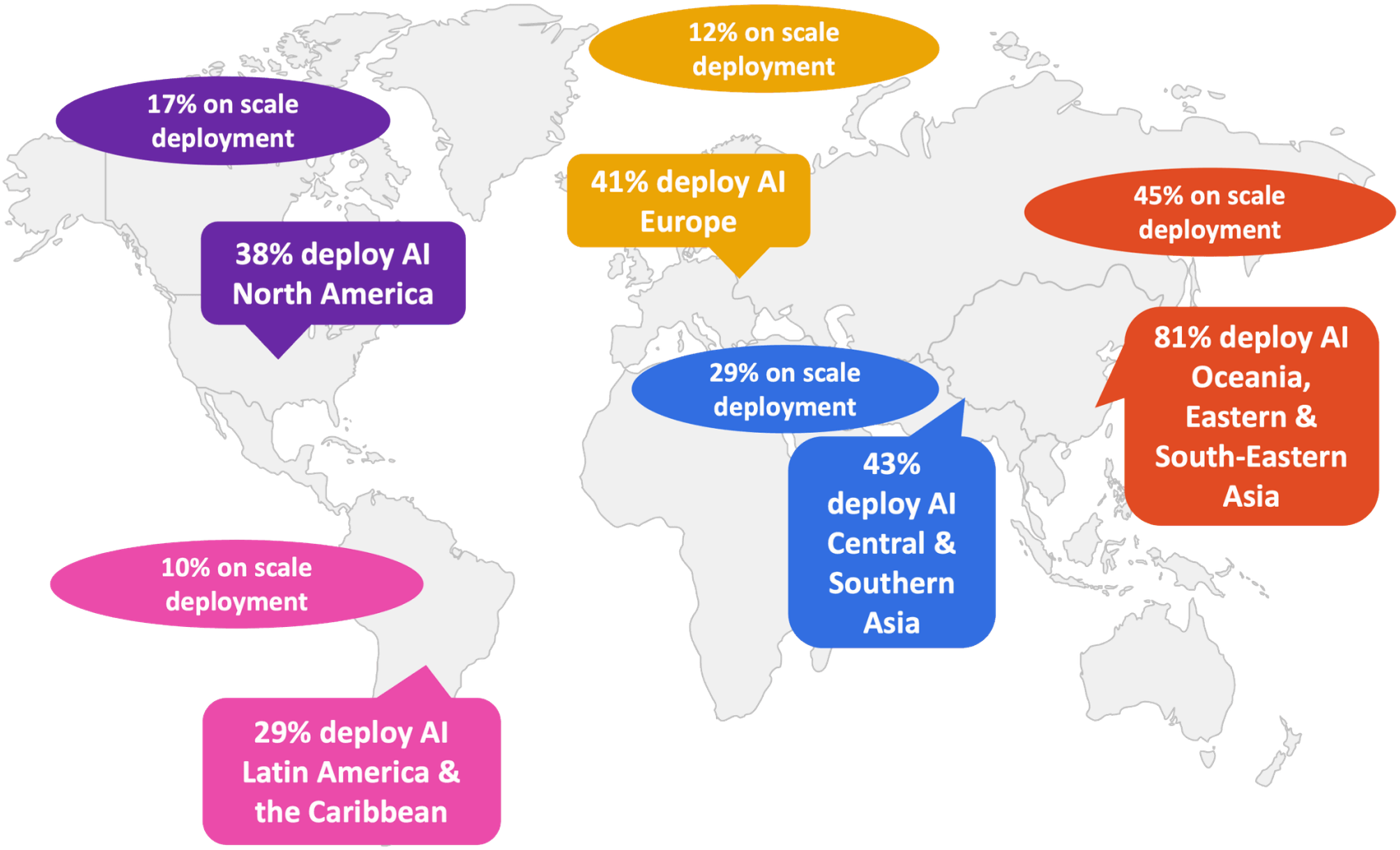
What is the state of AI deployment at your company today?



Source:: Omdia, AI in manufacturing Maturity Survey 2023
Notes: Manufacturing n=67, all n =368

Regional adoption patterns

According to recent Omdia market analysis, Asia and Oceania are at the forefront of AI adoption, with **81%** of companies deploying AI and **45%** doing so at scale. Western Europe and North America are adopting AI more cautiously. This high adoption rate in Asia highlights the region's aggressive push towards AI-driven manufacturing. It sets a benchmark for other regions and raises questions about how this will impact global competitiveness in the manufacturing sector.

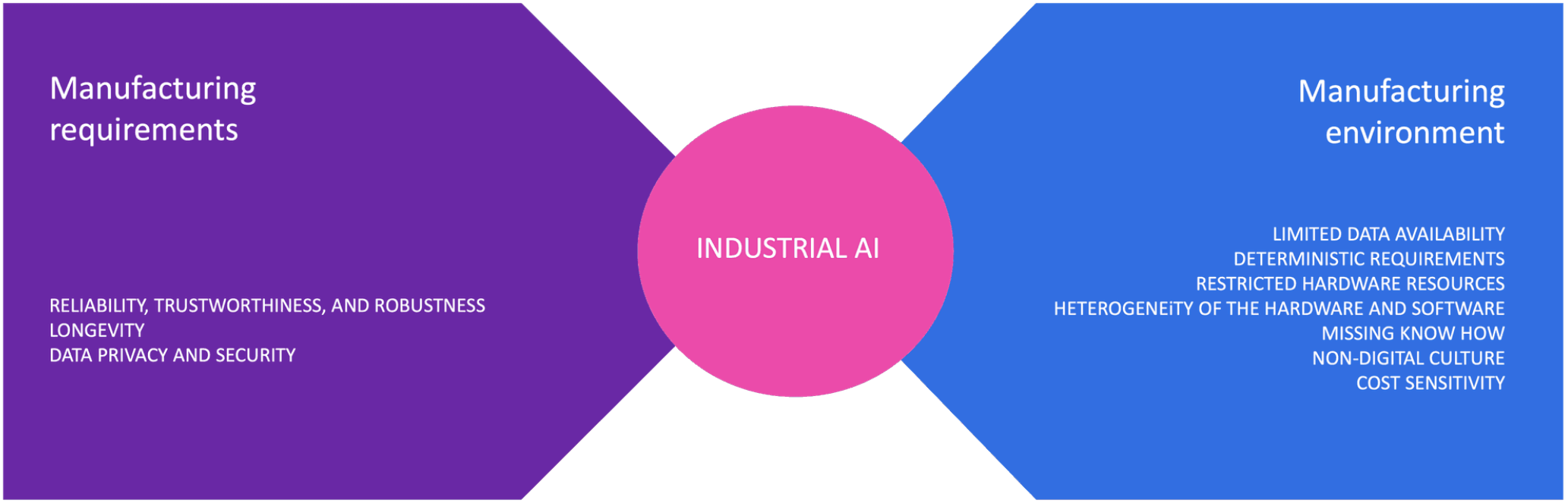


Source: Omdia | © 2024 Omdia

Understanding Unique Requirements for Industrial AI in Manufacturing

The unique challenges for AI implementation in manufacturing

Manufacturing environments present distinct challenges for AI implementation to those in the consumer or IT industries. Some of the unique **requirements that are specific for industrial AI include:**



Source: Omdia

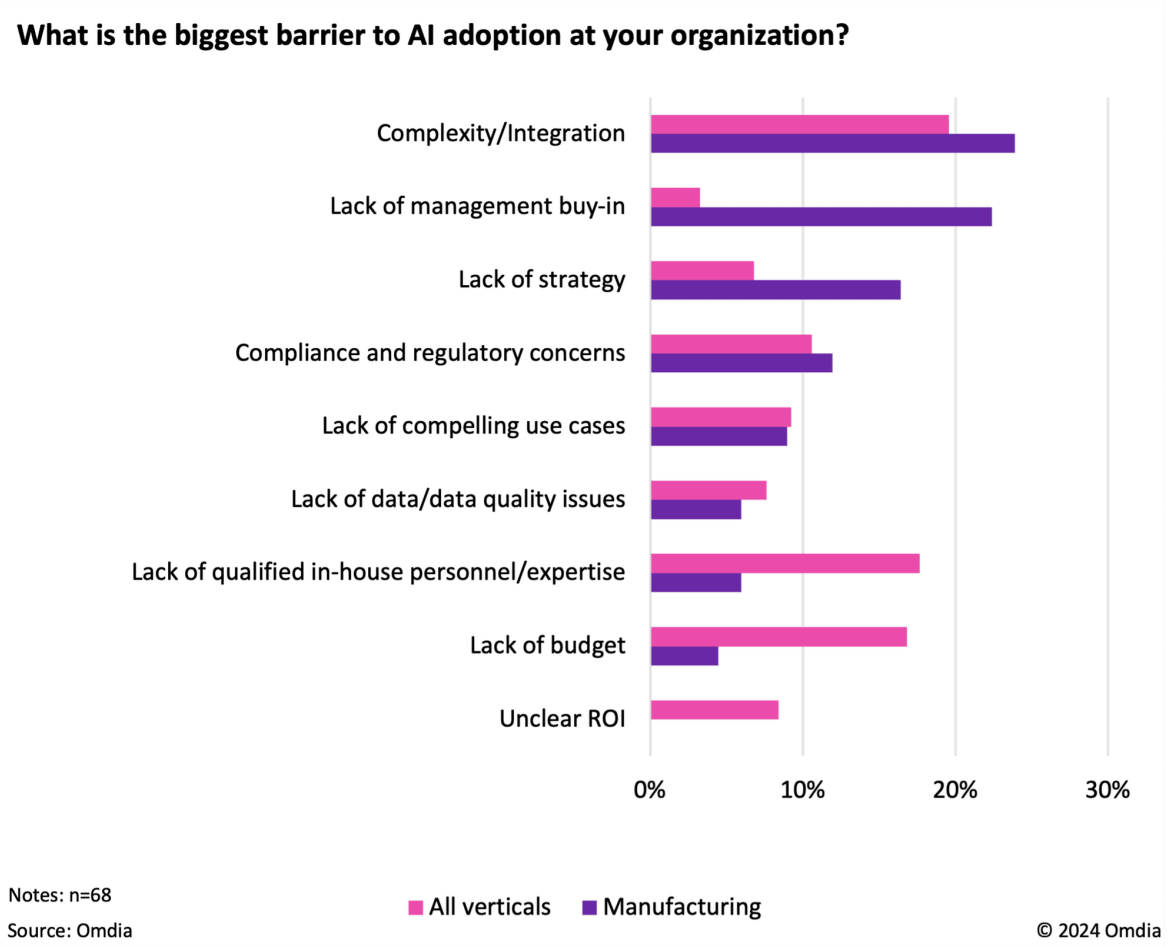
Data Drought: The Primary Obstacle to AI Success

Disparate systems challenge the implementation

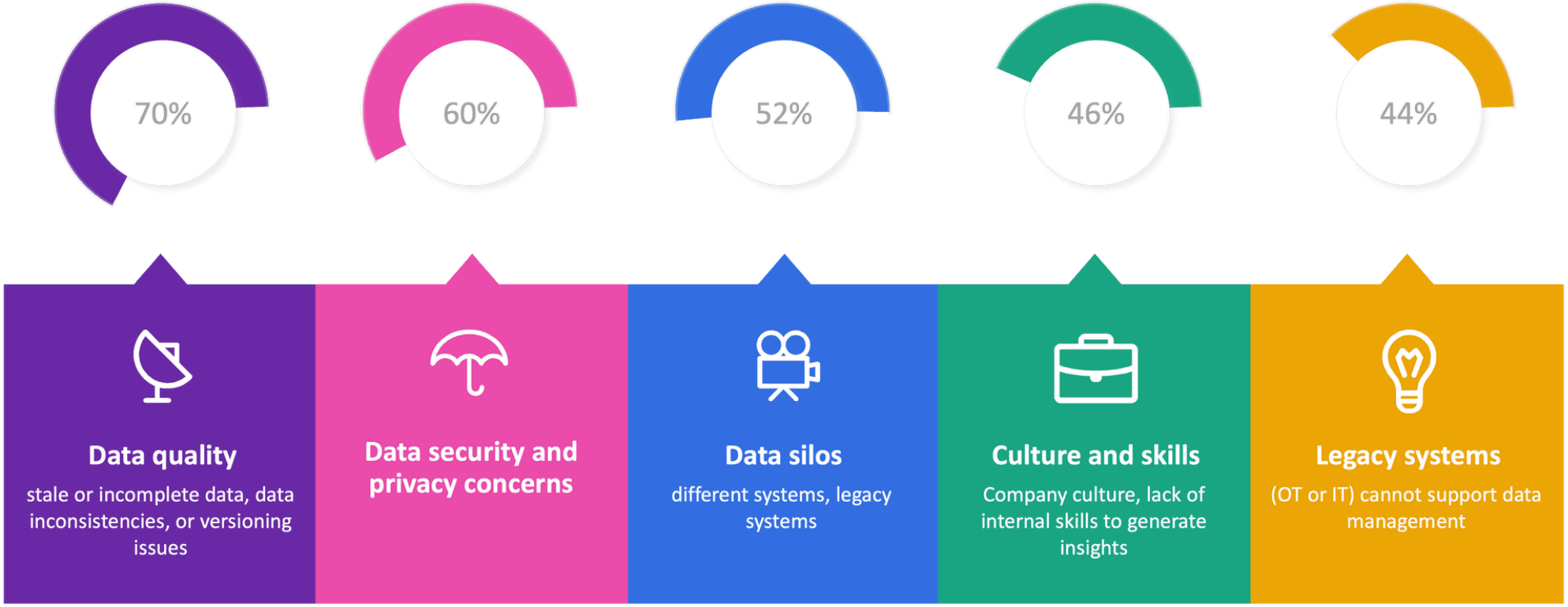
Limited data availability and quality pose significant challenges to AI success in manufacturing. Legacy non-connected equipment and heterogenous hardware, software, and systems, restrict data access and create data silos resulting in varying formats across different systems. According to Omdia's From Data to Decision Survey 2024, **52%** of manufacturers cite data silos as a major challenge for AI implementation.

Challenges in industrial settings

Complexity and integration is the number 1 hurdle when it comes to AI implementation, according to Omdia's AI in Manufacturing Maturity Survey 2023. Complexity was also caused by disparate systems and diversity of legacy systems, protocols, and varying levels of digital maturity.



What are the biggest challenges your organization is facing with your manufacturing data?



Source: Omdia, From Data to Decision Survey 2024, n=208
*Proportion of respondents

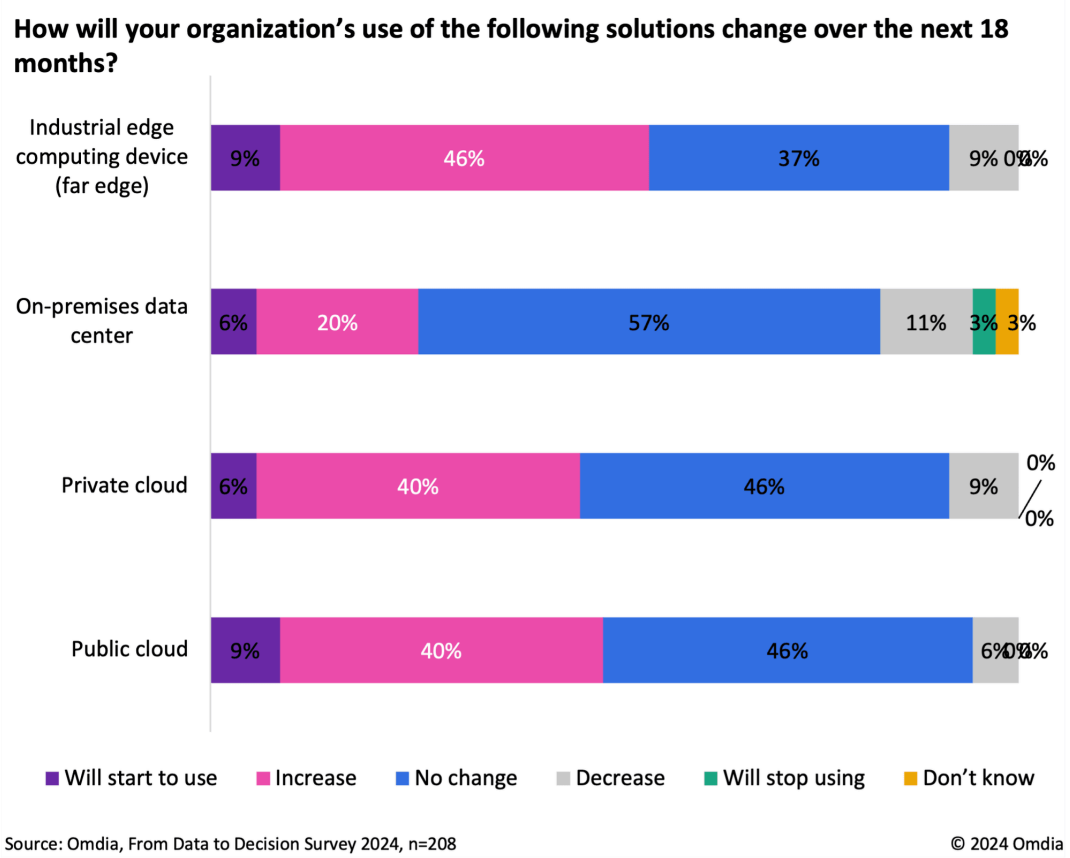
Edge Computing can Act as a Bridge for Integrating AI Applications Across Disparate Manufacturing Systems

Industrial equipment, including IPCs, usually has very restricted compute resources. Devices on the field level often allow the deployment of simple analytic application or data preprocessing. Cloud connectivity is not always available or desirable. Hardware upgrades are slow due to the long replacement cycles. here are two ways of solving the restriction for AI at the edge implementation.

Option one: Hardware upgrades:

AI-capable edge devices and servers being deployed to modernize OT networks: over **40%** of manufacturers plan to increase edge device usage within 18 months, according to Omdia's Industrial Edge 2023 Report.

The emergence of AI PCs is likely to create new opportunities for AI in the IPC. AI processor attach rates for industrial PCs and other edge servers projected to rise from **13%** (2022) to **50%** (2027), according to Omdia's AI Processors for the Edge Forecast 2023

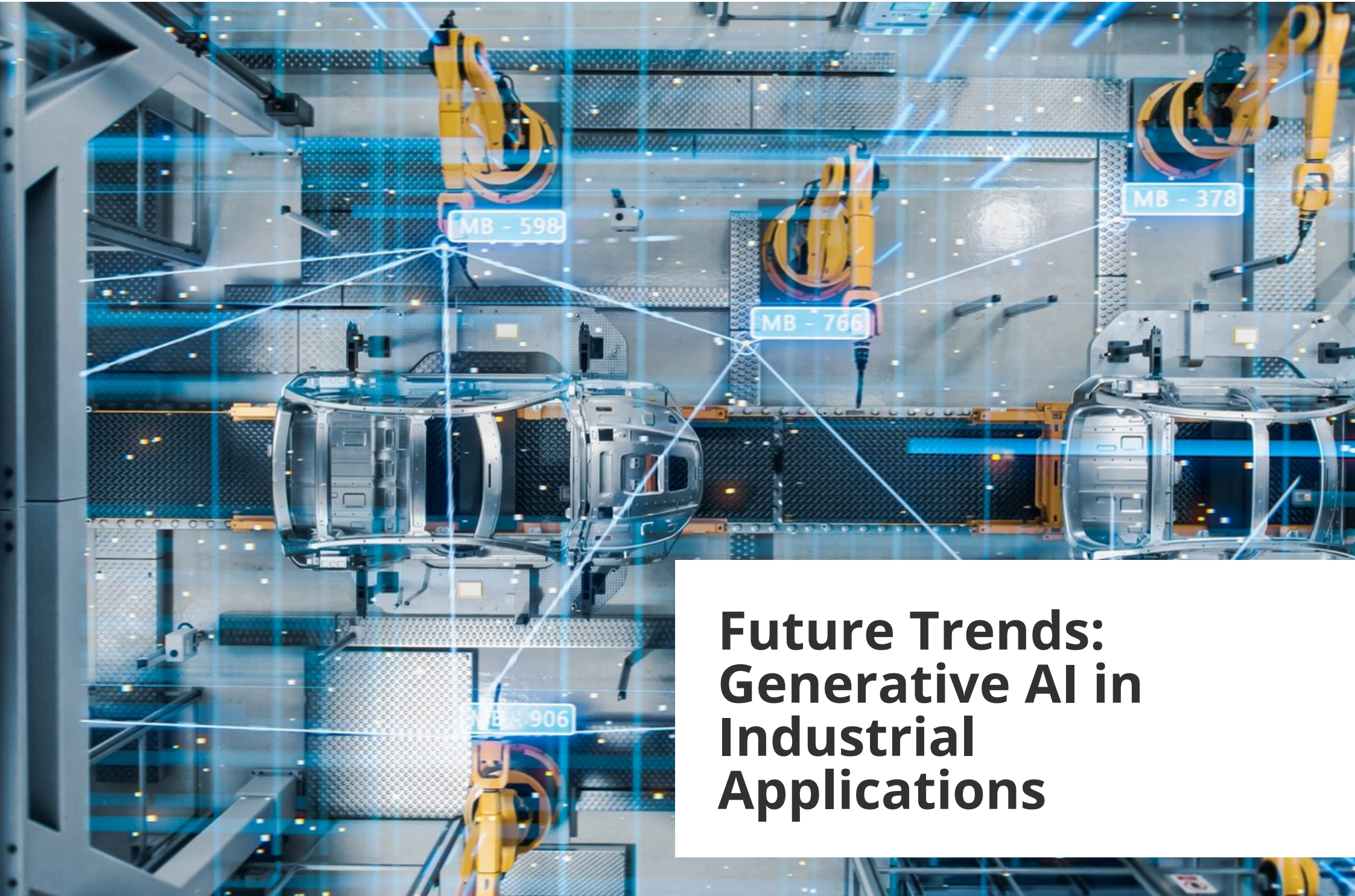


Option two: Usage of lightweight AI designed for restricted devices:

• TinyML brings AI capabilities designed to run on far-edge devices directly, down to the scale of microcontrollers (MCUs). At the same time the MCU industry – led by NXP, STMicro, and Renesas – is building significantly bigger and more powerful devices in the 32-bit MCU class to support the requirement for small AI models. A classic pattern is to train a general-purpose AI model on the data set and then build a statistical model that replicates the results – this both scales the model down for deployment to MCUs and provides for explainability, as the final model has relatively few parameters and their meaning is known.

• With TinyML, devices can also participate in federated learning by performing local training using their own datasets. Integrating TinyML with federated learning enables the development of efficient, privacy-preserving ML applications that can run on resource-constrained devices

The growth of AI large language models (LLM) slowed down in the so-called “large-scale era” since 2018. **Since LLaMa, hundreds of models have appeared** in the 5–50 billion parameter (5–50B) range at the lower end of the gap. Anything with 8GB of available VRAM is now a potential LLM platform. This brings LLMs’ extreme general-purpose capability to the edge and hence to industry.



Future Trends: Generative AI in Industrial Applications

Generative AI is poised to accelerate the adoption and development of AI in manufacturing

Generative AI has the potential to significantly reshape manufacturing processes, including design, knowledge management, operations, and communication.

It holds the promise of revolutionizing customer experiences and boosting overall value for businesses. One key innovation driving this transformation is **multimodality**—the ability of generative AI to handle different media types such as images, video, code, and graphical interfaces.

This capability enables broader applications of generative AI in manufacturing, where diverse data formats are often used for tasks like product design, predictive maintenance, and workflow optimization.

Efficient design for fast time to market

GenAI enables rapid prototyping, optimizing designs based on performance criteria. It allows for customized designs and multiple design options, integrates multimodal capabilities (handling images, video, and text), and enhances collaboration between design teams. GenAI also aids in virtual simulation and testing, enabling digital twin and reducing the need for physical prototypes. It supports data-driven decision-making, improving overall design efficiency and product performance. This applies not only for flexible and agile product design but can be applied for resilient supply chain or production line design.

Coding

GenAI in coding for manufacturing helps streamline the software development process by automating code generation, optimizing existing code, and reducing manual errors. It can enhance workflows by offering real-time code suggestions, translating natural language in the PLC code, debugging, and improving efficiency based on learned patterns from vast datasets. This results in faster, more efficient industrial software development not just to applications but also files for CNC systems, electronic design automation (EDA) tools, PLC, and robotics.

Knowledge management, documentation

One of the most common GenAI tasks is to summarize information, whether textual, images, other, or mixed, and to organize it in a desired format and create content. It can be used for any kind of automated creation of required documentation or question answering, such as customer requirements, documentation, internal chatbots, maintenance and customer service assistants.

Customer and user experience

Conversational AI has applications customer interaction. It holds the promise of revolutionizing customer experiences and boosting overall value for businesses offering personalized products and services, products recommendation, collaborative design process and enhancing customers interaction with AI chatbots and virtual assistants offering 24/7 trouble shooting and product support. It delivers feedback loop for continuous improvement based on customers' feedback.

Analyst Recommendations

As AI continues to transform the manufacturing landscape, organizations must navigate complex challenges to harness its full potential. Key takeaways for successful AI implementation in manufacturing include:

Scaling

- Highly customized AI projects limit ROI. Scalable approaches, supported by robust and scalable hardware and software infrastructure and data management, are crucial for success.

Ecosystem development

- Integrating AI into the manufacturing ecosystem requires a complex blend of technologies, processes, and stakeholders, from data access and IoT-enabled devices to multimodal AI applications that support and create value for customers and vendors.

Value creation

- Value creation for both customers and vendors is challenging. Customers expect increased value with scale, yet scaling AI projects proves difficult. Meanwhile, vendors also struggle to achieve ROI on their products within the supply chain.

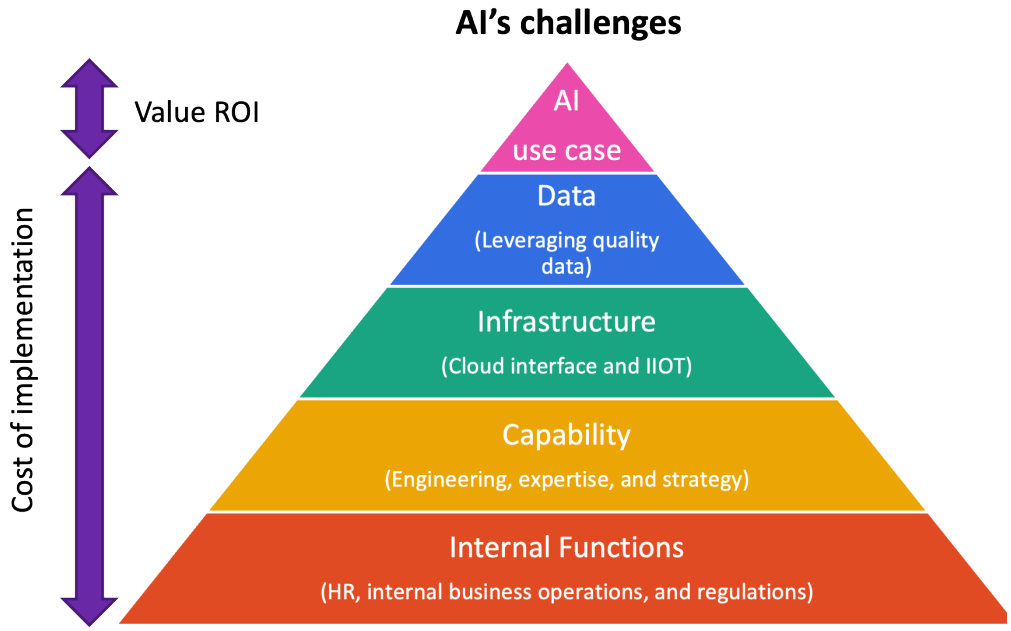
Transformation of mindset

- The collaborative nature of AI projects, with multiple handovers, demands effective teamwork across departments and a culture of collaboration. Embracing the probabilistic nature of AI requires a mindset shift, as well as managing uncertainties and applying the right technology in the right context to maximize AI value.

To increase the value of AI applications and their adoption, manufacturers must focus on:

Value Creation:

Value creation for both customers and vendors is challenging. Customers expect increased value with scale, yet scaling AI projects proves difficult. Meanwhile, vendors also struggle to achieve ROI on their products within the supply chain.A key issue is the misunderstanding of the AI development process. Customers frequently overemphasize model development while neglecting critical areas like data curation and system design—both essential for success. One of the biggest problems is the mismatch between fast-developing software and AI layers, and industrial machines with design lives in the decades. It is important to think **about how your AI application will be evaluated, maintained, and re-invented.**



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Thank you for reading

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