Accelerating Smart Manufacturing with AI-Ready Infrastructure

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Manufacturers Today Face Multiple Challenges

Discrete manufacturing organizations in industrial machinery, heavy equipment, and automotive navigate complex realities across multiple dimensions — from evolving product ecosystems and sophisticated production processes to expanding data environments and shifting customer expectations.

Forward-thinking manufacturers are increasingly asking the question, **how can AI specifically address our operational needs? In particular, they're seeking solutions for the following:**

Massive amounts of data exist from digitally enabled and connected products, assets, resources, and people. By 2030, according to IDC's 2024 datasphere research, manufacturing organizations (all industries collectively) will be managing, on average, 90 exabytes of data per day from their assets and processes.

Environmentally sustainable and energy-efficient assets must be in place and meet customer expectations, regulatory requirements, and financial goals.

Quality and safety must be assured throughout the plant — assets, production processes, and work environments — while ensuring high-quality products and customer experiences.

Global supply chain disruption is a constant, whether through unexpected events, fluctuating demand, parts shortages, or geopolitical or global trade issues.

The workforce is declining due to retirement and new, younger workers not entering the manufacturing sector. The focus is on how they balance augmentation and enablement through digital tech, such as AI.

Evolving from Industry 4.0 to Industry 5.0

A human-centric, AI-augmented approach to flexible, digital manufacturing must be in place to address these challenges:

Human-centric approach

The primary goal is to enhance human creativity and decision-making by employing advanced technologies as support tools. Unlike Industry 4.0, which often prioritizes efficiency at the expense of human input, **Industry 5.0 seeks to empower workers, often in conjunction with new tech such as collaborative robots (or "cobots") and AI.**

Personalization and customization

Industry 5.0 allows for greater personalization in production processes, meeting the individual needs and preferences of customers with the help of AI and human creativity.

Sustainability

Industry 5.0 takes a more holistic approach to sustainability, considering the environmental impact of industrial processes and the social and economic implications. **By emphasizing collaboration between humans, machines, and AI, it seeks to create more sustainable business practices** that prioritize the well-being of people and the planet.

Supply chain resiliency

A core tenet of Industry 5.0 is to **flexibly predict and respond to demand and customer needs,** and the approach has seen enhancements through AI, simulations, and digital twins.

AI Use Cases in Manufacturing:
Opportunities and Key Roadblocks

Strategic Asset Management	Asset instrumentation	Centralized asset monitoring and diagnostics	Augmented maintenance	Asset performance management	Autonomous asset tracking	Factory/operation document automation and mgmt.	Carbon tracking/ footprint mgmt. — factory/operations
Resilient Lean	Yield management		Resource management		Optimized materials consumption	Operational health and safety	Make-to-availability
Comprehensive Quality	Manufacturing intelligence		Cognitive root cause		Risk and compilance		Process performance feedback

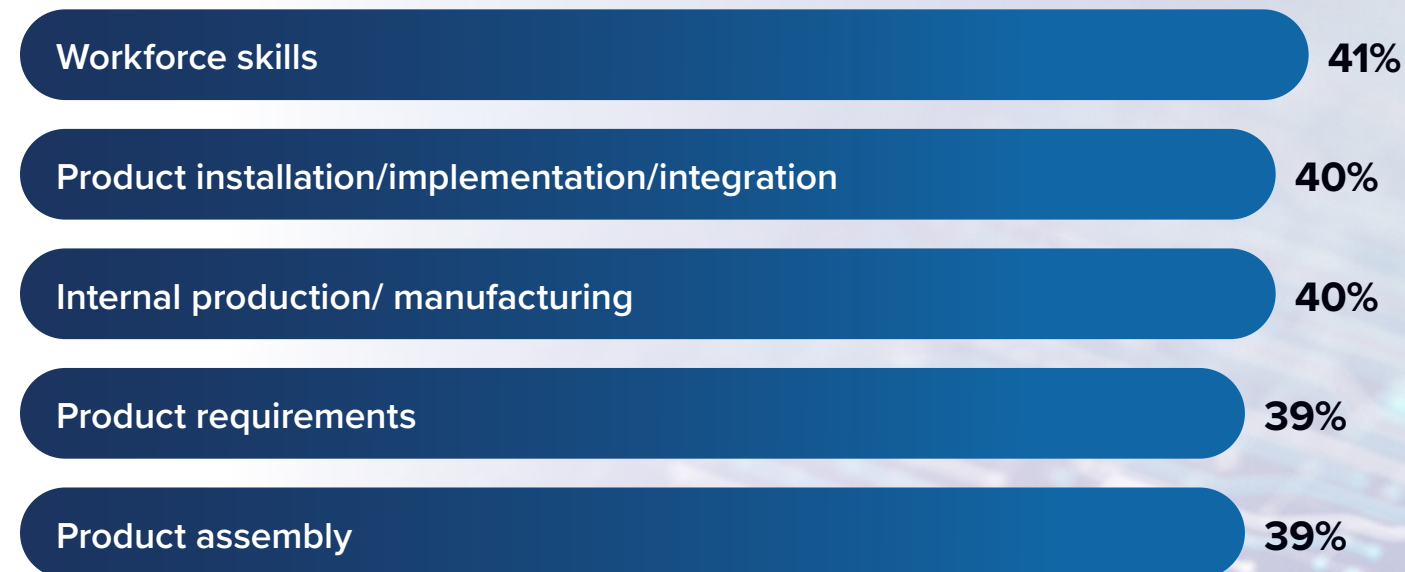🚧 **Roadblocks to AI in Manufacturing:**

▶ Organizational inertia

▶ Disconnected data, not a unified foundation

▶ No governance strategy and platform in place

▶ Security and compliance concerns

▶ Inadequate enterprise-to-edge architecture and technology

▶ Inability to keep up with rapidly changing technology

Ensuring Enterprise Quality and Workforce Optimization Are Leading Challenges for the Modern Manufacturer

A modern cloud-to-edge AI architecture can help address leading challenges.

What are the top 5 primary causes of product quality issues for your organization?

Challenge	%
Workforce skills	41%
Product installation/implementation/integration	40%
Internal production/ manufacturing	40%
Product requirements	39%
Product assembly	39%

Source: IDC's *2024 Product Quality and Digital Transformation Survey,* June 2024

A Cloud-to-Edge, AI-Powered Architecture Enables a Resilient Supply Chain — Top Priorities Are Infrastructure and Platforms

What are the top 3 priorities for your supply chain over the next 12 months and in the next three years?

■ 12 months ■ Next three years

Reduce costs/eliminate waste/drive efficiency
- 22%
- 12%

Continue to modernize/update IT-related supply chain infrastructure
- 20%
- 13%

Improve supply chain resiliency (visibility/agility)
- 20%
- 10%

How important are the following technologies to your supply chain?

■ 12 months ■ Next three years

Supply chain cloud platforms
- 27%
- 22%

Generative AI
- 26%
- 30%

Supply chain SaaS/cloud applications
- 24%
- 20%

Artificial intelligence/machine learning
- 23%
- 28%

Smart mobility/mobile devices
- 23%
- 18%
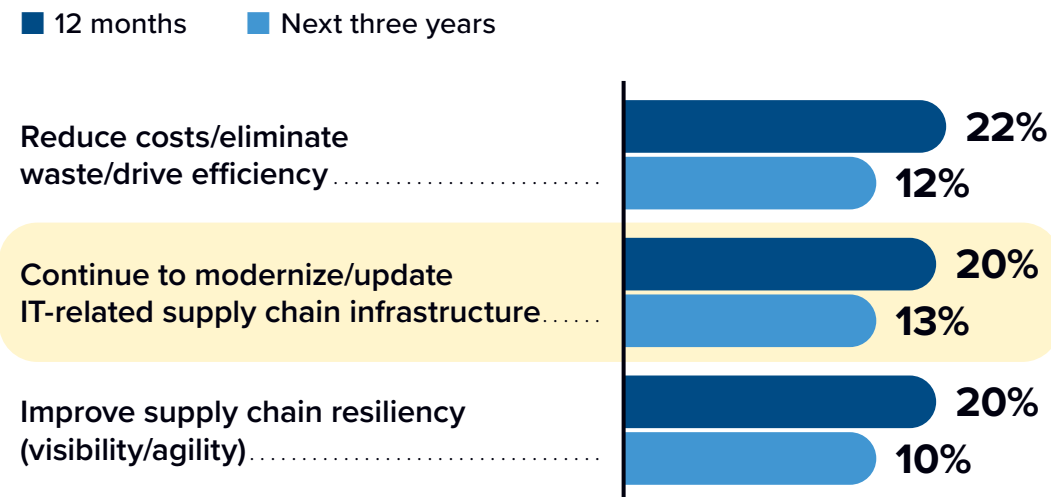
n = 672; Source: IDC's *Supply Chain Survey*, April 2024 | For an accessible version of the data on this page, see Supplemental Data in the Appendix.
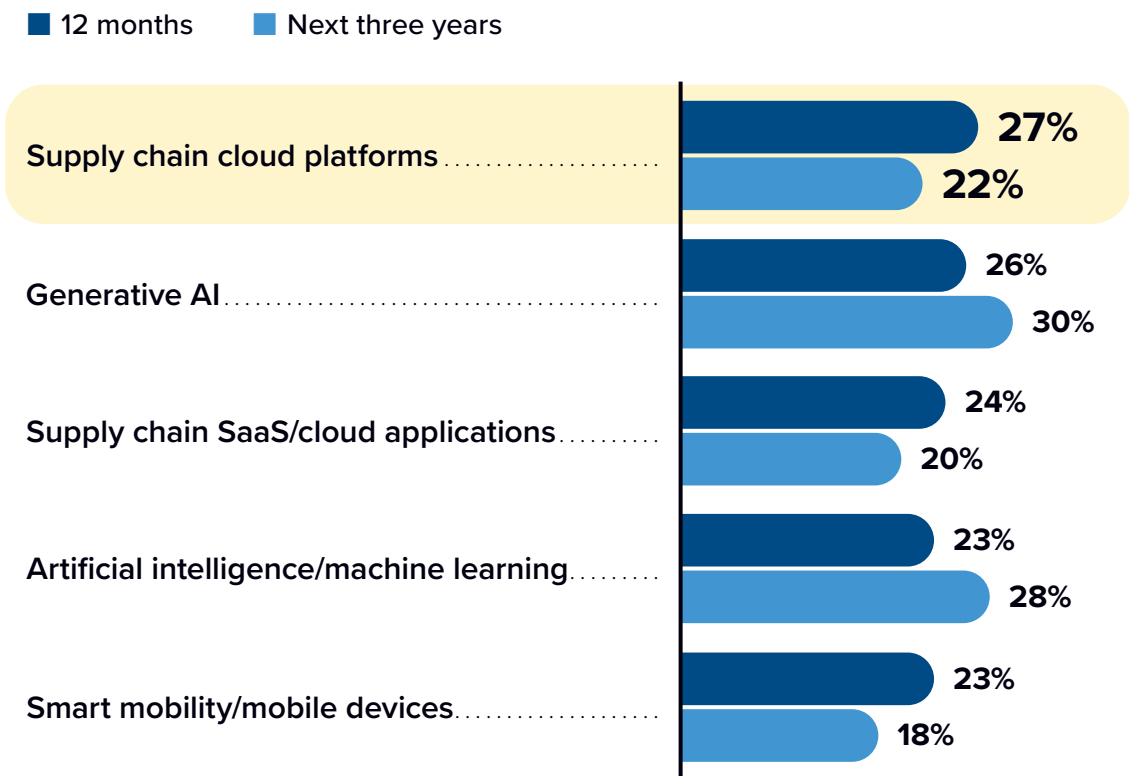
n = 672; Source: IDC's *Supply Chain Survey*, April 2024 | For an accessible version of the data on this page, see Supplemental Data in the Appendix.
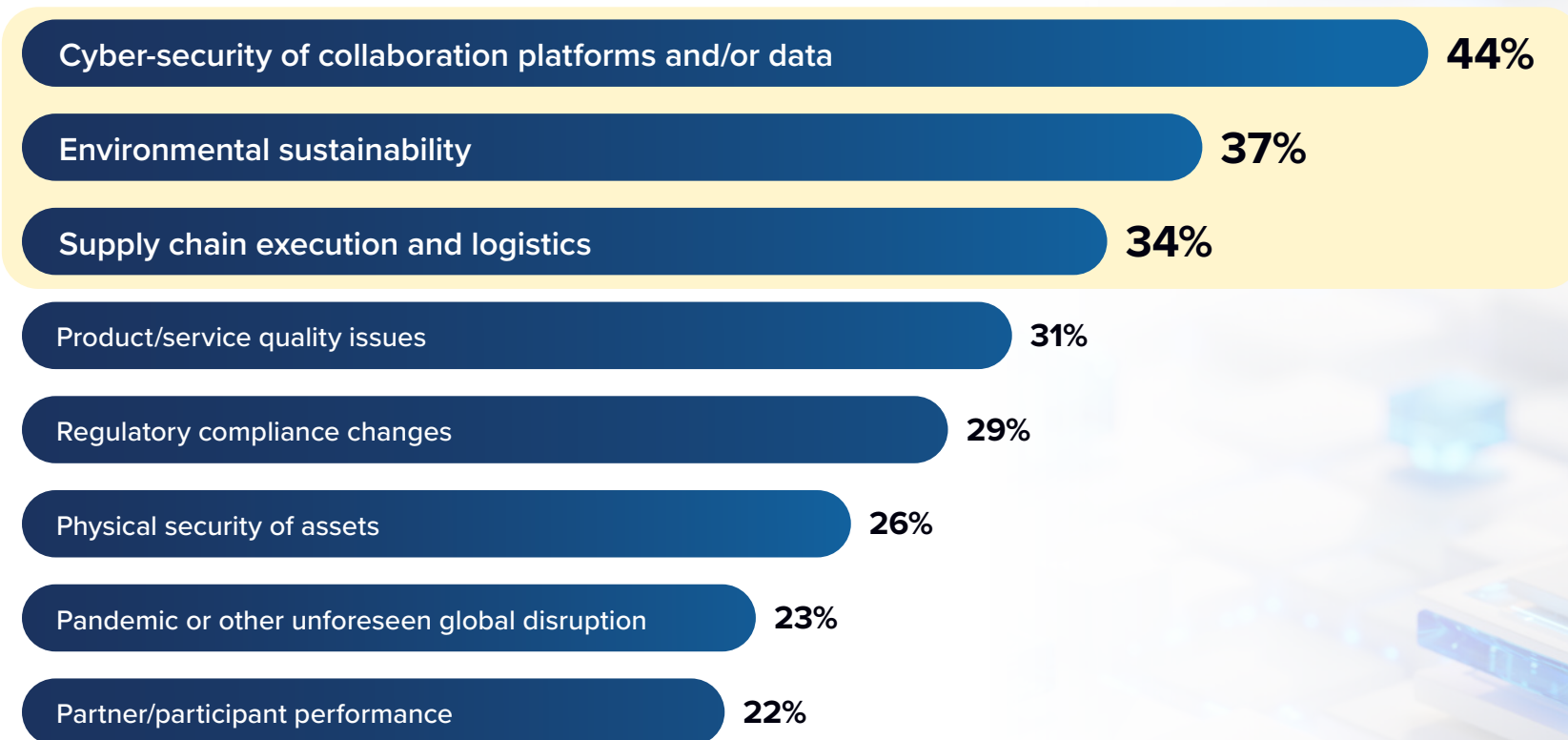
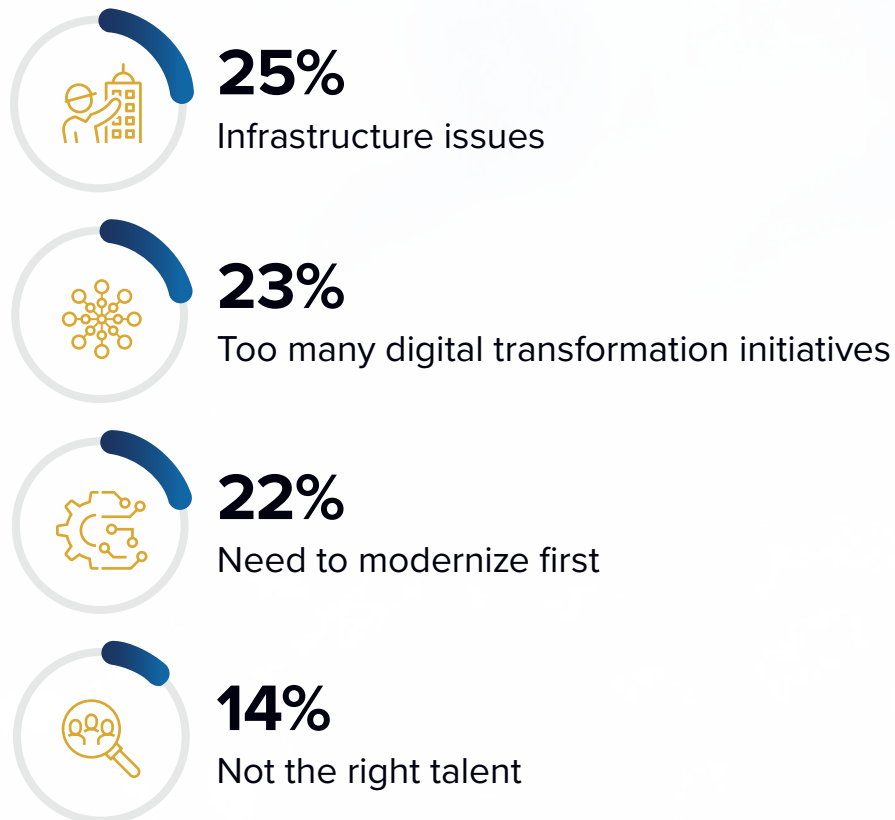# Top Risks to Mitigate in the Manufacturing Industry Ecosystem

What are the three most important areas of risk to mitigate in your industry ecosystems?

Risk Area	Percentage
Cyber-security of collaboration platforms and/or data	**44%**
Environmental sustainability	**37%**
Supply chain execution and logistics	**34%**
Product/service quality issues	**31%**
Regulatory compliance changes	**29%**
Physical security of assets	**26%**
Pandemic or other unforeseen global disruption	**23%**
Partner/participant performance	**22%**

n = 504; Source: IDC's *Future Of Industry Ecosystems Global Survey,* August 2024

A Modern Cloud-to-Edge Architecture That Scales with Your Business Is Critical for AI Success

What is the primary issue holding your organization back from pivoting to AI more quickly?

25%
Infrastructure issues

23%
Too many digital transformation initiatives

22%
Need to modernize first

14%
Not the right talent

What are the best practices for addressing these issues?

▶ Start with the proper design of IT and OT cloud-native architectures.

▶ Initiate small reference implementations before scaling.

▶ Utilize reference architectures to validate deployment.

▶ Facilitate edge orchestration of applications and data models to ensure consistent productivity and quality.

▶ Provide the latest rack server technology for training, inferencing, and retraining.

▶ Automate cloud deployment, onboarding, connectivity, and monitoring.

n = 1,534; Source: IDC's *2025 AI-Fueled Organization MaturityScape Benchmark Global Survey,* Feb 2025

Real-World AI Use Case: Predictive Maintenance and Quality Control (byteLAKE)

Powered by Lenovo's Edge Infrastructure and Intel's XPU Technology

Predictive maintenance

- ▶ Predicts downtime to enable data to drive decision-making

- ▶ Puts data into context, correlates sensor readings with history, and helps make better decisions

- ▶ Learns from historical breakdowns, filters irrelevant alarms, and improves maintenance strategies over time

Production optimization and quality assurance
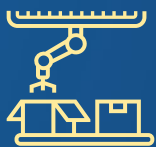
- ▶ Analyzes production data and helps industries reduce waste and become more efficient

- ▶ Diagnoses hidden root causes in production to prevent costly errors and improve quality

- ▶ Provides AI assistant that understands systems and documents to automate tasks and deliver real-time insights

Overall Benefit

The byteLAKE solution connects existing data from CMMS, SCADA, and MES, as well as real-time data from sensors, to perform analytics in context. It presents data in a multimodel and multimodal way that ensures high performance, safety, and quality.

Real-World AI Use Case: Computer Vision and Process Planning (Fogsphere)

Powered by Lenovo's Edge Infrastructure and Intel's XPU Technology

Advanced computer vision

▶ Combines contextual video feeds analysis with IoT data, manuals, and inspection reports; schedules service in the event of an equipment failure

▶ Facilitates the identification of root causes for equipment-related incidents through Generative AI-driven analysis, leveraging manuals and historical knowledge bases

▶ Notifies workers of safety issues in real time (e.g., too close to equipment, driving forklifts too fast)

Manufacturing process planning

▶ Enables safety managers, ops VPs, and plant management to see trends/anomalies and get a historical view

▶ Uses a built-in VLM (Visual Language Model) for rapid event processing to determine risks

▶ Enables the system to scale depending on the number of cameras that capture events and the client's data retention needs

Overall Benefit

Fogsphere leverages generative AI and IoT integration to ensure safety, security, and operational efficiency, combining visual analytics and the multiple data sources that exist in manufacturing facilities.
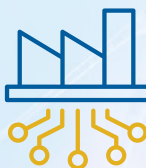
Essential Guidance for Manufacturers Transforming to Become AI-Fueled

Starting: Consider how your organization can benefit from AI. Include the key dimensions and subdimensions for your AI approach: strategy, people, and technology.

Evolving: Pivot and align to a structured AI approach. Institute a COE that your CIO or chief AI officer leads.

Transforming: Build your AI data foundation with iterative input from internal and external sources. Establish a unified data-governance model that spans all forms of AI, internal and external to your organization. Ensure there is continuous auditing of AI responses to guard against bias, drift, and incorrect conclusions from AI and agents.

Optimizing: Evolve into an AI-fueled organization. Complement GenAI deployment with agentic usage that augments workers and ecosystem partners. Orchestrate autonomous AI agents across the organization that complement GenAI use and other forms of AI that improve productivity and automation, data, and workflow decision-making.

Utilize the Lenovo and Intel technology and team combination to empower your AI efforts to support data visibility and decision-making, enterprise quality, and human augmentation across the manufacturing process chain.

Appendix: Supplemental Data

The tables in this appendix provide an accessible versions of the data for the complex figures in this document. Click "Return to original figure" below each table to get back to the original data figure.

SUPPLEMENTAL DATA FROM PAGE 7

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n = 672; IDC's *Supply Chain Survey,* April 2024

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SUPPLEMENTAL DATA FROM PAGE 7 (RIGHT SIDE DATA GRAPHIC)

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Smart mobility/mobile devices	23%	18%

n = 672; IDC's *Supply Chain Survey,* April 2024

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About the IDC Analyst

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As Research Vice President, Manufacturing Insights, Industry Ecosystems, and Business Networks at IDC, Jeffrey Hojlo leads one of IDC's Future Enterprise practices at IDC — the Future of Industry Ecosystems. This practice focuses on three areas that help create and optimize trusted industry ecosystems and next-generation value chains in discrete and process manufacturing, construction, healthcare, retail, and other industries: shared data and insight, shared applications, and shared operations and expertise. Hojlo manages a group focused on the research and analysis of the design, simulation, innovation, product life-cycle management, and service life-cycle management (SLM) market, including emerging strategies across discrete and process manufacturing industries, such as product innovation platforms and the closed-loop digital thread of product design, development, digital manufacturing, supply chain, and SLM.

[More about Jeffrey Hojlo]

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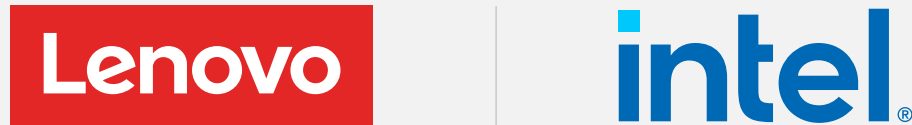
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