The evolution of automation in Warehousing and Logistics

How operations evolved — and how Al is driving the next leap forward

Infographic

Warehousing was entirely human-driven.

Manual labor

Workers manually moved products, tracked inventory on paper and relied on verbal communication and intuition to manage operations.



High risk of human error

and task repeatability

Challenges

- Slow, inconsistent throughput
- Safety hazards from repetitive, heavy labor Little to no operational data

>>> How companies adapted at the time

To improve consistency and reduce fatigue, manufacturers began introducing basic tools

like carts, manual lifts and checklists. These efforts focused on worker efficiency

This phase introduced machines that could assist or replace repetitive physical tasks—conveyors, forklifts, palletizers and fixed industrial robots.

Mechanical automation

These systems increased speed and safety but lacked data intelligence.

Higher throughput



1990

2000

2008

2025

Reduced labor dependency Safer work environments

Improvements:

- Standardized workflows

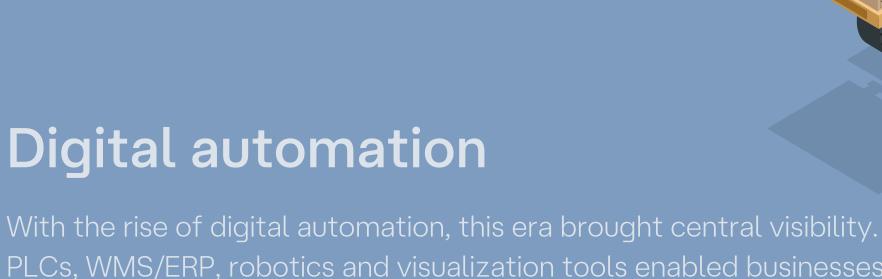


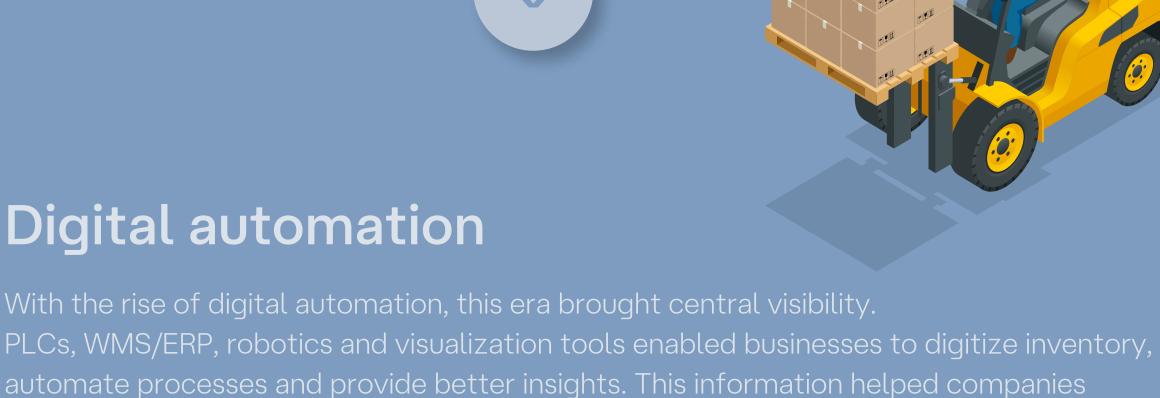
requiring scheduled maintenance and manual monitoring.

>>> How companies adapted at the time

plant layouts to optimize flow. Most systems ran independently,

Operations invested in semi-programmable automation and began organizing





Real-time status tracking

Faster decision-making

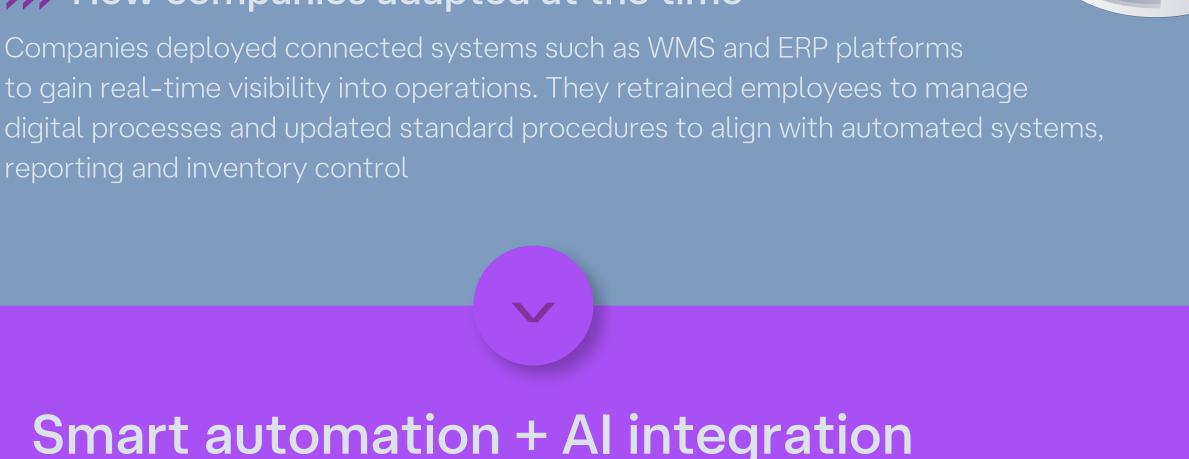
monitor operational performance and KPI results.

Improvements: Greater accuracy and traceability



Integrated reporting and dashboards

>>> How companies adapted at the time



decision-making across the supply chain.

Core elements like adaptive robotics, sensor-

driven insights, scalable cloud-edge systems

and Al-assisted optimization are reshaping

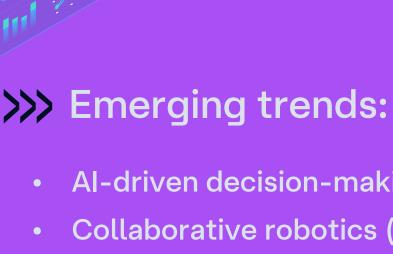
how facilities achieve greater efficiency,

flexibility and resilience.

Al-driven decision-making Collaborative robotics (cobots)

Today's operations are highly automated and advancing

with AI, cobots, LLMs and real-time data to enable faster, smarter



Predictive maintenance

Data-driven analytics

Factory-to-cloud integration

Digital twins

>>> Example Use Case | Conveyor motor health monitoring A high-throughput distribution center implemented anomaly detection on its

>>>

>>>

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Action taken: Maintenance was scheduled during off-peak hours to replace worn bearings.

Results: Avoided a motor failure that would have caused 8+ hours of downtime,

preserved order fulfillment schedules and reduced reactive maintenance costs.

What was detected: An increase in vibration amplitude outside of the expected

conveyor system. Vibration sensors installed on motor housings fed data to an edge

gateway running a machine learning model trained to identify early signs of wear.

range—subtle enough that it didn't yet impact throughput.

Predictive maintenance & condition monitoring

- Sensor-based equipment intelligence Cloud analytics for proactive alerts

Edge AI for real-time fault detection

Data-driven maintenance planning

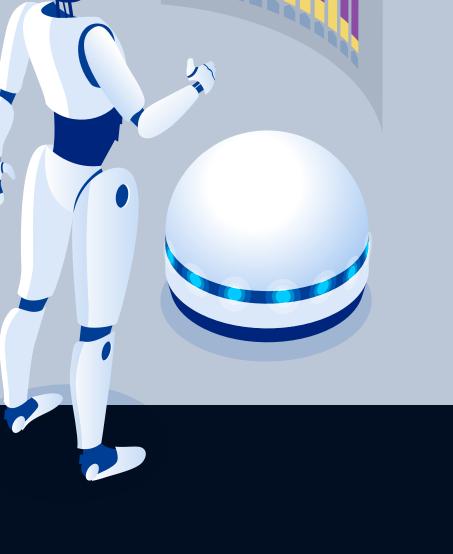
>>> Core trends behind adoption

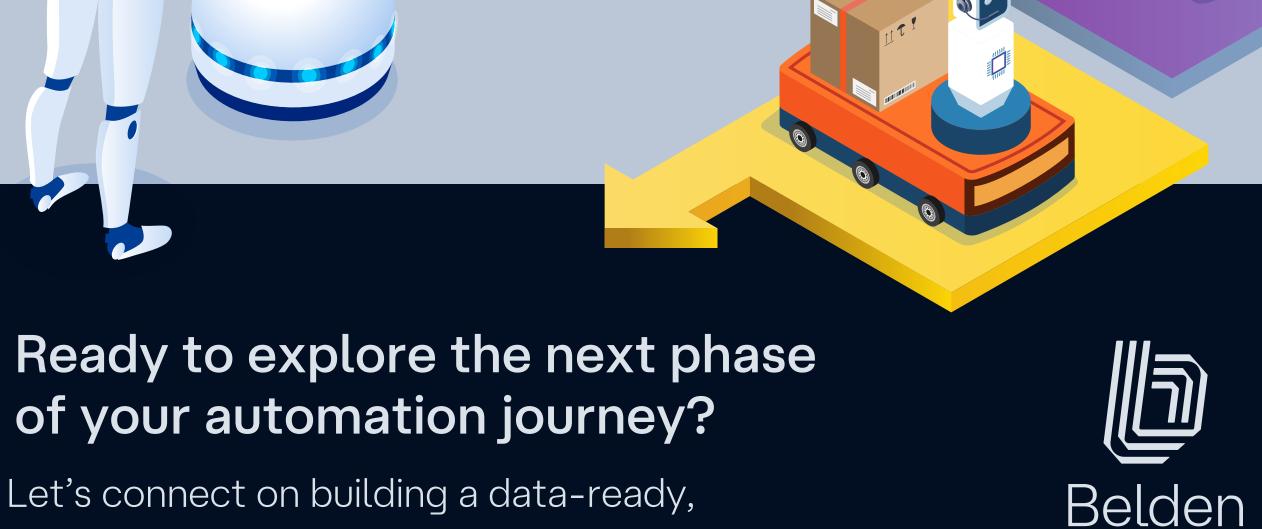
- Robust industrial networking reliable real-time connectivity Edge compute infrastructure - fast local processing for real-time data analysis

Scalable architecture - solutions that grow with your goals

How Belden supports smart automation

Belden enables your move to intelligent operations through:





>>> Ready to explore the next phase of your automation journey?

Al-optimized operation.



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