Warehouse Insights

4 Ways AI Transforms Intralogistics

kardex

Introduction

The challenges posed by rapid, unprecedented consumer demands have significantly impacted production efficiency. The rise of online shopping has expedited the need for dynamic warehouse space and streamlined logistics. Supply chain stoppages, 24/7 urgency, and labor retention issues are still crippling an industry struggling to keep up.

Despite its complex technological features, initial operating costs, and implementation challenges, adopting Artificial Intelligence (AI) has emerged as a crucial Industry 4.0 solution. The transition from manual to data-driven decision-making processes in warehouse logistics means smarter, faster, reactive, and proactive workflows.

This application is possible thanks to Machine Learning (ML), a subset of AI that finds insights from large amounts of data usually collected from the Internet of Things (IoT) systems, defined as the ability of devices, sensors, and computers to communicate, send data, and monitor in real-time.

Growing importance of AI & automation

AI can increase workplace safety by taking on monotonous and riskier tasks. It can also be an assistant, reducing human fatigue and improving the quality of work.[1] AI systems, powered by machine learning, robotic and vision technologies, can pick, pack, and sort pro-ducts around the clock to keep up with demand. It can utilize mined data to plan, process, and predict productivity and problems. Overall, AI can help cut costs while maintaining or even exceeding productivity.

Demand is putting pressure on all industries spanning manufacturing to e-commerce, and AI is on the radar as the solution. According to research by McKinsey & Company in 2022, automated systems will account for 25% of capital spending over the next five years, with retail and consumer goods industries planning to spend more than $500 million on its implementation, followed by food and beverage and automotive.

However, automation investment is highest amongst companies in the logistics and fulfillment space, accounting for 30% or more of their capital spending in the next five years.[2] Not surprisingly, the growth of e-commerce requires an average of three times the size of distribution space to operate compared to traditional brick-and-mortar stores.[3]

Kardex takes a deep dive into four core elements of AI technology that play a pivotal role in the evolution and scaling of warehouse optimization. We will examine its applications, benefits, and how to utilize its full potential while remaining sustainable.

1 Warehouse productivity

2 Warehouse safety

3 Accuracy and control

4 AI workforce

1 Planning and control of autonomous mobile robots for intralogistics: Literature review and research agenda, 2021. Giuseppe Fragapane, René de Koster, Fabio Sgarbossa, Jan Ola Strandhagen.
2 2022 McKinsey & Company Global Industrial Robotics Survey.
3 Prologis, a real estate investment trust quoted in Warehouse Digitalization: The Future of Warehousing, Cyzerg Warehouse Technology.

Warehouse productivity

Maximized space and efficient warehouse operations are critical to the functioning of the entire supply chain. This scenario is more apparent in e-commerce, where the primary demand is fast, same-day delivery and easy returns. AI plays a dual role in streamlining logistics, primarily in inventory optimization and smart scheduling, increasing overall productivity.

Increasing productivity from smart scheduling

Delivery-driven intralogistics synchronization (DDIS) between picking and sorting is even more critical in today's smart warehousing era to minimize time and cost. Therefore, batch sequencing for picking orders to reduce shelf visits and consolidating order assignments for delivery trips are tasks of utmost importance.[4]

AI performs repetitive and tiring jobs faster than manual labor which increases overall efficiencies. AI-programmed smart scheduling is dynamic, meaning tasks can be adjusted and executed at any time, overcoming the limitations faced during a labor shortage or downtime.

Inventory optimization

The complexity and variety of client orders impose additional challenges, and the need for a faster and more reliable supply chain without disruption is increasing.[5] A warehouse might store hundreds, if not thousands, of different products, in various sizes and shapes, that must be continuously picked, packaged and sometimes also returned.

AI-powered automated storage and retrieval systems (ASRS) manage inventory in a warehouse, with algorithms, sensors, and statistical models processing and detecting patterns in vast amounts of data to determine:

Storage
The most efficient storage methods and measuring real-time storage capacity to utilize warehouse space

Layout
Optimal placement for high-demand items that need to be retrieved quickly, alongside storage layouts that minimize warehouse walking time

Inventory levels
Using predictive analytics to forecast purchase patterns and better manage the storage cycle [6]

[4] Intralogistics synchronization in robotic forward-reserve warehouses for e-commerce last-mile delivery, Min Jiang, George Q. Huang.
[5] Applications of the internet of things for optimizing warehousing and logistics operations: A systematic literature review and future research directions, Devinder Kumar, Rajesh Kr Singh, Ruchi Mishra, Samuel Fosso Wamba.
[6] Warehouse Digitalization: The Future of Warehousing, Cyzerg Warehouse Technology.

Warehouse safety

The introduction of AI in warehouse logistics does not mean all human labor and intervention will stop, instead it will co-exist to ensure optimal safety. “Human and robot collaboration can be strengthened by industrial AI, enhancing worker’s safety by doing hazardous jobs and making tasks easier and efficient.”[7]

As a result, there are already prospects for industrial AI to be used in this domain, such as maintenance-related activities and worker training using mixed reality (MR). AI robots can perform tasks deemed dangerous and demanding for human workers. In real-time, the warehouse space, workers, and equipment are monitored with AI programs identifying potential safety hazards, predicted accidents, errors, mechanical failures, and defects. Virtualized training and predictive maintenance support this.

Virtualized training

In simplifying human tasks, human-computer interaction research has shown that the application of mixed reality in warehouse logistics contributes to greater visibility, training, and problem solving. It improves areas such as design, assembly, quality control, maintenance, and safety.

Augmented reality (AR) and mixed reality (MR), using applications like virtual reality (VR) headsets, are used to provide employees with access to digital information, like textual task descriptions, 3D models, and object recognition, to enable hands-free interaction in the physical world.[8]

[7] How artificial intelligence and machine learning assist in industry 4.0 for mechanical engineers, Gajanan Shankarrao Patange, Arjun Bharatkumar Pandya.

[8] Using Mixed Reality in Intralogistics – Are we ready yet? Werner Kurschl, Sebastian Pimminger, Johannes Schönböck, Mirjam Augstein, Josef Altmann Werner Kurschl, Sebastian Pimminger, Johannes Schonbock, Mirjam Augstein, Josef Altmann.

Predictive maintenance

Predictive maintenance (PdM) uses data analytics and AI models to predict and prevent hazards caused by equipment failure by monitoring machine conditions instead of their faults.[9]

Data can catalog a machine's life cycle and usage patterns, thus predicting degrading parts and wear of assets, preventing specific system failures, and correcting them. This series of warnings and suggested corrections, in turn, leads to fewer accidents, avoids costly breakdowns, lowers interruptions and downtime with planned scheduling, and limits safety incidents with human interaction.

“The impact of maintenance represents a total of 15 to 60% of the total costs of operating of all manufacturing.”[10] In response to the demand for automated digital services, Kardex is working towards even more innovative AI services. Through proactive monitoring, Kardex detected 1,800 events associated with potential problems through Kardex Connect in one year, of which 75% were solved remotely. The next step is reaching a fully predictive maintenance approach, determining the remaining useful time and wear of specific components.

Learn more about Kardex Connect

> “Human and robot collaboration can be strengthened by industrial AI... enhancing worker's safety by doing hazardous jobs and making tasks easier and efficient.”

[9] A predictive model for the maintenance of industrial machinery in the context of industry 4.0, Jose-Raul Ruiz-Sarmiento, Javier Monroy, Francisco-Angel Moreno, Cipriano Galindo, Jose-Maria Bonelo, Javier Gonzalez-Jimenez.

[10] Haarman et al., 2017; Mobley, 2002, in Predictive maintenance in the Industry 4.0: A systematic literature review, Tiago Zonta, Cristiano André da Costa, Rodrigo da Rosa Righi, Miromar José de Lima, Eduardo Silveira da Trindade, Guann Pyng Li.

Accuracy and control

Aside from future-proofing and predictive management of warehouse assets and logistics, AI is used to improve the accuracy and control of warehouse operations. Real-time data and detection technology become a quality control system used for:

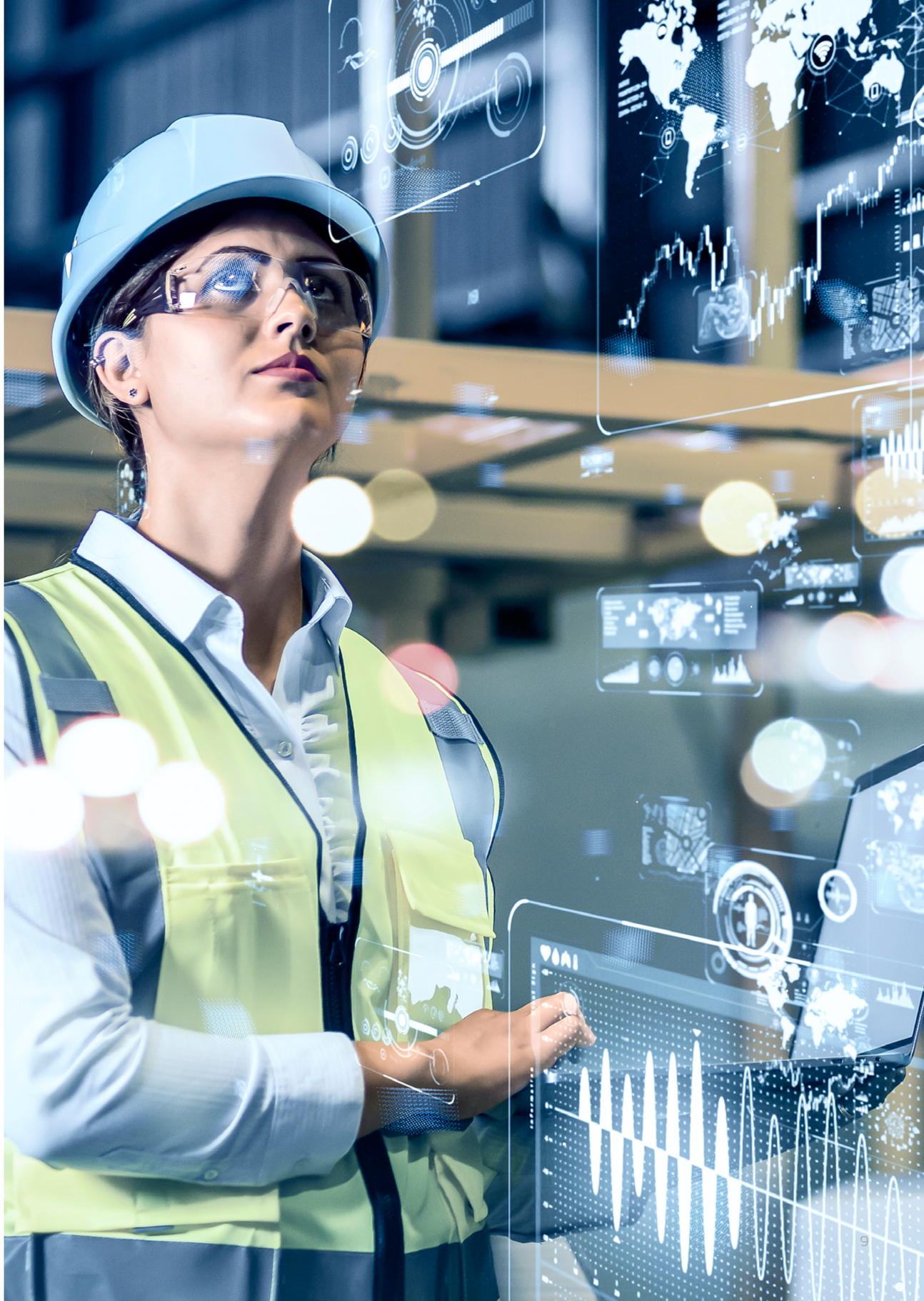
Monitoring inventory levels
Manage stock levels, prevent over-stocking, lower inventory costs, and identify low-stock items for automatic reorder.

Quality assurance
Lower manual labor time and automated quality control can scan and identify items with defects, expiration dates, or poor quality.

Real-time environmental monitoring
Ensures the handling of products within the desired conditions, such as temperature, humidity, and lighting.[11]

Machine sensing
Monitor warehouse spaces and "enable semi-automated, end-to-end product tracking by placing cameras in different parts of the warehouse that detect the movement and position of cargo. Computer vision can also aid drones to perform cycle counting by helping them navigate through the warehouse and scan items without the need of human intervention."[12]

[11] Applications of the internet of things for optimizing warehousing and logistics operations: A systematic literature review and future research directions, Devinder Kumar, Rajesh Kr Singh, Ruchi Mishra, Samuel Fosso Wamba.
[12] Warehouse Digitalization: The Future of Warehousing, Cyzerg Warehouse Technology.



AI workforce

AI can train and operate robotic systems to perform various tasks autonomously. However, the introduction of robotics in warehouse logistics can be controversial in how much it collaborates with and aids a human workforce verse replacing it. By the end of 2021, around three million industrial robots were in use worldwide.[13]

Pick and place robotics
Pick and place automation is not only about speeding up order picking, depalletizing, and replenishing individual items. "Transferring the most repetitive and dullest tasks to robots can improve employee engagement and retention rates. This is due to warehouse personnel feeling fulfilled when tackling more dynamic roles, such as operational analysis, customer service, maintenance, and more."[14]

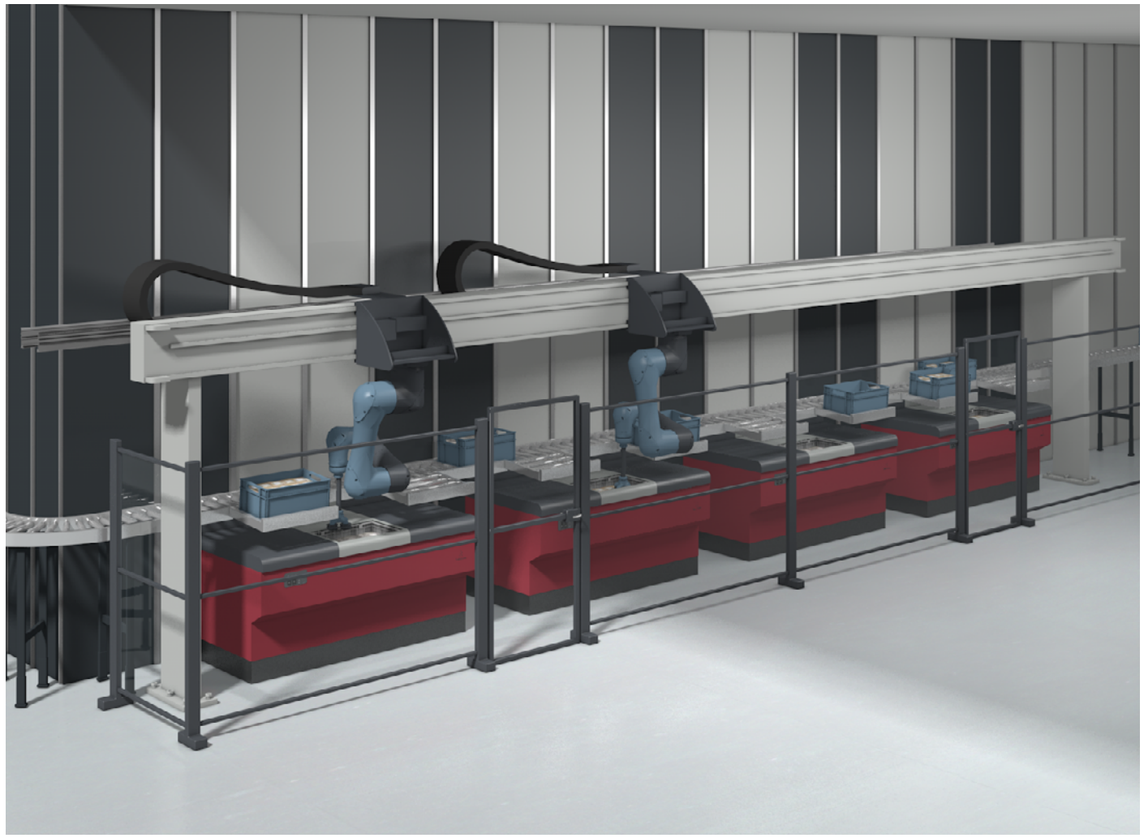
Robotics solutions will become an essential asset to intralogistics. Robots are the ultimate power pickers and packers, and when integrated with automated storage and retrieval systems (ASRS), they overcome the limitations of human performance in materials handling and the constant movement of items.

Find out more about how to integrate pick and place robotics in your warehouse

Fully integrated solutions combine AMRs and pick and place robotics with ASRS, such as Kardex Vertical Lift Modules and AutoStore systems, enabling a new dimension in efficiency. Robots can take over picking and replenishment activities at the access opening, creating a single step process and fully automated solution for picking, depalletizing, and replenishment.

Learn more about fully integrated AutoStore solutions

[13] Trend Manager, Mega-Trend: Exponential Industries, Macro-trend: Robotics
[14] Warehouse Digitalization: The Future of Warehousing, Cyzerg Warehouse Technology



Autonomous mobile robots (AMR) and automated guided vehicles (AGV)

At its core, the concept of an AI workforce, besides the reduction in expenditure given to wages, is to interact and operate with humans and automate processes prone to human errors, such as repetative tasks.

Accurate distribution centers
Utilizing AMRs for picking and packing orders enables accurate and faster fulfillment and dispatch.

Efficient production lines
Robotics are also used to schedule and adapt production lines according to demand without impacting manual labor. Pick and place robotics in production lines optimize materials handling, moving raw materials and semi-finished products close to the assembly line. Operating 24/7, robots separate, orientate, measure, sort, scan and transfer goods from A to B, increasing order accuracy and eliminating picking errors.

Increased human productivity
In using AMRs for lifting and unloading goods and utilizing AGVs for path planning and moving products from point to point across the warehouse, the human workforce is more efficient in other tasks.

Overcoming challenges

Scaling warehouse logistics in today's demanding climate is challenging, but so is the initial cost of time and resources to adopt and execute AI. There remains a lack of awareness of how organizations may capitalize on its potential and implement the foundational technologies.[15]

There is apprehension in setting up and implementing the entire data analytics infrastructure, from how to capture data (whether via manual input or with technologies such as sensors and cameras) to how to store, process and manage it. That's even before applying targeted AI models to address specific problems.

And while many are wary of the initial set up, the need is there. 62% of survey respondents agreed that "most customers favor robotics and automation providers that can provide full-service models for implementation."[16]

At Kardex, we understand our customers' unique challenges. We continue to work on a state-of-the-art product portfolio and customize intralogistics solutions to fit specific needs. We are at the forefront of innovation, especially in modern approaches to technological advancements like AI.

Contact us

[15] Applications of the internet of things for optimizing warehousing and logistics operations: A systematic literature review and future research directions, Devinder Kumar, Rajesh Kr Singh, Ruchi Mishra, Samuel Fosso Wamba
[16] 2022 McKinsey & Company Global Industrial Robotics Survey

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