



The Future of Warehouse Automation

Introduction to warehouse automation trends

In the dynamic field of logistics and supply chain management, warehouse automation is crucial for innovation and efficiency. It relies on advanced technology to streamline material handling in a warehouse with little to no human intervention. As a result, companies can eliminate tasks that require extensive manual labor as well as repetitive tasks, including those involving physical effort and data management. A number of factors are driving the transition to automated warehouses, each in its own way a catalyst for change in the operations of storage and distribution centers worldwide. This paper, which is the latest in Deloitte's warehouse automation series, offers a deep dive into the primary drivers behind the automation trend. Among the key issues we highlight are: the role of persistent labor shortages, supply chain disruption, the robotics-as-a-service (RaaS) business model, internet of things (IoT) integration, the importance of safety protocols and strategic space optimization.

The first section provides an overview of the key factors impacting the adoption of warehouse automation, followed by a section with examples of specific technologies and concluding with an introduction to the SAP Warehouse Robotics add-on.

As we explore the key technologies that shaped warehouse automation in 2024, we quickly realize how pivotal the synergy between robotics, AI, machine learning and other emerging technologies is in making warehouses more efficient, intelligent and responsive. This evolution is not just about adopting new tools; it's about redefining the very fabric of warehousing and logistics to meet the demands of the modern economy and society.

1. Transformation drivers

Most warehouses in the past were dependent mainly on human labor for tasks like picking, packing and sorting. The downsides of this method became more evident as companies faced labor shortages, rising operational expenses and demands for quicker order processing—warehouse automation offered a promising response to these challenges and more.

The pandemic also had a huge impact on the adoption of warehouse automation across the globe. Localized lockdown policies and a rapid decline in global demand for various commodities left many enterprises with a large backlog of products. Companies found that managing that backlog took a lot of staff and resources.

In this first section, we outline the key factors driving the adoption of warehouse automation in an effort to increase efficiency, precision and speed in the supply chain.

Persistent labor shortages

The shortage of skilled workers across several sectors has dramatically increased the adoption of warehouse automation technology. Faced with crippling shortages, businesses responded by introducing more robotics and automation systems to enhance efficiency and productivity beyond what human labor alone can achieve. The return on investment in these technologies has improved considerably as a result, especially in tight labor markets. Automation, thanks in particular to robotics, offers a twofold solution: It not only addresses the shortfall in human labor but also improves the operational skill set. Robotics is critical for augmenting human effort, minimizing dependence on manual labor for repetitive or risky tasks and facilitating the transition to more strategic, less labor-intensive activities. The ability to rapidly scale production to meet rising demand is the key to making the most of the current growth momentum, a trend expected to continue through 2024 and beyond.

Robotics-as-a-service (RaaS)

The robotics-as-a-service (RaaS) model has been a major factor in reducing the barriers to adoption of automation technologies in areas such as e-commerce and multi-channel retail. With RaaS in place, companies can conserve resources and avoid the substantial upfront investment for new capital goods. The service provider is responsible for regular maintenance and updates in this model, streamlining the management process for their clients. Especially given current inflation-driven challenges to the bottom line, businesses see warehouse automation as a transformative approach—and a much broader range of companies will have access to automation technologies with this model.

IoT and automation technologies

Thanks to recent technological advances, we are seeing more and more novel automation solutions coming to market, from autonomous mobile robots (AMR) and automated guided vehicles (AGV) to warehouse drones, conveyor systems and more. These technologies are the key to end-to-end automation solutions. For instance, using IoT in the warehouse drives automation by connecting devices and sensors to make material handling more efficient, reduce delays in fulfilment and improve tracking of inventory levels and stock availability.

Safety and efficiency

Increasingly, safety is becoming a critical imperative when it comes to robot-human collaboration. A new wave of technological innovations is designed to make robotic systems safer, e.g., embedding sensors within robots, using artificial intelligence (AI) to make operations smarter and advancing computer vision technology to prevent collisions.

Space optimization

In warehousing, where space is a critically valuable asset, enhancing productivity per square meter is a top priority. This calls for innovative design solutions that prioritize efficiency and optimal use of available space, including automation for high-density storage solutions, strategic use of vertical space and workflow reconfiguration.

2. Key technologies in future warehouse automation

Both society and the marketplace are calling for warehouse transformation, while technological advances provide the automation tools to make it a reality. Thanks to recent developments in robotics, artificial intelligence and data science, we can leverage technology to streamline warehouse operations, optimize workflows and maximize overall warehouse efficiency.

There are six sectors behind the push toward warehouse automation: wholesale, retail, grocery, e-commerce, logistics and manufacturing. The leading companies in these industries as well as financial institutions from investment banks to private equity firms are investing heavily in these technologies: SoftBank invested \$2.8 billion in AutoStore, which specializes in automation for the e-commerce and grocery sectors, while giants like Walmart and Amazon have also been channeling substantial resources into automation R&D. This trend is not, however, limited to big players. Smaller companies are adopting these technologies as well: German toy retailer Rofu Kunderland, for example, is boosting efficiency and delivery times thanks to a system with 57 robots that manage 3,500 products across over 28,000 bins in its new warehouse. The German supermarket chain Edeka, as part of a new €500 million project, allocated €93 million to enlarge its Berbersdorf warehouse, increasing the stock keeping unit (SKU) count from 2,900 to 12,700 and adding a semi-automated area for picking and storage covering approximately 28,000 square meters.

The following list outlines 10 key technologies from 2024 that will shape the global warehousing industry in the future.

AGVs and AMRs

Automated guided vehicles (AGVs) and autonomous mobile robots (AMRs) are expected to be widely available in future warehouses, moving with agility and precision. They will take on picking, sorting, transportation and other tasks to improve the speed and efficiency of warehouse operations.

ASRS

We expect future automated storage and retrieval systems (ASRS) to become even more sophisticated, using robotic picking arms, larger storage capacity and AI-driven optimization algorithms to deliver efficiency gains and more seamless, streamlined warehouse operations.

AI and machine learning

The introduction of artificial intelligence (AI) and machine learning (ML) will revolutionize warehouse management. Thanks to cutting-edge features that analyze extensive datasets, predict demand, fine-tune inventory levels and automate decision-making, AI will deliver a warehouse ecosystem that is not only more intelligent but also highly responsive.

Blockchain technology

Blockchain is a secure and transparent solution that is essential for increasing transparency in the supply chain. With a tamper-proof record of transactions, companies can track product movements in real time and reduce the potential risk of fraud or errors.

Internet of things (IoT)

The sensors and RFID tags powering the internet of things offer users easy access to real-time data on inventory levels, temperature and environmental factors. With all this data at your fingertips, companies can leverage proactive monitoring and preventive maintenance features to make warehouse operations more reliable and more efficient.

Cloud-based solutions

Scalable and easily accessible cloud-based warehouse management systems (WMS) provide real-time insights and allow for remote management. Moving to the cloud eliminates the need for major upfront investments in IT, makes operations more flexible and enables data-driven decision-making.

Fleet management systems

Cutting-edge fleet management systems help optimize transportation logistics. These systems monitor vehicle performance, guarantee on-time delivery and give companies greater control over the entire logistics network.

Warehouse drones

More and more companies are using drones as a strategic move to optimize warehouse management and operations. With sensors and high-quality cameras, these high-tech drones collect precise data and offer more accurate inventory tracking through remote or autonomous inspections. They bring a new dimension to the warehouse as they fly and hover, dodge obstacles across various warehouse floorplans, navigate indoors, land with precision and possibly operate in fleets.

Collaborative robotics

We expect human-robot collaboration to increase, with robots helping workers to lift heavy objects, perform repetitive tasks and promote a safer work environment. This collaborative strategy capitalizes on the strengths of both humans and robots, fostering a more efficient and streamlined workplace.

Data-driven insights

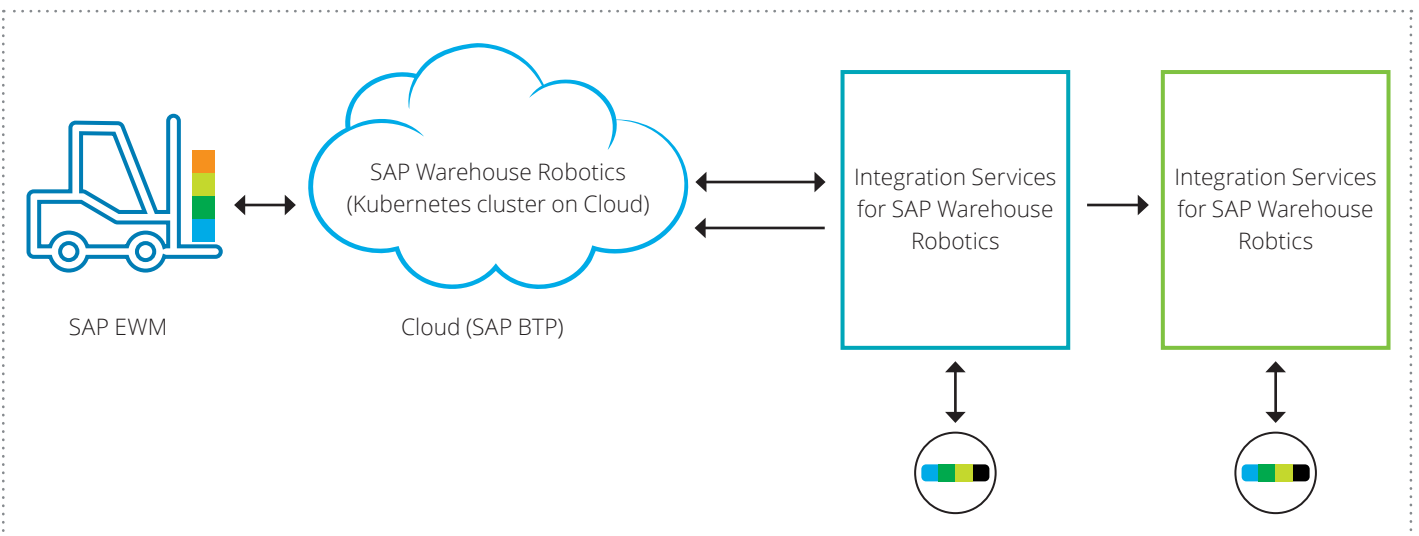
Optimizing warehouse operations relies heavily on data analytics. By providing insight into performance metrics, pinpointing bottlenecks and promoting proactive decision-making, data-driven analytics will be critical to maximizing warehouse efficiency and competitiveness over the long term.

3. Key technologies in future warehouse automation

SAP Extended Warehouse Management (EWM) is a comprehensive warehouse management solution designed to manage and monitor warehouse and distribution center processes. It offers a wide range of features, from inventory and warehouse layout management to picking, packing and movement tracking. SAP EWM is designed to handle complex logistics operations and is fully integrated with SAP's broader ecosystem, including production, quality management, sales and distribution.

Advances in technology and a more competitive market environment are just two factors driving traditional warehouses to consider adopting robotics systems. Given their potential for more efficiency, precision and overall effectiveness, robots have become essential for streamlined warehouse management. SAP Warehouse Robotics is a cloud-hosted service designed to automate warehouse tasks using robotics. It operates on the SAP Business Technology Platform and interacts autonomously with collaborative robots and other internet of thing (IoT) devices without the need for a Wi-Fi or network connection.

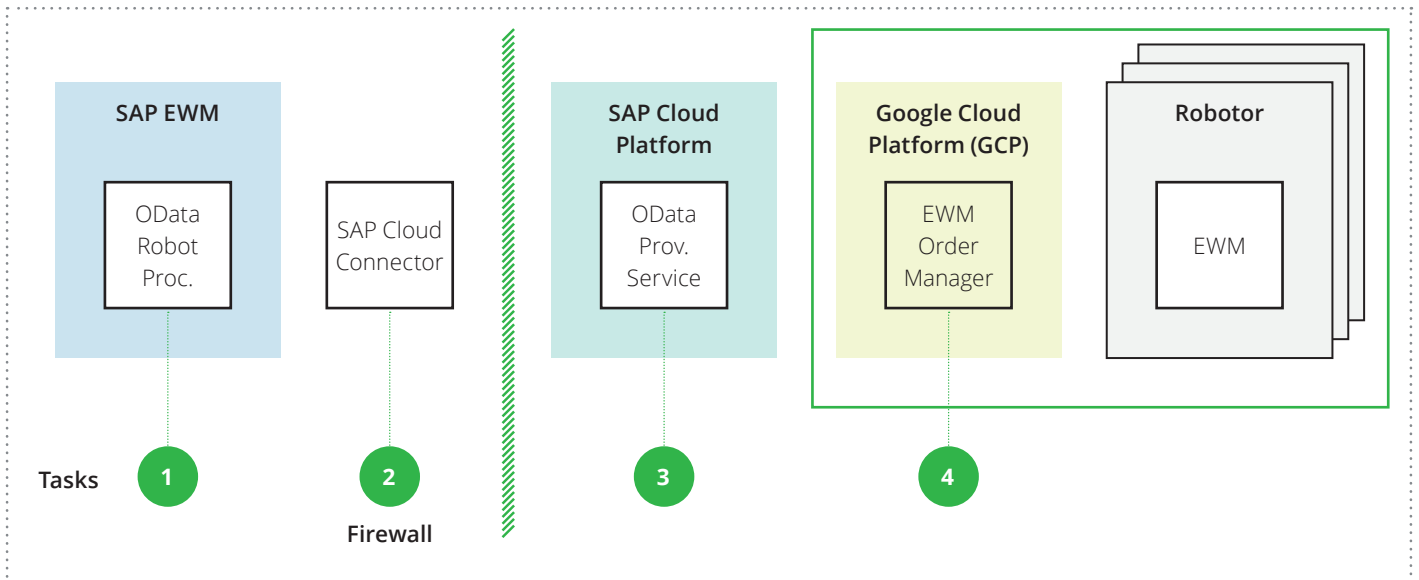
The graphic shows the general communication flow in SAP EWM for warehouse orders executed by a collaborative robotics (cobot):



The integration of robotics into SAP EWM offers a significant advancement in warehouse automation. Thanks to seamless connectivity, this solution gives users a straightforward “plug and play” integration process. Implementation is extremely fast, taking only a few hours or days as opposed to the weeks or months of conventional methods. Users quickly have a highly scalable solution able to manage mixed robot fleets under a unified software framework. SAP EWM makes it very easy and cost-effective to integrate next-generation collaborative robots and significantly lowers the barriers to warehouse automation, making it accessible and straightforward.

In a conventional system, the warehouse management system (WMS) sends precise instructions to the robots and keeps the order for the warehouse in the centralized hub. The robot carries out these instructions and regularly reports back on its progress to the WMS. This allows the WMS to assess and update the status of the warehouse order based on this feedback. Systems like these usually require customization to align with the unique needs of the robot manufacturer and the relevant application, often taking several weeks or even months to deliver.

In SAP Warehouse Robotics, EWM assigns a robot for the warehouse order and copies the order details onto the robot. While in operation, the robot consistently updates its local version of the order, ensuring it stays in sync with the WMS order. The graphic below illustrates the overall setup for an example with a MiR robot:



This approach ensures compatibility with robots from a wide range of manufacturers with minimal customization, enabling users to manage a diverse fleet of devices and to benefit from strategic versatility and cost-effective entry into warehouse robotics. Companies can expand into new operational domains as a result, including non-repetitive and assistive tasks, particularly those small to medium-sized enterprises previously unable to invest in robotic solutions. The system supports ad-hoc scalability and allows users to optimize their choice of devices and manufacturers without vendor lock-in or the complexity of managing different software frameworks. And as an open-source solution, it allows unrestricted access for use or customization.

SAP Warehouse Robotics offers rapid implementation and a straightforward, low-risk path to agile warehouse robotics for companies that already use EWM. You can better manage and optimize diverse fleets and material flows, while also gaining unprecedented scalability. This feature is particularly beneficial for meeting peak demand periods, where you can add additional robots within minutes.

SAP Warehouse Robotics is a relatively new solution that uses collaborative robots to streamline warehouse operations. This system offers several advantages over conventional automation methods, including better scalability and adaptability. However, users should be advised that not every feature of SAP EWM is compatible with SAP Warehouse Robotics. Integration requires careful planning and precise specification to meet the unique requirements of each business. They are still powerful tools for automating various tasks in the warehouse and increasing overall productivity. In the third paper in our series, we introduce different options for using automated guided vehicles (AGV) in SAP EWM.

Conclusion

This paper explored the dynamic, rapidly changing landscape of logistics and supply chain management, which is currently undergoing a major automation-driven transformation. The key factors driving this trend are persistent labor shortages, the impact of supply chain disruption and the growing potential of innovative technologies such as robotics-as-a-service (RaaS), the internet of things (IoT) and enhanced safety protocols. We highlighted how these elements collectively contribute to the strategic improvement of warehouse operations and offered a strong argument for adoption of automation technologies to boost operational efficiency, productivity and resilience even when faced with fluctuating market demands and a tight labor market.

The adoption of cutting-edge technologies, including automated guided vehicles (AGVs), autonomous mobile robots (AMRs), artificial intelligence (AI) and machine learning in the warehouse environment marks a significant step toward building a more intelligent, efficient and adaptive logistics infrastructure. These technologies not only streamline warehouse workflows but also provide unprecedented levels of agility and analytical depth across the broader supply chain network. And thanks to the strategic deployment of blockchain and cloud-based solutions, we see the industry shifting more toward greater transparency, scalability and data-driven decision-making.

The introduction of SAP Warehouse Robotics within the SAP Extended Warehouse Management system is a prime example of how robotics can be seamlessly incorporated into warehousing operations. This signifies a movement towards easy-to-use, plug-and-play solutions that simplify the transition to automation. Interoperability and the ability to manage diverse robot fleets are critical to providing scalable and cost-effective automation options for companies of all sizes.

Looking ahead, the more these technological advances align with the strategic initiatives of today's businesses, the greater the transformation of the warehousing and logistics sector will be. The growing trend of fully automated warehouses is not just a response to current industry challenges but a forward-thinking strategy that will shape the future of the sector. This approach keeps the industry at the cutting edge of innovation, operational efficiency and adaptability, ready to meet the evolving demands of the global economy and society at large.

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