



Introduction to Warehouse Automation

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As digitalization continues to advance and e-commerce plays an increasingly important role, companies are radically rethinking how they operate their warehouses. Warehouse automation, i.e., automated warehouse processes, is at the heart of this change and a key enabler for companies looking to increase efficiency, reduce costs and gain a competitive edge. From driverless vehicles and automated sorting to intelligent warehouse management systems, these new automation technologies not only promise to optimize processes but also open the door to more precision, speed and innovation in your logistics solutions.

In this paper, we outline the benefits of warehouse automation and how it will fundamentally change the way companies store, pick and distribute their products. SAP's Extended Warehouse Management (EWM) solution is an essential part of our analysis, and we will show you how it can address the most important tasks and challenges of a fully automated warehouse.

This paper, the first in a series of publications on warehouse automation, not only provides valuable insights into automation technologies from automated guided vehicles (AGVs) to conveyor systems, but also focuses on the benefits of implementing SAP EWM and the latest technological advances.

Definition of warehouse automation

Warehouse automation is the process of automating the movement of inventory in the warehouse and in the subsequent delivery to customers with minimal human intervention. It encompasses the connectivity of warehouse automation equipment as well as the design, construction and operation of any equipment used to automate a process or procedure. Warehouse automation equipment is strategically designed to improve the efficiency, accuracy and overall productivity of warehouse and logistics operations.



Advantages of warehouse automation

Warehouse automation serves a variety of purposes aimed at increasing the efficiency and productivity of warehouse operations. Key objectives include automating routine tasks such as storage, retrieval, sorting and packing of goods. Automated systems designed to perform tasks quickly and accurately increase efficiency and productivity—the primary benefit of automation. We also see a sharp reduction in labor costs with automation technologies because they don't require as many human workers to perform repetitive tasks.

Human error can be a serious challenge in the warehouse, while automation helps minimize mistakes and reduce the likelihood of damaged goods or incorrect orders. Having less staff on site in the warehouse has the benefit of improving safety as well. The fewer humans involved in warehouse operations, the less likely accidents or injuries will be.

Equipping warehouse robots with sensors for real-time inventory tracking also enables more data collection. This data is critical for inventory planning, demand forecasting and process optimization. And with today's highly scalable warehouse robotics systems, users can easily adapt to warehouse needs as they evolve, such as adding new robots or upgrading existing systems to further improve performance.

Optimizing the use of warehouse space is another key benefit. Warehouse robots can make efficient use of available storage space by stacking goods in denser rack configurations and relying on intelligent shelf placement algorithms.

And finally, improved inventory control is a critical asset. By tracking inventory in real time, these automated systems minimize the risk of item losses or stockouts. Real-time monitoring ensures a more accurate, up-to-date record of inventory levels and fosters a more streamlined supply chain.

Overall, warehouse robots provide an end-to-end solution for increasing efficiency, reducing costs and enhancing working conditions in the warehouse.



Disadvantages of warehouse automation

Automated warehouses are not without their challenges, however, and we advise new users to carefully analyze potential downsides. One significant hurdle is the large upfront investment required to implement these systems—not only the investment in the technology itself but also the cost of training staff in the skills needed to run as well as manage such complex systems. You need a highly skilled workforce to operate, maintain and troubleshoot automated systems, which could potentially lead to a sharp increase in training costs.

Job losses are also a serious concern associated with automation adoption. While companies stand to benefit from reduced labor costs, the flip side is the potential displacement of warehouse workers, and we must carefully consider the broader societal and employment impacts of this trend. However, faced with continuing advances in digitalization, companies also have an opportunity to train and develop their workforce.

Another downside to warehouse automation is becoming dependent on the technology. In the event of a breakdown in the automated system, the potential for major disruptions to warehouse operations looms large. To mitigate this risk, companies need a robust backup plan and a well-structured maintenance routine as an integral part of their warehouse management strategy.

Some of these automated systems are also quite inflexible. Designed to perform specific tasks, they may need reprogramming or even replacing when warehouse operations or the materials themselves change. There is both a time and cost implication to this kind of inflexibility, which could make automated warehouses less adaptable overall.

And finally, technical malfunctions and cyber-attacks are serious risks for automated warehouses. Like any technology, automated systems are vulnerable to malfunctions and cyber threats, which raises concerns about the resilience of warehouse automation systems. Users must have strong security measures in place to protect automated warehouses from technological risks and ensure their safe and consistent operation.

Key components of warehouse automation

State-of-the-art warehouse automation technology offers sophisticated tools that plug and play with a variety of key components and technologies, including robotic arms and grippers, sensors, control systems, communication systems, power supply, navigation systems, software and programming, safety systems, maintenance and diagnostic tools as well as data analysis or artificial intelligence. See below for in-depth descriptions of these tools:

Robotic arms and grippers:



These devices help robots perform physical tasks such as grasping, lifting and moving objects within the warehouse. Robotic arms can move in different directions and may be equipped with various gripping tools to handle a wide range of items.

Sensors:



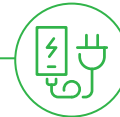
Critical for understanding the environment and avoiding collisions, sensors may rely on ultrasonic, infrared or laser sensors as well as cameras designed to navigate and detect objects.

Control systems:



Essentially the robot's "brain", control systems use software and hardware components to dictate its movements and actions. They frequently utilize algorithms for path planning, localization and decision-making.

Power supply:



Warehouse robots require a reliable power supply to perform their tasks, whether through batteries or power cables, which has a large impact on the runtime and efficiency of the robot.

Navigation systems:



Using technologies such as simultaneous localization and mapping (SLAM) and GPS, these systems help robots navigate the warehouse and plan optimal routes.

Software and programming:



Software is crucial for customizing robot features and performing specific tasks. Developers program the robots for material handling tasks such as picking, placing, sorting and stacking.

Safety systems:



Safety components such as emergency stop buttons, bumpers and safety zones are vital for preventing accidents and making human-robot collaboration safer.



Maintenance and diagnostic tools:

With these tools, users can monitor robot performance and detect issues in a timely manner, a key factor in minimizing downtime and keeping maintenance costs low.

Communication systems:



These systems allow robots to communicate with each other and with other warehouse systems, such as inventory management systems, other robots or conveyors. With robust communication technology, the devices can work in sync and manage the warehouse efficiently. These connected robot systems can use swarm intelligence to cooperate and make smart decisions on their own, optimizing their collaborative actions.



Data analysis and AI:

State-of-the-art warehouse management systems use data and artificial intelligence to make robots even more efficient, relying on predictive analytics to track inventory levels, forecast demand and optimize routes as well as tasks.

Warehouse automation using SAP EWM

SAP EWM (Extended Warehouse Management) is an innovative and flexible add-on for SAP's Warehouse Management System. It is not only designed to manage and optimize warehouses and their processes, but also offers a wide range of features for automating individual warehouse operations. These include inventory management, product movement tracking and real-time inventory updates. We outline the key features and advantages of SAP EWM in an automated warehouse below.

- **Steering and coordination:** SAP EWM is essentially the control center for automated warehouse facilities and equipment, providing the interface and intelligence needed to coordinate and monitor automated systems.
- **Process optimization:** Companies can maximize the performance of their automated systems by planning and implementing the most efficient workflows using the advanced algorithms in SAP EWM. When combined with process mining tools, it is not only possible to plan and implement efficient processes but also to analyze and refine them on an ongoing basis using real-time data.
- **Seamless integration:** SAP EWM offers seamless integration with a wide range of warehouse automation technologies, including automatic conveyors, warehouse robots, automatic high-bay warehouses, sorting systems and more. This improves data exchange and coordination between different automated systems.
- **Real-time transparency:** Using SAP EWM with our automation equipment provides real-time visibility into the status of inventory, orders in progress and warehouse activities, which leads to better planning and decision-making.
- **Flexibility and scalability:** SAP EWM is flexible and scalable; in other words, you can adapt the system to your company's specific requirements, regardless of the type of automated technology in use or the size of your warehouse.
- **Data capture and analysis:** With SAP EWM, you can collect and analyze data from automated warehouse equipment to monitor performance, predict maintenance needs and optimize processes.

Pick-by-light or pick-by-voice systems are a prime example of warehouse automation tools in SAP EWM. The seamless integration of pick-by-light devices and real-time order management enables this solution to streamline the picking process with optimized route planning and task allocation.

Another good example is the integration of automated guided vehicles (AGVs) with SAP EWM using interfaces and connectors provided by SAP. This allows for seamless coordination between AGVs and warehouse management processes, enhancing efficiency and automation. SAP EWM features such as task scheduling, resource optimization and monitoring help effectively manage and control AGV movements within the warehouse. Warehouse Robotics—the newest SAP solution in the area of AGV integration—supports this approach by providing a common platform to connect and organize different types of AGVs within the warehouses. Upcoming papers in this series will focus on the scope of this solution as well as its main advantages and disadvantages.

One final and already well-established example is the material flow system solution MFS included in SAP EWM, which integrates automated high racks, conveyor systems or even AGVs in the warehouses. We also plan to explore the role and features of MFS in an upcoming paper as part of Deloitte's warehouse automation series.

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