HOW TO DETERMINE WHETHER YOUR WAREHOUSE COULD BENEFIT FROM AUTOMATED ITEM PICKING

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GROWING DEMANDS ON WAREHOUSE OPERATIONS

Distribution centers and warehouses of all sizes have experienced significant changes in throughput, volume and order type due to demands for smaller order sizes, SKU proliferation and the growth of e-commerce across both B2C and B2B channels.

The extent of these changes depends on a variety of factors, including the type of product being handled, the number of orders, and the total number of SKUs. In general, distribution centers performing pallet handling have been the least affected as they have the simplest picking processes. Orders are often picked one at a time and contain a limited number of SKUs. The key issue in these warehouses is typically storage density, which can be optimized through pallet shuttle systems.

Carton or case picking can increase the complexity of picking processes but still have fewer SKUs and higher picks per SKU than most e-commerce warehouses. In many cases, cartons are picked from pallets stored on the floor or in racks, although more sophisticated picking strategies such as zone picking are used. Shuttle systems can also be used to increase the productivity of carton handling. In retail fulfillment applications, these systems may be combined with robotic palletizing systems to automate the process of creating store-ready pallets.

Item or piece picking operations have experienced the most disruption in recent years as these warehouses are dealing with growing SKU counts, fluctuating demand and reduced order cycle times. These warehouses are also more likely to have complex order profiles, requiring multiple SKUs to fill an order. As a result, they are under the most pressure to adopt new processes and technologies that enable faster order cycle times, reduce costs and alleviate challenges created by tight labor markets.

The Business Case for Item Picking Technology

Operators considering investments in picking technology should evaluate the potential impact of the investment in five areas:

LABOR
Labor availability remains a key challenge for warehouses in a number of regions. Peak seasons have become especially challenging for warehouse operators as they struggle to handle higher volumes, resulting in reduced service levels and delayed shipments.

COST
Picking is by far the largest factor in warehouse operating costs, contributing more to total costs than shipping, receiving and storage combined. Improvements in picking efficiency can result in significant reductions in total costs and generate a fast return on investment.

SERVICE
Customers are becoming less tolerant of delivery windows that exceed two-days and many businesses are seeking to create competitive advantage by moving to next-day or same-day delivery. Overreliance on manual or inefficient picking processes can severely limit a business's ability to react to market demands.

SKU PROLIFERATION
There is often a correlation between the number of SKUs a warehouse is supporting and picking time. Without automation, SKU growth can result in higher costs, slower fulfillment times and longer time-to-productivity for new employees.

RESILIENCY
As organizations seek to reshore some operations to improve security of supply, robotic automation can alleviate the labor challenges that can impede these initiatives.

STRATEGIES FOR IMPROVING PICKING EFFICIENCY AND PRODUCTIVITY

Warehouses use a variety of picking strategies based on the product mix and business goals, and those strategies continue to evolve as business growth and product changes drive the need for greater efficiency and productivity.

Operators just beginning their journey to increasing picking efficiency can often generate significant improvements by refining their manual picking strategies. These strategies represent more than a short-term solution as they can continue to deliver value after the organization transitions to automation by supporting more efficient manual picking of fast-moving items and items that don't fit in the automation system.

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Picking Strategies

Warehouse operators can improve productivity by moving from basic SKU-based picking, which can have a steep learning curve for new pickers, to more sophisticated picking strategies.

Location-Based Picking

Location-based picking enables product slotting to be independent of the SKU sequence, shortening the learning curve for new pickers. This strategy can also be used to enable heavy, difficult-to-handle or fast-moving products to be slotted in the easiest-to-access locations or spread throughout aisles to alleviate congestion. While more efficient than picking by SKU, a significant amount of the picker's time is spent in transit between pick locations, limiting the ability to optimize pick efficiency.

Zone Picking

"Pick and pass," or zone picking reduces the time pickers spend in transit. In this scenario, location-based picking is used, and workers are assigned to a specific zone rather than having to cover the entire warehouse. Orders are moved through the warehouse from zone to zone, bypassing zones that do not contain SKUs needed for the order.

Technologies to Enhance Picking

To maximize the efficiency of zone picking, many companies have introduced light-directed, RF-directed or voice-directed picking. Voice-directed picking has become more common for organizations using person-to-goods processes while pick-to-light technology, which helps ensure high pick accuracy, has emerged as a best practice for automated goods-to-person picking systems.

Goods-to-Person Automation

In warehouses struggling to keep pace with demand, dealing with compressed order cycles or having trouble recruiting labor even after optimizing manual processes, goods-to-person automation should be considered. There are a variety of automation technologies available that are designed to deliver products to stationary pickers, eliminating the time pickers spend walking the warehouse floor and enabling SKU range increases. In addition, these systems can often increase storage density and improve pick accuracy.

For higher throughput environments, shuttle systems provide an ideal balance of density and throughput. When equipped with goods-to-person pick stations, these systems support picking with high throughput and excellent availability. They are also versatile in the types of products supported, including bins, totes, cartons and cases.

Zone Picking in Action

Radwell International, an industrial distributor with a huge inventory of industrial automation, pneumatic, electrical and other plant equipment, employed zone picking as a bridge to automation. As the company developed plans for a new automated warehouse to support its growth, they were able to more than double their picking efficiency by moving to zone picking. Their automation would ultimately more than triple the pick rates achieved with manual zone picking, but this move bought time and allowed the company to transition to the new, automated facility without jeopardizing customer support.

Autonomous mobile robots, such as the Swisslog CarryPick system, provide a flexible and cost-effective goods-to-person automation solution for lower throughput applications.

Cube-based AS/RS, such as AutoStore, also support goods-to-person automation with outstanding density and good throughput. These systems deliver exceptional reliability because all products remain accessible if a robot has to be taken offline. They also provide operators with the flexibility to configure automation to existing buildings and to scale throughput and storage independently.

What all these systems have in common is that they employ a goods-to-person strategy to significantly increase pick rates and throughputs by eliminating the need for pickers to travel across the warehouse. They also create an ideal platform for supporting robotic item picking.

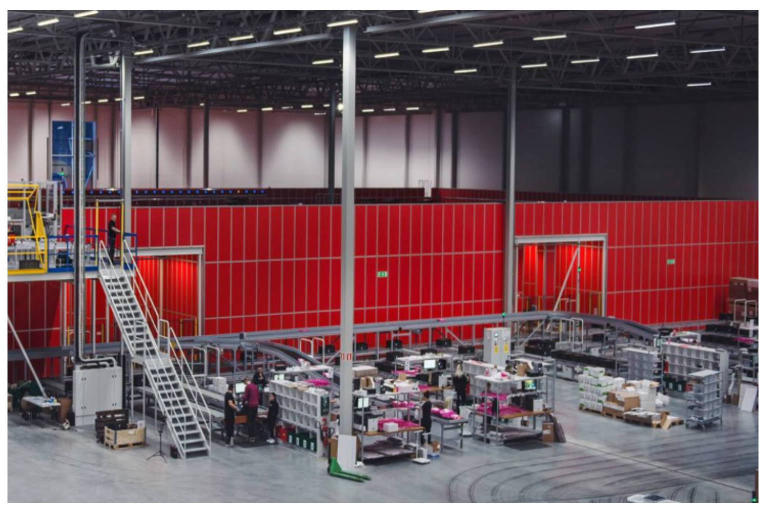


Figure 1: Goods-to-person automation systems optimize the productivity of human pickers and represent an ideal environment for introducing item picking robots into the warehouse.

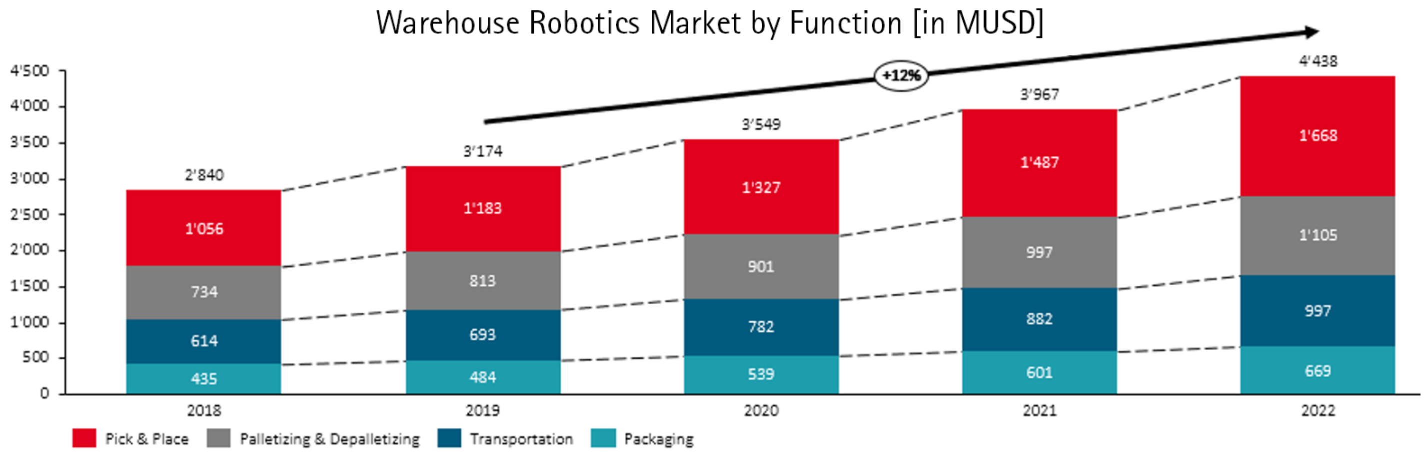


Figure 2: Pick-and-place robots capable of picking individual items are expected to represent a significant component of the fast-growing market for warehouse robotics.

In the last several years, robots have become more common in the warehouse. From robotic palletizing systems to packaging systems, warehouse operators are turning to robotics to increase efficiency and reduce costs. According to MarketsandMarkets, the largest segment of this growing market is "pick-and-place" robotics. Typically mounted on a stable stand, pick-and-place robots are positioned to reach products in a bin or on a conveyor, pick products using a specially designed gripper system, and transfer them to another bin or conveyor, freeing up human workers to focus on more complex tasks.

There are a wide range of potential applications for pick-and-place robots in today's warehouse that are not directly related to order picking. In receiving, for example, the technology could be used to support more efficient deconsolidation, sorting, and returns processing. Other potential applications include put-away and packing. However, for e-commerce and omnichannel warehouses dealing with scarce labor resources and rising fulfillment costs, order fulfillment presents the most promising applications for pick-and-place robots.

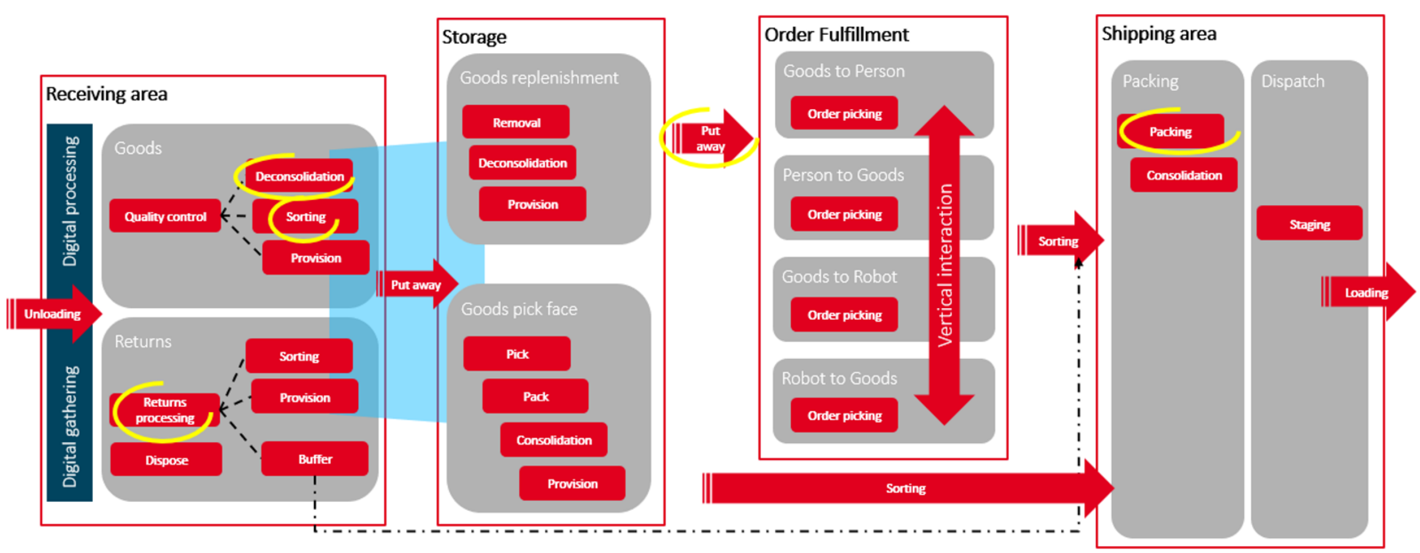


Figure 3: Pick-and-pass robots have multiple applications in today's warehouse, but the largest opportunity is in order fulfillment.

Using Item Picking Robots for Order Fulfillment

Pick-and-place robots designed for material handling are similar in some basic ways to the robots that have become common in manufacturing environments. However, the demands on robotic systems in material handling are very different than those in manufacturing. In manufacturing applications, robots are performing repetitive activities using highly standardized parts or components. In item picking, robots must recognize and handle a broader range of products sizes, shapes and weights.

To meet the demands of material handling applications, pick-and-place robots require a higher level of sophistication in some key systems than robots used in manufacturing. The key components of a robotic picking system include:

Vision System

The vision system features sensors that enable the robot to recognize the characteristics of the product being picked. A highly evolved vision system is required in material handling because the items robots may be expected to pick in a warehouse will not only have a variety of sizes and shapes but be positioned at different locations within the bin and sitting at different angles and orientations. Accurately perceiving the product and its orientation is the first step in enabling the robot to pick the item in the most efficient way. Today’s vision systems are relatively mature and can recognize a broader range of products than previous generations of robotics.

Gripper

The robot gripper system in material handling applications must replicate the functionality of the human hand as much as possible, which may use one finger and the thumb for smaller items and the entire hand for larger items. The most robust and capable gripper systems as applied in the Swisslog AutoPiQ solution use a central gripping unit surrounded by “fingers.” Incorporating suction into the central gripper and the fingers allows these components to work together or independently to effectively grasp different sizes, shapes and weight (Figure 4).

Arm

The robot arm plays a key role in enabling picking speed and application flexibility. The arm must move quickly enough to support desired pick rates while enabling the reach required to perform pick-and-place activities within an AS/RS pick station.

Brains

The brains of the system must operate on two levels. First, device-level decision making that enables the system to recognize products and determine how to grip and place them and learn over time from its experience (see sidebar). There is also the system-level brain that coordinates activities between the automation system feeding the robots and the robots themselves to enable order tracking throughout the process.

Central unit for small and medium size items | **Three fingers** for light or instable items | **Central unit plus three fingers** for large items | **Central suction and hold** for bottle shaped products

Figure 4: The gripper system used in item picking robots must be flexible enough to adapt to varying product sizes and shapes.

These systems must work together to manage the complexity of item picking that is not present in pallet or carton handling. Pallets, for example, have standard sizes and dimensions that simplify material handling while cartons have common, symmetrical shapes with packaging designed to provide some protection for the contents. This level of standardization does not exist in the individualized world of e-commerce and omni-channel fulfillment where products being handled by pick-and-place robots may range from a bar of soap to a scrub brush or from a pair of socks to a pair of pants.

Robots in item picking applications are thus generally evaluated on their ability to achieve a balance between speed, flexibility and reliability. How a robot performs in each area will determine how well it can achieve site-specific KPIs and deliver a solid return on investment:

Speed

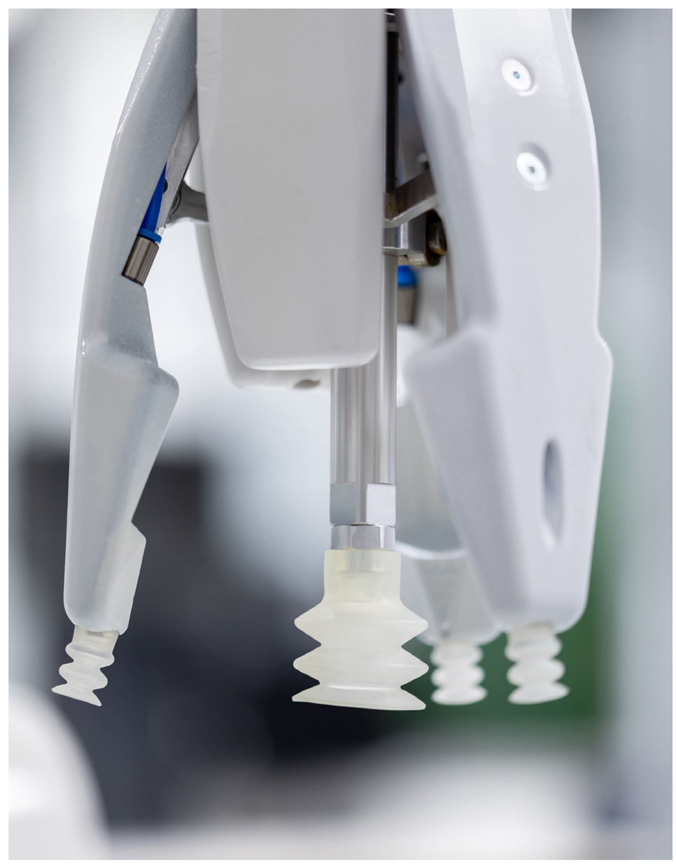
What a robot is capable of in a tightly controlled lab environment compared to what it can achieve in a real-world application are often very different. While pick-and-place robots can achieve technical speeds of 1,000 picks an hour, these speeds require very clear requirements in the warehouse. Technical speeds are measured using similar products available to the robot with no delays under ideal conditions. In the warehouse, presentation speed, hit rate per bin, whether products are being dropped or placed, and the range of products being picked can all impact speed. Depending on the product mix and process, application speeds for today's pick-and-place robots range from 6-18 seconds per pick. The key to maximizing robot productivity is in solution designs that leverage robots' ability to work uninterrupted across multiple shifts.

Flexibility

The higher percentage of products a robot can pick in a particular application, the greater its value. In applications with a high number of SKUs, today's pick-and-place robots will be unable to pick 100% of products, but they should be able to pick a high percentage of products. Setting realistic expectations for what a robot can accomplish in a particular environment plays a key role in determining the feasibility of this technology for an application and in ensuring appropriate processes are put in place to handle products that cannot be picked by the robot. As the technology continues to evolve and relies more on machine learning, the range of products that can be effectively picked will expand.

Reliability

Robots intended for use in warehouse environments should be designed with industrial-grade vision and gripping systems. Consumer-grade technologies, while offering good technical performance, are not well suited to the continuous demands and long lifecycles of warehouse automation. Today's industrial-grade robots can deliver excellent reliability over their expected lifecycle in warehouse environments.



The Self-Learning Robot: The Role of Machine Learning in Advancing Item Picking

Machine learning enables robots performing item picking to learn from experience. Using adaptive algorithms, the robot can improve its picking performance based on the data it collects and using that data to detect patterns, make associations and gain insights. The more "experience" the robot gains in an application, the more data it has to learn from and the better it can perform. This experience can even be shared across sites and companies to accelerate the learning process. Machine learning is being integrated into the current generation of robotic item pickers, which will enable these systems to pick faster and more efficiently the longer they are in operation.

Application Considerations for Using Robots in Order Fulfillment

Providing automated picking support for goods-to-person automation systems is a very promising application for pick-and-place robots that could significantly improve warehouse operations. To be effective in this application, the robot must be able to effectively pick a significant percentage of products stored in the automation system. This is possible in a growing number of applications due to the advances in robotic vision and gripping systems that occurred in the last several years.

The current generation of robotic item pickers have demonstrated the ability to recognize and handle a wide range of products without special testing. Products must, of course, be small enough to be graspable by the gripper. In the case of the Swisslog AutoPiQ solution, the gripper can handle products with dimensions of 25 mm by 20 mm with heights up to 300 mm and weights to 1.5 kg. Other characteristics that facilitate effective gripping include stable and closed objects/packaging, carton or hard plastic packaging with regular surfaces, and packaging with surfaces not permeable to air.

Figure 5: Representative products that can be picked without special testing by the current generation of pick-and-pass robots.

Product Characteristics that Impact Pickability		
Suitable for picking	May be suitable but require testing	Not suitable for picking
▪ Stable and closed objects/packaging ▪ Carton or hard plastic packaging with regular surfaces ▪ Packaging not permeable to air	▪ Irregular shapes ▪ Semi-transparent packaging	▪ Open packages or those that could open during picking ▪ Moving center of gravity ▪ Fully transparent packaging ▪ Packaging permeable to air ▪ Foil-sealed packaging susceptible to ripping

Pairing Pick-and-Place Robots with Goods-to-Person Automation

AutoStore represents an ideal platform for integration of pick-and-place robots. The system is highly standardized, which enables specific application considerations to be precisely replicated in the lab. This allows throughput to be accurately projected and a business case for robotic item picking to be developed. In most cases, the business case will be driven by cost savings resulting from increased productivity of human pickers or a reduction in the number of man hours required to complete a particular task.

Due to its large installed base and use of standardized bins, integrating robotic item picking into AutoStore pick stations operating alongside manual pick stations represents an ideal application for demonstrating the viability and value of using pick-and-place robots for order fulfillment.

This can be accomplished today by using robotic item pickers to pick the portion of an order they are capable of picking and then sending the partially picked order back into the system for consolidation with the portion of the order picked by humans. Bins are color-coded to distinguish between bins to be picked from and bins that contain partial or completed orders. In this use case, the item picking robots could pre-pick orders overnight or on weekends, significantly increasing the number of orders human pickers could fulfill during their shifts.

Generally, the automation solution must be designed to the technology. Item picking robots aren't as flexible as humans and solution design should account for this. In addition, the WMS must support the robots through capabilities such as order splitting, volume calculations and expanded error handling. Tight integration of all components in the solution is crucial to overall performance.

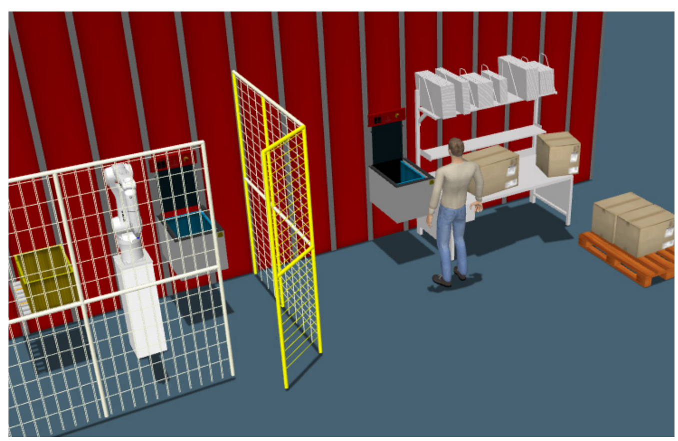
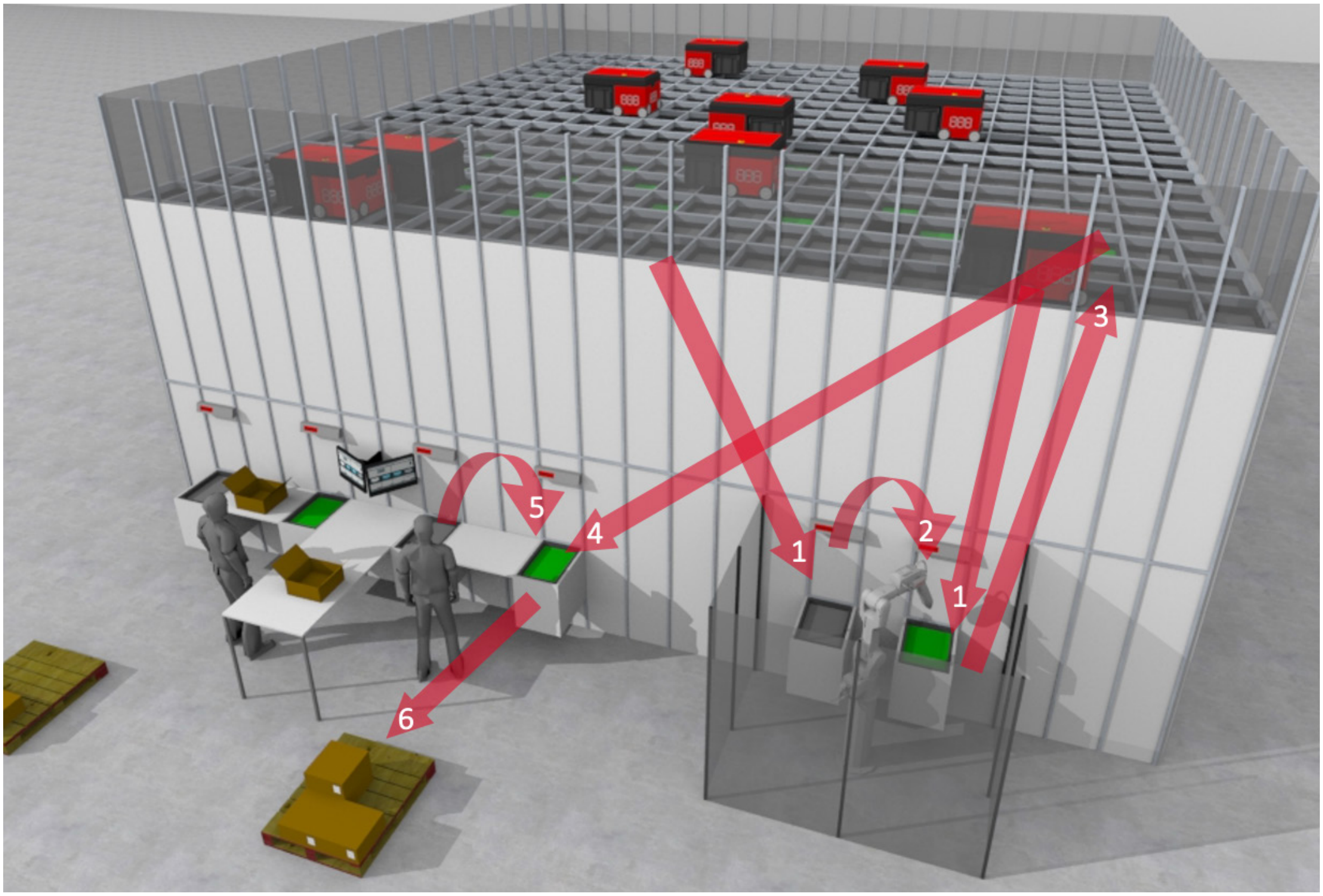


Figure 6: AutoStore system with robotic item picking and manual picking working together to support order fulfillment.



Automated Picking Process

1. An order bin (green) is sent to the robotic picking station.
2. Storage bins (grey) are sent to the robotic picking station and the robot picks from storage bins to order bins.
3. When the robot-picked portion of the order is complete, the order bin is sent back into the AutoStore system for temporary storage.
4. The order bin is brought out for consolidation/packing with other storage bins with non-robot pickable products
5. The order from the automation system is consolidated with manually picked products
6. The final order bin is ready for packing and shipping

Pre-picking of orders through the integration of pick-and-place robots and AutoStore represents just the first application for robotic item picking. Vision and gripping systems are continuing to be refined and when supported by machine learning, will expand the range of products that can be safely and efficiently handled by robots.

In addition, as the technology gains traction, Swisslog is developing plans to integrate robotic item picking with other goods-to-person automation systems, such as the Swisslog CycloneCarrier shuttle.

For special applications, Swisslog is partnering with Berkshire Grey. As part of the Berkshire Grey Partner Alliance program, Swisslog now serves as strategic systems integration partner for Berkshire Grey scalable AI and robotic solutions, adding these high-value solutions to its portfolio of flexible, robotic and data-driven automation.

Swisslog brings together the robotic expertise of KUKA with the company's own extensive experience in goods-to-person automation to deliver robotic item picking solutions that reduce labor requirements and warehouse costs. For help in developing a business case to support using item picking robots for order fulfillment, contact logistics@swisslog.com.

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