

# OPTIMIZING THE CONFIGURATION AND PERFORMANCE OF THE AUTOSTORE GOODS-TO-PERSON STORAGE SYSTEM



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## INTRODUCTION

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AutoStore has emerged as a highly effective solution for organizations that need to maximize storage density and accelerate pick speeds. The system's unique architecture delivers extremely dense storage while supporting goods-to-person (or robot) picking to enable significant improvements in productivity and throughput.

As the technology has matured, AutoStore has demonstrated the flexibility to support a growing number of applications in terms of order lines per hour and number of SKUs supported by the system. To take full advantage of this flexibility, the AutoStore system must be tailored to the requirements of pickers and the application by an experienced system integrator.

With more than 130 AutoStore systems installed across a variety of industries, Swisslog has more experience configuring AutoStore than any other organization. Swisslog has also developed a broad family of proven pick station configurations for the AutoStore system and is pioneering the use of automated picking robots with AutoStore.

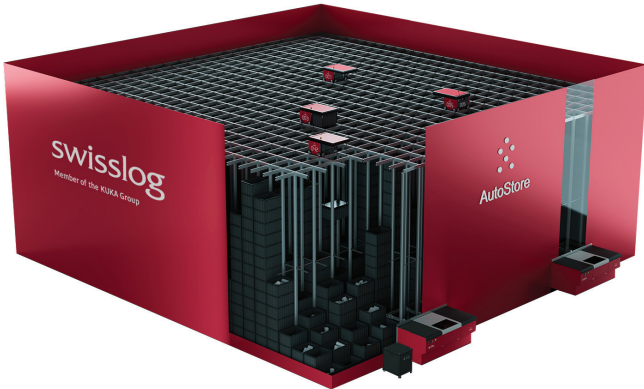
This paper draws from that experience to share best practices in configuring the system to optimize storage, throughput and scalability.



# ABOUT AUTOSTORE

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AutoStore consists of a modular, three-dimensional grid of self-supporting bins that are retrieved by robots and delivered to pick stations. The robots travel across the top of the grid, working independently or collaboratively, to retrieve bins based on the orders required by pickers. Depending on the application, bins may contain a single SKU or can be subdivided to contain multiple SKUs.



*The AutoStore system provides dense and scalable storage with flexible goods-to-person picking.*

All robots can reach any position on the grid and any pick station, eliminating the risk of single-point system failure. Pick stations are integrated into the grid using standard ports that are tailored to application requirements by the AutoStore system integrator.

Robots are controlled by an automation control system, which, in the case of Swisslog, is integrated into the Swisslog WMS, SynQ. The SynQ software controls bin location and collects real-time data from the AutoStore system to provide visibility into product and bin location. Data from the system can also be used to manage system availability through the SynQ Availability Manager. (See sidebar for more on the role software plays in enhancing AutoStore performance.)

## CONFIGURING AUTOSTORE FOR SCALABILITY AND PRODUCTIVITY

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Effective configuration of the AutoStore system requires collecting and analyzing a variety of data to properly size the system in terms of storage capacity and throughput, tailor pick stations for fast and accurate picking, and integrate the AutoStore system with other warehouse systems and processes.

The information used to guide configuration decisions should include historical order data, the number of days of inventory to be held by the system, the desired throughput, the ratio of fast-moving to slow-moving SKUs, the physical dimensions of SKUs, and the projected growth rate in terms of storage requirements and throughput.

### Configuring for Scalability

Three variables are key to optimizing the AutoStore configuration to meet initial requirements while maximizing future flexibility:

#### Robots

AutoStore robots provide the ultimate in flexibility as they can be added on the fly, allowing the number of robots in the initial system configuration to be matched to initial throughput and inventory. As those requirements change, more robots can be added without any disruption to operations.

# CONFIGURING AUTOSTORE FOR SCALABILITY AND PRODUCTIVITY

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## *Pick stations*

The number of pick stations is also scalable but requires planning during configuration. Generally, the AutoStore structure is configured to accommodate more pick stations than are initially required by constructing the grid with openings for pick stations that are not filled initially. When new pick stations are required, they can be slid into place within hours.

There is a correlation between the number of robots and the number of pick station, but this ratio will vary from application to application. An experienced integrator will take the time to analyze the potential "hit rate" for pick stations to reduce the number of robots required to support the desired throughput and optimize the system ROI. A higher hit rate means fewer robots are required to achieve the desired throughput because the picker is pulling multiple orders simultaneously.

## *Grid size*

While the modular AutoStore grid is expandable to accommodate growth, if an organization is on a steady growth trajectory, the most economical approach is to size the grid for some defined future state, typically two years, to prevent having to expand the system too soon after installation.

The grid itself is a relatively inexpensive component of the system, providing a strong business case for building in some excess capacity during configuration. As inventory grows, the empty areas of the grid can be populated without any interruption in operation. When it does become necessary to expand the grid, one section can be shut down, allowing robots to continue to serve pick stations while the structure for the expansion is put in place.

This high degree of flexibility is one of the main factors contributing to the success of the AutoStore system in recent years. At the Swisslog AutoStore Users Conference, held in Northbrook, Illinois, in 2018, Paul Ancona, vice president of engineering at Medline, a medical supplies distributor that is operating eight AutoStore systems across its distribution network, shared that, "the biggest advantages [of AutoStore] for us were flexibility and redundancy. We can add robots and ports as we need them and if a robot needs service, we can take it off-the-grid and still run the system as intended."

"The big problem we were having was space and AutoStore is much denser than the alternatives we were looking at. With AutoStore we can fit 20 percent of our inventory in about 3 percent of our building space."

*Paul Ancona*  
*Vice President of Engineering, Medline*

Isaac Poole, distribution center director for omni-channel sportswear retailer LIDS, also shared his experience at the Users Conference, emphasizing the value of the dense storage and flexible design the AutoStore system provides. "The big problem we were having was space and AutoStore is much denser than the alternatives we were looking at. With AutoStore we can fit 20 percent of our inventory in about 3 percent of our building space. We currently have some excess capacity within the grid so the first step for us in scaling the system is adding more robots. But we were careful to leave room around the AutoStore system as well, so we can expand the grid as we need to."

## **Configuring for Productivity**

AutoStore systems are available with several standard port options that enable the system to deliver bins to the picker or receive bins for re-stocking.

# CONFIGURING AUTOSTORE FOR SCALABILITY AND PRODUCTIVITY

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These standard ports include only the basic conveyor interface and operator worksurface. They must be tailored to the application to support AutoStore's role within the warehouse and equipped with the necessary technology to enable fast, accurate picking.

Key to the pick station configuration is the operator display, which provides information from the WMS to the operator on what items to pick from the bin. The display should be designed to present only the information the operator needs as simply as possible, including, in many cases, a visual of the product to be picked. Swisslog supports the operator display with pick-to-light technology, which directs a beam of light at the product to be picked to increase pick speed and accuracy.

In addition to this productivity-enhancing technology, pick stations must be configured based on the role of AutoStore within the warehouse. This role can be broadly categorized as pick-and-pass, pick-and-pack, or all-in-one.

## Pick-and-Pass

In many applications, AutoStore is configured to support operators who pick products into a tote or cart that is then moved downstream by a conveyor, manually or by lift truck for order top-off and/or packing. This approach provides maximum picking performance because pickers don't spend time packing and also consumes less space because auxiliary equipment such as automated weighing and labeling systems are usually not required.

The other advantage of pick-and-pass configurations is that operators can often handle multiple open orders in parallel, increasing the hit rate and workstation utilization. This allows the AutoStore system to present fewer bins per station while supporting the same number of order lines, requiring fewer robots and pick stations while still achieving a very high throughput.

For example, an omni-channel retailer can support e-commerce and store replenishment from a single pick station, with the operator picking multiple orders from the same bin. The end result is that individual e-commerce orders are picked with no additional strain on the system and without additional pickers.

In its simplest form, a pick-and-pass station utilizes a single takeaway conveyor for internal bins to be removed from the station. The operator takes an empty tote from a pallet, place it on their picking position and then start picking.



*Single-conveyor pick-and-pass pick station.*

Alternately, a two-tier conveyor system can be installed to return empty totes to the operator, speeding their return back from the packing station, or supporting case picking. Another alternative is to use carts to enable downstream manual picking prior to packing. This can be a good solution to accommodate bulky items that don't fit in the AutoStore system.

## Pick-and-Pack

Pick-and-pack stations are configured to enable the picker to pick and pack products from a single pick station. In this case, the pick station is often equipped with automatic closing and labeling equipment, requiring more space for the station but ultimately saving space in the warehouse as additional packing stations are eliminated. It also reduces labor requirements as a single picker can perform both operations.

Throughput per workstation is lower with a pick-and-pack operation because the picker is doing more with each order and it can be more challenging to balance loads across pick-and-pack stations because pack times vary with order complexity.

# CONFIGURING AUTOSTORE FOR SCALABILITY AND PRODUCTIVITY



*Pick-and-pass operation using conveyors and robotic carton erection cell to support the pick stations with order cartons of different sizes. Order cartons are automatically closed and labeled on their way to dispatch.*

For one customer, Swisslog designed a pick-and-pack operation to support e-commerce picking as well as store replenishment using four different carton sizes. The resulting solution shows how much can be accomplished in a small space and demonstrates the potential to integrate AutoStore with other automated systems. In this case, a robotic carton-erection cell supports the pick stations, providing pre-labeled order cartons of multiple sizes.

## **All-in-One**

All-in-one stations allow operators to perform complete order preparation from a single station. This provides the flexibility to handle multiple order types and can generate cost savings in the conveyor layout because all picking and packing efforts can be executed in one type of workstation.

For omni-channel fulfillment, direct picking into order cartons avoids the duplicate effort of re-packing products from order totes into order cartons while retaining the flexibility to pick and pack individual SKUs. To support the necessary tasks, these

stations are typically equipped with automated closing and labeling equipment, a buffer area and a shipping sortation area.

A clothing retailer with ten different retail chains as well as an e-commerce channel, uses an all-in-one pick station designed by Swisslog to manage store replenishment, which is often done on an individual item basis, and e-commerce order fulfillment. The retail cartons go to a cross-belt that sorts cartons for dispatch and order consolidation while the fully packaged and labeled e-commerce orders go directly to a sorter.



*All-in-one pick station configuration.*

# USING ROBOTIC PICKING WITH THE AUTOSTORE SYSTEM

The next evolution in AutoStore pick stations is the integration of item picking robots. As part of KUKA, a global leader in robotics, Swisslog is at the forefront of this evolution.

Where previous-generation robots made compromises in performance to enable human-robot collaboration, it is now clear that robotic item pickers are most valuable operating independently of humans, enabling much higher pick speeds. This new generation of robotics is exemplified by the next-generation Swisslog ItemPiQ. With this new solution, ItemPiQ has been enhanced with new robot technology and new intelligent vision software to achieve speeds of up to 1,000 picks per hour.

Machine learning uses image data from the system to continually optimize system performance and the system's simple user interface enables quick set up with no knowledge of robotics required.

The core of the advanced ItemPiQ is the KUKA KR AGILUS-2 – a fast, lightweight, 6-axis robot. It features a robotic arm that extends up to 110 centimeters, making it ideal for use in AutoStore pick stations. The enhanced vision system consists of a 3D camera and smart image recognition software that allows the system to quickly and reliably identify optimal grasping points.

The multifunction gripper system features a central suction finger supported by three smaller vacuum cups that encircle it. The central suction finger is used for smaller items. For larger

objects and items with uneven surfaces, the central suction finger works in concert with the three vacuum cups to gently and securely grasp the item. The software can toggle quickly and flexibly between the different gripping modes without time-consuming mechanical retooling.

Machine learning uses image data from the system to continually optimize system performance and the system's simple user interface enables quick set up with no knowledge of robotics required. When needed, the learning logic could be cloud-based to allow robots from multiple sites to share their learnings.



*The next-generation Swisslog ItemPiQ.*

The benefits of robotic picking used in conjunction with AutoStore include reduced dependence on human labor, faster, more consistent picking and the ability of robots to operate over extended periods with no fatigue or degradation in accuracy.

# THE ROLE OF SOFTWARE IN OPTIMIZING AUTOSTORE PERFORMANCE

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Realizing the full potential of an AutoStore system requires expert configuration and warehouse control software that enhances flexibility and operation of the system. Here are six things to consider when evaluating the software that will support your AutoStore system.

## 1. Extensibility

Most AutoStore control software operates as a stand-alone system outside the primary WMS. This can limit the ability to fully integrate AutoStore with other distribution center systems and processes and force operators to continually adapt to different user interfaces depending on what system they are supporting. By contrast, the AutoStore Director in SynQ functions as a module within the SynQ platform. This provides the flexibility to implement the module as a standalone control system that integrates with an existing WMS or to use SynQ as the primary WMS with AutoStore Director operating within the larger platform. The latter option is often the best for applications where AutoStore is supporting other distribution center processes as it creates tighter integration across those processes, eliminates the need to integrate various warehouse software platforms and ensures end-to-end product visibility.

## 2. Versatility

Different AutoStore applications require different workstation configurations and not all AutoStore software is versatile enough to accommodate special requirements, such as combining two ports into one workstation to allow a single operator to pick multiple operator orders simultaneously. The architecture of SynQ allows for a multitude of workstation setups as well as the ability to connect conveyor systems to AutoStore to move products downstream for picking, packing and shipping. SynQ also provides the versatility for an operator to change the bin layout or switch between picking, put-away or cycle counting on the fly.

## 3. Manageability

Warehouse control software can play a key role in AutoStore management. For example, SynQ offers a 3D Visualizer for AutoStore that provides an overview of the system at any point in time. SynQ also makes it easy to add business intelligence tools, such as Cockpit Manager, which provides a dashboard view of KPIs, and Availability Manager, which monitors system health.

## 4. Performance Optimization

Optimizing the performance of AutoStore requires the ability to balance loads across workstations to maximize picks per workstation and overall system throughput. SynQ includes smart algorithms and strategies, honed over more than 130 AutoStore implementations, to intelligently orchestrate bin delivery to balance capacity and support just-in-time picking for operators picking multiple orders.

## 5. Usability

Are operators receiving exactly the information they need to pick accurately and quickly and nothing more? And, are operator interfaces standardized across various warehouse systems to reduce training requirements, increase workforce flexibility, and improve operator efficiency? Because SynQ represents a platform that supports multiple warehouse control modules, it enables the use of a universal user interface across the warehouse. Swisslog's experience supporting AutoStore has also resulted in optimized AutoStore user interfaces that deliver exactly what operators need to pick quickly and accurately.

## 6. Support for Emerging Technologies

Item-picking robots represent an important part of the future of AutoStore. However, integrating robotic picking into an AutoStore system presents challenges from a software perspective. Processes such as cubing, order allocation, workload balancing and exception handling all need to be updated to leverage this technology. The SynQ AutoStore Director module is the first AutoStore control software to integrate robot item picking capabilities.



# CONCLUSION

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AutoStore continues to gain traction in the market by delivering high-density storage, outstanding application flexibility and unrivalled reliability. But properly configuring the system to the application can make a huge difference in the ability of the system to meet objectives in the most cost-effective way. As the first integrator to work with the AutoStore system and with more installations than any other organization, Swisslog is uniquely qualified to effectively configure and optimize AutoStore for a wide variety of applications and to integrate robotic item picking with the AutoStore system.

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