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INTRODUCTION

AutoStore is one of the fastest growing – and most flexible – automation solutions available to warehouse operators seeking storage density and operator productivity. As the world's leading integrator of AutoStore, Swisslog has developed this e-book to provide a comprehensive introduction to AutoStore's capabilities, configuration options and ownership experience. For more information on whether AutoStore is right for your operation, contact logistics@swisslog.com.

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› THE RIGHT TECHNOLOGY + THE RIGHT INTEGRATOR

AutoStore is a compact, innovative robot-based automated storage and retrieval system that supports goods-to-person or goods-to-robot picking. It is designed to handle both fast- and slow-moving small-order and small-case-pick SKUs with extremely high storage density.

As the world's first AutoStore integrator, Swisslog has played a significant role in expanding the applications for AutoStore. Originally developed for electronic parts distribution, AutoStore is now being used across a wide range of applications.

Today, Swisslog is the world's leading AutoStore integrator with over 370 projects sold worldwide across 27 countries, including recently completing the first AutoStore deployment in Thailand. This has created a depth of experience in evaluating the applicability of AutoStore for a particular application and configuring system hardware and software to optimize performance.

Carefully understanding the needs of an application prior to solution selection enables Swisslog to fully leverage the benefits of the AutoStore system in applications where it makes sense while also offering more cost-effective solutions for applications that don't require the dense storage AutoStore delivers.

Our experience also helps ensure the AutoStore system meets storage and throughput requirements in the most efficient way possible, streamlines the configuration and installation process, and has enabled us to develop the most mature and sophisticated AutoStore control software.

Swisslog Experience with AutoStore

13,100 Robots

9.5 Mio. Bins

+370 Projects including extensions

27 Countries

99.6% Up-Time

Swisslog has more experience with AutoStore deployments than any other organization.

Learn more about the role software plays in optimizing AutoStore capabilities.

How it Works

The AutoStore system consists of four main components: a three-dimensional storage grid, storage bins that contain product inventory, a team of robots that retrieve bins, and ports that serve as the interface between the operator and the AutoStore system.

Together these components, with activities orchestrated by the integrator's automation control software, provide a dense, goods-to-person or goods-to-robot retrieval solution. Potential benefits of a properly configured solution in the right application include increased productivity, reduced worker fatigue, faster order cycle times, and maximum warehouse space utilization.

In addition, the modular design of the system helps future-proof inventory management by allowing increased throughput or storage capacity as needed. The ability of the software to scale with the system is key to achieving these benefits.

Watch the video to learn more about AutoStore's capabilities and see the system in action.

The standard version of AutoStore is called the Red Line and has been very effective at supporting standard throughput requirements up to 350 bins/hour per port. Special configurations of the Red Line developed by Swisslog have achieved higher throughputs.

The AutoStore Black Line, introduced in early 2019, increases the throughput capabilities of the system. The AutoStore Black Line achieves higher throughputs through a new generation of robot that is designed for faster acceleration, is powered by lithium ion batteries and includes an internal cavity to hold the storage bin. Also new to the Black Line is a "double-double" track design that allows robots to pass side by side in both the x and y axis. In addition, the Black Line can support larger bins (425 mm), allowing bulkier products to be stored in the system.

Because AutoStore is modular, Red and Black Line modules can be configured together. The AutoStore Black Line robots can even operate on the AutoStore Red Line "single-double" track to take advantage of the increased acceleration and fast-charging lithium ion batteries; however, they will lack the functionality enabled by the double-double track.

The Swisslog Advantage: Experience

No one has deployed more AutoStore systems than Swisslog, and that experience translates directly into more mature design processes and more robust software.

Watch how Hat World, a leading U.S. provider of sportswear operating under the retail brand Lids, used a Swisslog-configured AutoStore to achieve a 20-time improvement in e-commerce pick rates, optimize storage capacity, and meet their goal of 100 percent order fulfillment accuracy while offering guaranteed 24-hour delivery.

〉 DETERMINING IF AUTOSTORE IS RIGHT FOR YOUR BUSINESS

AutoStore is an extremely powerful automation solution in the right application but may not be ideal for every situation. Fortunately, it is one of multiple options available to warehouse managers seeking to increase productivity or space utilization.

Working with an integrator that takes the time to understand the specific needs of your application and has access to a wide range of solutions is vital to optimizing the cost effectiveness and performance of material handling technology. Alternatives to AutoStore that might be considered include:

Autonomous goods-to-person robots: Autonomous robots that deliver racks of products to pickstations provide the productivity benefits of goods-to-person picking with outstanding application flexibility and scalability. They can be a very cost-effective solution in applications where storage density is not a priority.

Mini-load cranes: Mini-load cranes form the basis for automated warehouse systems that cover a wide range of small loads in terms of size and weight. They can be a cost-effective solution for applications that don't require the storage density or throughputs of an AutoStore system.

Shuttle systems: For case and tote storage, Swisslog's CycloneCarrier is a high-density, high-throughput shuttle system can retrieve up to 2,000 totes per hour per aisle. Like AutoStore, the modular shuttle system allows easy scalability and can be tailored to various building shapes and sizes.

Swisslog CarryPick goods-to-person robots


Swisslog Tornado mini-load crane

Swisslog CycloneCarrier shuttle system

The sweet spot for AutoStore is applications that combine the need for high storage density of small items or cartons and total throughput requirement in the range of 500-2,000 bin presentations per hour. Under these conditions, AutoStore has the potential to deliver a faster ROI than other automation solutions while future-proofing your warehouse through the combination of flexible, data-driven, and robotic automation.

Unparalleled Storage Density

AutoStore's unique cube design, in which storage bins are stacked vertically up to six meters high, represents the most space efficient automation system available today.
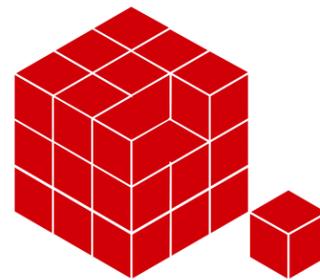
AutoStore's design also allows it to be constructed around pillars and in irregular shapes to take maximum advantage of available warehouse space. Port locations are flexible, and the system design enables simultaneous pick and replenishment. In addition, AutoStore can be configured to work in buildings with low ceiling heights.
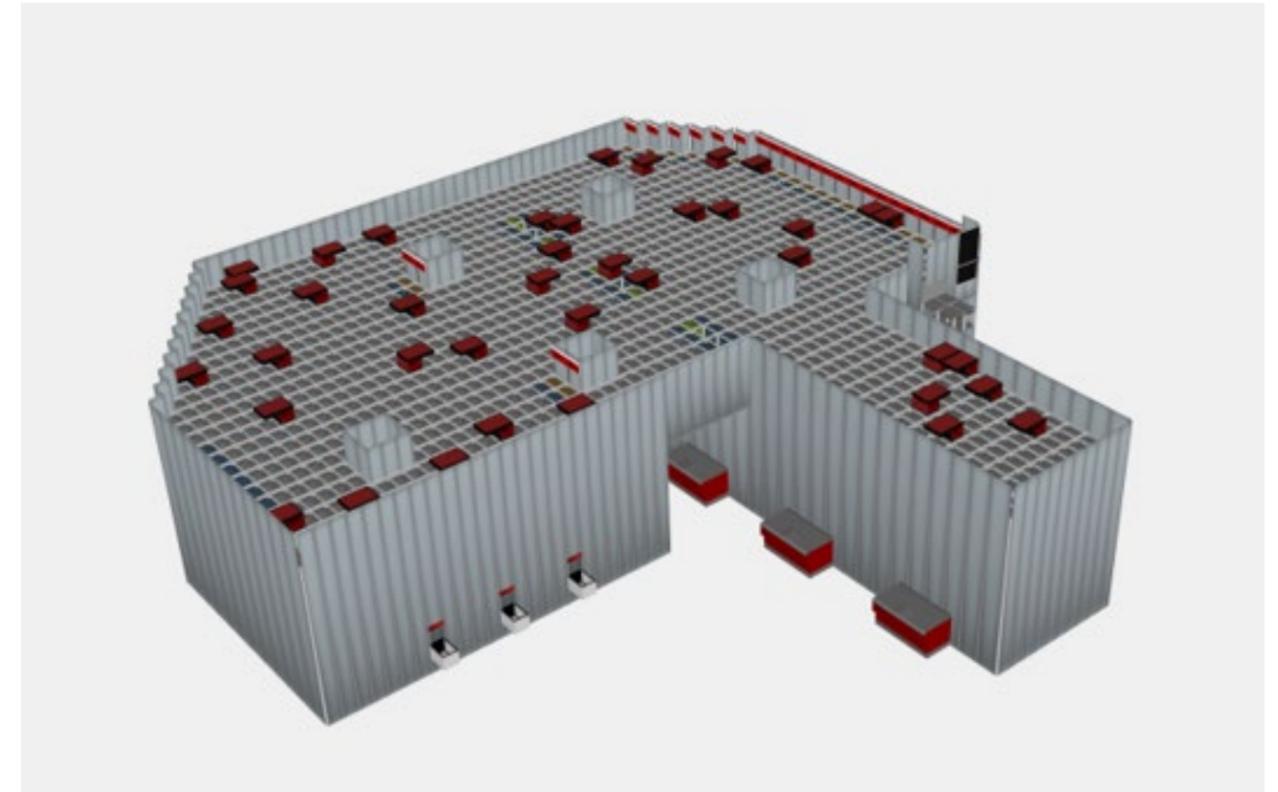
Example of an AutoStore system configured to adapt to building shape and utilize space around obstacles.

Goods-to-Person Productivity

Relying on hard-to-find labor to meet fluctuating or growing demand significantly increases business risk. AutoStore helps you mitigate that risk in multiple ways.

First, as a goods-to-person or goods-to-robot solution, AutoStore can increase the productivity of warehouse personnel. Many AutoStore customers find they can increase pick rates by moving to goods-to-person picking from traditional approaches where operators walk the warehouse floor picking products. This can eliminate the need to supplement staff during peak seasons or enable some pickers to be re-assigned to other tasks.

In addition, robots don't have the physical limitations of human labor. They don't get tired, take breaks or need seven hours of sleep each night. That provides the flexibility to extend work shifts by, for example, having robots stage orders before human workers arrive on the job or by integrating robotic picking systems with AutoStore.

Learn more about using robotic picking with AutoStore.

Easy Scalability

AutoStore's modular design makes it easy to adapt the system to support changes in throughput or inventory by adding ports, robots or storage modules. By working with an experienced integrator, your AutoStore can be configured to minimize your capital investment

Read more about how to optimize your AutoStore configuration.

while ensuring the ability to efficiently adapt to growth as it occurs.

The AutoStore control software enables this scalability by being able to handle expansion of the system without modification and ensuring assets are fully utilized, inventory is re-slotted based on demand, and

Learn more about the role software plays in optimizing AutoStore performance.

issues that could affect system availability are detected.

There's a reason AutoStore is gaining traction in the market today. Or, rather multiple reasons. If you have low to medium throughput requirements and space limitations, AutoStore might be the right solution for you.

Watch the video to learn about a few of the organizations using AutoStore today and the benefits they are realizing.

The Swisslog Advantage: Application expertise

With a complete suite of material handling automation solutions, Swisslog is able to tailor automation solutions to the specific requirements of the application.

THE "BRAINS" BEHIND AUTOSTORE: WHY SOFTWARE MATTERS

AutoStore is a physical system with integrated intelligence, but it relies on third-party software to orchestrate its activities based on data from a WMS or ERP system. The ease with which AutoStore can be deployed, operated, and expanded is as dependent on the capabilities of the software as it is on the design and configuration of the hardware.
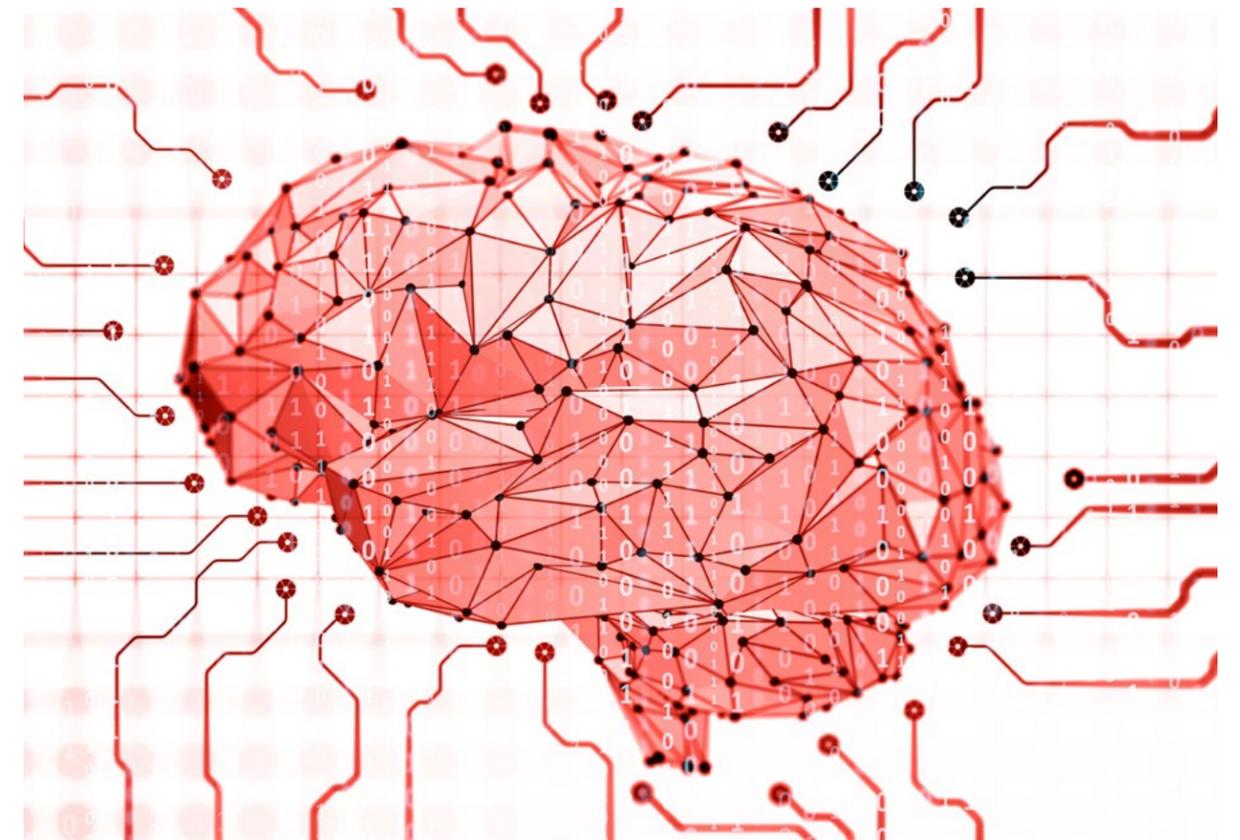
The challenge prospective users face is that each AutoStore integrator uses different AutoStore control software with different architectures and capabilities. Understanding those differences is critical to getting the most from your AutoStore investment as they can impact performance and flexibility in the following ways:

Usability

The software determines the way operators interact with AutoStore and the information they receive. The best practice is to standardize operator interfaces across various warehouse systems to reduce training requirements, increase workforce flexibility, and improve operator efficiency.

This is best accomplished with an AutoStore control software that is integrated into a WMS platform that supports multiple warehouse control modules as is the case with Swisslog's SynQ and its AutoStore Director.

Through this architecture, the WMS enables the use of a universal user interface across the warehouse. While the interface is standardized, the information presented to operators can be customizable based upon the specific application and optimized for ergonomics and simplicity. All of the various automation control modules, or Directors, within SynQ use an intuitive universal user interface.

Performance optimization

Your AutoStore control software plays a key role in optimizing the performance of the system by balancing loads across pickstations to maximize picks per station and overall system throughput.

The AutoStore Director software covers all functions needed to run AutoStore as a "black box." Local inventory management components and sophisticated material flow strategies are included to leverage the overall system performance in the best possible way. It also allows for different order batching strategies that ensure the most efficient use of the system overall, including utilizing the same pickstations for picking and storing goods and supporting robotic picking.

Swisslog ensures your control software includes smart algorithms and strategies, honed over thousands of operating hours across multiple installations, to intelligently orchestrate bin delivery to balance capacity and support just-in-time picking for operators picking multiple orders.
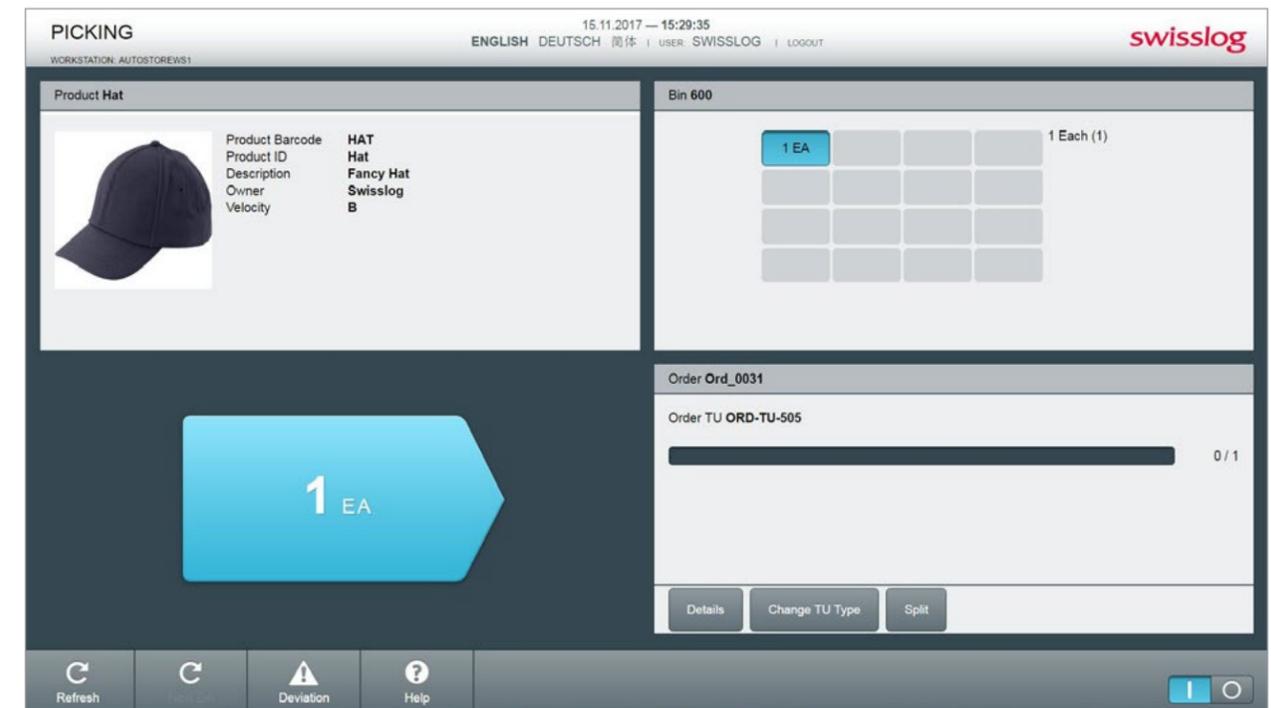
Extensibility

Most AutoStore control software operates as a stand-alone system outside the primary WMS. This can limit your ability to fully integrate AutoStore with other warehouse systems and processes and force operators to continually adapt to different user interfaces depending on what system they are supporting. SynQ also provides robust standard functionality, including enabling operators to change the bin layout or switch between picking, put-away or cycle counting on the fly.

AutoStore control software that operates within the WMS, while retaining the ability to operate as a standalone module, such as AutoStore Director, ensures AutoStore can be integrated into existing warehouse operations in the most efficient way possible. AutoStore Director can also operate independently, integrating with other WMS and ERP software platforms through standard APIs.

Versatility

Different AutoStore applications require different pickstation configurations and not all AutoStore software is versatile enough to accommodate the right configuration for a particular application. The architecture of SynQ supports a multitude of pickstation setups as well as the ability to connect conveyor systems to AutoStore to move products downstream for picking, packing and shipping.

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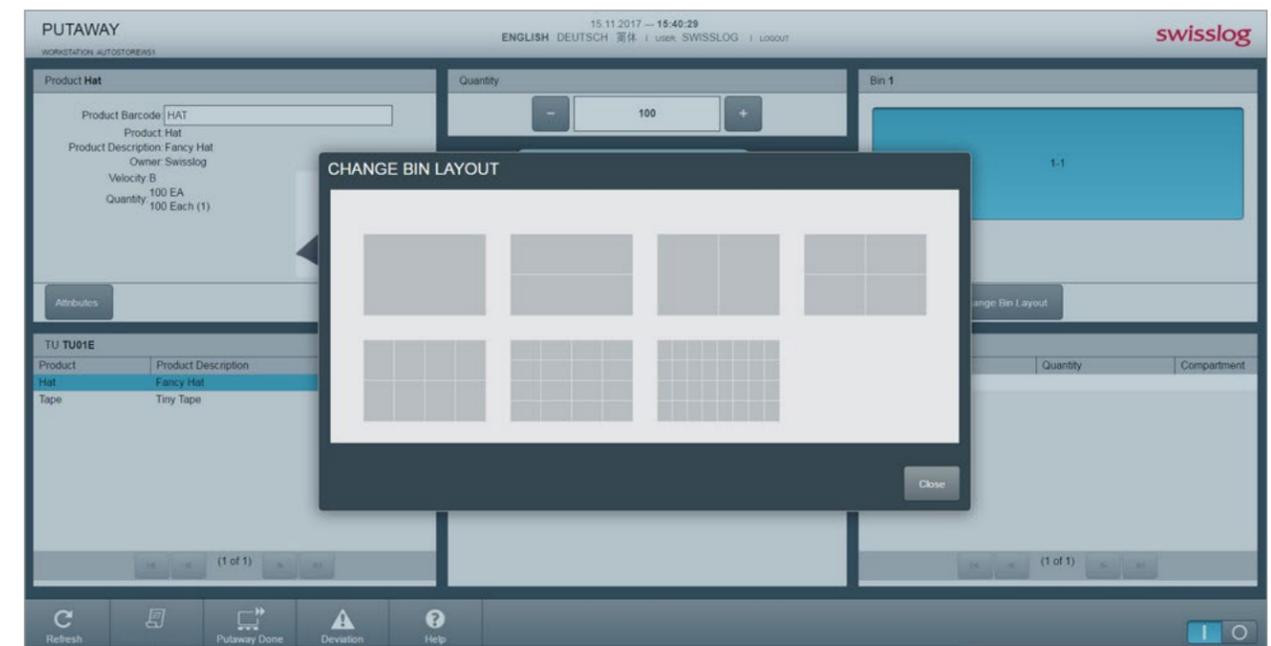
Manageability

State-of-the-art AutoStore control software includes 3D visualization capabilities that present a simple, holistic overview of the system at any point in time. Also look for the availability of business intelligence tools that provide a dashboard view of
KPIs and simplify system health monitoring.

Swisslog's AutoStore Director includes 3D visualization as well as business intelligence tools, such as Cockpit Manager, that provide a dashboard view of KPIs, and Availability Manager, which monitors system health.

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. Swisslog control software supports automated picking.

The Swisslog Advantage:
SynQ Software with AutoStore Director

The Swisslog AutoStore Director is fully integrated into our WMS platform, enhancing integration between AutoStore and other systems and providing a consistent operator interface across systems.

Watch the video to see an overview of the SynQ software system.

❮ Back to THE RIGHT TECHNOLOGY + THE RIGHT INTEGRATOR

› OPTIMIZING YOUR AUTOSTORE CONFIGURATION

Tailoring AutoStore hardware, software and service options to your application ensures you get the most from your investment. Swisslog has a mature and rigorous AutoStore configuration process that includes factors such as fire safety that other integrators may omit.
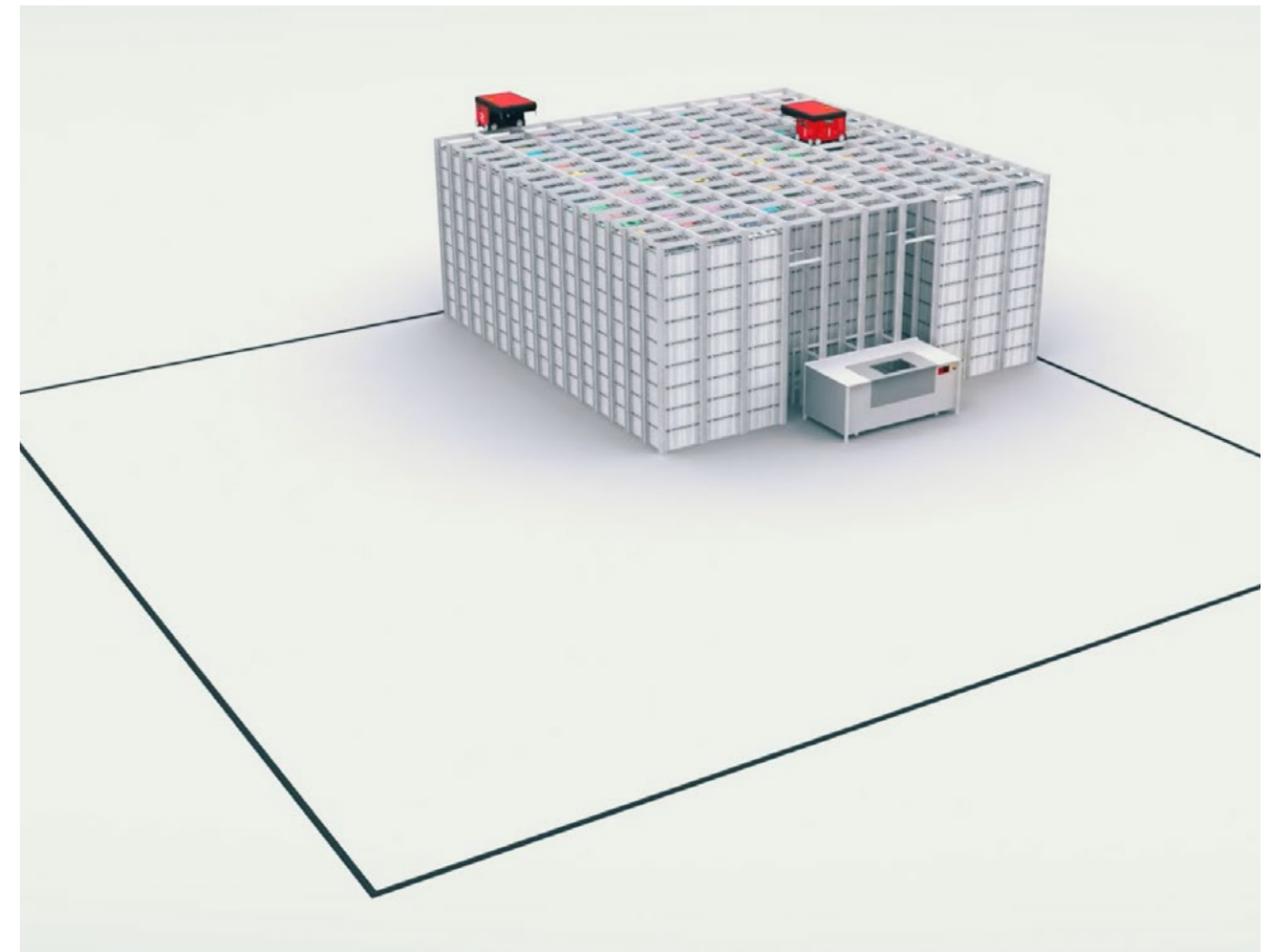
Configuring Hardware

Determining the initial size of the system and the number of robots and ports requires an integrator willing to collect and analyze a wealth of data. This 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.

Three variables are key to optimizing the AutoStore hardware configuration based
on this analysis:

1. **Grid size**

   Construction of the AutoStore system has been compared to an erector set in that it uses standard, modular components that make it easy to physically expand the system as your needs change. Generally, the AutoStore grid is sized based on inventory projections for two years from the startup date. As inventory expands, the system will automatically move inventory into unused areas of the grid, providing seamless growth.

   If additional storage is required at a later date, the grid can be

expanded without shutting down the entire system. Only part of the grid is shut down and inventory is consolidated in the remaining modules while the new module is added. Once the expansion is complete, the system will redistribute inventory across the entire grid.

2. Robots

AutoStore robots provide the ultimate in flexibility as they can be added without any downtime, 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.

3. Pickstations

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

There is a correlation between the number of robots and the number of pickstations, 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.

‹ Back to DETERMINING IF AUTOSTORE IS RIGHT FOR YOUR BUSINESS
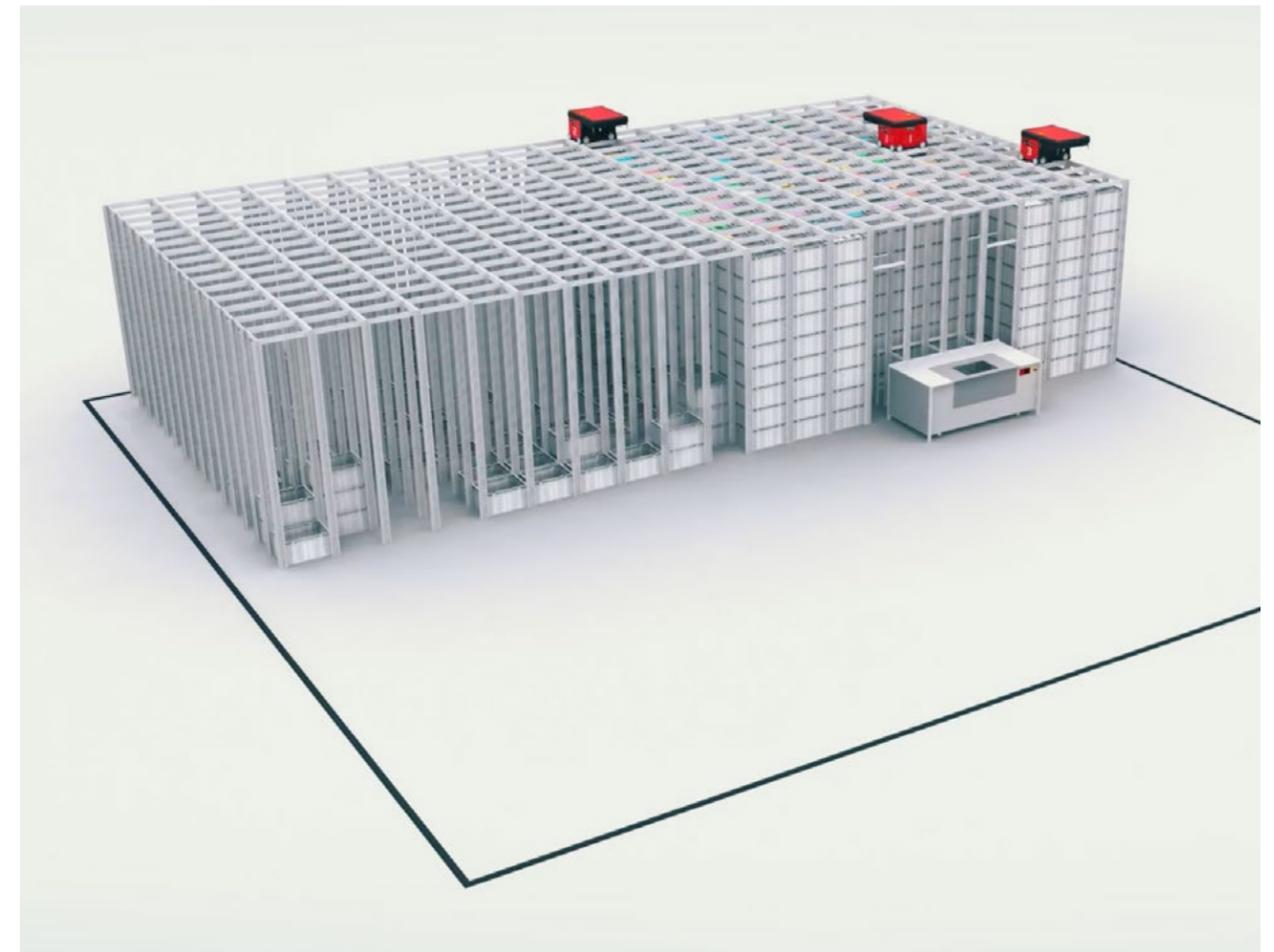
Configuring Software

Choosing the right automation control software for AutoStore and tailoring the software to your needs are as important as ensuring AutoStore hardware meets throughput and inventory requirements. Here are four keys to getting it right.

### 1. Minimize software layers

One of the challenges of deploying any automation system in the warehouse has been the need for a material flow control layer between the WMS and the automation system. This complicates integration and has the potential to create data silos.

Integrated WMS systems such as SynQ include the automation control, inventory management and order allocation functionality for AutoStore all within one platform, eliminating the need for third-party software and simplifying deployment.

2. Reduce customizations

Every warehouse has slightly different requirements and processes. But the need for customization of the software supporting AutoStore can be minimized or eliminated by working with an experienced integrator that has systematically turned past customizations into standard features.

For example, the standard SynQ AutoStore Director now offers such rich functionality that approximately 30 percent of Swisslog's AutoStore customers deploy the exact capabilities they need without any software customization. Because customizations take time to develop and test, being able to deploy "AutoStore on Demand" can cut months off of the implementation timeline and reduce software costs.
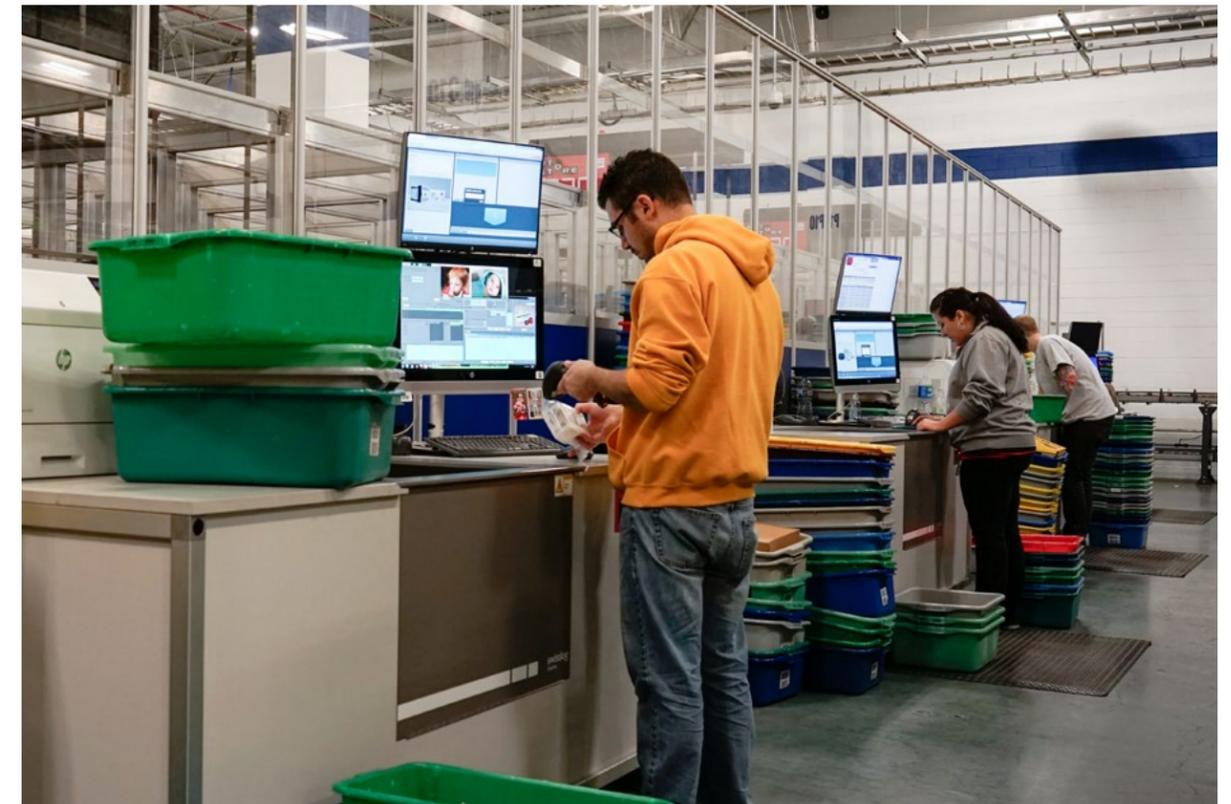
3. Understand integration requirements

Even if you're using a WMS with integrated automation control, such as SynQ, integration with other platforms, such as the ERP system, can expand the value of your AutoStore system. APIs within the automation control system should enable simple integration with warehouse management and ERP systems.

4. Leverage business intelligence

As we move toward more data-driven warehouse management, automation systems must be integrated into the warehouse in a way that allows them to contribute to, and benefit from, business intelligence tools. SynQ is architected in a way that allows the AutoStore control functionality to be extended through a library of business intelligence tools designed to support higher availability and easier management.

Watch how paper, packaging and specialty products distributor Antalis worked with Swisslog to deploy an AutoStore system that maximized space utilization, improved customer service and enables easy expansion.

The Swisslog Advantage: AutoStore on Demand

Based on the number of software customizations we've already performed, many of which have been integrated in the standard AutoStore Director, Swisslog customers have the option of choosing AutoStore on Demand, which cuts implementation time and costs.

› TAILORING AUTOSTORE TO YOUR PROCESSES

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

Conveyor Port: A simple and functional port configuration that moves bins to the operators through an opening outside of the grid.

Carousel Port: A high-performance port that operates with three rotating arms, each holding one bin tray, allowing rapid bin presentation.

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Swing Port: A ground-floor port that enables AutoStore to be mezzanine-mounted.

Relay Port: A fast, dynamic port for high-demand operations, specially designed for the AutoStore Black Line.

Cluster Port: An exclusive Swisslog design that optimizes the put-away process to the correct department.

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 pickstation performance 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. Pick-to-light technology, which directs a beam of light at the product to be picked, can be a valuable addition as it can increase pick speed and accuracy.

In addition, pickstations 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 pickstations while still achieving a very high throughput.

Watch how paper, packaging and specialty products distributor Antalis worked with Swisslog to deploy an AutoStore system that maximized space utilization, improved customer service and enables easy expansion.

Pick-and-Pack

Pick-and-pack stations are configured to enable the picker to pick and pack products from a single pickstation. In this case, the pickstation 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.

Online sports retailer Sportamore supports a wide range of products from more than 300 manufacturers and was experiencing rapid growth. See how an AutoStore pick-and-pack solution allowed the company to maintain a high rate of growth without compromising customer service by providing flexible, robotic and data-driven automation.

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. To support the necessary tasks, these stations are typically equipped with automated closing and labeling equipment, a buffer area and a shipping sortation area.

All-in-one pick station configuration designed to support store replenishment and e-commerce within a single workstation.

The Swisslog Advantage:
Better Pickstation Design

Swisslog's universal operator interface, optimized for AutoStore, and ability to integrate AutoStore pickstations with other warehouse processes through conveyor systems, creates more efficient and flexible pickstation designs.

› MAKING THE MOVE TO ROBOTIC ITEM PICKING

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

One of the main benefits of this transformation is increased productivity. Automated systems don't take breaks, get tired or lose focus. This allows AutoStore users who integrate the new generation ItemPiQ robot into their AutoStore system to get more from their investment in automation.

In AutoStore, the robots moving across the top of the grid work together to compensate for the downtime of any single robot, allowing the system to achieve extremely high availability. ItemPiQ is based on robotic technology proven in demanding manufacturing applications. Together, the two systems provide the availability to support 24/7 picking.

Swisslog's next-generation ItemPiQ robot is designed for speed and accuracy. Operating at up to 1,000 picks an hour in ideal circumstances, the ItemPiQ robot picks from the AutoStore bin and places the product in a target bin or carton. Additional conveyor systems can be added to enable automatic removal of the target bin.

ItemPiQ can reach over 1,100 mm, increasing application flexibility and allowing ItemPiQ to be used with standard AutoStore port configurations. The multifunction gripping system features a central suction cup, which is supported by three fingers with smaller suction cups that encircle it. The ability of the central suction cup to work alone or in combination with the supporting fingers allows ItemPiQ to pick a wide range of product shapes and sizes.

Watch the ItemPiQ robot in action.

Since ItemPiQ and AutoStore are both controlled by the SynQ platform, they work together seamlessly. ItemPiQ also includes standard interfaces that allow it to easily connect with any WMS.

Built-in intelligence within SynQ enables the system to learn as it picks. The first time it encounters an item, it will make a decision on the best way to pick it. The next time it scans the same item, it will remember whether that choice was successful and make constant improvements that translate into shorter cycle times and higher pick success rates the longer the system is in operation.

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. Best of all, robotic item pickers can be integrated into an AutoStore pickstation at any time over the life of your system.

DREAM TEAM

The Swisslog Advantage: Goods-to-Robot Picking

Swisslog is the first AutoStore integrator to combine the software updates and robotic item picking technology required to enable robotic item picking with AutoStore.

› JOINING THE AUTOSTORE COMMUNITY

You know a technology has reached mainstream adoption when it can support a robust community of users. That has happened with AutoStore.

Swisslog hosted the first North American AutoStore Users Conference. The event offered AutoStore users the ability to network with peers, share key learnings and best practices, learn about the latest software and technologies from Swisslog and AutoStore, and drive future innovation.

Held at Medline, a manufacturer and distributor of medical supplies that is the world's largest AutoStore operator, the event also provided attendees with the opportunity to tour the company's distribution center, which features a Swisslog-configured AutoStore system.

Users came from a variety of industries, including electronics, apparel, auto parts, medical, and grocery. One of the highlights of the event was the roundtable sessions in which users presented their key learnings and had a chance to pose questions to other users and the experts in attendance.

The Swisslog Advantage: Shared Experience

Swisslog created the first AutoStore Users Group as a platform for users to share experience and learn about advances in the AutoStore system and complementary technologies.

AutoStore user Brian Janusz, global program manager at Radwell International, shared his three key takeaways from the event on the Swisslog blog. Here's a summary of what he had to say:

1. **AutoStore has no boundaries.** In terms of applications, the AutoStore system is nearly limitless. From groceries to hats, electronic devices, tractor parts, shoes and sports equipment, AutoStore can store and deliver a wide range of items in a time-efficient manner. We all enjoyed learning about how different systems are tailored to fulfill the unique requirements of each customer. We also learned how other users are taking advantage of the characteristics of AutoStore to increase their competitive advantage.

2. **AutoStore users share a common desire for collaborative innovation.** It was clear from the beginning of the conference that the participants were at the forefront of technology in their industry. This does not just happen overnight but requires a great deal of expertise and time to achieve. AutoStore was a clear choice for many who attended as another way to maintain their competitive edge. Because of this, most of the attendees at the conference have a strong desire for innovation and for solving real-life problems, as well as curiosity about how others solved similar problems.

3. **AutoStore is here to stay.** We learned about the growth of AutoStore over the past decade. Less than 15 years ago there were only five robots running around on an aluminum grid picking up bins. Now there are close to 10,000 robots. Only a few years ago the first AutoStore was installed in the U.S. Now, there are installations all over the country with even more on the horizon. To top it off, the capabilities and the support from Swisslog are enormous and a community of devoted users is developing.

With more than 12 million SKUs in inventory at any time, industrial equipment distributor and refurbisher Radwell International needed an automation system that could increase pick speeds and storage density. Watch how a Swisslog-configured AutoStore gave them the solution they were looking for.

〉 THE VALUE OF EXPERIENCE

There are a number of integrators that can offer AutoStore hardware today. But not all AutoStore deployments are created equal. The software platform, and the experience of the integrator you choose, can affect the ease of deployment, the amount of customization required, the accuracy and productivity of the pickers supported by the system, and the ability to support emerging technologies as they become available.

Only Swisslog brings together the experience gained over 370 deployments with the robust capabilities of our AutoStore Director and SynQ WMS platform to enable you to get the most from your AutoStore investment.

Swisslog's team of automation specialists is available to help you select the right automation system for your business, configure the system to balance initial cost with future growth and give you the support you need throughout the life of your system.

For more information, contact logistics@swisslog.com.

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