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FLEXIBLE ROBOTICS: A PILLAR OF THE FUTURE-READY WAREHOUSE

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EVOLVING CAPABILITIES, NEW USE CASES

A procession of new technologies continues to enhance the efficiency with which we do business. Cloud computing, Big Data, artificial intelligence (AI) and the Internet of Things (IoT) all represent potential breakthroughs for productivity and have received considerable attention. Yet, an equally powerful technology is often overlooked because it has been around for decades.

That game changer is robotics, and its breakthrough comes from new and more varied capabilities, smaller and mobile form factors, and lowered deployment costs. While not new, robotics has advanced in significant ways that open the technology to exciting new use cases in the supply chain.

The stationary robotic arms that have been used successfully for decades in sectors such as automotive manufacturing remain highly valuable, but the new gains in markets like distribution are coming from smaller robots that can work collaboratively alongside humans (cobots), and mobile autonomous robots that can travel through warehouse aisles to execute tasks more efficiently than human labor alone can.

These advances are being made by established leaders in robotics, such as Swisslog's parent KUKA. KUKA has leveraged its own robotics expertise, along with the supply chain expertise within Swisslog, to bring these new mobile and modular robotic solutions to the warehouse.

The robotic solutions now being used in the warehouse are different from those of the past in several important ways. First, costs have come down significantly, making robots more cost effective to implement in more situations. And, while costs are on the decline, capabilities are growing and use cases are expanding. Sensors, vision, gripping and navigation technology have all advanced, enabling greater autonomy and safe operation around humans. Finally, recent developments in AI and machine learning are reducing development costs and increasing adaptability, making more applications possible with greater cost effectiveness and enhanced safety.

The increasing value proposition of robotics is reflected in bullish predictions. Analyst firm Interact Analysis forecasts the market for autonomous mobile robots (AMR) and smart automatic guided vehicles (AGV) for logistics will grow from $300 million in 2017 to $3 billion by 2022, roughly a 10-fold increase.

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EVOLVING CAPABILITIES, NEW USE CASES

Improved speed and productivity is at the core of the increased adoption of robotics. A recent study by McKinsey Global Institute that looked at the impact of automation, including robotics, machine learning, and AI, forecasts that these technologies will raise productivity growth globally by 0.8 to 1.4 percent annually through 2065. The study also predicts that automation, contrary to conventional wisdom, should create jobs rather than take them away because of stronger economic growth and new, emerging job roles.

The new generation of warehouse robotics resolves significant issues with traditional approaches to intralogistics automation, which are fixed to the floor and so can't easily adapt to change. With less need for fixed infrastructure, and the ability to work collaboratively with humans and each other to adapt to changes in demand, automation solutions based on robotics are less costly and more flexible than the automation of the past.

As a result, Swisslog has identified robotics as one of the three pillars of the future-ready warehouse, along with flexible and data-driven. Together, these pillars create the foundation for a new generation of warehouse technology capable of increasing throughput, reducing order cycle times, and increasing productivity. Their flexibility and modularity also enable new financial models, allowing a pay-as-you-grow approach to automation, and make these solutions key to the emergence of small, ultra-local mini-warehouses that bring products closer to consumers and support a variety of last mile delivery options.

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FOUR ROBOTIC SYSTEMS FOR TODAY'S WAREHOUSE

The current generation of intralogistics robotics solutions integrates a range of technological advances to bring down costs, enable new applications and improve performance. These include significant advances in vision and sensing, navigation, gripping and machine learning. They also leverage recent advances in warehouse management systems that have broken down silos between automation control systems and the WMS. These three examples illustrate the progress that has been made.

Autonomous Mobile Robots

Goods-to-person picking systems change the traditional dynamic of picking products. Instead of having pickers walk miles each day to search for and pick products, a goods-to-person system brings the products to the picker. This dramatically reduces pick times and improves the ability to adapt to fluctuations in demand. This is particularly valuable for e-commerce operations where speed is paramount, and warehouses often support a wide range of SKUs that can increase the time and travel distance required for manual picking.

An effective and scalable solution for goods-to-person picking is autonomous mobile robots as represented by the Swisslog CarryPick system. CarryPick consists of mobile racks, autonomous mobile robots, ergonomic workstations with pick-to-light technology, and warehouse management software with integrated automation control capabilities.

CarryPick combines storage with replenishment and picking functionality, and handles returns efficiently.

FOUR ROBOTIC SYSTEMS FOR TODAY'S WAREHOUSE

The multifunctional workstations are continually supplied with mobile racks by the autonomous robots, which lift and carry the racks to the workstations. Controlled and monitored by the warehouse management system, CarryPick combines storage with replenishment and picking functionality, and handles returns efficiently.

The modular design permits starting small and growing as warehouse and picking capacity needs to be expanded. It can easily integrate into existing structures, requires minimal modifications to enable autonomous navigation, and can even be set up in a small facility without a 30 to 40-foot ceiling height. As the operation grows, more robots and workstations can be added as needed and the entire system can be re-located to a larger facility if that becomes necessary. There is even the potential to keep a small reserve of robots that can be quickly deployed to meet peak seasonal demands in retail and e-commerce distribution centers.

CarryPick is also flexible in the types of products that can be supported. It supports storage in cartons, bins or single items in its mobile goods carriers. Each mobile rack within the CarryPick system can be variable. Depending on the requirements, the rack can be equipped with bottom inserts, compartments, drawers, bins or hanging bars. This allows storage of products with a variety of sizes and weights and makes it easy to accommodate product changes.

Watch CarryPick in Action

Automated Storage and Retrieval

Mechanized storage and retrieval systems (AS/RS) can be inflexible and space intensive. Robotic-based AS/RS are more compact and flexible and provide an alternate to autonomous mobile robots for support of good-to-person picking. The AutoStore system provides the best example. AutoStore is designed to handle high volumes of both fast- and slow-moving small-order and small-case-pick SKUs for fulfillment operations that require high storage density.

AutoStore consists of a three-dimensional grid of self-supporting bins that are moved to pick stations by independently operating robots. The robots are equipped with a lift for picking up, carrying and putting product into the bins that are stored within the grid. All robots can reach any position on the grid, eliminating the risk of single-point system failure.

The bins are stacked on top of each other, which makes it a very compact solution. This results in up to 60 percent better utilization of space than other automatic storage systems, and 300 percent better than a conventional rack system. In typical installations, up to 87 percent of the available cube space can be used for storage.

AutoStore consists of a three-dimensional grid of self-supporting bins that are moved to pick stations by independently operating robots.

When a robot delivers a bin to a pick station, the worker picks the required number of units and the robot returns the bin back to storage. The new bins are delivered back-to-back, and the operator rarely has to wait for bins. Picking and putting can be executed simultaneously. A variety of workstation configurations can be deployed to allow batch picking based on orders or SKUs. Any order can be redirected to any one of the pick stations as the need arises. Machine learning allows the AutoStore system to identify fast-moving items and keep them at the top of the grid for faster access.

FOUR ROBOTIC SYSTEMS FOR TODAY'S WAREHOUSE

AutoStore can be configured to fit different building heights, span multiple levels and even surround obstacles in the warehouse, such as pillars or walls. If future needs warrant, additional storage space can be added by simply extending the system's grid. Pick rates can be enhanced by adding more robots to the existing grid.

Automated Item Picking

Automated picking has been enabled by major strides in robotic vision and gripping technology as well as machine learning. As a global leader in robotics, KUKA has been at the forefront of applying these advances to expand the use cases for robots in picking applications.

Traditionally, robots had to be instructed on each task through costly programmatic means, but with machine learning a picking robot can learn new picking tasks on its own. This is bringing the vision/gripper system of picking robots closer to the level of what eye/hand coordination in humans can accomplish—at higher speeds and without fatigue.

Swisslog's ItemPiQ is a robotic-based solution for picking single items from source bins and placing them into order bins. It uses the lightweight KUKA LBR iiwa robot, which is equipped with state-of-the-art sensor technology and a 7-axis arm. A multifunctional gripper, an intelligent vision system and a moveable platform complete the flexible robot application. The robots, which can work safely alongside human pickers without a barrier or fence, can be networked with automated goods-to-person warehouse systems. A single ItemPiQ robot can pick at a rate of up 35 to 600 items per hour, depending on item characteristics.

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Robotic picking systems are evolving quickly as key technologies continue to advance. This will enable even faster, less expensive picking robots capable of handling a wider range of products in more applications. A second generation of ItemPiQ is currently under development and is expected to be demonstrated in the near future.

Automated Case Picking

The Swisslog ACPaQ robot provides a similar function as ItemPIQ for mixed case palletizing. It automates the process of creating customized mix pallets for individual stores from single-SKU pallets. ACPaQ is a fast, reliable and flexible solution that can deliver throughput of up to 1,000 units per hour – two to three times more than traditional solutions.

ACPaQ can be used in ambient temperature and chilled warehouse zones, and can handle almost all types of cartons, shrink wrapped or foiled packages, and pallet types used in the retail and beverage industries using gentle, non-damaging gripping technology. Palletizing software allows customization of the order to improve the efficiency of in-store replenishment and helps ensure the stability of mixed-case pallets.

MAKING THE CASE: THE PAYOFF FROM INTRALOGISTICS ROBOTICS

In the past, the payoff from mechanized conveyor systems and warehouse automation was heavily focused on replacing labor. Swap in a robot to replace a crew of assembly workers or labor in palletizing goods, and that robot eventually would pay for itself.

These FTE-dependent ROI projections are becoming less relevant to many operators, particularly in retail and e-commerce. They are typically based on some future state that may never exist in today's fast-changing world and don't take into account a number of factors that have become critical to success, most notably speed, flexibility and a well-defined plan for growth.

In e-commerce, speed means more than just faster pick times. It means compressing the cycle time between order and shipment. Consumers now routinely expect two-day shipping and regardless of how efficient an operation is, not all orders placed on a particular day will be processed that same day. In those cases, businesses have to absorb the costs of next-day shipping to maintain the customer relationship. In addition, even if the e-tailer gets the product out the day it is ordered, it may not arrive on time if they are shipping cross country. Many use zone skipping, or shipping product in bulk to the zone where the customers for those products are located, to ensure two-day delivery.

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This brings added complexity to order processing, which is difficult to optimize manually. Automation software, supporting robotic goods-to-person or item picking, can intelligently manage how orders are allocated down to the floor, providing an organized and efficient approach to near real-time order processing that can reduce cycle times and shipping costs. This can be a significant factor when determining the ROI of warehouse automation.

The other consideration is the up-front investment required. Today, warehouse operators want to pay as they grow by making a limited investment at the front end and then adding modules as needed from their operating budget. This eliminates the lengthy processes associated with capital expenditures and allows them to adapt to conditions on the ground as they occur, neither of which is considered in the traditional ROI model.

Other factors that may be neglected include the ability to easily expand or shrink the system as demand changes and the ability to re-deploy the system to a new location. This can be a huge benefit to any organization that may outgrow its existing warehouse within the life of the automation system. With a traditional conveyor-based automation system that means leaving the automation behind with the old warehouse. With mobile robotics, the automation system can move to the new warehouse, extending its useful life.

The new breed of collaborative and mobile robots does deliver labor efficiencies, but, more importantly they help warehouse achieve the speed, flexibility and controlled growth they are seeking. These benefits can be viewed from an operations management, C-level, and information technology (IT) management perspectives.

Operations Management:

From a warehouse manager's view, collaborative, mobile and good-to-person robotics provide the throughput, labor savings, and flexibility characteristics needed to optimize e-commerce and omni-channel fulfillment in a way that hits both throughput and cost goals. Robotic goods-to-person systems decrease pick times and increase accuracy.

A goods-to-person system, such as CarryPick or AutoStore, eliminates the many miles of human travel manual methods entail each shift. According to a report from DHL and consulting firm St. Onge, it's possible to save 50 percent of warehouse picking labor time via goods-to-person robotics. Coordinated order management and faster picking also helps compress cycle times and minimize excess shipping costs required to maintain strong customer relationships. Labor saved by eliminating picker travel frees up those resources for other duties such as replenishment, returns processing, cycle counting, receiving and other processes that enhance throughput or add a personal touch to packaging. Human labor can also be used more productively at ergonomic workstations using pick-to-light technology.

MAKING THE CASE: THE PAYOFF FROM INTRALOGISTICS ROBOTICS

C-Level:

Return on investment (ROI) and risk mitigation are top C-level concerns. Warehouses can't always justify fixed infrastructure systems that might take five years for payback, or, in the third-party logistics provider (3PL) market, can't be adapted to serve multiple clients. It's better for ROI if solutions are modular with expansion coming out of operating rather than capital budgets.

At the same time, many warehouses simply can't afford not to automate. The risk of not being able to meet high consumer expectations during peak seasons in today's tight labor market is simply too high. With low unemployment in many markets, growing minimum wages, and high competition for warehouse laborers, intralogistics robotics reduce upfront labor needs and eliminate some of the more physically demanding or repetitive tasks. This can improve morale, reduce health problems and minimize turnover. Human labor can also enjoy greater productivity at the ergonomic workstations robotics solutions employ.

From an executive management perspective, intralogistics robotics help reduce risk, capture the e-commerce opportunity and enable more efficient use of capital and human resources.

IT Management:

From an IT perspective, robotic solutions that come with integrated warehouse and automation control software make it possible to use the robotics as part of an integrated system for warehouse operations, rather than as an island of automation.

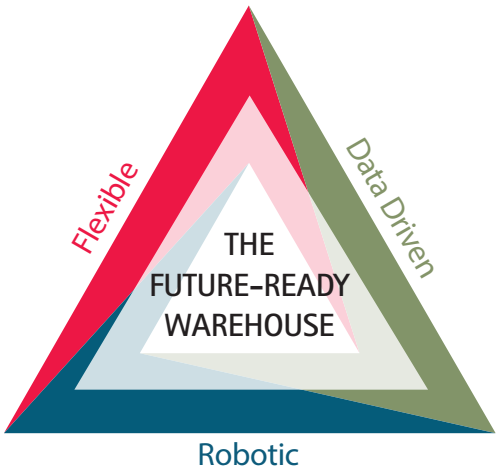
Swisslog's SynQ software uses standard interfaces or APIs to coordinate order and inventory data with ERP or other software systems. With systems that are modular, collaborative, and self- learning, it becomes much easier to scale or adapt to new requirements.

These systems also enable more effective use of warehouse and market data to enable predictive analytics and are well-suited to facilitate adoption of emerging technologies, such as IoT and machine learning.

ENABLING THE FUTURE-READY WAREHOUSE

While it's impossible to predict what any particular warehouse will look like in the future as technology continues to advance at an unprecedented pace, it is possible to anticipate the requirements those warehouses will need to meet. These include increased productivity to minimize the impact of the labor shortage, enhanced flexibility and space utilization to accommodate the growth in SKUs, greater anticipation of demand, higher throughputs and faster deliveries.

Fixed mechanized and automated sortation and conveyor systems, while addressing the need for greater productivity, have been unable to adapt to changes in product mix or characteristics and market demand. To meet the demands of the present and future, warehouse technology must increasingly be Flexible, Data Driven and Robotic.



ENABLING THE FUTURE-READY WAREHOUSE

1. Data-driven

Data is a powerful tool in warehouse management, but one that remains largely unharnessed. From bar codes on products to sensors on equipment, there is a wealth of data available today that can help improve equipment availability and efficiency, personnel productivity and safety, and process throughputs. The key to harnessing the power of warehouse data lies in the combination of the warehouse management system and the embedded intelligence in warehouse automation systems.

As warehouse management software has evolved, siloes have been created, with warehouse management, warehouse execution and automation control systems all operating in a way that leaves data isolated, limiting its potential to improve operations. Today's warehouse management systems integrate these capabilities in a single platform, while offering standard interfaces to ERP and other software systems. This provides new insight into equipment availability and performance while also enabling new capabilities, such as virtualization.

Data is also the fuel for the artificial intelligence systems that will enable intralogistics systems to learn and evolve on their own. Through the power of data and artificial intelligence, warehouse systems can learn to recognize patterns, regularities, and interdependencies from structured and unstructured data to anticipate demand and adapt, dynamically and independently, to new situations.

The future will be driven by data and the warehouse software and hardware systems being implemented today must be capable of using data to increase visibility into operations, improve coordination across systems, and adapt to changes in real time.

2. Flexible

The supply chain has become one of the most dynamic operations within many businesses. Rapid shifts in demand, product line changes and expansions, new channels and compressed delivery times all create the need for greater flexibility and scalability in processes and throughput.

Where once organizations could adapt to change by adding people, that is no longer an option. The labor shortages that exist in many developing markets is making it extremely difficult to attract and retain warehouse workers. And, the process of recruiting, hiring and onboarding new associates simply can't be conducted fast enough to respond to the speed of business today.

The challenge of flexibility isn't limited to the short term. Warehouse operators that make investments in warehouse technology—both software and hardware—need to do so with confidence that their systems and processes can adapt to whatever the future might bring, whether that is continued growth in omni-channel fulfillment, new competitive threats, even shorter delivery cycles or unexpected advanced in technology. Responding quickly to these challenges requires automation solutions that are easy-to-deploy, grow modularly and include the embedded intelligence required to take advantage of machine learning and other developments.

3. Robotic

The final pillar in the future-ready warehouse is Robotic. As more organizations move toward the vision of Industry 4.0, in which cyber-physical systems cooperate and communicate with each other to make decisions and optimize processes in real time, robotic systems such as CarryPick, AutoStore, ItemPiQ and ACPaQ will play a key role.

INTRALOGISTICS ROBOTS IN ACTION

While robots are firmly entrenched in manufacturing, some warehouse operators continue to perceive them as a technology that will only come to the warehouse sometime in the distant future. In reality, while the use cases for robotics will continue to expand, robotic goods-to-person systems are already being used in a surprising number of warehouses. Swisslog alone has deployed more than 100 AutoStore systems and CarryPick has been embraced by a host of e-commerce and omni-channel retailers seeking to support controlled growth, increased productivity and reduced cycle times. Here are five examples:

Waytek

Waytek, a distributor of electrical equipment, chose CarryPick to automate fulfillment in its Minnesota distribution center. The company prides itself on offering high-quality electrical components and a high-quality customer experience to manufacturers of wire harnesses and mobile equipment, including trucks, trailers, ag equipment, construction equipment, emergency vehicles, and boats. As Waytek continues to grow, it recognized that manual picking could no longer provide the productivity and speed required to meet customer demands. They also understood that flexibility was essential in today's dynamic environment. Both of these factors were key considerations in the selection of CarryPick. According to Mike Larson, COO and co-owner of Waytek, "It's our job to make sourcing electrical parts extremely easy, and we believe the Swisslog CarryPick automated solution will make it even easier.

WAYTEK®

Berggård Amundesen

Berggård Amundesen, an electrical equipment supplier, needed a warehouse automation solution to improve the efficiency of order fulfillment and they needed the flexibility that could only be achieved through a modular design. AutoStore fit the bill perfectly, allowing the company to make better use of available space, shorten lead times, increase efficiency and improve accuracy. The system, which includes 10,000 storage bins and two pick stations, was installed within the existing warehouse within a short period of time and created additional cost savings by avoiding building expansion and moving expenses. "We required a storage system that would utilize storage space in the existing facility," said Rolf-Inge Danielsen, Logistics Director at Berggård Amundsen. "Today we have an efficient material handling system that enables us to fulfill customers' requirement of next-day delivery."

Von Maur

Von Maur is a growing multi-channel U.S. retailer with 32 stores across 15 states. The strength of the brand lies in delivering an enjoyable and unique shopping experience with a wide selection of brand-name merchandise, and a commitment to excellent customer service. The company chose CarryPick to automate fulfillment within its warehouse to ensure they can continue to deliver this experience to all customers while accommodating future growth.

VON MAUR®

INTRALOGISTICS ROBOTS IN ACTION

Hat World

Hat World, a leading U.S. provider of sportswear operating under the retail brand Lids, has 1,100 stores and multiple distribution channels. To meet their customer promise of delivering merchandise of "any team, anytime, anywhere" the company implemented the Swisslog AutoStore system. "We chose AutoStore because we believe it is the best way to increase efficiency and productivity," said Tony DeFrench, vice president at Hat World. The benefits the organization has realized validate that belief. They have experienced a 20-time improvement in e-commerce pick rates, optimized storage capacity, and met their goal of 100 percent order fulfillment accuracy with the ability to guarantee delivery times under 24 hours.

Salon Hagel

Salon Hagel, a Hamburg-based provider of hair care products, is another e-commerce company that is moving to the CarryPick system. The company's 4,000 square meter warehouse has been equipped with 12 CarryPick robots and 230 mobile racks to improve fulfillment speed and efficiency.

CLOSING ARGUMENTS: ROBOTICS DELIVER ON EFFICIENCY AND FLEXIBILITY

With the continued march of e-commerce and omni-channel fulfillment, warehouse operators must get efficient at order picking at the "each" level. Simply throwing more human labor at the challenge becomes expensive and hard to sustain.

That leaves automation as the answer. The problems: many traditional automation solutions either aren't very flexible or carry high price tags.

The answer is flexible, modular, intralogistics robotics. While robots have proven their worth in DC applications such as palletizing/depalletizing, or automated guided vehicles (AGVs), there is a new breed of flexible robotics that delivers efficiencies without sacrificing flexibility. Smaller, collaborative robots for automated item picking (AIP) can work alongside human labor, while mobile robotics enable modular, scalable goods-to-person solutions.

CLOSING ARGUMENTS: ROBOTICS DELIVER ON EFFICIENCY AND FLEXIBILITY

The bottom line is that today's warehouse robotics are substantially different from the fixed robotics of the past, opening more varied, scalable uses cases. Key features of these robots include:

- The mobile robotics of today feature modular autonomous robots and relatively low cost mobile racks. The racks are highly adaptable for different goods, the robots need minimal navigation infrastructure and are controlled by software intelligence to fine-tune travel for optimal routes or adapt to congestion.
- Goods-to-person systems leverage ergonomic work centers where, potentially, picking robots could be paired with human labor.

The bottom line is that today's warehouse robotics are substantially different from the fixed robotics of the past, opening more varied, scalable uses cases.

- Characteristics such as the ability to work safely alongside human labor, and modular hardware elements, makes today's intralogistics robotics highly flexible. You can scale them quickly by adding more labor to the equation, or more modular system elements.
- Flexible robotics are supported by software which delivers functions such as Resource Optimizer to provide efficient routing, and machine learning and data science insights from the provider to continuously improve the efficiency of robot movements and make them more versatile and reliable.

These features enable a new set of benefits for intralogistics robots. While ROI will vary based on factors like order profiles and labor costs, here is what to expect:

- Faster ROI than many traditional automated solutions that lack modularity and require Big Bang implementation.
- Easy ability to scale capacity by adding modular components.
- Since today's collaborative picking robots don't need elaborate safety infrastructure, have multiple axis/pivot points, and are software and data driven, they are adaptable to different work tasks and work centers with only minimal reconfiguration.
- Robots support a highly productive, steady pace of work, while also removing some of the most physically demanding and repetitive tasks from human workers. These factors improve employee morale and aid in achievement of metrics, freeing up labor for other processes.
- Robotics, working with warehouse management software, can compress cycle times and optimize order management to curb the rise in shipping costs created by increasing customer expectations.

Flexible intralogistics robots aren't futuristic—there are solutions such AutoStore, CarryPick, ItemPIQ and ACPaQ available and providing value now. They deliver on the blend of order picking efficiency and operational flexibility that fulfillment centers need to outperform competitors.