

Evaluating Goods-to-Person Technologies

White Papers

A guide for determining the optimal automated goods-to-person storage and retrieval system in order fulfillment operations.



Introduction

Online retail sales in the U.S. hit \$445 billion in 2017 – that’s right – BILLION, with a “B”. E-commerce sales are projected to reach \$600 billion by 2020, with analysts forecasting a 12% compound annual growth rate (CAGR) from 2016 until 2020. And there’s not slowing down in site as projections show US online retail sales surpassing \$1 trillion by 2027 representing 25% of all domestic retail sales.¹

That \$445 billion represents a considerable number of individual, one- and two-line orders, picked, packaged and shipped by warehouse and distribution center (DC) associates. The dramatic uptick in online orders means corresponding growth in the need for workers who can fill them. However, the warehousing and logistics industry is currently experiencing labor shortage. By 2018, the industry will need to fill approximately 1.4 million new jobs at a rate of 270,000 per year.² The Bureau of Labor Statistics reports that warehouse workers quit at a rate of 36%.³ And, when surveyed, more than 250 top logistics and supply chain managers said their three biggest workforce challenges are:

1. Finding and keeping qualified/skilled/dependable workers (62%)
2. Increasing workforce productivity (57%)
3. Controlling labor costs (45%)⁴



Compelled by the twin challenges of exponential e-commerce growth and workforce drought, more order fulfillment operations are considering automated, goods-to-person solutions. These automated storage and retrieval (AS/RS) systems create highly compressed storage of pallets, cases or plastic totes, and eaches (individual items). Controlled by sophisticated software and mechanical controls, goods-to-person technologies deliver items required by an order directly to an operator.

Goods-to-person systems eliminate the need for pickers to walk to, and search for, stored items—an activity that can waste as much as 60% of their productive time.⁵ Instead, these technologies deliver products to operators stationed at workstations at the optimal ergonomic work height, called the “Golden Zone,” or waist-high. The workstations are designed to minimize stretching, pulling, bending, twisting and reaching, preventing the overexertion that leads to musculoskeletal injuries (costing U.S. businesses \$59.9 billion in non-fatal workplace injuries 2017).⁶

¹ Christa Hart, Khaled Haram and John Yozzo. “2017 U.S. Online Retail Forecasts.” *FTI Consulting*, 2017. Accessed June 4, 2019. <http://www.fticonsulting.com/~media/Files/us-files/insights/reports/2017-us-online-retail-forecast.pdf>

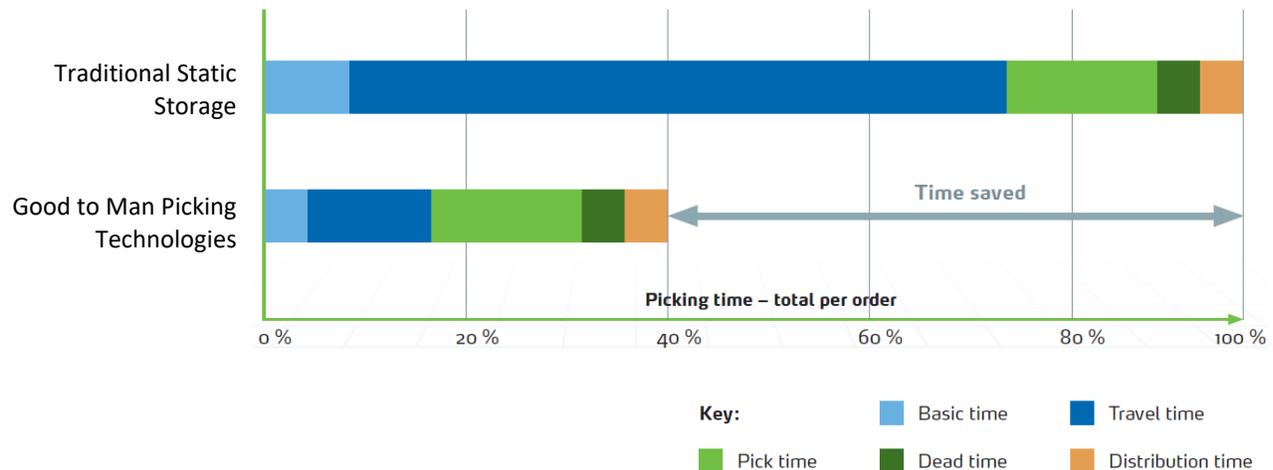
² Gue, Kevin, Ed., et al. “The U.S. Roadmap for Material Handling & Logistics.” MHI. January 2014. Accessed June 19, 2019. <http://www.mhlroadmap.org/roadmap.html>

³ Peerless Research Group. “Labor management strategies in the warehouse.” *Logistics Management*. September 10, 2014. Accessed June 4, 2019. http://www.logisticsmgmt.com/article/labor_management_strategies_in_the_warehouse

⁴ Ibid.

⁵ Ruriani, Deborah Catalano. “Improving Picking Practices.” *Inbound Logistics*. September 2006. Accessed June 4, 2019. <http://www.inboundlogistics.com/cms/article/improving-picking-practices/>

⁶ 2017 Liberty Mutual Workplace Safety Index. Accessed June 4, 2019. <https://business.libertymutualgroup.com/business-insurance/Documents/Services/Workplace%20Safety%20Index.pdf>



In addition to reducing the risk of injury and fatigue, goods-to-person picking systems can also speed up order processing. This allows an operation to extend their order cutoff times—in some cases by as much as four hours, so more orders can be filled⁷. Further, installing one of these systems can reduce labor requirements by as much as 66%; can save as much as 85% of floor space required to store the same number of items in shelving; and can increase accuracy levels to more than 99.9%.⁸

Which automated goods-to-person picking system is the best fit for your operation? That depends on a variety of factors. In fact, many of the most current installations include two or more different goods-to-person technologies, strategically matching the system to the different inventory profiles and handling characteristics required to create a complete, hybrid solution.⁹

This white paper overviews the various, self-contained, goods-to-person AS/RS systems available for handling the totes, cases and eaches most frequently faced by e-commerce order fulfillment operations, and the typical applications for each.

Goods-to-Person Automation Technologies

Several different original equipment manufacturers (OEMs) design, engineer and manufacture a wide variety of self-contained, goods-to-person [AS/RS systems](#). The technologies handle different volumes, types and velocities of non-palletized inventory at variable speeds to accommodate varying throughput demands. When considering the options, keep in mind both the storage density your facility needs as well as your throughput goals.

Automated goods-to-person picking technologies can be broken down into three categories:

1. Shelf based picking - an entire shelf or tray of product is delivered to an operator
2. Bin based picking - an individual bin or tote is delivered to the operator
3. Robotic picking - delivery robots are operating within some type of enclosed shelving system to deliver goods to an operator

⁷ Specter, Sara Pearson. "Flexibility: The hallmark of today's automated goods-to-person installations." *Modern Materials Handling*. October 1, 2015. Accessed June 19, 2019. http://www.mmh.com/article/flexibility_the_hallmark_of_todays_automated_goods_to_person_installations

⁸ MHI's Automated Storage & Retrieval Systems (AS/RS) Industry Group. "Discover ASRS Latest & Greatest Applications & Technologies at ProMat." ProMat 2015 Presentation. March 23, 2015. Accessed June 19, 2019. <http://cdn.promatshow.com/seminars/assets/908.pdf>

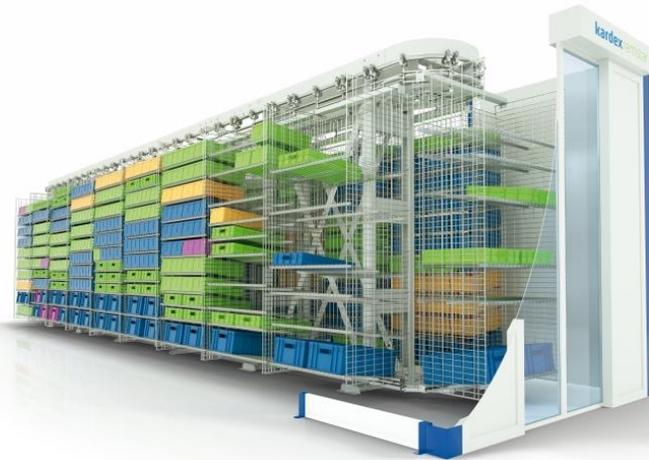
⁹ Specter, Sara Pearson. "Flexibility: The hallmark of today's automated goods-to-person installations." *Modern Materials Handling*. October 1, 2015. Accessed June 19, 2019. http://www.mmh.com/article/flexibility_the_hallmark_of_todays_automated_goods_to_person_installations

Shelf Based Picking Technologies

Vertical Carousels – Comprised of a series of carriers attached to a chain drive, a motor powers the carriers’ bi-directional travel in a vertical loop around a track—similar to a Ferris wheel. These automated storage and retrieval systems deliver slow- to medium-velocity items safely and quickly to an ergonomically positioned work counter at the operator’s command. Offering throughput at rates of 100 to 400 lines per hour, the higher rates can be achieved with the addition of light-directed picking technologies and batching stations that allow picking of multiple orders simultaneously. The latest models offer capacities of 1,650 pounds per carrier,¹⁰ and are more affordable than larger, more complex systems and deliver a fast return on investment.



Horizontal Carousels – Consisting of highly dense storage bins mounted on an oval track that rotates horizontally to deliver slow- to medium-moving product storage locations to an operator, these automated storage and retrieval systems handle both items and cases weighing up to 200 pounds. To generate maximum throughput, they are often installed in groups, known as pods. This allows a picker to access product from one carousel while others spin to queue up the next required item, yielding throughput rates from 150 to 450 lines picked per hour—the higher rate achievable with light-directed picking technologies and batching stations that allow simultaneous fulfillment of multiple orders. Horizontal carousels offer excellent space utilization and high storage density at a vastly lower initial investment than larger, more complex systems.



¹⁰ MHI’s Automated Storage & Retrieval Systems (AS/RS) Industry Group. “Current Trends and Technology in Storage & Inventory Management.” ProMat 2015 Presentation. March 24, 2015. Accessed June 19, 2019. <http://cdn.promatshow.com/seminars/assets/873.pdf>

Vertical Lift Modules (VLMs) – With trays capable of handling up to 2,200 pounds,¹¹ these enclosed automated storage and retrieval systems consist of two columns of trays with an inserter/extractor in the center. The inserter/extractor automatically locates and retrieves stored trays of slow- to medium- velocity items from both columns and presents them to the operator at a waist-high pick window at rates from 125 to 475 items per hour. Systems used to store the heaviest items can be equipped with automatic tray extractors and an overhead crane and hoist to help operators handle and maneuver their picks. Because the height of the items placed in each storage tray is measured as it is put away, the VLM stores the trays dynamically—as close as one inch apart—to maximize storage density. That allows the system to offer some of the highest space utilization rates available, up to 85%, for a fast and high return on investment.



Bin Based Picking Technologies

Crane-Based Mini-Load AS/RS – With a single, crane-mounted load handling device dedicated to each extremely dense storage aisle, mini-loads handle loads in cases, totes or trays that weigh between 220 and 750 pounds. The cranes travel either on rail or wheel. Ideal for slow moving items, mini-loads are capable of delivering 1 load per minute, for throughput rates of 60 to 100 lines per hour.¹² Compact and weight-optimized, they can be installed in freezer or cooler warehouses with temperatures as low as -22° Fahrenheit. Because of the structures associated with the system, crane-based mini-load AS/RS is typically one of the more expensive goods-to-person systems.



¹¹ Ibid.

¹² MHI's Automated Storage & Retrieval Systems (AS/RS) Industry Group. "Discover ASRS Latest & Greatest Applications & Technologies at ProMat." ProMat 2015 Presentation. March 23, 2015. Accessed June 19, 2019. <http://cdn.promatshow.com/seminars/assets/908.pdf>

Vertical Buffer Modules (VBM) – The newest solution available, the Vertical Buffer Module, is a cost effective tote handling system for smaller applications not requiring a large expensive system like mini-loads and robotic-shuttles. The machines consist of an enclosed shelving system with a movable mast running down a center aisle for picking and storage of totes. The unit is designed to be able to work ahead of the operator and queue up the next pick for maximum throughput of the system.

Totes can be delivered to an ergonomic turntable picking station or can be automatically handled via inbound and out conveyor. The machine can also be configured with a manual station for replenishment of totes during picking operations. This way picking never needs to be interrupted for replenishment activities.

Multiple units can be connected via conveyor and totes can be delivered to remote picking stations. The system is designed to be modular, scalable and highly energy efficient.



Robotic Picking Technologies

Robotic Shuttles – Handling cases, totes or trays weighing from 35 to 65 pounds, this type of goods-to-person automated storage system can deliver increasingly higher throughput based on the number of independently moving robotic shuttles inducted into the system. The shuttles travel independently from level to level, riding on narrow rails at each storage level. They retrieve stored items at high speeds, with throughput ranging from 200 to 700 lines per hour.¹³ These systems are characterized as being modular, scalable and flexible—meaning they can be expanded with minimal structural modifications as business needs change. That high throughput and flexibility come at a cost, with a high initial investment required to install this system.



¹³ Ibid.

Floor Robots – The system acquired and used by the world’s largest online retailer stores inventory on portable, high-density storage shelving retrieved and transported from storage to picker by a fleet of autonomous, mobile robots. After the picker selects the required item or items from the shelf, the robot returns it to storage. Ideal for slow to medium velocity inventory, throughput ranges from 100 to 300 lines per hour. Throughput can also be expanded easily with the addition of more robots. Because the shelving must be ergonomically accessible by operators, the system sacrifices maximization of the vertical space within a facility (although it is ideal for low ceiling height operations). Likewise, the autonomous robots used to access and deliver inventory require a considerable amount of programming and maintenance, meaning these systems are among the costliest to install.¹⁴



Which automated goods-to-person picking system is the best fit for your operation?

Table 1: Side-by-Side Comparison of Automated Goods-to-Person Picking Technologies

Goods-to-Person Technology Comparison	Ability to handle Item Velocities			Storage Density	Floor Space Savings	Labor Savings	System Throughput	Cost
	Slow	Med	Fast					
Shelf Based Picking Systems								
Vertical Carousels	x	x		5	5	4	2	\$
Horizontal Carousels	x	x		5	4	4	3	\$
Vertical Lift Modules	x	x		5	5	4	2	\$
Bin Based Picking Systems								
Crane-based Mini-Load AS/RS	x	x		4	4	5	4	\$\$\$
Vertical Buffer Modules	x	x		4	4	4	4	\$\$
Robotic Picking Systems								
Robotic Shuttles	x	x	x	4	4	5	5	\$\$\$\$
Floor Robots	x	x	x	4	2	3	5	\$\$\$\$

The ideal solution will often include two or more different goods-to-person technologies, strategically matching the system to the different inventory profiles and handling characteristics required to create a complete, hybrid solution.

¹⁴ MWPVL International. “Is Kiva Systems a Good Fit for Your Distribution Center? An Unbiased Distribution Consultant Evaluation.” February 2012. Accessed June 19, 2019. http://www.mwpvl.com/html/kiva_systems.html

About Kardex Remstar

Kardex Remstar, LLC, a company of the Kardex Group, is a leading provider of automated storage and retrieval systems for manufacturing, distribution, warehousing, offices and institutions. For information about the company's dynamic storage solutions visit www.kardexremstar.com.