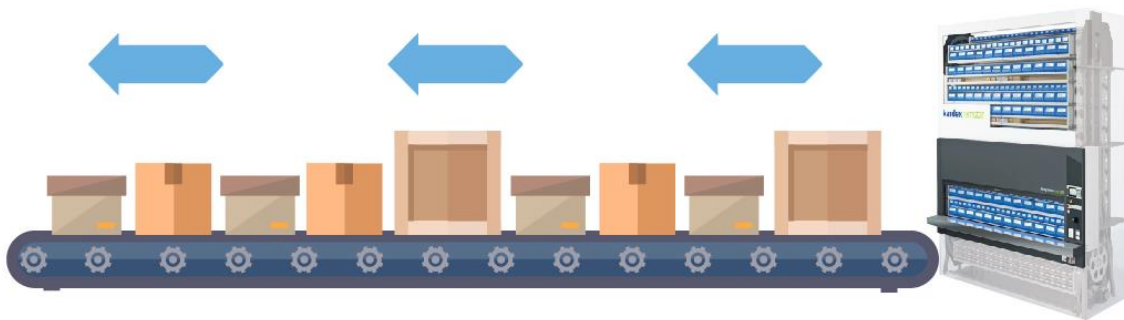


Order Picking with Vertical Carousels

White Paper

Learn how vertical carousels support optimized picking in manufacturing, warehouse and distribution settings, particularly for orders that average four lines per order.



Introduction

First introduced more than 60 years ago, today's [vertical carousels](#) feature a variety of design improvements that deliver increased accuracy and throughput for optimized order picking. More affordable than larger, more complex automated storage and retrieval systems, vertical carousels offer a faster return on investment as well as swift retrieval times, high throughput and minimal operator travel time. This makes them ideal for manufacturing, warehouses and distribution centers picking orders that range from three to five lines per order.

Vertical carousels store products within a series of carriers attached to a chain drive. Driven by a motor, the carriers travel bi-directionally in a vertical loop—similar to the operation of a Ferris wheel. Software directed, the carriers rotate around until the one containing the required stock keeping unit (SKU) is delivered to the operator at an ergonomic access opening.

Vertical carousels can be outfitted with a variety of carriers to enhance storage flexibility, with modules designed specifically to accommodate the items being stored. To maximize storage density, standard shelf carriers can be sub-divided or easily changed or adapted in the future. Rollout drawers can be installed to hold small parts. Further, a variety of custom inserts can be specified to securely hold products ranging from heavy tools and dies to sensitive electronic components.

Advancements in engineering and componentry have resulted in vertical carousels that require less energy to operate than previous models, have a lighter overall unit weight, and deliver a higher mean time between failure (MTBF) rate than most household appliances. Because they maximize a facility's overhead space, [vertical carousels](#) increase storage density and save floor space to the tune of 75% in comparison to shelf or drawer storage.

This white paper examines the myriad ways vertical carousels support optimized picking in manufacturing, warehouse and distribution settings, particularly for orders that average four lines per order.

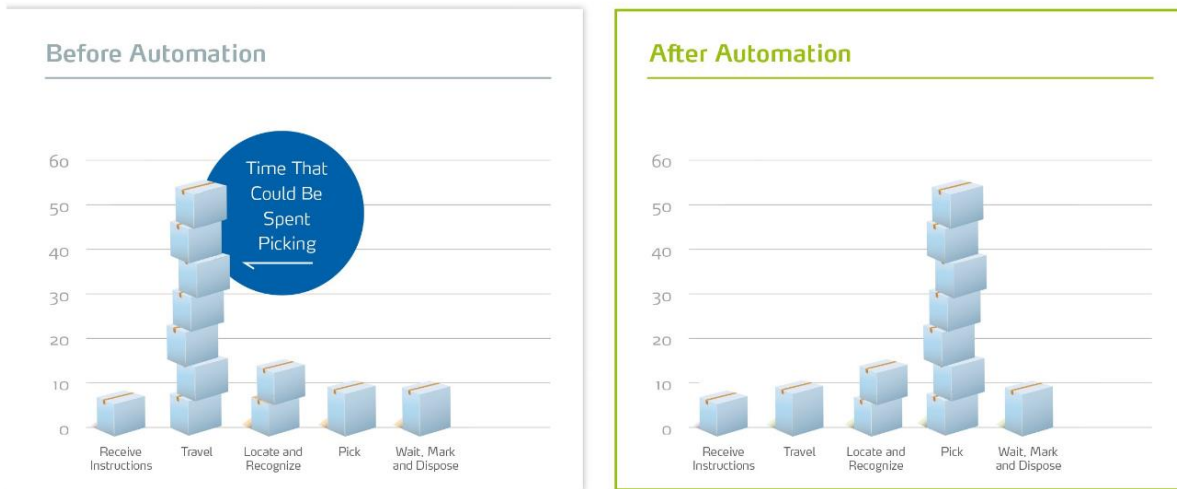
How Vertical Carousels Optimize Picking

One or more vertical carousels with inventory management software storage can provide a variety of optimized picking benefits. These benefits include:

- Reduced Travel Time
- Enhanced Accuracy
- Fast Delivery
- Increased Productivity
- Operator Ergonomics & Safety
- Inventory Security



Reduced Travel Time: Most warehouses are filled with pallets, cases and pieces, making the order fulfillment process a facility's "most labor-intensive and costly activity...where the cost of order picking is estimated to be as much as 55% of the total warehouse operating expense."¹ That's because travel time—the time it takes a picker to walk from the point where they receive a picking order to the stored SKU, select the required items, and transport them to the point of shipping—can account for as much as 60-65%² of a facility's direct labor activities.



The primary advantage of a vertical carousel is that the system enables the operator to generally remain in a single location, and the carousel delivers the item to the operator – removing the walking from the process. In an effort to further reduce travel or dwell time, most industrial facilities opt to implement more than one vertical carousel, known as a “pod.”

A pod operates as follows: a batch of orders is assigned to each pod, where a typical batch is five to fifteen orders, with one to five lines per order, and some number of items per line. A tote is typically used to gather the set of items associated for each order within the batch. All of the items for the batch will reside in the carousel units in the pod. Integrated software directs each carousel to retrieve the items.... The picker then travels from one carousel to another in the pod and picks all required SKUS. This continues until all items are picked for the entire batch of orders.³

The design of the pod is also of significant importance to minimizing walk time. For example, a typical vertical carousel measures 12 feet wide. Therefore, lining up four vertical carousels side-by-side (in a row) would create a 48-foot-long area for an operator to cover. Alternately, by placing two vertical carousels next to each other and the other two vertical carousels across from the first two, the operator only has to walk a maximum distance of 24 feet to make a pick.

Enhanced Accuracy: The integration of inventory management software with a vertical carousel enables smart functionality such as inventory monitoring and pick-to-light technology. In addition to keeping track of the contents stored within the vertical carousel, the software also interfaces with a facility's warehouse management system (WMS) and enterprise resource planning (ERP) systems. This function allows managers to closely monitor stock

¹ Martin Murray, "Order Picking in the Warehouse," About.com Logistics and Supply Chain Guide, accessed June 19, 2019, http://logistics.about.com/od/operationalsupplychain/a/order_pick.htm.

² Lee Rector, "Warehouse Slotting," Toolbox.com SCM Blogs, accessed June 19, 2019, <http://it.toolbox.com/blogs/warehouse-planning/warehouse-slotting-6655>.

³ Ibid.

levels in real time—and potentially eliminate physical counts—to reduce the amount of inventory they must have on hand.

Vertical carousel pick-to-light technology has evolved into complete message centers that communicate to the operator the precise area within the carrier of the item to be picked, display the part number or description, pinpoint the exact location, direct either picking or storage, and the required quantity. This increases picking accuracy exponentially—achieving rates up to 99.9%—due to a reduction in processing errors. It is estimated that more than 35% of facilities experience ongoing error rates of 1% or more. Although 1% may sound like a slim margin for improvement, it adds up quickly, as illustrated here:

Average Facility	
250	Lines per Hour
X 3	Average SKUs/Order
750	SKUs Picked Per Hour
X 8	One 8 Hour Shift
6,000	SKUs Picked Per Day
X 1%	Mispick Rate
60	Mispicks Per Day
X \$100	Average Cost Of A Mispick
\$6,000	Total Lost Revenue Per Day

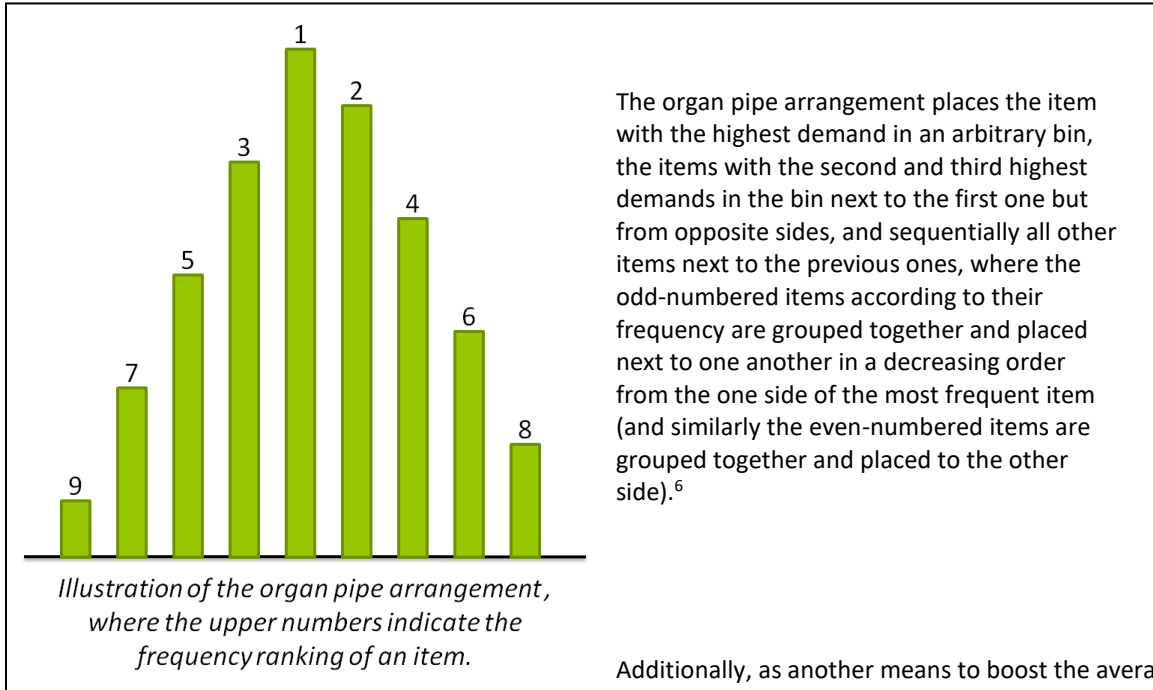
A facility picking 250 lines per hour, averaging three SKUs per order, and running one 8-hour shift per day picks 6,000 items daily. If 1% of those picks are incorrect, that translates to 60 mispicks. The cost of each mispick—including the expenses associated with shipping the item back, processing it upon receipt, returning it to stock, and loss of customer satisfaction—can average as much as \$100 a piece, or more⁴. Therefore, 60 mispicks equal \$6,000 in lost revenue a day.

Fast Delivery: When directed by inventory management software, a vertical carousel will only rotate around one time to present all carriers with picks required for an order. The carousel presents the first carrier then the next carrier glides up or down until all items have been picked.

This means the time it takes to deliver a complete order to the operator will never be longer than the time it takes for a vertical carousel to make one full rotation. Since most vertical carousels are no taller than 20 feet, a full rotation can be completed in 90 seconds on average. In comparison to other automated storage and retrieval technologies that require an extractor to remove, transport and present an individual tray—then repeat the process in reverse to return the tray to its storage location prior to extracting, transporting and presenting the next tray—it can take as much as 132 seconds to deliver four trays to an operator.

⁴ Hannah Kain, "Simple Fulfillment Errors Will Affect The Bottom Line," accessed June 19, 2019, http://www.alom.com/wp-content/uploads/2014/03/ALOM_SimpleShippingErrors.pdf

Additional delivery time gains can be achieved via proper slotting of the items stored within the vertical carousel. Slotting means that SKU location “assignments are made using a maximal adjacency principle, that is, two items are placed closely if their probability of appearing in the same order is high.”⁵ By positioning the most frequently picked items (called “fast movers”) on carriers that are close to one another, machine delivery time is reduced. Taking this a step further:



Additionally, as another means to boost the average response time of the order fulfillment process, vertical carousels can be programmed to return to a pre-positioned “home” location that serves as the starting point for all orders.

Choosing the right starting point of a carousel in anticipation of an order is also referred as dwell point selection.... This strategy becomes relevant when the items are stored under the organ pipe arrangement. In this situation the dwell point should be chosen to be the location of the most popular item.⁷

Should the machine sit idle for a pre-determined amount of time, with no order currently being picked, it will automatically rotate to the home position. This ensures that when the next order is queued up, the vertical carousel is already waiting at to the “home” position where fast movers are stored.

Increased Productivity: As a general rule of thumb, productivity doubles when a facility transitions from picking inventory stored in static shelving to a vertical carousel—or, from picking 50 lines to 100 lines per hour. Productivity doubles again—from picking 100 lines per hour to 200 lines per hour—with the addition of light-directed picking. By illuminating to visually indicate both the location and quantity of the items required to fill an order, an operator is able to immediately find the picks, rather than wasting valuable time scanning shelves searching for the appropriate SKU.

⁵ Nelly Litvak and Maria Vlasidou, “A Survey on Performance Analysis of Warehouse Carousel Systems,” p. 31, accessed June 19, 2019, <http://www.win.tue.nl/~mvlasiou/documents/publications/carouselReview.pdf>.

⁶ Ibid.

⁷ Ibid.



Productivity again doubles—from picking 200 lines per hour to 400 lines per hour—with the introduction of the batch order picking methodology: “A popular strategy for reducing the mean travel time per order in carousel storage and retrieval systems is batching together a number of orders and then picking them sequentially. A batch is a set of orders that is picked in a single tour. Two consecutively picked items do not necessarily belong to the same order.”⁸ In batch order picking a single operator picks all SKUs required by multiple orders simultaneously during one rotation of the vertical carousel, increasing throughput substantially.

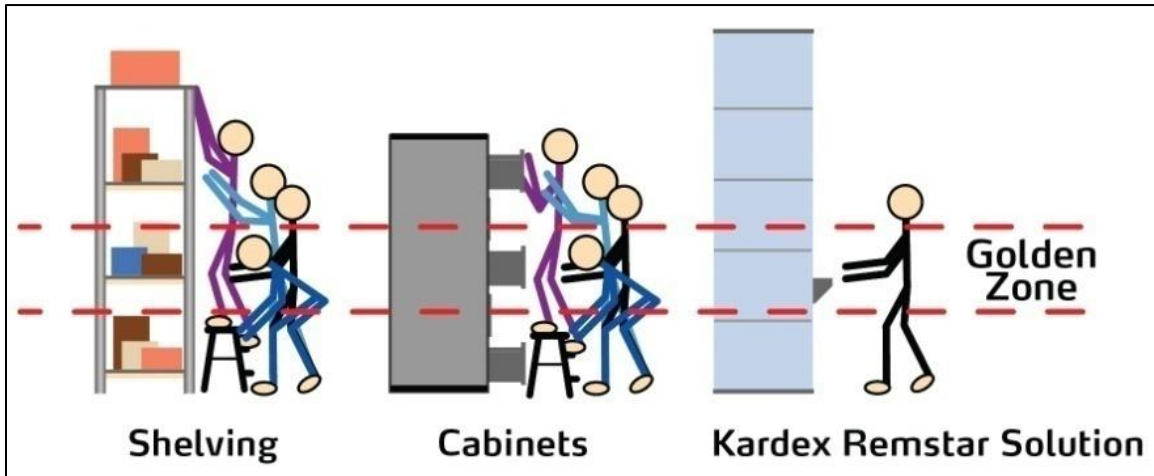
To enable batch picks, an integrated combination of vertical carousels with pick-to-light technology, inventory management software, and a batch station work together. The batch station is located in front of the carousels and the operator stands between the two. To initiate the process, the operator assigns a tote to each order lane located on the batch station. The software coordinates the picking sequence, and the carousel rotates around to present the operator with the first carrier. Lights direct the operator to pick a specific quantity of the SKU from the carousel. The operator then turns to distribute the SKUs picked among the batch of orders located on the batch station and the process repeats until all orders are filled.

Further productivity gains can be attained through strategic replenishment of the vertical carousel so that it “does not interfere with the order picking (i.e., replenishment is handled off-shift or is only performed when the carousel would be stopped otherwise, termed opportunistic replenishment).”⁹ The same advantages seen in batch picking may also be gained in batch replenishment.

Operator Ergonomics and Safety: Every item stored in vertical carousel is delivered to the operator at the correct ergonomic work height, called the “Golden Zone” (waist-high to eliminate bending down to retrieve an item stored low, or stretching up to grab an item stored high). Because the carriers are delivered to the operator, the system minimizes unnecessary or excessive motions required for retrieval of items from drawers or shelves (such as lifting, reaching, walking, stretching, bending, pushing, pulling, twisting, spinning or stooping). Likewise, ladders and climbing are no longer necessary. Because the chance of worker injury is substantially lessened, absenteeism, insurance premiums and claims for worker’s compensation are reduced.

⁸ Ibid.

⁹ Meller and Klotte.



To further ensure worker safety and prevent injury, modern vertical carousels include standard safety light barriers located at potential pinch points. When the carousel is in motion, a light barrier triggers an automatic stop should the beam be broken, preventing operator injury. Vertical carousels can also be constructed with more than one access opening, allowing operators to store items at one access point and retrieve items from another access point. This allows items to be replenished on one level then retrieved from a different level without the need to carry the inventory up stairs or transport it via cart or elevator.

Inventory Security: As an added benefit, vertical carousels provide secure inventory storage. With lockable security doors and inventory management software that provides traceability, vertical carousels are ideal for storing high dollar value items. For maximum security an optional automated security door will remain closed while the carousel rotates to the required carrier, preventing an operator from reaching in and accessing other stored items as they pass by the access opening. The door only opens after the carousel has queued up the desired level, allowing access to only the stored items on that specific level.

Further, to access a vertical carousel's contents, authorized operators can be required to first input a software-traceable personal login and password, enabling missing or misplaced items to be quickly tracked back to an individual. This enhanced level of accountability and security improves inventory shrinkage and its negative impact on the bottom line.

To learn more about how vertical carousels can help your facility achieve your optimized order picking goals, contact your Kardex Remstar representative today.

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Vertical Carousels in Action

Vertical Carousel System Optimizes Picking for Electronic Contract Manufacturer

To optimize batch picking of electronic components used to produce printed circuit board assemblies, a Utah-based contract electronics manufacturer installed three, 20-foot-tall [Kardex Remstar vertical carousels](#) to replace static, shelf-based inventory storage.

The vertical carousels are equipped with pick-to-light technology to assist operators in selecting the correct part and quantity, as required by the facility's just-in-time manufacturing line. All inventory stored within the vertical carousel is controlled by [inventory management software](#), which interfaces with the company's enterprise resource management (ERP) system.

When a job is queued up for fulfillment, the order is downloaded from the ERP system to the [inventory management software](#). The operator then initiates the order fulfillment process, prompting the vertical carousels to spin into position for picking and the batch lights to illuminate. A single operator moves easily between each of the three vertical carousels—from one pick to another—to fill each job order. Most job orders contain between 100 and 150 lines.

Because the parts are now stored in the vertical carousels, the travel distances required to fill each order have been tremendously compressed into an area of far lower square footage than the previous shelving system. As a result, the company now uses fewer people to fill the same number of job orders faster. In addition to productivity improvements, the light-directed picking functionality has resulted in a considerable uptick in picking accuracy.

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.