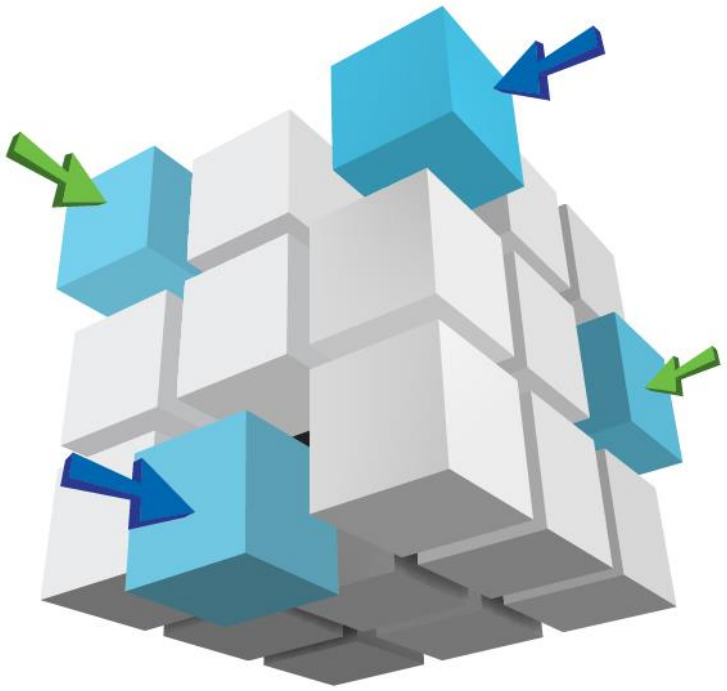
Maximizing the Storage Capacity of Your Current Facility

White Paper

Implementing high-density automated storage and retrieval systems immediately reduces the amount of square footage required by shelving to store items.



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Introduction

Rare is the manufacturing, warehousing or distribution facility that does not suffer from some amount of space limitations. Sometimes inventory, parts or work-in-process have exceeded current capacity. Or perhaps the footprint of the facility prevents the addition of more storage equipment without an expensive addition of more square footage through construction. Either way, space is nearly always at a premium.

For facilities that rely on traditional shelving[1]—made of upright posts, formed steel sheet panels as horizontal shelves, and end and back braces or sheet steel back and side panels for support—for storage for non-palletized loads, automated storage and retrieval equipment is available as an alternative. These self-contained systems offer higher density storage in a more compact footprint than manual equipment can provide. Four primary types include:

Horizontal Carousels – Consisting of bins mounted on an oval track that rotate horizontally to deliver stored items to an operator. These automated storage and retrieval systems save up to 60% of floor space when compared to standard shelving and rack.

Vertical Carousels – Comprised of a series of shelves that rotate around a track—similar to a Ferris wheel—these automated storage and retrieval systems quickly deliver stored items to an ergonomically positioned work counter at the operator's command. When compared to static shelving and rack, they save up to 75% of floor space.

Vertical Lift Modules (VLMs) – An enclosed automated storage and retrieval system that incorporates two columns of trays with a central inserter/extractor that automatically locates and retrieves stored trays from both columns, then presents them to the operator at a waist-high pick window. These systems save up to 85% of floor space compared to static shelving and rack.

Vertical Buffer Modules (VBMs) – In the middle of a multi-segment shelving system is an aisle, where a moveable mast with a telescopic gripper operates. The control unit sets the gripper in motion picking a bin and transporting it to a picking station.

[1] Material Handling Industry, "Glossary>Shelving," accessed June 19, 2019, http://mhia.org/learning/glossary/s#shelving.

Each type of automated storage methodology offers different benefits in comparison to traditional, static shelving, including the amount of space/footprint required and ease of expansion, as shown in Table 1.

TABLE 1: Storage System Comparison Ranked by Their Benefits
Rankings: 5=Best, 4= Great, 3=Better, 2= Good, 1=Fair

Benefits	Shelving	Horizontal Carousel	Vertical Carousel	VLM
Space/Footprint	1	4	5	5
Expandability	5	4	3	4

Implementing one of the three types of high-density automated storage and retrieval equipment immediately reduces the amount of square footage required by shelving to store items. This is because the volumetric efficiency of each automated technology is so much greater, as shown in Table 2.

TABLE 2: Storage System Comparison of Net Cube

Technology	Capacity (Wasted Space Within Unit)	Space (Wasted Vertical Height Based on 20' Ceiling)
Shelving	50 - 70%	70%
Horizontal Carousel	25%	30%
Vertical Carousel	20%	10%
VLM	10%	10%
VBM	15%	10%

These space efficiencies can be further leveraged either through the storage of more products in the same amount of facility footprint, or via an expansion in the number of SKUs stored.

This white paper outlines the calculations that can demonstrate how an investment in horizontal carousels, vertical carousels, VLMs or VBMs as a replacement for static shelving will yield significant gains for a facility, both in terms of increased storage capacity and floor space.

Storage Capacity Comparison

One way to compare automated storage and retrieval technologies to shelving is based on the available capacity within each system. A capacity comparison reveals how many sections of shelving fit into an automated storage machine, quantifying storage density within the unit. To do these calculations, assumptions have to be made as to space utilization within the unit. Assumptions also have to be made about the size of the automated system. For the purposes of this white paper, common installation sizes were used to compare capacities.

Before comparing shelving to the various automated technologies, we first must determine the capacity of a standard section of shelving.

Standard Industrial Shelving Capacity

Assuming 7 shelves per shelving section

Unit Specifications: 3 ft wide x 1.5 ft deep x 6.35 ft tall = 28.58 ft^3 of storage space per shelving unit

Assuming 30% utilization of shelving = 8.58 ft^3 of storage space per shelving unit

Now that we have determined that each section of shelving provides 8.58 ft^3 of storage space, we can compare this to the available capacity of each automated system.

One Section of Shelving

Horizontal Carousel Capacity

Carrier Specifications = 2.05 ft wide x 2 ft deep x 7 ft tall = 28.7 ft^3 (cubic storage space per carrier)

Number of carriers per horizontal carousel: 22

28.7 ft^3 x 22 carriers = 631 ft^3 (cubic storage space per unit)

631 ft^3 x 2 horizontal carousels = 1,262 ft^3

Assuming 62% utilization of horizontal carousel = 782 ft^3

Two 22 bin horizontal carousels provide 782 ft^3 of storage capacity

To Calculate Capacity Savings in Cubic Feet: 782 ft^3/8.6 ft^3 = 90.9

One Horizontal Carousel Carrier

Calculation Result: 90 Sections of Shelving Fit into Two, 22 Carrier Horizontal Carousels

Vertical Carousel Capacity

Carrier Specifications = 10 ft wide x 2 ft deep x 1.16 ft tall = 23.2 ft^3 (cubic storage space per carrier)

Number of carriers per vertical carousel: 18

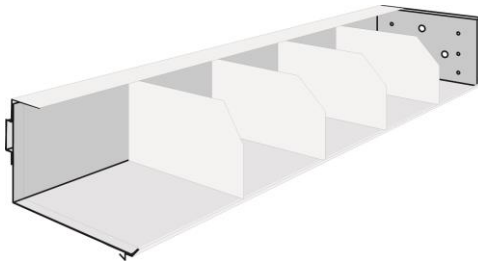
23.2 ft^3 x 18 carriers = 418 ft^3 (cubic storage space per unit)

Assuming 75% utilization of vertical carousel = 326 ft^3

One 16 ft tall vertical carousel provides 326 ft^3 of storage capacity

To Calculate Capacity Savings in Cubic Feet: 326 ft^3/8.6 ft^3 = 37.9

Calculation Result: 37 Sections of Shelving Fit into One 16 ft Tall Vertical Carousel



One Vertical Carousel Carrier

Shuttle VLM Capacity

Unit Height = 22.69 ft

5.9 in tray spacing allows 71 trays for storage (front and back storage with room for access opening)

Average product height per tray = 5.12 in (0.426 ft)

Tray Dimensions = 8.04 ft wide x 2.83 ft deep x 0.426 ft tall = 9.7 ft^3 (cubic storage space per tray)

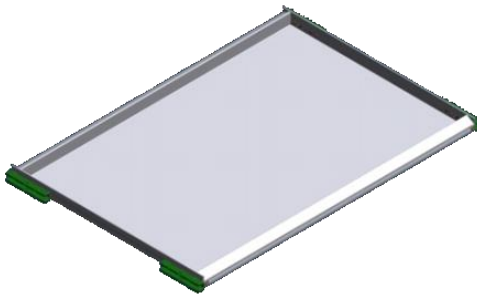
9.7 ft^3 x 71 trays = 689 ft^3 (storage space per unit)

Assuming 75% utilization of VLM = 516 ft^3

One 23 ft tall Shuttle VLM provides 516 ft^3 of storage capacity

To Calculate Capacity Savings in Cubic Feet: 516 ft^3/8.6 ft^3 = 60.0

Calculation Result: 60 Sections of Shelving Fit into One 23 ft Tall Shuttle VLM



One Shuttle VLM Tray

To further maximize cubic density, Shuttle XP VLMs permit dynamic allocation of trays for variable increment storage heights inside the machine—rather than limiting each tray to a fixed height storage space. Equipped with an automated hardware and control system, the Shuttle VLM incorporates a sensor that measures the height profile of each storage tray's contents as it passes onto the lift platform. The control system then determines the best storage location in the unit based on the least amount of space used for the fastest retrieval position. This function permits storage trays to be placed within 1 inch of each other, providing up to an additional 50 percent of storage capacity per unit. This technology has been factored into the capacity calculations above.

Floor Space Savings Comparison

Another way to compare these technologies is based on floor space, measured in square feet. As a general rule of thumb, when compared to standard shelving, horizontal carousels save up to 60 percent of floor space, vertical carousels save up to 75 percent of floor space and VLMs save up to 85 percent of floor space.

As with capacity, when comparing floor space savings, certain assumptions need to be made, such as aisle space and access space. For purposes of these white paper calculations, 3.5 feet of aisle space and 4 feet of access (or turnaround) space have been assumed.

Horizontal Carousel Floor Space Savings

To determine the equivalent capacity of standard shelving to a horizontal carousel, first determine how many shelves of inventory can fit into a typical horizontal carousel (approximately 16 feet tall). Assumptions are included within the calculations, which also take into account the width of standard access aisles required for access to the storage medium.

Horizontal Carousel:

Unit Width: 6.22 ft x 2 carousels = 12.44 ft, plus 1 ft space between carousels and 0.5 ft on each side= 14.44 ft

Length (22 carrier unit): 26.75 ft, plus 4 ft access = 30.75 ft

Horizontal Carousel Floor Space Occupied: 14.44 ft wide x 30.75 ft long = 444 ft^2

110 Shelving Sections:

Width: 3 ft with 4 ft turnaround

Depth: 1.5 ft with 3.5 ft aisle access

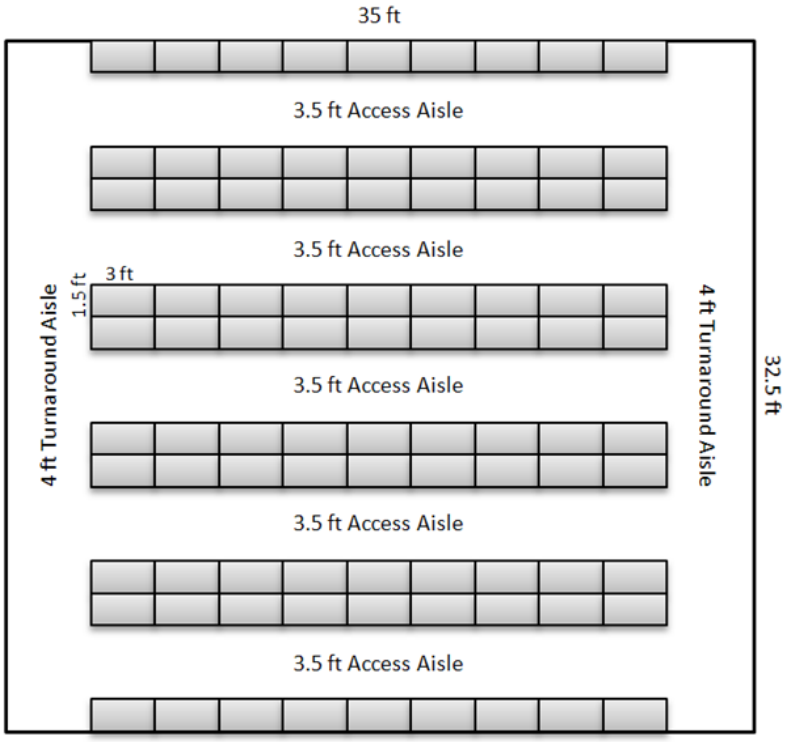
Width: (3 ft wide x 9 bays) + (2 x 4 ft aisle)= 35 ft wide

Depth: (1.5 ft deep x 10 sections) + (5 x 3.5 ft aisle) = 32.5 ft deep

Shelving Floor Space Occupied: 35 ft x 32.5 ft = 1,137 ft^2

To Calculate Floor Space Savings in Square Feet: 1,137 ft^2 – 444 ft^2 = 693 ft^2 /1,137 ft^2 = 0.60

Calculation Result: Horizontal Carousels Save 60% Floor Space!



Combining Floor Space Savings with Capacity Savings

Further, applying the capacity numbers from above can determine how much additional cube is provided. It was determined that each section of shelving provides 8.6 ft^3 of capacity, while each horizontal carrier provides 28.7 ft^3 of capacity.

8.6 ft^3 per shelving section x 110 shelving sections = 946 ft^3 of storage capacity

28.7 ft^3 per horizontal carousel carrier x 44 carriers = 1,262.8 ft^3 of storage capacity

To Calculate Additional Capacity in Cubic Feet: 1,263 ft^3 - 946 ft^3 = 317/1263 = 0.25

Calculation Result: Not only can horizontal carousels save 60% floor space, they provide 25% additional capacity.

Vertical Carousel Floor Space Savings

To determine the equivalent capacity of standard shelving to a vertical carousel, first determine how many shelves of inventory can fit into a typical vertical carousel. Assumptions are included within the calculations, which also take into account the width of standard access aisles required for access to the storage medium.

Vertical Carousel:

Unit Specifications: 12 ft wide x (5.5 ft deep + 5 ft access area = 10.5 ft) = 126 ft^2

36 Shelving Sections:

Width: 3 ft with 4 ft turnaround

Depth: 1.5 ft with 3.5 ft aisle access

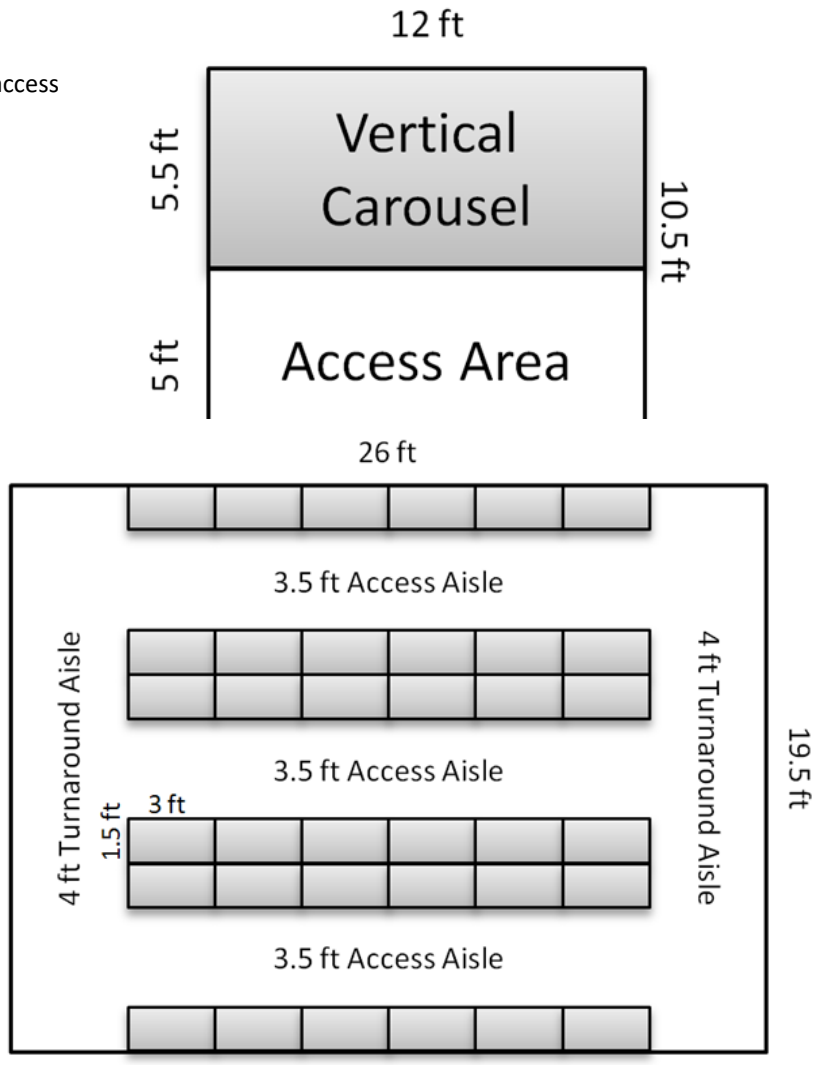
(3 ft wide x 6 bays) + (2 x 4 ft aisle)= 26 ft wide

(1.5 ft deep x 6 sections) + (3 x 3.5 ft aisle) = 19.5 ft wide

Shelving Floor Space Required: 26 ft x 19.5 ft = 507 ft^2

To Calculate Floor Space Savings in Square Feet: 507 ft^2 – 126 ft^2 = 381 ft^2 /507 ft^2 = 0.75

Calculation Result: Vertical Carousels Save 75% Floor Space!



Combining Floor Space Savings with Capacity Savings

Further, applying the capacity numbers from above can determine how much additional cube is provided. It was determined that each section of shelving provided 8.6 ft3 of capacity, while each vertical carousel carrier provided 23.2 ft^3 of capacity.

8.6 ft^3 per shelving section x 36 shelving sections = 309 ft^3 of storage capacity

23.2 ft^3 per vertical carousel carrier x 18 carriers = 417 ft^3 of storage capacity

To Calculate Additional Capacity in Cubic Feet: 417 ft^3 - 309 ft^3 = 108/417 = 0.25

Calculation Result: Not only can vertical carousels save 75% floor space, they provide 25% additional capacity.

VLM Floor Space Savings

To determine the equivalent capacity of standard shelving to a VLM, first determine how many shelves of inventory can fit into a typical VLM (approximately 23 feet tall). Assumptions are included within the calculations, which also take into account the width of standard access aisles required for access to the storage medium.

Shuttle VLM:

Unit Specifications: 9.12 ft wide x (10.09 ft deep + 3.5 ft access area = 13.59 ft deep) = 124 ft^2

60 Shelving Sections:

Width: 3 ft with 4 ft turnaround

Depth: 1.5 ft with 3.5 ft aisle access

(3 ft x 6 sections) + (2 x 4 ft access aisle)= 26 ft deep

(1.5 ft x 10 sections) + (5 x 3.5 ft aisle) = 32.5 ft wide

Shelving Floor Space Required: 32.5 ft x 26 ft = 845 ft^2

To Calculate Floor Space Savings in Square Feet: 845 ft^2 – 124 ft^2 = 721 ft^2 /845 ft^2 = 0.85

Calculation Result: Shuttle VLMs Save 85% Floor Space!

Combining Floor Space Savings with Capacity Savings

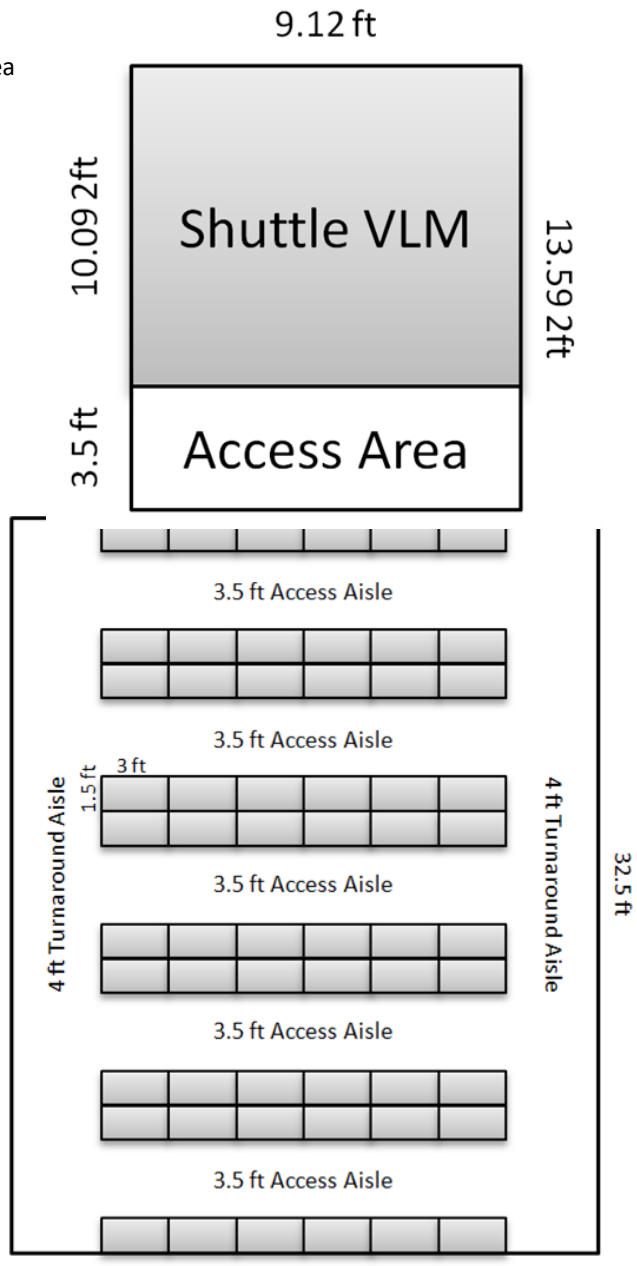
Further, applying the capacity numbers from above can determine how much additional cube is provided. It was determined that each section of shelving provided 8.58 ft^3 of capacity, while each Shuttle VLM tray provided 9.7 ft^3 of capacity.

8.6 ft^3 per shelving section x 60 shelving sections = 516 ft^3 of storage capacity

9.7 ft^3 per VLM tray x 71 carriers = 689 ft^3 of storage capacity

To Calculate Additional Capacity in Cubic Feet: 689 ft^3 - 516 ft^3 = 173/689 = 0.25

Not only can Shuttle VLMs save 85% floor space, they provide 25% additional capacity.



To learn more about calculating the increased cubic capacity and floor space savings you can expect to gain from an investment in horizontal carousel, vertical carousel or VLM technologies as a replacement for static industrial shelving, contact your Kardex Remstar representative today.

Space Savings in Action: Kubota

OEM parts supplier saves 71% floor space with horizontal carousels; 83% floor space with VLMs

With a commitment to keeping replacement parts available for 20-plus years to support their full line of tractor and utility vehicles, Kubota Canada Ltd.'s Markham, Ontario distribution was challenged to store more than 78,000 SKUs in a 60,000 square foot facility. In order to maximize storage density in the minimum square footage, the company implemented automated storage and retrieval technologies in phases.

In the first phase, Kubota purchased six Kardex Remstar horizontal carousels to replace a three-story mezzanine that occupied 3,000 square feet per floor (9,000 square feet of inventory storage total). Including a workstation, picking area and six, 24-foot-long horizontal carousels the system occupies 2,600 square feet—71 percent less floor space than the mezzanine. Additionally, all the parts are now stored on a single floor, enabling a single operator to pick parts ergonomically and more than 90 percent faster without walking up and down stairs.

Instead of a considered building expansion, the company installed Kardex Remstar Shuttle XP VLMs as part of the second phase of the picking system implementation. The first two VLMs replaced 2,400 square feet of 18-foot-high bay shelving. Shortly thereafter, two more Shuttle VLMs were installed to replace 1,200 square feet of 24-foot-high bay shelving. In this zone, the workstation, picking area and four VLMs now occupy 620 square feet, allowing Kubota to free up just under 3,000 square feet of floor space for an increase in parts capacity—and 83 percent floor space savings. In addition to increased part capacity and improved ergonomics, picking productivity in the VLM zone has doubled simply by eliminating travel time to part locations.

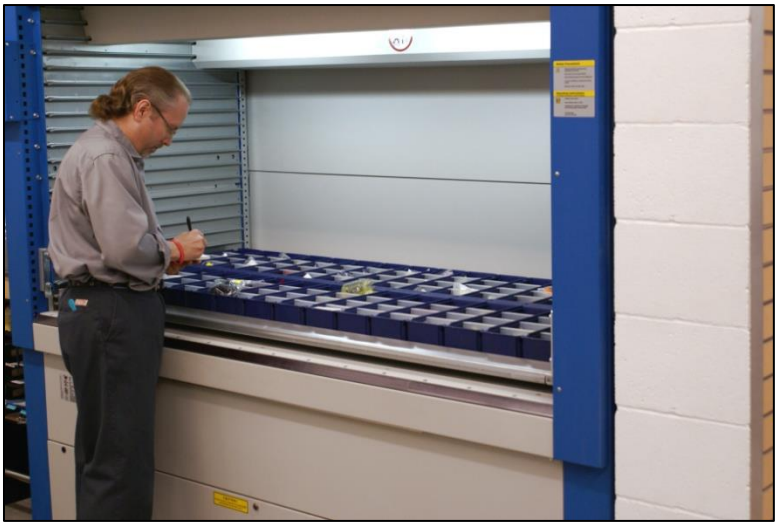
The investment in automated storage and retrieval systems has enabled the facility to accommodate 70 percent growth over the past 12 years with minimal increases to its labor force. Further, the current automated storage and retrieval system has enough remaining capacity to allow the facility to sustain that rate of growth for an additional five to eight years.

Space Savings in Action: Zimbrick European

Auto parts department uses VLM to save 84% floor space

At Zimbrick European in Madison, Wisconsin, the company services Mercedes-Benz, Porche and Audi car lines. Its parts department provides needed items to service technicians, local body shops and retail customers.

When the company relocated to a new facility, its parts department was downsized from a single, first-floor-level 2,300 square feet to a 384-square-foot counter area on the first floor with a second-floor mezzanine storage space—84 percent less space than the previous parts department. Storing the majority of the parts on the second floor allows for larger showroom and service areas on the first floor.



The facility needed a means to move parts between the first and second floors that didn't require parts department personnel to run up and down the stairs. Productivity, labor costs and the risk of worker injury in transporting parts via the staircase were of concern.

To keep parts accessible in the new building, Zimbrick European installed a dual access Kardex Remstar Shuttle XP VLM to store the fast-moving smaller parts (slow moving, larger parts are stored on the second-floor mezzanine in bin shelving). The VLM is equipped with selectable access pick windows that link the first and second floor work areas together and facilitate part sharing in storage and retrieval operations. On the first floor, the access opening is located in the parts department directly behind the retail customer counter. For convenient receiving and storage, the VLM's access opening on the second floor is located near a freight elevator used for stocking.

If a requested part is located in bin storage, a clerk on the second-floor mezzanine delivers it to the first-floor parts department using an open tray in the Shuttle XP VLM, eliminating the need for additional personnel to move parts between floors manually.

With part inventory increasing nearly 15 percent per year on average, new parts are always being added into inventory. However, the VLM is currently only at 66 percent capacity, leaving plenty of room for growth.

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.