Whitepaper

Choosing the Right Storage Strategy

Static Shelving vs. Vertical Lift Modules vs. Cube-Based AS/RS

Storage isn't one-size-fits-all. This guide compares three common approaches — and shows where VLMs can provide the just-right balance of density, flexibility and automation.

A Practical Guide for Manufacturing, MRO, and Order Fulfillment Operations

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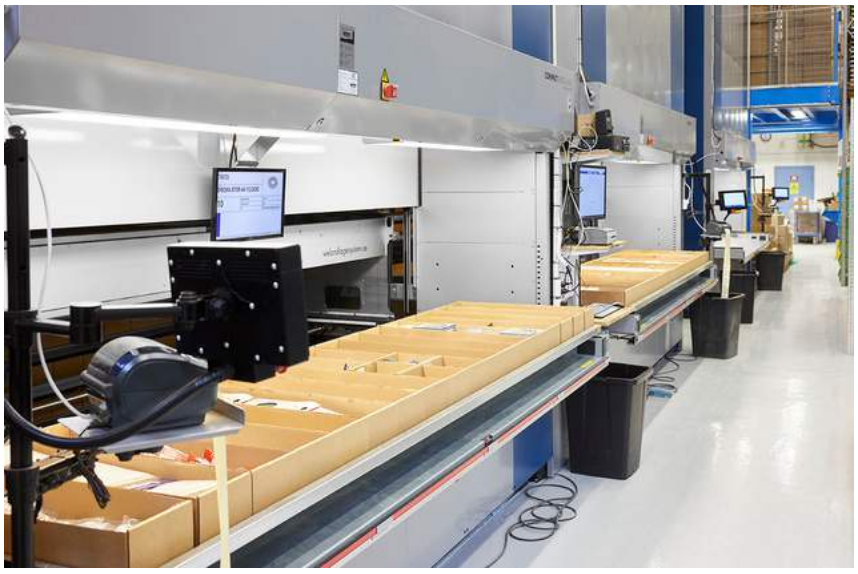
Executive Summary

Storage isn't one-size-fits-all. Utilizing static shelving can create travel, space, and retrieval constraints, while a highly automated system may add more capacity, complexity and investment than the application requires.

OPTIONS AT A GLANCE

Technology	Core Definition & Mechanics	Capital Investment	Key Operational Characteristics
Static Shelving	Manual rack-and-bin storage requiring person-to-goods travel.	Low ($)	• Heavy walking & search times • Ergonomic & safety risks (ladders/overhead lifting) • Consumes massive floor space
Vertical Lift Modules	Enclosed goods-to-person vertical columns delivering divided trays to a single waist-height access window.	Moderate ($$)	• Optimal ergonomic picking height • Reclaims up to 85%+ floor space • Dynamic tray height adjusts for variable item sizes
Cube-based AS/RS	Ultra-dense grid structure where overhead robots deliver stacked, standardized plastic bins to picking ports.	High ($$$)	• High aggregate throughput for massive volume • Limited to standardized bin dimensions • Complex installation & infrastructure requirement



The right storage strategy depends on inventory, space, workflow and throughput requirements.

Finding the Just-Right Level of Storage Automation

Not every operation needs the same level of storage automation. The right fit depends on inventory, workflow, available space and throughput needs.

STATIC SHELVING

- Manual retrieval
- Requires floor space & aisles
- Limited automation

VERTICAL LIFT MODULES

- Goods-to-person
- Flexible inventory storage
- High vertical density
- Incremental automation

CUBE-BASED AS/RS

- Dense grid-based storage
- High aggregate throughput
- Centralized system
- Small, standardized inventory

LESS AUTOMATION

More walking and handling
Lower throughput

JUST RIGHT

Balanced goods-to-person automation
Flexible and scalable

MORE AUTOMATION

Higher complexity and investment
Built for high-volume fulfillment

The goal isn't the most automation. It's the right amount of automation for the operation.

1. Inventory Fit: Choosing the Right Solution for Your Operation

The physical characteristics of your inventory—size, weight, shape, and variability—rapidly determine operational fit, while ergonomics and safety shape day-to-day productivity.

STATIC SHELVING

Broad inventory scope, but rigid physical & safety constraints

Can accommodate a wide variety of item sizes, but fixed shelf heights and widths require additional organization (bins, dividers, or totes) for smaller or irregular items. Manual retrieval introduces significant safety and ergonomic risks, requiring operators to climb ladders or perform awkward overhead lifting.

VERTICAL LIFT MODULES

Unlimited flexibility with automated vertical delivery

Delivers maximum storage flexibility with adjustable partitioning for small parts up to heavy or oversized items. All picks are automatically presented at an ergonomic waist-height window.

DYNAMIC HEIGHT SENSING
Measures stored items to optimize vertical space on every cycle.

CUBE-BASED AS/RS

High-density storage optimized for standardized bins

Ideal for high-volume, small-to-medium parts, but constrained by rigid physical limits. Most systems offer just 2 to 5 standard bin sizes and caps near 60 lbs, restricting overall item fit.

STANDARD BIN LIMITS[1]
Max payload ~60 lbs per bin with fixed height options.

THE STORAGE UNIT MATTERS

STATIC SHELVING	VERTICAL LIFT MODULES	CUBE-BASED AS/RS
Flexible + Manual	Flexible + Automated	Standardized + Automated

2. Space Utilization: How Is Your Available Space Shaped?

Floor space, ceiling height, and floor condition dictate storage feasibility. Each approach utilizes building dimensions and structural foundations differently.

STATIC SHELVING

Expands across the floor

Shelving expands horizontally, requiring wide aisles for access. Because manual picking restricts safe overhead reaching, it usually cannot take advantage of ceiling height—creating severe space constraints.

VERTICAL LIFT MODULES

Creates high-density vertical storage

VLMs maximize overhead volume up to 52 ft high. Standard shimming accommodates most uneven floors, usually avoiding costly concrete slab replacement.

CUBE-BASED AS/RS

Eliminates internal storage aisles

Cube storage packs bins tightly into a dense grid, requiring massive cubic volume (height, width, depth). It demands precision-level floors, making older buildings a major installation challenge.

THE BUILDING MATTERS

STATIC SHELVING

Spreads Out
Consumes floor space

VERTICAL LIFT MODULES

Builds Up
Installs on uneven floors

CUBE-BASED AS/RS

Rigid Grid
Requires level floors

3. Retrieval & Operator Travel: How Does Inventory Reach the Operator?

How inventory reaches the operator affects walking, search time and overall picking efficiency.

STATIC SHELVING

Person-to-goods retrieval

Operators walk to storage locations to search and retrieve items manually. This travel creates significant walking and search time while hurting overall picking accuracy and introducing workplace safety risks from manual handling, bending, and reaching.

~50%[2]

of total picking time can be spent traveling in picker-to-parts operations.

VERTICAL LIFT MODULES

Goods-to-person retrieval

The system automatically delivers requested trays directly to a single access window at an ergonomic waist level. This eliminates operator travel and searching, ensuring safe, continuous picking while keeping workers within a fixed, comfortable work area.

CUBE-BASED AS/RS

Goods-to-person through picking ports

Robots retrieve standardized bins from a shared storage grid and deliver them directly to designated picking ports. This approach supports efficient, high-volume fulfillment where inventory movement is centralized and predictable.

THE RETRIEVAL METHOD MATTERS

STATIC SHELVING

Operator Goes to Inventory

Walk, search, higher safety risks

VERTICAL LIFT MODULES

Inventory Comes to Operator

Ergonomic waist-level delivery

CUBE-BASED AS/RS

Bins Come to Picking Ports

Robot retrieval + port delivery

4. Access Point Productivity: Picking Tools & Accessories

How guidance tools at the access opening reduce search time, improve picking accuracy, and keep workflows moving.

STATIC SHELVING

Manual visual identification

Picking relies entirely on manual label reading and operator memory. With no automated guidance tools available at the rack, operators must manually cross-reference paper lists or handheld screens with shelf tags, increasing mispicks and slowing down fulfillment.

~10x Higher Error Rates

of total picking time can be spent traveling in picker-to-parts operations.

VERTICAL LIFT MODULES

Precision visual guidance & control

ASRS access windows integrate visual tools like LED light bars (to indicate columns) and laser pointers (to pinpoint exact compartments). Paired with foot pedals for hands-free confirmation and pick displays, operators pick faster with near-zero error rates.

CUBE-BASED AS/RS

Port-based picking displays

Robots deliver whole bins to fixed picking ports equipped with pick-to-light screens or put-wall displays. While highly efficient for standardized items, visual guidance options are restricted by port design and bin layout rather than pinpoint item projection.

THE ACCESS WINDOW MATTERS

STATIC SHELVING

Manual Verification

Relies on paper lists & label checks

VERTICAL LIFT MODULES

Integrated Guidance

LEDs, lasers & hands-free confirmation

CUBE-BASED AS/RS

Port-Bound Displays

Fixed screens at designated pick ports

5. Throughput: How Much Does the Operation Need?

Throughput requirements vary widely. The right storage approach should support the pace of the operation without adding unnecessary complexity.

STATIC SHELVING

Throughput depends on manual retrieval

Every pick requires an employee to travel to storage, locate items, and retrieve them manually. As pick volume increases, walking and searching severely bottleneck overall facility throughput.

VERTICAL LIFT MODULES

Automated throughput matched to the application

Dual-tray models like the Compact Twin stage the next tray while the operator picks, minimizing wait times. Delivery speeds vary by unit height—taller machines mean trays stored near the top take slightly longer to reach the window.

Up to 120 tray cycles/hour[3]
Delivery speed varies by unit height

CUBE-BASED AS/RS

Built for very high aggregate throughput

Multiple robots operate across a shared grid to deliver 600–650 bins per hour to picking ports. Bin retrieval times fluctuate significantly: delivery can take as little as 3 seconds for top bins, but up to several minutes for deep-stacked bins.

600–650 bins/hour
Retrieval ranges from 3 seconds to minutes

THE REQUIRED THROUGHPUT MATTERS

STATIC SHELVING

Manual Pace

Travel + search limit output

VERTICAL LIFT MODULES

Paced by Machine Height

Dual-tray staging speeds retrieval

CUBE-BASED AS/RS

High Aggregate Volume

Fast top picks, slower deep retrieves

6. Storage Location: Where Is Inventory Needed?

Where inventory is stored can affect travel, response time and how easily automation fits into the operation. Some applications benefit from distributed storage near the point of use, while others are designed around centralized fulfillment.

STATIC SHELVING

Distributed storage, manual retrieval

Shelving can be placed near production, maintenance, assembly or other work areas. This keeps inventory close to where it is needed, but retrieval remains manual and inventory can be removed or used without a recorded transaction.

VERTICAL LIFT MODULES

Point-of-use automation

VLMs can be installed near the departments that use the inventory while providing automated goods-to-person retrieval. Multiple VLMs can be distributed throughout a facility to support different departments. Integrated inventory controls can also help ensure inventory movements are recorded, supporting traceability and more accurate inventory data.

CUBE-BASED AS/RS

Centralized automation

Cube-based AS/RS generally consolidates inventory within a shared storage grid. Robots retrieve bins and deliver them to designated picking ports connected to the centralized system. From the picking port, retrieved inventory must then be moved to its final destination, such as a shipping dock or manufacturing area.

WHERE INVENTORY LIVES MATTERS

STATIC SHELVING

Distributed Storage

Close to use + manual retrieval

VERTICAL LIFT MODULES

Point-of-Use Automation

Point of use + automated retrieval

CUBE-BASED AS/RS

Centralized Automation

Shared grid + picking ports

7. Scaling & Investment: How Do You Want to Spend?

Growth does not always require the same type of investment. Some storage approaches expand one rack or machine at a time, while others scale within a larger shared automation system.

STATIC SHELVING

Low-cost, incremental expansion

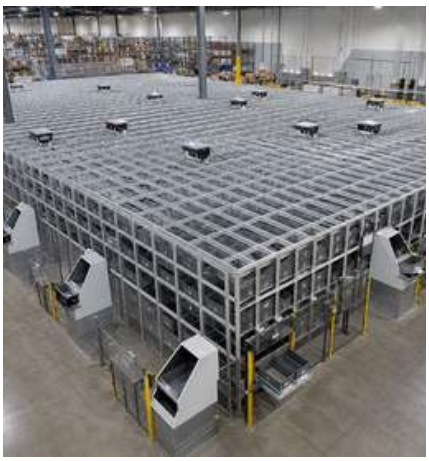
Adding shelving is simple and relatively inexpensive. But each new rack expands the same manual process, including walking, searching and retrieval.

VERTICAL LIFT MODULES

Incremental automation

Start with one or two VLMs and add machines as storage, production or departmental needs grow.

Automation can expand by application or point of use without requiring a large system implementation.



CUBE-BASED AS/RS

Higher-cost installation, scale within a shared system

Cube-based AS/RS typically requires the largest upfront investment. Capacity and throughput can grow by adding robots, picking ports and grid space.

THE SCALE OF THE INVESTMENT MATTERS

STATIC SHELVING

Add More Storage

Low initial investment + manual process

VERTICAL LIFT MODULES

Add Automation Incrementally

Add machines as needs grow

CUBE-BASED AS/RS

Expand the Shared System

Robots + ports + grid

8. Heavy & Irregular Inventory: What Can Each System Handle?

Size, weight and shape can quickly narrow the right storage approach.

STATIC SHELVING

Flexible storage, manual handling

Shelving can accommodate varied inventory sizes and shapes, but heavy or awkward items still require manual access and handling. Retrieving heavy products from elevated shelves or using ladders can also create safety risks.

VERTICAL LIFT MODULES

Flexible storage + automated retrieval

VLMs can store small parts alongside heavy, oversized and irregular inventory, then automatically deliver the requested tray to the operator.

Lift-assist options can also support heavier loads.

UP TO 3,300 LB PER TRAY
Compact Heavy

CUBE-BASED AS/RS

Optimized for standardized bins

Cube-based systems work best with small, lightweight inventory that fits standardized bins.

Items that exceed the system's bin dimensions or load limits may require a different storage approach.

EXAMPLE: UP TO 66 LB PER BIN[4]
AutoStore

THE INVENTORY ITSELF CAN DETERMINE THE FIT

STATIC SHELVING

Broad Physical Flexibility

Flexible storage + manual handling

VERTICAL LIFT MODULES

Flexible Heavy-Load Automation

Varied inventory + goods-to-person retrieval

CUBE-BASED AS/RS

Standardized Bin Storage

Small, lightweight inventory

9. Reliability & Architecture: How Is Availability Built In?

Each approach handles availability differently — and affects the operation differently when something goes down.

STATIC SHELVING

Simple system, manual dependency

Static shelving has little automation-related downtime, but retrieval depends entirely on employees being available to locate, access and move inventory.

VERTICAL LIFT MODULES

Independent machine architecture

Each VLM operates independently. In a multi-VLM installation, an issue with one unit does not inherently stop the others, distributing automated storage across separate machines.

CUBE-BASED AS/RS

Redundancy within a shared system

Cube-based AS/RS uses multiple robots operating across a shared grid. If one robot requires service, others can typically continue operating, providing redundancy within the shared system.

THE ARCHITECTURE MATTERS

STATIC SHELVING

Simple + Manual

Minimal automation dependency

VERTICAL LIFT MODULES

Independent Automation

Separate machines + distributed availability

CUBE-BASED AS/RS

Shared-System Redundancy

Robot fleet + common grid

Which Storage Approach Fits Your Operation?

There is no single best storage technology for every application. The right choice depends on inventory, space, retrieval needs, throughput and how much automation the operation actually requires.

STATIC SHELVING

A good fit when:

- Retrieval frequency is relatively low
- Inventory volumes are variable
- Floor space is readily available
- Manual access is acceptable
- Automation is not yet justified

VERTICAL LIFT MODULES

A good fit when:

- ✓ Floor space is constrained
- ✓ Inventory varies in size, shape or weight
- ✓ Goods-to-person retrieval would improve the workflow
- ✓ Storage is needed near production, MRO or tooling
- ✓ Automation needs to be added incrementally
- ✓ Throughput matters without fulfillment-scale automation

CUBE-BASED AS/RS

A good fit when:

- Inventory is small and standardized
- Order volumes are very high
- Fulfillment is centralized
- Many simultaneous inventory movements are required
- A large shared automation system fits the operation

THE GOAL ISN'T THE MOST AUTOMATION. IT'S THE RIGHT AMOUNT OF AUTOMATION.

White Intelligent Storage

Need help choosing the right storage approach?
Talk with a White Systems storage specialist.

whitesystems.com | 508-771-9400

Sources & Notes

The statistics and product specifications referenced in this guide come from independent research, industry reports and manufacturer documentation. They are provided to support the comparisons and statements made throughout this whitepaper.

#	CLAIM / SPECIFICATION	SOURCE	WHERE USED
1	 **Up to 425 mm / 16.73 in. Tall Bin height** Example: AutoStore	**AutoStore** *Bin Specifications – FAQ* autostoresystem.com/faq/bins Tall Bin: 425 mm / 16.73 in. high Internal height: ~400 mm / 15.75 in.	**Inventory Fit: What Are You Storing?**
2	 **~50%** of order picking time can be spent traveling.	**de Koster, R., Le-Duc, T. & Roodbergen, K.J.** *"Design and control of warehouse order picking: A literature review." European Journal of Operational Research, 2007, 182(2), 481–501.*	**Retrieval & Operator Travel**
3	 **DUAL-TRAY VLM THROUGHPUT** Peer-reviewed throughput modeling for dual-tray VLMs	**Dukic, G., Opetuk, T. & Lerher, T.** *"A throughput model for a dual-tray Vertical Lift Module with a human order-picker." International Journal of Production Economics, 2015, 170, 874–881.*	**Throughput**
4	 **Up to 66 lb** maximum load per bin *Example: AutoStore*	**AutoStore** *Bin Specifications – FAQ* autostoresystem.com/faq/bins Maximum bin load: 30 kg / 66 lb.	**Heavy & Irregular Inventory**

NOTES

Statistics may vary based on operation, layout, inventory mix and system configuration.
Always perform a detailed assessment to determine the right storage approach for your operation.