

INDUSTRIAL SPACE OPTIMIZATION



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ORGANIZATION & LAYOUT GUIDE

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SPACE UTILIZATION IS CRITICAL

SMART DESIGN AND SPACE OPTIMIZATION MAKES EVERYTHING WORK BETTER



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“Poor space planning—even when you have plenty of room—sabotages your operation in ways you might not realize. Disorganization, poor ergonomics and slow throughput can be improved by the way your space is used. Layout affects everything you do from the minute material hits receiving until it’s processed, picked and shipped out. Let us help you take advantage of your space with a fully optimized layout—let’s talk today.”

— Mario, Employee-Owner Since 2020
Systems Integration



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WAREHOUSE LAYOUT FACTORS

DESIGN CAN MAKE OR BREAK YOUR OPERATION



“If you define your objectives in advance, everything else gets easier. Do you want to minimize labor costs for picking/packing/shipping? Maximize storage density? Is the focus on organization and ease of stock access? Do you have a slotting methodology in mind so that you can position storage equipment correctly? Knowing your focus is critical when you create a layout.”

— Christine, Employee-Owner Since 2003
Account Executive

Optimized layout makes you more productive and faster while it reduces overhead costs. Plan on expansion. Plan for shifts in business and process changes for a decade. **Plan for change.**

Anticipate future growth

- Use the vertical cube. You may not need it now, but a good plan notes that you can erect taller pallet racks, or a mezzanine for when you need it. The ability to add pallet positions or platforms may be critical.
- Over-specify storage equipment: If your current loads are in the 1,500 pounds per pallet position range, you could specify racks capable of 2,500 pounds. Heavier racks are expensive, but flexibility is priceless.
- Factor in void space for temporary storage, work areas, storage buffers or overstock areas.
- Include space for common areas like aisles, dunnage, equipment, parking, work cells, etc. Are there too many dock doors, or not enough?

Align processes and layout

Map your processes before you open your CAD software or start scribbling on notepads. How will you manage the operation today? How might that change? Base your conveyors, racks, shelving, picking equipment, and workcells on that process map.

- Involve warehouse managers/workers. You'd be surprised how frequently the people who work in a facility aren't included in expansion, initial layout, or renovation plans—and how often that results in problems and bottlenecks for years to come.
- Include team members from every department in the planning process. This participation can be surprising and extremely useful.
- You could see outsize productivity gains by involving your picking, packing, receiving, and material handling teams.



Pick paths should be a top priority

Pick rate failures are usually blamed on pickers, but it can also be the warehouse design—the way you use your space. Warehouse operations that do not adequately plan paths between bin/shelf locations risk being handicapped by their layout. Picking pathways should start as far as possible from the shipping area, and end with the picker emerging at the shipping area. Sketch your pick paths in advance and work other things around them so that pickers can execute in a single path.

THE LOGIC OF LAYOUT

GOOD LAYOUT ALWAYS DEVELOPS FROM THE GENERAL TO THE SPECIFIC



“Every function of a plant is part of an interconnected whole. Think of a rope. When it’s tugged, knotted or coiled, the entire length is affected. Plant layout is the same way. Along its length, all parts—every department and function—are impacted by changes to another. Any changes affect the entire plant—sometimes in less than obvious ways. It’s always worth taking a comprehensive look.”

—Brandon, Employee-Owner Since 2023,
Systems Integration



The logical flow of people, materials and product traveling between the front door and the shipping dock is the primary plant layout challenge. The ultimate goal is to optimize the workflow of people and product now and into the future.

It’s not a simple “bucket brigade”

If the production process was simply a matter of one person handing their work to the next person in line, an efficient layout would be easy. Too bad it doesn’t work that way.

As long as each one in the line was right next to their upstream and downstream partner, the production line could snake around any which way without affecting output. The major operations of a manufacturing or distribution facility can be thought of single individuals that hand work down the line.

But a bucket brigade isn’t taking place inside most plants. Each department has multiple interactions with the others—the warehouse gets “handed” incoming shipments from the receiving department at the same time that it gets “handed” orders from the fulfillment department. It’s doing half a dozen things at once for half a dozen different groups. At the same time, people are leaving functional areas to take a break.

Operations managers have to juggle work-in-process, staging, and other material handling completely internal to their department.

Departmental layouts

For any given department, there are two layouts to consider: overall plant layout—the grand scheme—and how the department fits into it. In developing the grand scheme you must decide how much floor space each department gets.

Then you have to consider departmental layout, including equipment footprint, traffic, product flow and staging. The “grand scheme” depends on the layout of several departments and functions in any given distribution or manufacturing facility.

General before specific

If you lay out your facility from a departmental adjacency perspective, you create flexibility. Creating a full kitting area layout, for instance, constrains the entire design process. It forces you to accommodate that specific area. Don’t fall in love with a specific departmental arrangement that restrict your design options.

It’s like trying to draw a landscape by starting at one corner of the paper and sketching your way across the sheet to the other. By the time you get to the opposite corner the drawing is distorted.

Each element of design influences, and is influenced by, many other elements. It’s only when these elements have been selected, positioned, and configured in accord with some higher governing principle that they form a coordinated, efficient plant layout.

Resolve all the questions

Questions inevitably come up during this initial layout process. You should value them and use them to optimize the design. Make sure all outstanding items are considered and addressed as you proceed.

The Logic of Layout: Continued on next page

PLACING PEOPLE, PROCESSES

Planning equals success

Time and sweat on the front end always pays off. Spend the time gaming scenarios and generating different ideas. Make sure the stakeholders in various departments are consulted to avoid costly surprises. Because smart layouts let you store, handle and process faster and more efficiently, the effort is worth it.

Will your layout survive the test of time?

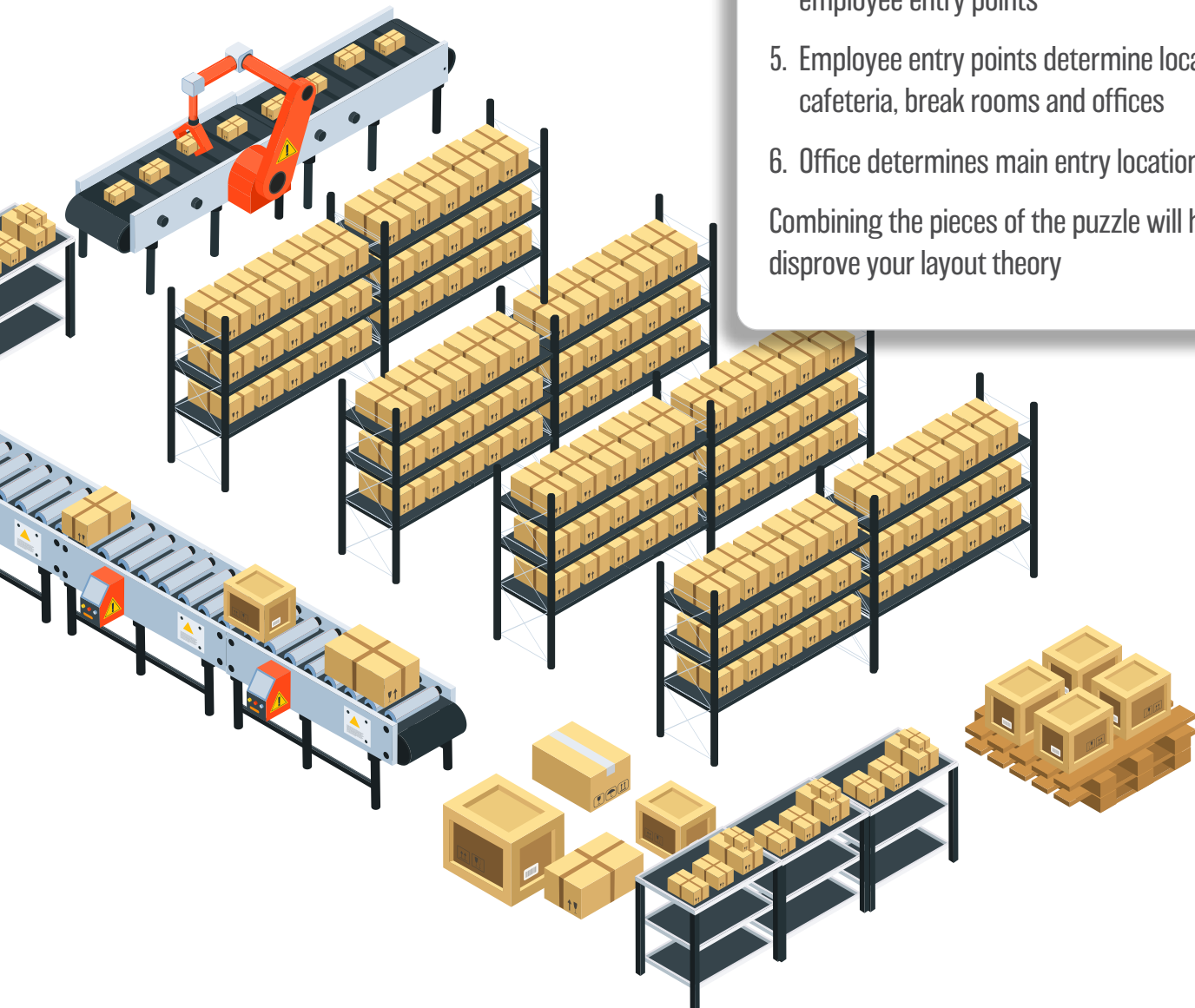
The real test of any layout is whether it has an extended shelf life—whether it can accommodate unforeseen new markets, customer growth or new machinery or inventory. The ability to expand and adapt is the yardstick of successful plant layout.

A TWISTY PROCESS

By following the layout logic's bouncing ball you can see the connections that comprise the whole:

1. Customer (market) determines product type
2. Product type determines warehouse and equipment needed
3. Equipment locations determines material and personnel workflow
4. Workflow determines location of office and employee entry points
5. Employee entry points determine location of cafeteria, break rooms and offices
6. Office determines main entry location

Combining the pieces of the puzzle will help prove or disprove your layout theory



EVALUATE THE CUBE

HOW TO MEASURE AND IMPROVE INDUSTRIAL STORAGE SPACE EFFICIENCY



Storage efficiency springs from layout, vertical cube usage, aisle widths, and storage equipment types

All too often, companies struggle because they considered the size of their warehouse during planning, but not the efficiency of that space—or its future possible use.

You have opportunities to evaluate your business mix, order trends, product slotting, and facility layout that can improve everything from storage density to pick speed to error rates. But to get there, you should know the total storage potential of the facility.

Calculate the vertical cube

Assume you have the following situation:

- Your warehouse is 30,000 square feet (after you subtract non-storage areas, such as offices, bathrooms, etc).
- The tallest rack you can use is 20 feet (to clear ceiling height—the distance from the floor to the bottom of the lowest obstruction). For the sake of this exercise, clear ceiling height is 24 feet.

Multiply $30,000 * 24 = 720,000$ cubic feet using the entire cube. In real-world scenarios this would be broken down extensively. Now that you have the total cubic feet, it's time to calculate the total storage cube, which provides the cubic storage volume.

- If your racks aren't tall enough to take advantage of the full clear ceiling height (24' in this example), consider it unused cubic space.

- Calculate this for all reasonable storage areas. Count areas where shorter storage equipment, such as shelving or carton flow racks are being used, since those in theory are part of your storage cube. In this example, we'll say that 8,000 square feet isn't part of the storage cube ($8,000 * 24 = 192,000$ cubic feet).
- Subtract 192,000 from 720,000. This leaves you with 528,000 cubic feet of potential storage space.
- Then, divide the building cube (720,000) into the storage cube (528,000). This gives us a 26.6% ratio, which is in line with industry average of 22-27% cube utilization.

It's useful to understand the potential storage of a facility as if you are considering moving into a new building or revamping a current one. High density storage can help increase storage density if you have the unused cubic feet.

You aren't attempting to use every last inch—only to understand how much space you do use and what might reasonably be available for reconfiguration or future use. If your ratio is less than 22%, you may be able to revamp storage rather than moving or adding additional square footage.

MEZZANINES USE THE CUBE

“



“Mezzanines are one of the best ways to use your space efficiently. Most high-bay warehouses don't take advantage of their vertical cube. Mezzanines use existing climate resources and square footage. We'll help you add high-density storage at a fraction of the cost of relocation or new construction.”

—Alex, Employee-Owner Since 2013
Account Executive

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Visit www.cisco-eagle.com/mezzanines for specs, details and resources



STRUCTURAL: MOST FLEXIBLE

Structural mezzanines are more versatile because they allow easier size and shape customization. Depending on the storage media involved, they may also have higher capacities. That complete flexibility and high capacities let you add flexible working or processing space. Structural systems can withstand heavier point loads, providing you the ability to store heavy loads or install conveyors or other production machinery atop them.



SHELF-SUPPORTED: DENSE STORAGE

When you need to organize parts, tools or inventory in concentrated space, shelf-supported mezzanines are an ideal solution. Shelf-supported mezzanines pack more parts, bins and other stored items into a small area by using the vertical cube—and they keep those parts more organized for faster access.

Shelf-supported systems let you use various types of shelving and storage concepts for high-density storage you can re-slot or easily change.



RACK-SUPPORTED: MIXED PALLET/CASE STORAGE

Sometimes called catwalk systems, these mezzanine configurations are high bay pallet racking with walkways in the aisles between the rack. These racks can be fitted with flow tracks for high-density order picking and mixed storage of pallets along with hand-loaded items in just about any storage scheme you can imagine.

Rack mezzanines give you options above high bay pallet rack. They're economical compared to structural mezzanines. You can add space in which to place more pallet positions, office space, work zones or just about anything else.

MULTILEVEL PICK MODULES

HIGH-DENSITY, HIGH-THROUGHPUT PICKING SYSTEMS



“Pick modules give you first-in, first-out rotation and increase picking productivity. Plug a bay of carton flow into a series along a conveyor line on multiple levels, and you have high-density storage that drives fast, accurate order picking in a compact vertical footprint.”

—Joel, Employee-Owner Since 1999
Systems Integration

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Lots more information: visit www.cisco-eagle.com/pickmodules



Scaled to your needs

While there is no such thing as a standard pick module, they share common traits. Pick modules integrate various storage solutions inside multi-level work platforms that move product efficiently through a distribution facility. These levels can include static storage, flow storage and conveyors.

The anatomy of a pick module

These order picking systems are multi-level, and combine elements of mezzanines and work platforms with [conveyors](#), [spirals](#), [carton flow racks](#), [pallet flow](#), [static racks](#) and sometimes [carousels](#), or other equipment that delivers loads for pickers on each level.

PICKING APPLICATIONS

First-in, first-out picking. Replenish inventory from the load side while pickers are always presented with inventory.

Save space. Pallet picking operations save about 35% in a typical 6-deep configuration. Cartons or totes do even better. The more vertical cube you can utilize, the more space you'll save.

Reduce labor expenses. When you concentrate storage and picking operations, you eliminate nonproductive walk time, which lets you focus on productive work.

Replenish inventory easier than ever. Because you're concentrating picking operations, you can re-stock faster.

They produce faster picking in less space than floor level storage. This results in significant cost savings for broken pallet, full-case or open-carton picking functions. Pick modules reduce wasted “walk time” for pickers, who are situated in areas where they spend more time picking orders and less time chasing SKUs. Orders are typically conveyed away from the pickers to packing and shipping. This reduces picking times and increases accuracy.

STORAGE & PROCESS BUFFERS

Storage buffers: methods and space

Block stacking: large numbers of similar or same SKUs

Block stacking—when loads are floor-stacked atop each other—is used when space isn't a big concern. If the load and space limitations work, it's an excellent method. Factors include:

- Lane design: Forklift operators require space to efficiently locate and remove pallets.
- Load suitability: Block stacking is last-in first-out storage, so it can be used only for items that don't require rotation. Removing pallets creates voids that you can't easily restock.
- Load strength & stability: Can you stack loads without damage? Can loads be stacked high enough to be effective? Can it be done safely?
- Pallet conditions: Your pallets must be undamaged, strong and stable.
- Environment: Whatever you're storing, it should be in identical or similar conditions to its final storage positions or processing area.



Racks: density, picking agility, organization and safety

To recoup operating space, look at bare floors used for temporary storage or buffers. Racks give you flexibility. You aren't locked into one way to load and a constant dance of pallets moving in and out. Rack storage of any type is more organized than block stacking.



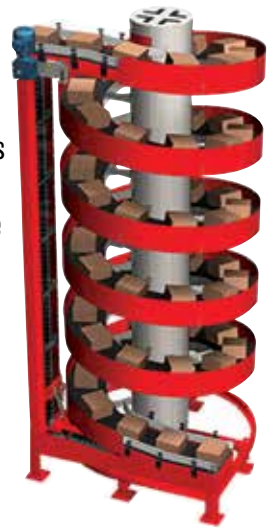
- Selective racks are the most flexible solution, since you can access every pallet all the time.
- Pushback racks aren't as flexible as selective racks but give you far more storage density due to deep lane storage.
- Drive-in racks allow you to access inventory more easily. They're one of the most space-efficient storage buffer methods.
- Pallet flow racks: For storage buffers, flow racks are the ideal choice when it comes to time-critical items that require inventory rotation.

Buffers bridge the gap when supply, timing and demand don't match. Any process that can be sequenced and involves pauses or waiting periods utilizes buffering. Optimized buffering enhances productivity, but space is always an issue.

Conveyor process buffers for hold & release applications

Conveyor buffers are a “pause button” between process steps. They balance operational surges by allowing you to hold products while one operational area catches up with another. Most conveyor types can be used in buffering roles, depending on the load, volume and situation involved.

- Overhead conveyors can hold recently painted or washed items until dry. This is a frequent manufacturing application.
- Accumulation conveyors buffer cartons before they reach packing. It's common to queue cartons until they can be weighed, checked, packed, taped or processed.
- Spiral accumulation buffers divert products onto high-density vertical spirals that use vertical space. They buffer and control the pace for a large number of products in a small footprint.



ASRS and carousels

Buffer storage using carousels, pallet shuttles or automated storage-retrieval systems usually sits between production or process areas. In manufacturing, it could be a sub-assembly buffer for finished components awaiting the next step buffered in an automated system. You'll have those components ready without jamming the production zone.



ASRS unit load systems can handle full pallets and release them as needed. Pallet shuttles are frequently used for storage buffers in high-density, high-output processes.

DENSITY VS. SELECTIVITY



“Because pallet racks occupy so much square footage, they’re always worth consideration. To find the right balance between pallet access and storage density, you should use the right type of rack for the load and application. You need to access some loads daily and have to turn them quickly. Others, you can store in high-density racks with less convenient access. We can help you figure it out.”

—Luke, Employee-Owner Since 2020 • Account Executive



Visit www.cisco-eagle.com/palletracks for videos and detailed information

MIX AND MATCH RACK TYPES FOR FLEXIBLE SPACE EFFICIENCY

Selective Rack: 100% constant access to all pallets with less storage density

Selective rack is the most versatile option, with 100% access to every pallet at all times. Because it needs an aisle for every row, it has lower storage density. It's ideal for faster moving product in most warehouse applications and is the standard rack for most warehouses.



Pushback: last-in-first-out with good storage density, medium selectivity, more versatility

When forklifts unload pushback racks, the next pallet rolls to the front. Pallets are pushed back in a last-in, first-out storage scheme when loaded. You can place a different SKU on every level. Pushback systems require angled pitch, which consumes vertical space. They're denser than selective, but less dense than drive-in.



Drive-in racks: last-in, first-out picking with excellent storage density, lower selectivity

Drive-in racks are “last-in, first-out” systems with reduced selectivity, and excellent product density. Ideal for items that have longer life in storage and don't require immediate access. It is frequently used for cold storage applications where every inch of expensive space is critical. Drive-in & drive through systems are ideal for items with a longer life in storage that don't require immediate access.



Pallet flow: first-in, first-out; great storage density with less selectivity and reduced handling costs



Pallet flow systems give you the most storage density. Depths are limited only by facility size. Flow rack automatically rotates inventory. Aisle space can be reduced by 75%.

FORKLIFT AISLE WIDTHS

SPACE EFFICIENCY, PALLET RACK AND AISLES SHOULD BE EVALUATED



Since pallet rack aisles consume considerable space, they should be evaluated for functionality, space utilization and safety. Aisles are often given 12 feet as a rule of thumb because that's the minimum needed for counterbalance trucks to handle 48" pallets.

General aisle configuration guidelines

Typical aisles for 3 or 4 wheel, counterbalance forklifts are wider than for other types of trucks. A simple "rule of thumb" calculation for minimum aisle width:

1. Measure the head length: the distance from the back of the forklift to the front of the load back rest.
2. Measure load length: the length of the pallet plus its load overhang.
3. Add these two lengths together.
4. Add at least 12" maneuvering space: remember to add a minimum 6" for pallet load overhang from the rack on each side of the aisle. Wider aisles help drivers avoid backing into racks, but eats space.
5. Add all together for the minimum width for a typical counterbalanced forklift. Remember that this is only a guide and that most forklifts come with detailed specifications on aisle widths.
6. Know your forklift turning radius to ensure drivers can easily access pallets without risk of striking racks.

These calculations work for standard forklifts in selective rack applications. For narrow or very narrow aisle racks, your equipment determines aisle widths. Always consult your forklift documentation when making these determinations.

FORKLIFT & PICKING TYPES

To fully understand whether or not you can narrow your aisles to save space, you should have a full grasp of the type of forklifts in use.

- **Sit-down counterbalanced:** when people think of forklifts, they think of this common type. It needs plenty of operating space—at least 12 feet.
- **Stand-up deep-reach:** built for narrower aisle operations of 9 to 11 feet.
- **Stand-up single-reach:** these lifts can operate in even less space than deep reach models—as little as 8 feet due to shorter forks.
- **Turret or swing-mast narrow aisle:** because the forks can pivot 90°, these lifts don't turn to face rack aisles. Aisles can be less than 5'6".
- **Narrow-aisle order picker:** use the least space—between 4 and 5 feet—since the operator usually walks behind the lift.

STORAGE SYSTEM COMPARISONS

SHELVES VS. MODULAR DRAWERS VS. FLOW RACKING VS. CAROUSELS








“Check this table to compare the relative advantages and disadvantages of various storage and picking equipment. Most advanced storage methods contrast themselves to shelving—not necessarily to each other. For instance, if cost isn’t an issue (and it always is) carousels provide the most storage density. Modular drawers also save tons of floor space, while carton flow is the choice in high-speed picking. It comes back to this: what’s most important for you?”



—Lance, Employee Owner Since 2019, Sales Director



Storage Media		Load Type	Versatility	Cost	Space Efficiency	Productivity	Notes
Shelving		Cartons, bins, bulky items	High	Low	Poor	Fair	Many types and options available; integrate to mezzanines
Modular Drawers		Tools, small parts, components	High	Moderate	Good	Good	Secure; highly configurable
Flow Storage		Cartons, bins	Moderate	Moderate+	Excellent	Excellent	First-in/first-out accessibility for fast picking and selection
Mobile Aisle		Cartons, bins, bulky items	High	Moderate+	Excellent	Good+	High density due to aisle elimination; needs powered or manual movement
Carousels		Cartons, components, bins	High	High	Superior	Excellent	Automation for speed and accuracy; high density and secure

SHELVING & DRAWER SYSTEMS

ECONOMICAL, SPACE-EFFICIENT WAREHOUSE SHELVING SYSTEMS

Visit www.cisco-eagle.com/shelving for prices, specs and layout assistance



Shelving systems are used in most every facility—including highly automated distribution centers—because they're versatile and are the best way to store a number of items, including reserve stock and slow moving items that require organized storage. Shelving is frequently used in shelf-supported mezzanine systems that concentrate overhead storage for space efficiency. Shelving is the baseline storage system that other methods use to measure their efficiency.

MODULAR DRAWER SYSTEMS ARE HIGH-DENSITY AND CUSTOMIZABLE

Visit www.cisco-eagle.com/modular for details and options

Shelving vs. modular drawers

If you're storing lots of boxes and bins on shelving, then your storage area is a candidate for modular drawers—either cabinets or drawer/shelf combinations. What are the factors?

- **Space efficiency:** shelving uses 70% more space for the same loads vs. modular drawers. Upper, lower levels and the rear of shelves are hard to see and reach. They often wind up unused. Modular drawers fully extend to let you use every inch.
- **Ergonomics:** full extension modular drawers allow easy access and full use of the deepest corner of each drawer. This is much easier than reaching into the back of shelf.
- **Costs:** modular systems are costlier than shelving, but modular A typical drawer system can replace about five shelving/bin units. You should also take operational costs and space into account.
- **Security:** if security is a factor, shelving is far more difficult to lock and secure than modular shelving.



MOBILE AISLE SHELVES



“You can move aisles mechanically or manually. Mechanical systems use a drive shaft/gear chain arrangement to move loads up to 10,000 pounds—it’s as easy to move that row as it is to turn as the power steering in your car. Manual systems are operated with a crank at the end of each row. All-track drives let a single person move up to 1,000 pounds per linear foot smoothly and uniformly, without strain or difficulty. Call us today for advice on your mobile system.”

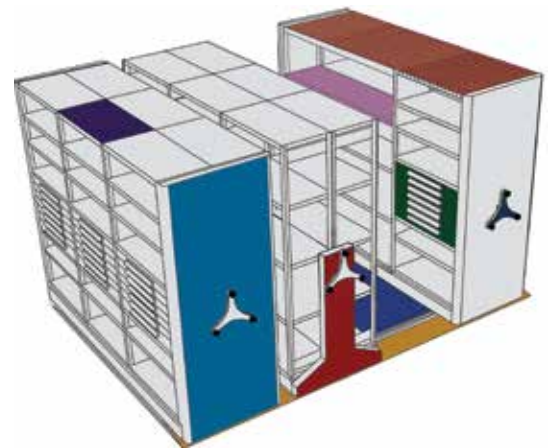


Kevin, Employee-Owner since 2020
Account Executive

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Storage density, accessibility and flexibility

High-density mobile aisle systems let you collapse the space between rows, freeing existing floor space for other uses by reducing the number of access aisles. The system can double your storage in a smaller footprint. Retrieval is enhanced because workers take fewer steps to access stored items. Shelving and modular drawer components can be reconfigured as space and storage priorities change. Great for archival storage, manufacturing parts & supplies, maintenance, pharmacy, weapons racks, R&D, medical records, tool rooms and more.



SPEEDCELL HIGH-DENSITY STORAGE FOR PALLET RACK BAYS

Visit www.cisco-eagle.com/speedcell for details, specifications, video and more

Add more SKUs in less space with sliding compartment systems

SpeedCell is a dynamic high-density storage solution that maximizes space utilization within existing racks, helping warehouse and backroom operations improve pick speed and accuracy for time and cost savings. SpeedCell installs in pallet rack bays to create columns of moving compartments with 100% product accessibility—a sliding system. A wide variety of sizes and configurations makes it ideal for order picking.

- Store 400+ different SKUs in one rack bay, all accessible 100% of the time
- Designs from 1-3 rows deep, up to 12 columns wide (144" wide bays)
- Store pallet loads on higher rack levels while using the floor level for pick and pull operations
- Storage Capacity - cell: up to 35 lbs; column: up to 240 lbs
- Works for operations where you must access many SKUs in a small space



CARTON FLOW & SPACE

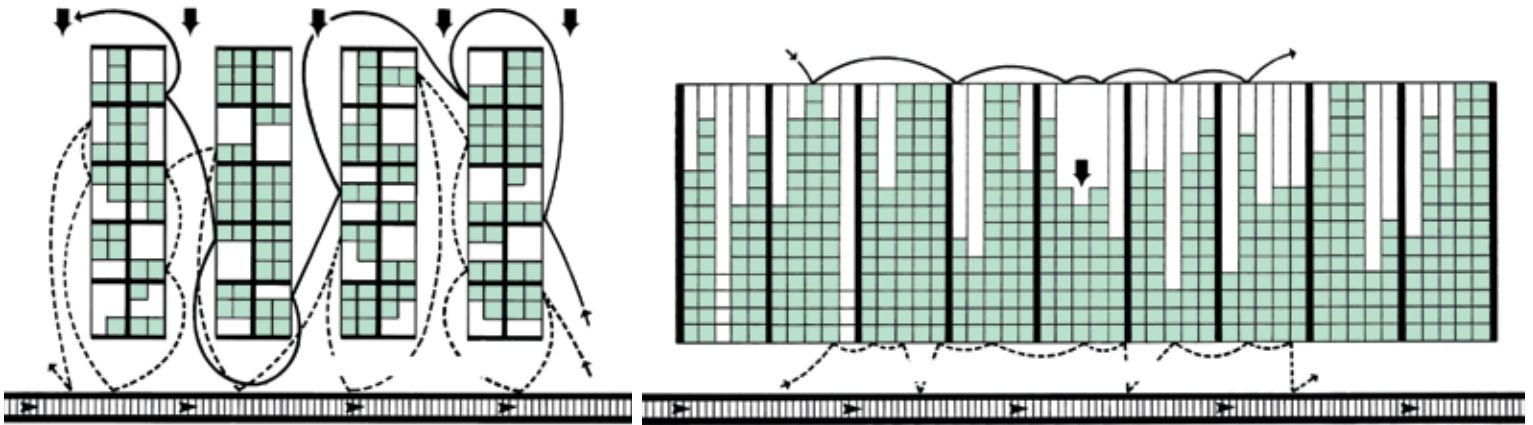


“Carton flow saves space by concentrating inventory and allowing pickers to access more product across fewer pick faces. It’s efficient because pickers need fewer aisles and access points to work with more pick faces. You can combine carton flow with lower pallet rack bays to spin up space-efficient parts or piece picking.”

—Mark, Employee-Owner Since 2023
Account Executive



Visit www.cisco-eagle.com/cartonflow for articles, video, specs and more



Left: Shelving line where pickers walk around shelving to retrieve SKUs. Right: Pickers are positioned in front of goods-to-person storage.

Carton flow space efficiency

Factor	Flow Storage	Static Shelves	Gain w/ Flow Storage
If total floor space is:	Equal	Equal	None
Then items stored:	155	120	+29%
Shelves high:	5	3	+2
Cases per opening:	15	12	+3
Total cases:	2,325	1,440	+61%

High-density storage

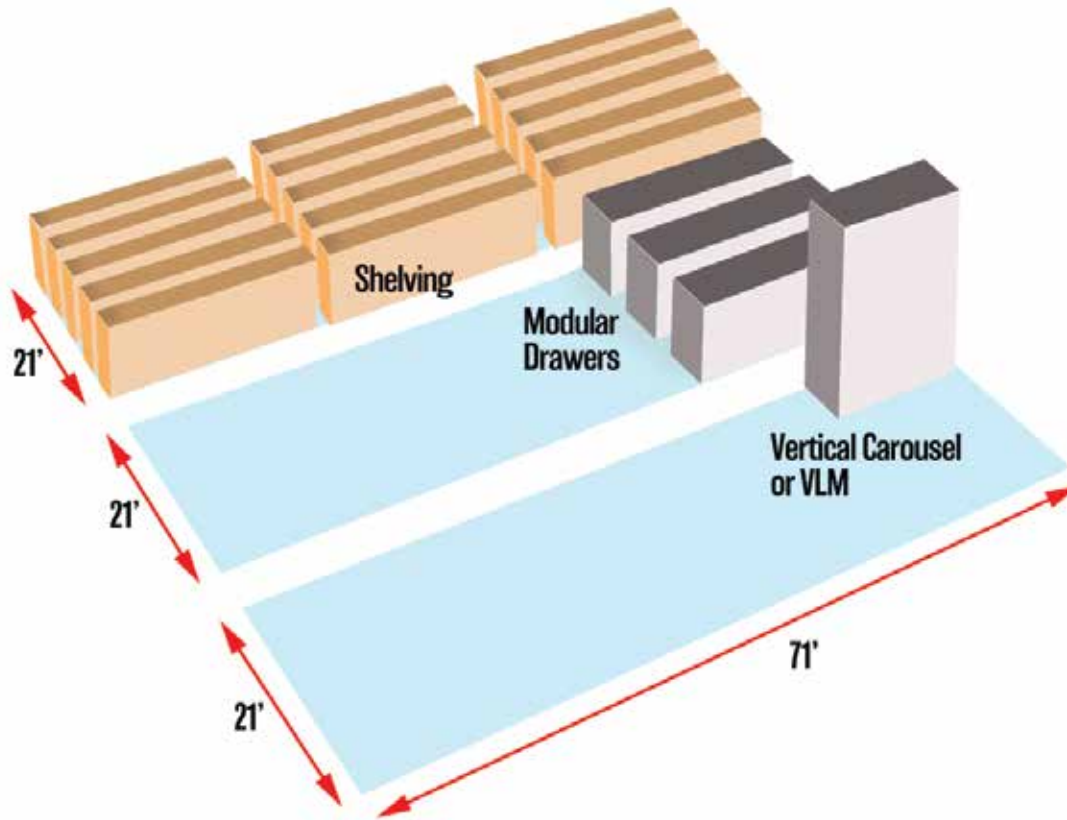
Carton flow lets you reduce walking and makes picking faster, and also concentrates storage compared to shelves. In the example above, carton flow hosts 61% more cases in the same square footage. Integrate carton flow into pallet rack bays for flexible, mixed-use pallet/case storage.



CAROUSEL SPACE UTILIZATION

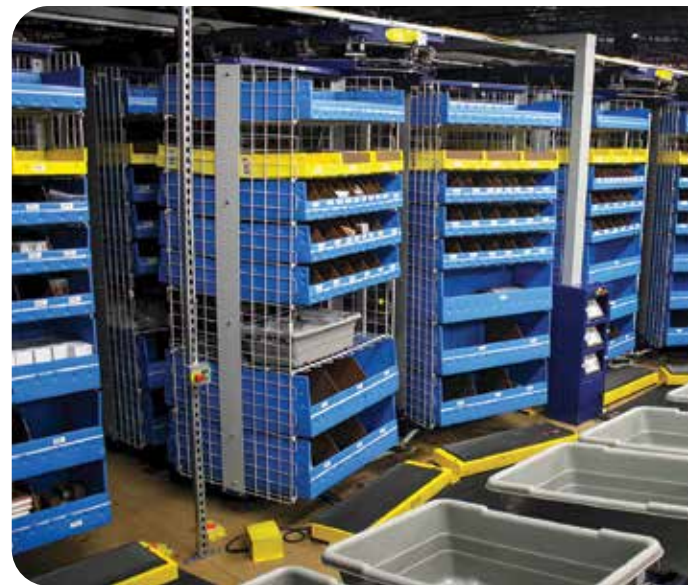
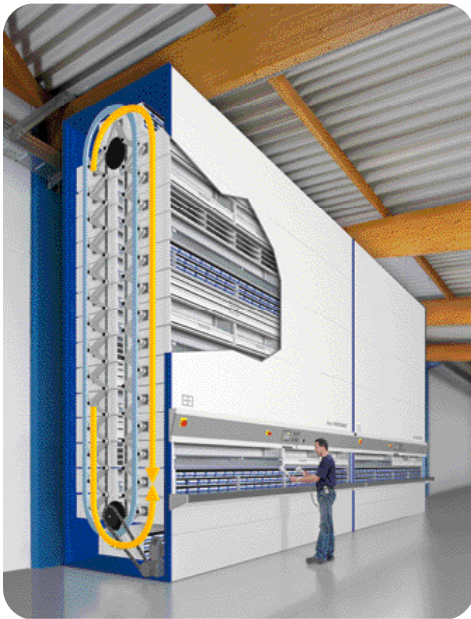
HOW CAROUSELS CREATE EFFICIENT, ORGANIZED, HIGH-DENSITY STORAGE

Visit www.cisco-eagle.com/carousels for detailed information & videos



Comparing storage system space consumption

Vertical carousels or VLMs provide the same amount of storage space as several rows of shelving or modular drawer cabinets. In this instance, a single vertical carousel saves over 1,400 square feet of floor space compared to shelving. Flow racks also compare favorably to shelving in terms of space utilization.



Left: Vertical carousel. Right: Vertical lift module. These systems offer high-density storage by using the vertical cube.

Horizontal carousels tend to reduce space requirements because you don't require pick and replenishment aisles