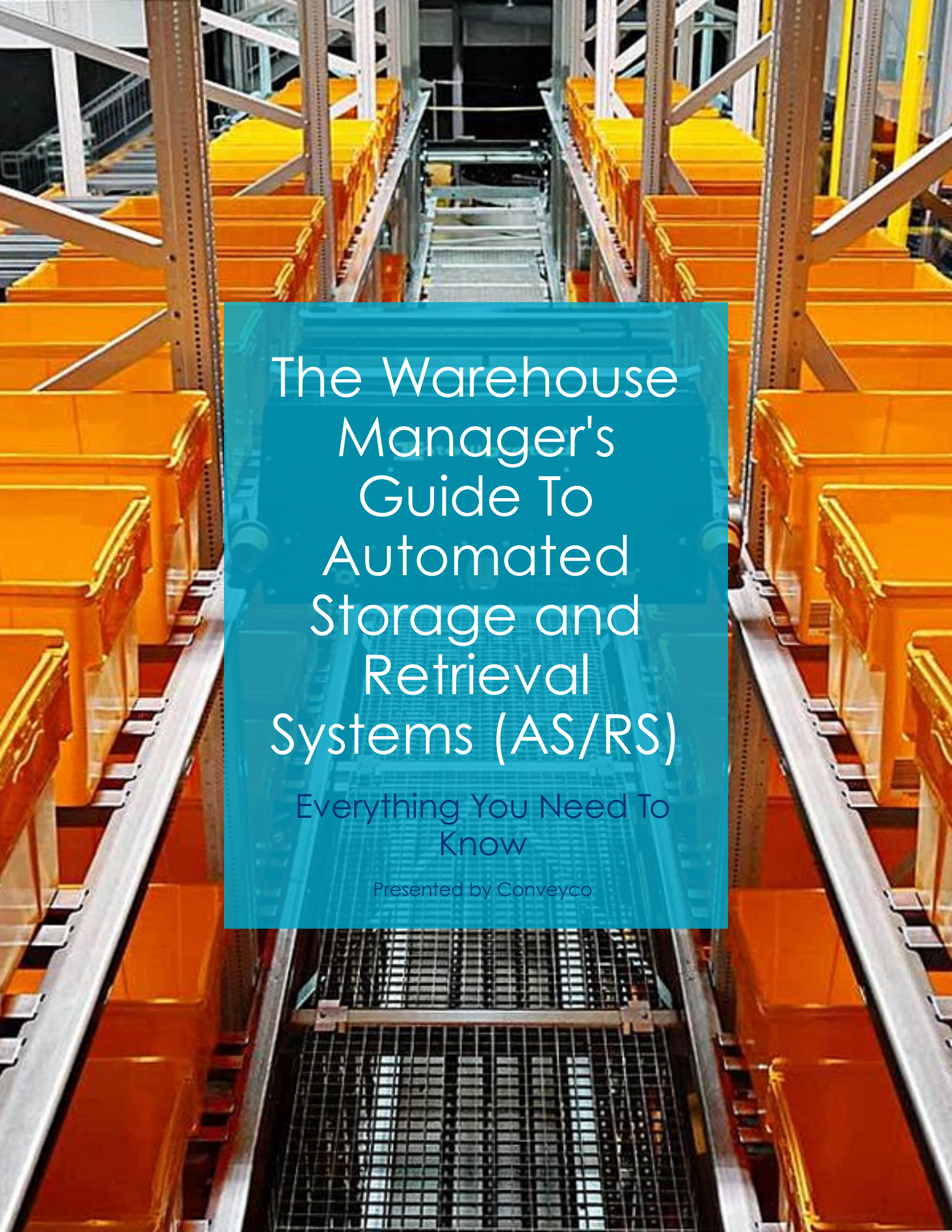




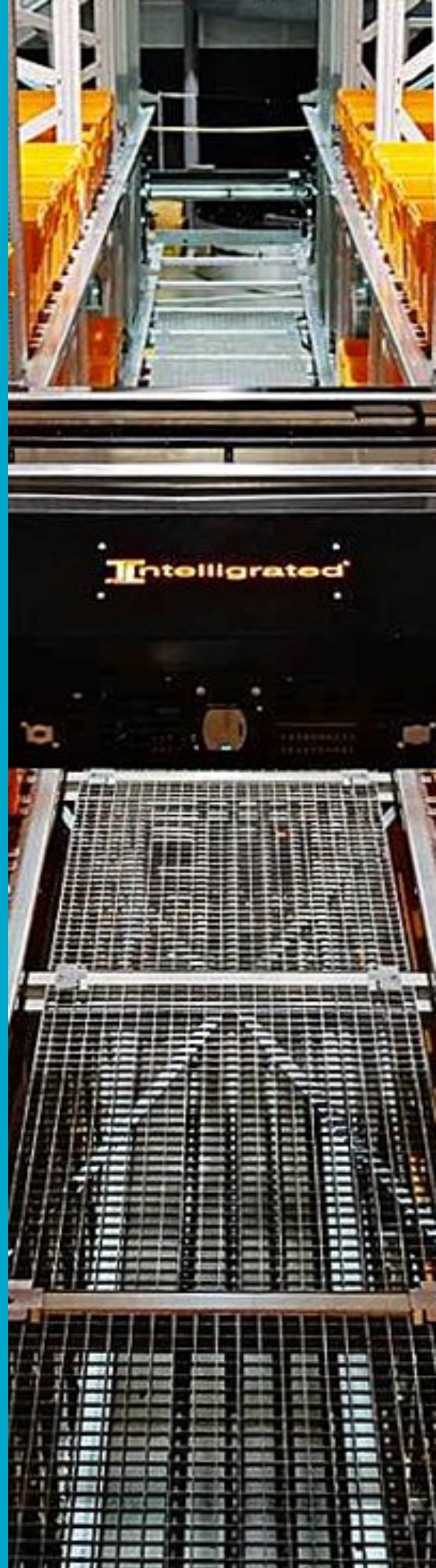
The Warehouse Manager's Guide To Automated Storage and Retrieval Systems (AS/RS)

Everything You Need To
Know

Presented by Conveyco

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Introduction

If you work in the materials handling or order fulfillment industry, then you know how important it is for your warehouse or distribution center to be continuously improving: Growing more efficient, more cost-effective, and more profitable.

And that makes sense: Especially in today's world, which is so heavily influenced by ecommerce and other trends in order fulfillment, the ability to fulfill your customers' order quickly and cheaply is your only defense against the competition.

Implementing an automated storage and retrieval system (AS/RS) in your facility is one relatively easy way to boost your efficiency, cut costs, and make your operation more profitable.

In this ebook, we'll discuss:

- Whether or not AS/RS is right for your operation
- Some of the common applications for AS/RS in warehouses and DCs
- The pros and cons of AS/RS that you need to take into consideration
- Cost factors of AS/RS that you should be aware of
- The different types of AS/RS that you can leverage to increase efficiency in your warehouse

Read on to learn more about how an automated storage and retrieval system can impact your bottom line, as well as important information that you'll need to select the right technology to help you meet your business goals.

Is AS/RS Right for My Operation?



If you work in the order fulfillment, materials handling, or manufacturing industries, then you've probably been hearing a lot about how Automated Storage and Retrieval Systems (AS/RS) can increase the productivity and efficiency of your operation and make your business more profitable. And for good reason: It's true.

AS/RS technologies offer a wide range of benefits. But they can also be costly to implement, so just like any other investment, you're conscious of the need to keep ROI top of mind. It's for that reason that you might find yourself asking: Is AS/RS technology right for my operation?

Whether or not AS/RS technology makes sense as a part of your operation will depend largely on the specifics of your individual business. Factors like your business cycle, operational goals, level of growth, and available investment capital will all impact your ability to implement a system, and it would be a good idea to speak with warehouse design consultant or systems integrator to help determine if AS/RS makes sense for you.



That being said, listed below are few questions you can ask yourself to help determine whether or not implementing AS/RS would be a good investment for your business.

Are Your Labor Costs Increasing?

Regardless of your industry, labor costs are likely to be one of the largest expenses of your operation. And they're constantly rising: Salary increases, retirement benefits, time off, and other perks for employees never cease to increase from year to year. Even if business is good and you're in the midst of an expansion, the extra hands that you need to hire to fill that increased demand is eating into your capital.

Automated storage and retrieval systems allow you to reduce your labor costs by replacing low-skilled labor with automation. If your labor costs have been rising lately and you're worried about keeping up with those rising costs, AS/RS and other automation solutions should be considered.

Is Labor Hard to Find or Keep?

Even if you've got the funds to hire an entire fleet of new workers, you can run into another challenge: A lack of skilled workers. Either you can't find employees, or you can't hold onto them once you do hire them.

Often this is completely outside your ability to control, and is influenced by geographic or demographic conditions. But it can have a detrimental effect on your ability to operate efficiently: A lack of workers means that you are not able to operate at full capacity, which can be especially challenging during your peak seasons.

To solve this issue, you could decide to increase wages in order to draw more applicants to the area. But this would have the negative effect of reducing the profitability of your uptick.



Automation like AS/RS is another option for operations facing a labor shortage. Because AS/RS performs the repeatable and low-skill task of moving goods. Implementing an AS/RS system allows you to move your existing workers to tasks that add more value to your business.

Are You Running Out of Space?

If your operation is constrained by a small facility, then you face the inevitable risk of running out of space. This lack of space can not only translate into less area for your critical processes to take place, but it can also mean less space for you to store the inventory critical for your business.

To solve the issue of space, you've typically got a few options: Increase the size of your existing facility through a costly redesign, move to a larger facility that can better accommodate your operation, or make better use of the space that you currently have.

Implementing AS/RS technology in your facility may be the perfect solution for operations in need of more space that do not want to or cannot afford a costly redesign or the logistical nightmare of a facility move. By allowing you to reclaim vertical space otherwise not in use and build upward instead of outward, automated storage and retrieval systems can help you better make use of your existing space and give you many more years in your current facility.

Do You Need Better Inventory Control?

Order fulfillment and materials handling operations, especially, have the potential to see an added benefit from implementing AS/RS technologies: It offers better inventory control, which is critical to reducing waste, optimizing storage and space usage, and creating a more efficient—and more accurate—operation.

If your operation is having issues with stock being wasted or expiring before it is used or sold, (agriculture, food, pharma, etc.), implementing AS/RS can ease the concerns by auto-rotating stock on a first-in/first-out (FIFO) basis. If



your operation has seen a large amount of product damaged or destroyed due to human error, the fact that AS/RS removes the human element and reduces risk of accidents is an obvious advantage.

Additionally, by integrating with your Warehouse Execution Software (WES), AS/RS can allow for more accurate, automatic inventory control than what is possible through manual operations.

Choosing the Right Technology to Reach Your Goals

Whether AS/RS technology is the right fit for your operation will depend on many factors, including your budget, operational goals, and specifics about your business. That being said, operations experiencing the problems outlined above stand to gain the most by implementing AS/RS as a part of their warehouse automation strategy.



Pros and Cons of AS/RS for Warehouse Automation



Automated storage and retrieval systems (AS/RS) have gained a lot of traction over the years as more and more warehouses, order fulfillment operations, and materials handling operations have embraced the technology. And it makes sense why: There are many advantages to using AS/RS to automate or partially-automate a warehouse.

With this growing use of AS/RS, the logical question that comes to mind for many warehouse managers is: How can I know whether AS/RS is a good fit for my industry and for my operation? Is investing in AS/RS the right decision for my business? What is the ROI of implementing AS/RS? What are the pros and cons of using AS/RS that I can weigh to decide whether or not implementing them makes sense for my business?

If you're thinking about using AS/RS technology to automate your warehouse or order fulfillment operation, it's important to realize that they are not a perfect fit for every industry, operation, or business. To help you determine whether or not implementing AS/RS makes sense for your operation, we've compiled a list of the major pros and cons of AS/RS that you should consider before making any decision.



Advantages of Automated Storage and Retrieval Systems (AS/RS)

1. Reduced Labor Costs

By implementing an automated storage and retrieval system in your operation, you can reduce labor costs in a number of ways. In extreme cases, some operations can employ a single AS/RS to replace all picking labor, freeing up workers to focus on other more productive functions. Although this is not typical, the potential efficiencies gained by a thoughtfully executed AS/RS can have a positive and lasting impact on your profitability. By removing the need to expand your workforce, the one-time investment of purchasing and implementing the AS/RS system has the potential to remove the ongoing costs that would come with a new hire such as healthcare, payroll taxes, salary increases, training, etc.

2. Fewer Labor Constraints

Even if an operation has the funds to expand their workforce with new hires, sometimes outside factors (geography, job market, demographic trends) can constrain the labor supply and make it difficult to expand. AS/RS removes some of these constraints by allowing automation to take the place of employees. This means that warehouse employees can be redirected to higher-value tasks that make your operation more profitable while lower-value, repetitive tasks are handled by technology.

3. Increased Safety

Whether because of distraction, fatigue, hunger, psychological or emotional stress, one thing is certain: Humans make mistakes. When humans make mistakes while operating heavy machinery such as forklifts, tragedy can result. Incorporating AS/RS systems into your operation allows you to remove some of this unpredictable human element by replacing workers with machines that do not get tired or distracted. This can have a tremendous positive impact on an operation by increasing safety, thereby reducing accidents and damage to product, structures, and equipment.



4. Increased Accuracy, Productivity, and Efficiency

As mentioned above, humans are error-prone. No matter how well-trained or diligent, eventually errors will happen. In addition to causing safety issues or damaging product, these errors can also impact workflows and lead to inefficiency. A pallet of product delivered from storage to the wrong department can, for example, cause confusion, traffic jams, and a shutdown of order processing until the error is fixed. By allowing AS/RS systems to manage the components of your operation that can be automated, these inefficiencies can be removed, ultimately reducing waste and increasing output. And all of this will allow your operation to become more accurate and, therefore, profitable.

5. Can be Modular

Though an AS/RS system can be a costly expense for an operation to absorb (as we discuss below), one oft overlooked benefit is the fact that they can be modular. An operation can migrate inventory segments into AS/RS one at a time—for example, prioritizing fast-moving product first—limiting initial expense, and allowing you to slowly transition to full automation.

6. Better Use of Space

AS/RS carries another benefit for operations that are constrained by a small footprint. By making better use of the space available in a facility, AS/RS can remove the need for a costly redesign or expansion. AS/RS typically requires narrower aisles than do human-operated forklifts; racks can reclaim vertical space; and automation can allow for high-density storage that is difficult to achieve by traditional means.



Disadvantages of Automated Storage and Retrieval Systems (AS/RS)

1. High Initial Investment

The the long run, implementing an automated storage and retrieval system is likely to reduce labor costs and by increasing productivity. But these benefits come at a cost: The cost of the initial investment. Like many automation endeavors, purchasing an AS/RS is more expensive in the short term than hiring personnel or using other equipment such as forklifts. This initial investment can be a challenge for smaller operations that don't have ready access to capital (although equipment leasing options can help some businesses reduce this barrier to entry).

2. Maintenance

As with any kind of equipment or technology, AS/RS will need to undergo routine maintenance and occasional repair. This will undoubtedly lead to some operational downtime as occasional repairs and maintenance are made. And though still cheaper than the ongoing costs of hiring and employing additional staff, the costs of this maintenance should be considered before implementing any new system.

3. Not Suitable for Highly-Variable Operations

AS/RS, like all automation technologies, are best suited for operations that have regular, predictable, and repetitive tasks. Operations that vary widely in terms of product or materials handled from week to week or month to month may find it difficult to make AS/RS fit into their business plan. Because AS/RS works according to preset systems, processes, and analysis, rapid change can be difficult to facilitate.



4. Can Require Technical Skill and Retraining

As with any new warehouse equipment, your employees will need to be adequately trained to safely handle your new AS/RS systems and get the most out of the technology. This will of course lead to some downtime while training takes place, and could lead to turnover of current staff.

Weighing the Pros and Cons

Though AS/RS is a powerful tool that can dramatically increase productivity, efficiency, and profitability for many operations in many industries, it isn't for everyone. If you are considering implementing an automated storage and retrieval system in your facility, be sure to weigh the pros and cons of AS/RS use that we have outlined above to determine whether they would compliment your operations.



4 Common Applications for AS/RS in Warehouses and DCs



By now, most warehouse managers know the benefits that automated storage and receiving systems (AS/RS) can bring to an order fulfillment or materials handling operation: Everything from reducing labor costs to increasing safety to boosting efficiency, and more.

But exactly how can an operation utilize AS/RS in order to meet these goals? What applications within your operation are best suited to take advantage of AS/RS technology?

Traditionally, AS/RS has been seen as a technology meant to serve a single function: To provide long-term storage for product in a way that makes the best use of an operation's space. But the truth is, there are many ways that an operation can use AS/RS to become a smarter, faster, and better.



To help you better understand the role that AS/RS can play in your workflow, below we explore some of the ways that your operation might be able to incorporate AS/RS in order to increase productivity and reach your warehouse automation goals.

Applying AS/RS in the Warehouse

1. Long-term Storage

One of the primary benefits of AS/RS is its ability to store product in a way that makes the most efficient use of available space, especially over the long term. By implementing AS/RS, an operation can automate their long-term storage of raw material or product and retrieve what they need when they need it.

By integrating the AS/RS with their Warehouse Execution Software (WES) they can intelligently auto-rotate stock as new product/materials are delivered so that older product is always used first, reducing waste and spoilage (especially when it comes to handling food or pharmaceuticals).

2. Managing Buffer Storage

In a typical warehouse or factory, different processes take different amounts of time to complete. If these discrepancies are not properly managed, then all it takes is a poorly-timed machine breakdown in one stage of production to bring an entire operation to a standstill.

Buffering aims to prevent such a breakdown by ensuring that enough supplies/product are always on hand in different stages to keep an operation running. But while buffering makes sense, poorly managed it can become a logistical nightmare, requiring miles of conveyor to properly buffer and stage.

AS/RS has the potential to replace these conveyor buffering systems, allowing an operation to efficiently store buffer product and retrieve it as necessary. And, depending on the specifics of the operation, this buffer management can be put in place in multiple areas of an operation's



workflow, whether that is staging product/raw material as it is delivered (“Inbound Receiving Buffer”) or storing inventory exactly where it will be needed along the production line (“Assembly Line Point-of-Use Buffering”).

3. Staging Orders for Shipping

The impact of ecommerce and omni-channel delivery on the order fulfillment process can not be overstated. Customers are now able to shop and place orders around the clock, and they want their product delivered fast and on time. But even if an operation accepts and processes orders 24/7, there are often constraints to shipping windows: Due to worker shifts, for example, or exorbitant night and weekend delivery fees.

To make up for these constraints, an operation can pick and process orders continuously and use an AS/RS to place them in a sort of buffer storage to stage them until the shipping window is open. This saves time and allows an operation to continuously produce, even when orders can not physically leave the facility.

4. Goods-to-Person for Order Picking and Packing

Picking and packing product for orders can be some of the most time-consuming tasks in the order fulfillment process. In fact, the process of walking and manually picking orders can account for more than 50 percent of the time associated with picking. AS/RS offers an alternative to this through the use of Goods-to-Person (G2P) order picking.

In a goods-to-person order picking system, the worker does not physically move from product location to product location to pick an order. Instead, a mini-load AS/RS crane is able to retrieve the necessary stock from storage and delivery it directly to the worker, who operates in a pick/pack station. Once the appropriate amount of product has been picked, the stock is returned to storage and the next item needed for the order is delivered to the worker for picking.

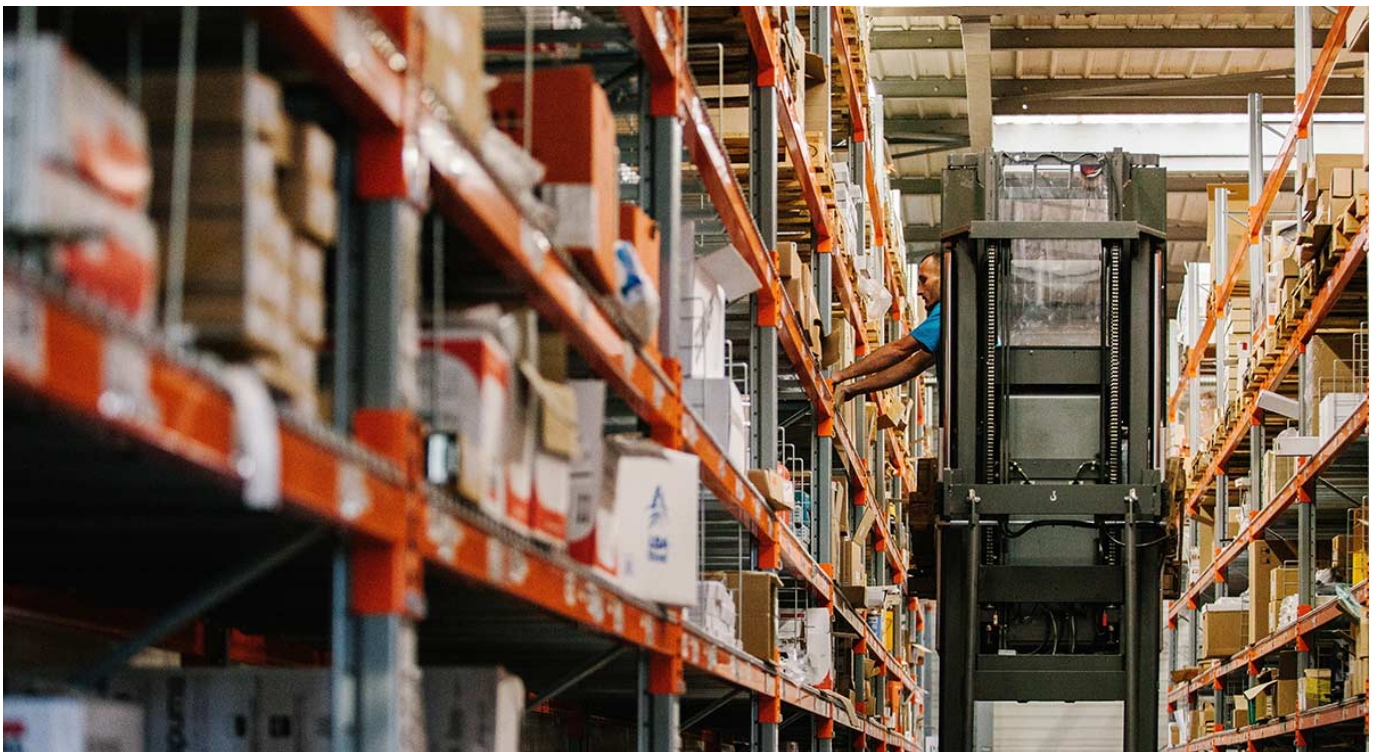
This can be done on a full-case or split-case basis, depending on the operation. In either scenario, the AS/RS can sequence product so that it



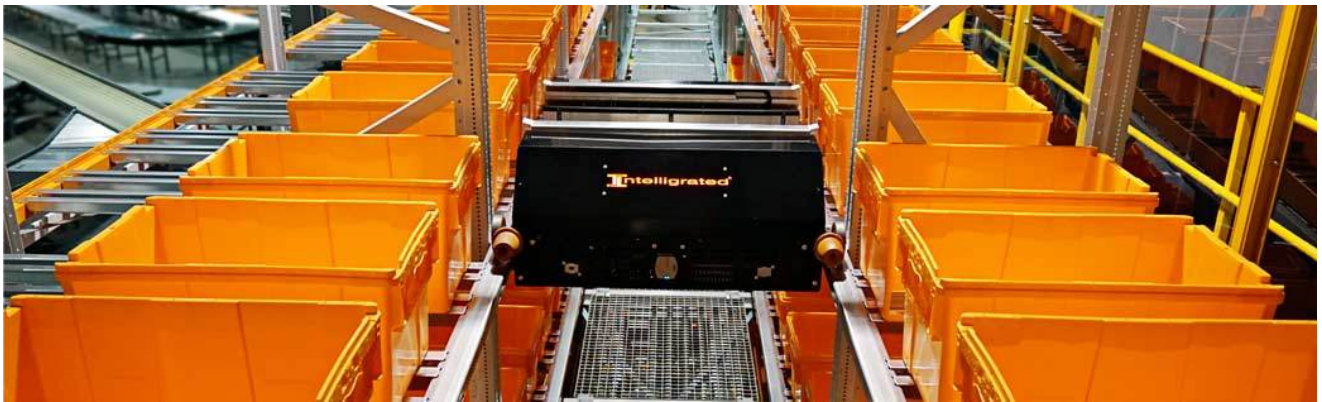
makes the most logistical sense—allowing cases of heavy product to be placed on the bottom of a pallet, for example, or organizing product so that similar products are together.

Beyond Storage

Though originally conceived as a means of providing efficient, compact, long-term storage of goods and product, automated storage and retrieval systems have the potential to touch many different systems within your operation: from providing long-term storage of raw materials or product to providing shorter-term buffer storage, staging orders prior to shipping, and enabling goods-to-person picking solutions.



5 Cost Factors For Automated Storage and Retrieval Systems (AS/RS)



Automated storage and retrieval systems (AS/RS) are a bucket of technologies that have tremendous potential to positively impact the bottom line of order fulfillment operations in a wide variety of industries. But despite the many advantages of AS/RS, it is important to note that embracing AS/RS can be a costly endeavor. Implementing AS/RS is a big investment, but one that offers tremendous ROI by increasing the efficiency of your order fulfillment operation.

Because cost is such a major consideration for a major purchase such as this, it's important for you to know some of the major factors that could potentially impact the final cost of your new storage and retrieval system.

The **cost of AS/RS** can vary widely from operation to operation and from industry to industry—the devil is in the details, after all. That being said, to help you determine where on the cost spectrum your new system is going to fall, here are five factors that can impact the cost of AS/RS:



- Available clear height in your facility
- Type of environment where it will be implemented
- The size (and quality) of the load to be handled
- The delivery and takeaway systems in place to feed the AS/RS system
- Your "type" of facility: Whether steel-frame or rack-supported

1. Available Clear Height

The available clear height in your facility has the potential to dramatically impact the cost of implementing AS/RS. This is primarily due to the fact that the higher you are able to build your system, the less expensive each additional vertical foot becomes. On a per-location basis, this means that shorter AS/RS systems will cost more than taller systems.

Why? Because the costliest component of any AS/RS is the the moving parts—the retrieval/storage component. This means that adding more storage vertically is less expensive than adding additional aisles of AS/RS. The more clear height your operation has for AS/RS, the better it will be for your budget.

It is also worth noting that vertical space is, for many operations, wasted space. Reclaiming some of this space and putting it to use through AS/RS allows your operation to become more productive and efficient while using less actual floor space—a win for operations.

2. Environment

The type of environment that your AS/RS will be expected to operate in can impact the final cost of the system—or even preclude it as an option for your operation. AS/RS operating in warehouses or distribution centers with a moderate, ambient temperature are typically on the lower end of the cost spectrum, while those operating in coolers or freezers are typically on the higher end of the cost spectrum.



This difference in cost is due to the material and installation costs associated with building an AS/RS that can withstand colder temperatures. AS/RS technology may be suitable for many hazardous environments (dusty, chemical, explosive, etc.) however this will need to be evaluated on a case-by-case basis.

3. Size and Quality of Load

The size of the load that the automated storage and retrieval system is expected to handle can have a major impact on the cost of the system, because the size of the load will determine what type of AS/RS you implement. Unit Load (i.e. pallet, gaylord, drums, large totes, etc.) AS/RS typically being more expensive to implement than mini-load or shuttle system (i.e. cases, totes, etc.) AS/RS.

This difference in cost is due to the fact that Unit Load AS/RS handles much larger quantities of product and therefore more weight. The need to move heavier product necessitates more heavy-duty machinery and a larger system overall, which drives up cost.

Additionally, because of predictably poor quality pallets, a Unit Load ASRS will often require the application of a captive “slave-board” for each pallet in the system. In other words, each pallet is automatically placed on a slave-board, which ensures a reliable handling surface irrespective of the quality of the actual pallet itself. The need for the boards and the board handling subsystem will add to the cost of implementing AS/RS.

Mini-load or shuttle AS/RS, conversely, handles smaller quantities of product at a time—cases and totes—which allows for the use of lighter duty machinery that is typically less expensive to implement. Although seldom the case, the quality and actual size range of the cases/totes itself may require special handling techniques and could add to the system cost.



4. Delivery and Takeaway System

The method with which you plan for product to be delivered to and taken away from the automated storage and retrieval system will have an impact on the overall cost of your project, though it will be an indirect cost.

Generally speaking, delivering product by hand truck or forklift will require little in terms of upfront investment, while implementing a conveyor, shuttle car, or AGV system will require more of an upfront investment to put in place.

5. Steel-framed vs. Rack-Supported Buildings

If you are considering implementing AS/RS as a part of a new warehouse or distribution center project, it is important to note that the type of building you already have or choose to construct can have a tremendous impact on the final cost of your system. For example, choosing to construct a rack-supported building (up to 120' tall) opposed to a more traditional and larger footprint steel-framed building (40' tall) may offer significant capital savings.

This is because, from the perspective of storage, a rack-supported building offers much more total storage space per square foot compared to a steel-framed (i.e. lower height) building. A steel-framed building's rack system layout is to some extent dictated by the many roof-support columns needed throughout the building (and the dead space these supports create).

Alternatively, a rack-supported building paired with AS/RS can use more of the available footprint more efficiently by eliminating dead space via its integrated roof supports (which allows more freedom in the rack system design), thereby allowing for more storage in less physical space.



The Bottom Line on ROI

Budgeting for any large project is always easier when you know what factors may impact the final cost. When it comes to implementing AS/RS in your order fulfillment or distribution center, everything from the height of the system, to the environment it must operate in, to the size and type of the load, and more will have an impact on the final cost of your new system.

It is important to keep in mind, however, that these factors speak only to the required investment of upfront capital, and don't take into account the potential for productivity improvements, inventory control/accuracy gains and other operational and maintenance savings that AS/RS technologies may bring to the table. Whether seeking to optimize an existing facility or designing a brand new one, AS/RS should be seen as just a single piece of the warehouse automation puzzle.



6 Types of AS/RS to Increase Efficiency in Your Warehouse



Automated storage and retrieval (AS/RS) has been having a bit of a moment the last few years as its adoption has become more widespread in warehouses and order fulfillment operations. This is a trend that will only continue and strengthen going forward. But what exactly is AS/RS, how does it work, and what types of AS/RS technologies are available to help you make your operation more efficient?

AS/RS brings with it a number of advantages that help you make your warehouse or order fulfillment operation more efficient, but perhaps the largest is the fact that it allows you to more smartly allocate personnel to higher-value tasks. By automating labor-intensive and repetitive tasks—such as product retrieval and replenishing, for example—with an AS/RS, those labor hours can now be reallocated to other important areas of your business.



Types of AS/RS Technology

Automated storage and retrieval systems come in two main varieties:

Unit-Load AS/RS and Mini-Load AS/RS. Some of the most popular types of AS/RS technologies include:

- Fixed-Aisle Unit-Load AS/RS Cranes
- Movable-Aisle Unit-Load AS/RS
- Cranes Mini-Load AS/RS Crane
- Mini-Load AS/RS Shuttle
- Carousel-based AS/RS
- Vertical Lift Module (VLM)

We explore each type of technology in more detail below.

Unit-Load AS/RS

Unit-load automated storage and retrieval systems typically handle larger loads of goods and material (including weights measuring in thousands of pounds). Often, this means that the AS/RS tech is handling and moving full or partial pallets or cases.

Unit-load AS/RS is a great option when pallet-level storage is limited and quick retrieval is critical.

Unit-load AS/RS can come in many forms, including:



- **Fixed-Aisle Unit-Load AS/RS Cranes:** In fixed-aisle unit-load AS/RS systems, pallet racks are arranged with narrow aisles between them. A crane travels between these aisles moving both vertically and horizontally to retrieve and store product. The crane is fixed to a single aisle of pallets.
- **Movable-Aisle Unit-Load AS/RS Cranes:** This type of AS/RS, consisting of a crane moving between narrow aisles of pallets, functions in much the same way as fixed-aisle AS/RS. The key difference is that it is not fixed to a specific aisle and can service multiple aisles.

Mini-Load AS/RS

Compared to unit-load AS/RS, **mini-load AS/RS** typically handles smaller loads of product. Instead of full pallets, this often translates into a mini-load AS/RS handling totes, trays, or cartons. These systems are sometimes also called “case-handling” or “tote-stacking” systems.

Mini-load AS/RS is especially well suited for operations that require storage locations for a large amount of SKUs but which lack the floor space required for traditional carton-flow shelving to provide a pick face for each SKU. Mini-load AS/RS systems can also be used to buffer and efficiently release/sequence product to picking or palletizing stations, and can be used to automatically replenish pick locations like carton-flow.

Like Unit-Load AS/RS, Mini-Load AS/RS can come in many forms, including:

- **Mini-Load AS/RS Crane:** The mini-load AS/RS crane operates in the same basic way as unit-load AS/RS cranes, with a crane operating between narrow rows of goods. Instead of pallets, this system moves totes, cartons, or trays.
- **Mini-Load AS/RS Shuttle:** Mini-load AS/RS Shuttles deliver product via a shuttle that runs on a track in between a racking structure. They can operate on a single level or multiple levels depending on the needs of the operation and can be battery- or capacitor-powered. When an item is requested, the shuttle drives to the location of the product and retrieves its tote/carton. It will then take the



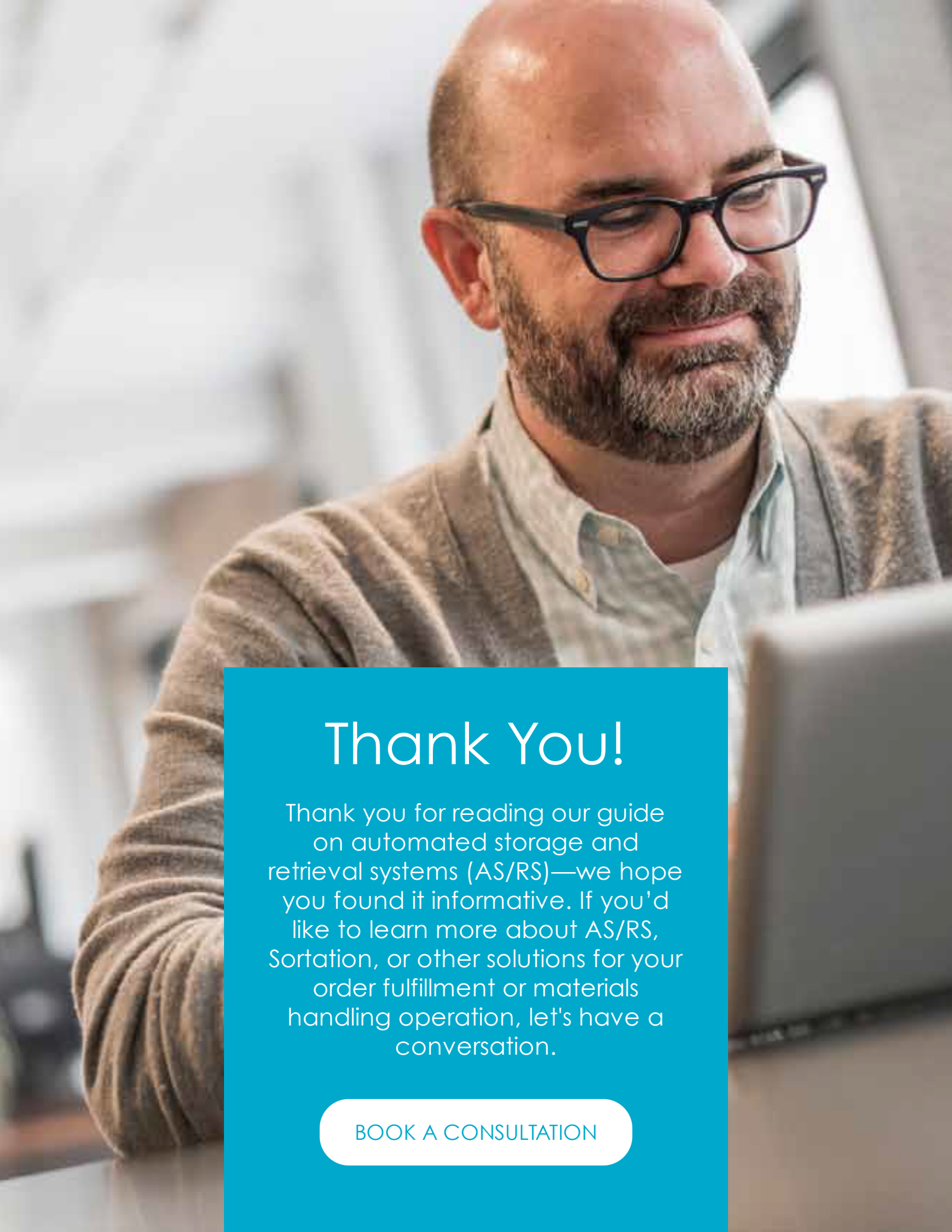
tote/carton directly to a workstation or transfer it to a conveyor to convey the tote/carton to a workstation.

- **Carousel-based AS/RS:** In this kind of AS/RS, totes or cartons are stored and retrieved from horizontal or vertical sorters by a device called an inserter extractor. The system operates by spinning into position until the bin containing the shelf where the product is to be stored or retrieved from is in position with the inserter extractor.
- **Vertical Lift Module (VLM):** Vertical Lift Modules are enclosed systems with an inserter extractor in the center and a column of trays on either side. The inserter extractor locates the necessary tray and delivers it to an operator, who completes an order before the tray is returned.

Multiple Types to Fit Your Needs

By incorporating one or a number of the automated storage and retrieval systems (AS/RS) discussed above into your warehouse or order fulfillment operation, you can achieve a significant boost in efficiency, cost-savings, and productivity. Which technology ultimately makes the most sense for you to include in your operation depends on a number of factors including rate, your typical order, the type of product that you handle, and more.



A man with a beard and glasses is looking at a laptop screen. He is wearing a brown sweater over a light blue shirt. The background is blurred, showing what appears to be an office or warehouse setting.

Thank You!

Thank you for reading our guide on automated storage and retrieval systems (AS/RS)—we hope you found it informative. If you'd like to learn more about AS/RS, Sortation, or other solutions for your order fulfillment or materials handling operation, let's have a conversation.

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