The Supply Chain Pros Guide to Warehouse Automation

CONVEYCO | Integrated Solutions & Software

CONVEYCO | Integrated Solutions & Software

Table of Contents

Introduction	**03**
The Business Case for Automation	**04-13**
How Automation Can Fit Into Your Warehouse	**14-56**
Trends in Automation	**57-64**
Preparing for Your Warehouse Automation	**65-77**
Protecting Your Investment	**78-80**
Conclusion	**81**

Introduction

If you work in the order fulfillment or materials handling industries, you know that automation is no longer a question of “if” but “when.” Over the past few decades, warehouse automation technologies, systems, and strategies have exploded, all promising to make your operation more competitive, less wasteful, and to drive profitability. Supply Chain Management Review has gone so far as to say that, “Warehouse automation is one of the last areas where long term costs can be significantly reduced.” And with good reason - as a firm evolves and grows, operational improvements can boost efficiency, increase profits, and help meet customers growing demands for faster delivery. But even if those types of promises are bold and warrant further investigation, with all hype and excitement about automation you may be wondering: if it is truly the right path for you and your operation?



WE’VE PULLED TOGETHER THIS GUIDE TO HELP YOU BETTER UNDERSTAND HOW AUTOMATION CAN IMPACT YOUR OPERATION AND FACILITIES.

PART ONE

The Business Case For Automation

If you are considering automation for your warehouse or distribution center but are unsure if the investment is worth it, it is best to first evaluate the most common outcomes. This will help you determine whether automation can improve key areas of your operation.

The four main benefits of warehouse automation are:

- **Reduced labor costs,**
- **increased operational efficiency,**
- **increased workplace safety, and**
- **better labor availability management.**

The secret to achieving these benefits? Identify repetitive tasks and unnecessary movements of resources or inventory, then find ways to eliminate or optimize them with automation.



The Business Case For Automation



REDUCED COSTS

Warehouses and distribution centers handle a high volume of repetitive tasks, time sensitive tasks often hundreds or even thousands of times a day. By integrating the right combination of automation and software, operations can reduce the strain on their workforce, improve throughput, and achieve measurable cost savings.

This approach is especially valuable in today's labor market, where staffing has become one of the most pressing challenges. Many facilities struggle to recruit and retain workers for physically demanding or monotonous roles. High turnover rates, burnout, and unfilled positions can disrupt operations and increase costs associated with training, overtime, and temporary staffing.

Automation doesn't replace people. It helps organizations reallocate human effort to more meaningful, engaging, and strategic tasks. While there is a significant upfront investment, automation can reduce the long-term expenses that come with high labor turnover and the ongoing need to hire and train new staff. It also helps minimize the operational impact of labor shortages, absenteeism, and inconsistent scheduling.

The Business Case For Automation



The costs tied to human labor such as:

- **Healthcare**
- **Vacation Time**
- **Retirement Plans**
- **And Rising Wages**



These are not just numbers on a balance sheet; they reflect the value of real people who deserve fair compensation. However, when these costs are paired with staffing instability and growing demand, they can become unsustainable without operational support. Automation helps create a more balanced, reliable system that supports both financial health and workforce well being.

A great example is the use of automated or semi-automated sortation systems. These systems reduce the need for manual labor in repetitive sortation tasks, allowing teams to focus on more complex problem solving, quality control, and supervisory roles. This ultimately drives greater value across the operation.



The Business Case For Automation

Consider the inefficiency of using a traditional forklift equipment for discreet case picking from storage racks. By implementing a batch-picking system with a conveyor, you can process multiple SKUs at once, which greatly increases the rate at which items are picked, often by a factor of four or five. In item-picking systems, where goods are stored in a sea of shelving, the picking process can account for over half of warehouse labor. By creating batch totes, operators can pick up items for multiple orders simultaneously, dramatically improving efficiency.





Instead of focusing on individual orders, work can be grouped by zones, and items can be sorted out at a central unit sorter, decreasing the need for manual labor while increasing throughput.

Automating key areas of warehouse operations not only reduces the strain on human resources but also enhances overall productivity. Once the initial investment is recouped, the ongoing benefits of automation deliver a direct boost to the bottom line, making it an essential strategy for businesses looking to remain competitive in an ever-changing market.

The Business Case For Automation



INCREASED EFFICIENCY

Automating your warehouse can impact your bottom line in more ways than just controlling labor costs. One of the most powerful benefits of automation is the ability to enhance operational efficiency. Something that human workers, despite their best efforts, often struggle to match.

Humans make mistakes, it is inevitable. When workers are responsible for complex tasks across various stages of order fulfilment, errors are bound to happen.

Products may get damaged, orders can be mixed up, or customers may receive incomplete or incorrect items. These mistakes result in lost time and money, as well as frustrated customers who may turn to competitors for a better experience.



By automating these processes, you eliminate much of the potential for error, reducing waste and improving overall output.

The Business Case For Automation

Automated systems are designed to work with precision and consistency, increasing the accuracy of your operations and ultimately making your warehouse more productive. This improvement in efficiency can have a major impact on key performance indicators (KPIs), which could lead to substantial long term benefits.





For example, by reducing your total order cycle time through automation, you can fulfill customer orders more quickly, keeping them satisfied and encouraging repeat business. Similarly, increasing your perfect order percentage by just 3 percent – thanks to the improved accuracy of automated sortation systems – can result in a 1 percent increase in profit margin. While it might seem like a small improvement, the impact on profitability is notable.

The Business Case For Automation

INCREASED WORKPLACE SAFETY

Humans are prone to mistakes and this doesn't just lead to product damage or order errors; it can also compromise workplace safety. Fatigue, distraction, and simple lapses in attention can result in accidents that not only damage goods but also puts workers at risk.

Workers may miss an obstacle until it is too late, colliding with equipment or structures. The consequence can be costly; damaged products that are no longer sellable, expensive equipment repairs, or structural damage. In the worst case scenario, accidents can lead to OSHA-reportable injuries or even fatalities.

These accidents also indirectly drive up operational costs through increased insurance premiums, potential OSHA fines (which can exceed $12,000), and time lost to injury recovery or facility repairs.



The Business Case For Automation

By removing the human element from dangerous tasks, automation significantly improves safety. Automated systems will reduce the likelihood of accidents by keeping workers away from hazardous situations, such as operating heavy machinery in high risk environments.



A prime example of this is the use of Automated Guided Vehicles (AGVs) in fulfillment and distribution centers. While still relatively new in many industries, AGVs are already making a difference in areas like e-commerce. These vehicles handle tasks that are potentially dangerous for workers, such as transporting hazardous materials, working in extreme temperatures, or moving heavy loads. AGVs are designed to operate smoothly with controlled acceleration and deceleration, and their speeds are carefully monitored. This is in stark contrast to manual forklift operators, who may drive at high speeds, creating safety risks for themselves and others in the facilities. The result is an overall safer workplace, reduced damage, and once again, lower costs.

The Business Case For Automation

LABOR AVAILABILITY CONCERNS

When discussing labor issues, rising or unsustainable costs and workplace safety are often the primary concern driving companies towards automation. However, automation also addresses another critical challenge: the undeniable shortage of skilled workers.

If you're unable to find necessary workforce to meet your operational needs, scaling your business becomes quite difficult. Moreover, a shortage of qualified workers often leads to higher wages as employees seek better paying opportunities.

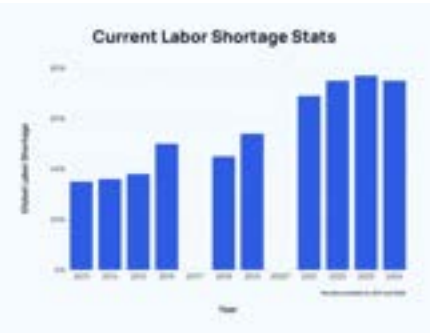


Labor shortages are typically influenced by factors like geography and demographic trends, which are often beyond your control.

Unless you're willing to relocate to an area with a larger labor pool, your options for maintaining a competitive and growing operation are limited. Automation provides an effective solution.

The Business Case For Automation

Automated systems excel at handling repetitive tasks like mentioned before, such as picking, sorting and packing. By offloading repeatable time-consuming tasks to machines, you can reallocate your personnel to more valuable tasks that require human expertise. This shift not only improves the overall efficiency of your operation but also provides your employees the chance to develop new skills, making them more competitive in the workforce.





Additionally, in competitive job markets, automation can improve your work environment and attract job candidates. Just as climate controlled warehouses attract workers in warmer regions, the automation of physical, repetitive tasks can make your facility more appealing by offering a less physically demanding and more pleasant work experience.

PART TWO

Where Automation Can Fit Into Your Operation

Automation can optimize and virtually touch nearly every repetitive, error prone, or time consuming task in your warehouse, from the moment inventory arrives to when it ships out as part of an order. This boosts efficiency and helps address labor concerns without compromising on growth potential.

WAREHOUSE AND INVENTORY MANAGMENT

Warehouse Execution System (WES)

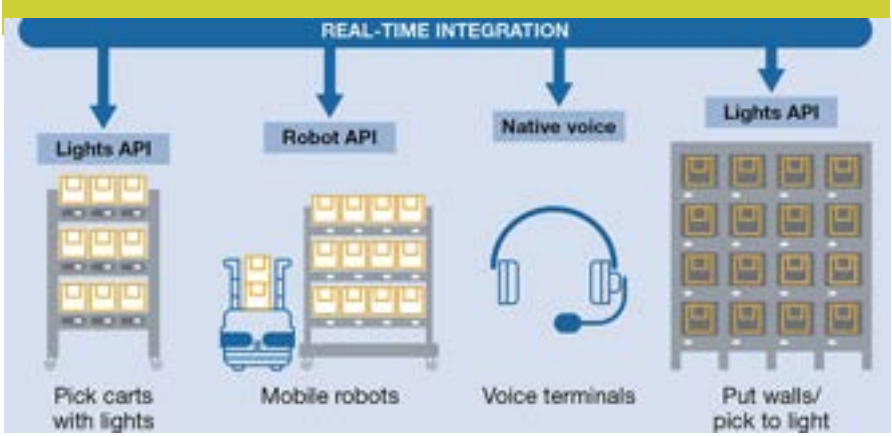
Managing an operation that processes thousands of orders daily requires more than manual oversight. Between inventory management, automated processes, and order flow, a robust Warehouse Execution System (WES) is essential for smooth operation.



Where Automation Can Fit Into Your Operation

A WES acts as the nervous system of your warehouse, coordinating the movement and placement of inventory and efficiently directing work across various functional areas. Depending on your needs a WES can:

- Dynamically **track and manage** inventory through the warehouse, including **storage, replenishment, and picking**.
- Optimize the fulfilment process using **wave and batch picking strategies.**
- Minimize **dimensional weight changes** through efficient cartonization management.
- Oversee automated systems like **AS/RS, tote and pallet shuttles, automated packaging, carousels, pick zone routing, and sortation.**
- Manage the entire shipping process, including **parcel manifesting, order consolidation, palletization, and wave management.**



Where Automation Can Fit Into Your Operation



Whether you are breaking down a delivery after it has arrived in your warehouse or simply moving product from location to location within your facility, automation has the potential to dramatically increase your operation's productivity.

Automation can greatly enhance productivity in product handling, from receiving deliveries to moving items within your warehouse.

Conveyor systems are among the most effective automated solutions for moving products efficiently across your facility.

It is crucial to choose the right conveyor type based on your available space and types of products you handle. We will go over some common conveyor systems and their applications in the next few pages.



Where Automation Can Fit Into Your Operation

Accumulation Conveyor

- **The accumulation conveyor is an integral part of most modern distribution systems.**
- **Accumulation conveyors buffer work between processes, allowing for continuous picking even when dock workers are backed up.**
- **This system is ideal for merging multiple conveyors, buffering products between order selection and assembly, and smoothing irregularities in the workflow.**
- **For delicate or lightweight products, it is essential to control speeds, release modes, and alignment to avoid damage.**
- **Types of accumulation conveyors, such as minimal pressure, zero pressure, and non-contact accumulation and release modes like singulation, slug, and auto-slug help address these needs for such products.**



Where Automation Can Fit Into Your Operation

Case Conveyor

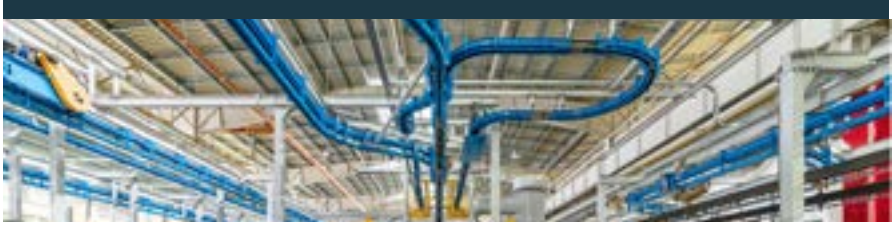
- **Case conveyors are a critical component of any operation that handles cases or cartons. It allows for the movement of cases from location to location within a facility.**
- **In addition to aiding in receiving, case conveyors play a large role in case sortation, which we discuss below and which can impact picking, packing, and shipping.**



Where Automation Can Fit Into Your Operation

Overhead Trolley Conveyor

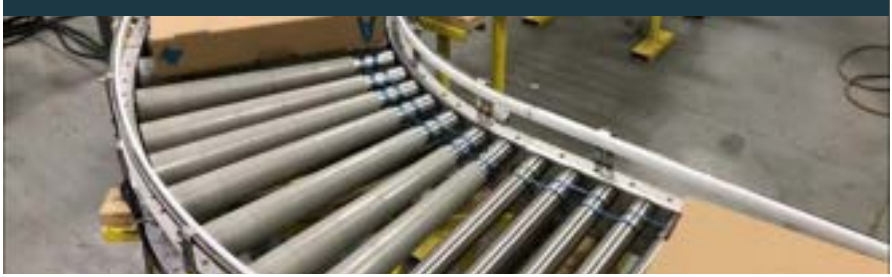
- **Overhead trolley conveyors are versatile systems that use a chain to move materials via secondary fixtures or trolleys in an enclosed track.**
- **These systems are installed in a closed loop configuration and can be powered by one drive depending upon the total chain pull and loading on the system.**
- **Multiple drives can support longer loops and the drives are synchronized to work in tandem.**
- **There are multiple styles of powered and non-powered overhead trolley conveyor systems that are tailored towards certain industries and applications. Some examples of this include:**
  - **Delivery of empty corrugated cartons or totes for picking and packing**
  - **Takeaway of trash from picking areas and transport to balers or compactors**
  - **Handling of garments on hanger (GOH)**
  - **Sortation of garment on hanger trolleys**
  - **Sortation of individual garments on hanger**
  - **Hanging of goods through paint line applications**
  - **Handling of heavy parts through manufacturing operations**



Where Automation Can Fit Into Your Operation

24V Motorized Driven Roller (MDR Conveyor)

- **The 24V Motorized Driven Roller uses independently powered rollers driven by 24V motors in each zone. Utilizing a 24V – Motorized Driven Roller allows for a number of benefits, including:**
  - **Energy savings, since the roller runs on demand**
  - **Decreased noise pollution, because there are no chains or sprockets**
  - **Creative applications for operations with small footprints**
  - **Increased workplace safety**
- **It is ideal for applications like sorting, merging, product separation, and routing transfers in areas with limited space.**
- **The rollers can even be belted to allow for inclines, declines, and the handling of bags or envelopes.**



Where Automation Can Fit Into Your Operation

Trash Conveyor (Empty Corrugated Conveyor - ECC)

- **Trash conveyors are essential for removing waste, like corrugated materials, generated during the receiving and picking processes.**
- **These conveyors transport refuse to areas for disposal, such as bailers or compactors.**
- **Merging multiple lines into one can help efficiently manage waste removal while preventing jams, especially when increasing conveyor width at transfer points.**



EACH OF THESE CONVEYOR SYSTEMS PLAY AN IMPORTANT ROLE IN IMPROVING THE EFFICIENCY OF PRODUCT HANDLING AND ORDER FULFILMENT, REDUCING MANUAL LABOR AND ENSURING SMOOTHER WORKFLOWS ACROSS YOUR FACILITY.

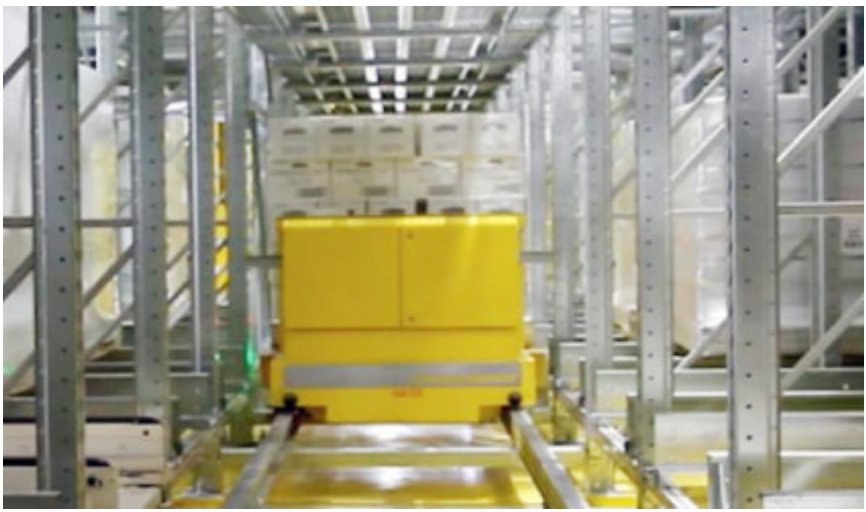
Where Automation Can Fit Into Your Operation

PALLET HANDLING SYSTEMS

Pallet Handling Systems have the potential to greatly increase the efficiency of a warehouse by automating functions that usually require dedicated forklift operators.

Just as with case conveyors, the success of a pallet handling system is dependent upon selecting the right system for the needs of your operation.

We will go over some common pallet handling systems and their applications in the next few pages.



Where Automation Can Fit Into Your Operation

Chain Driven Live Roller (CDLR)

- **Chain Driven Live Rollers are designed to handle pallets, slave boards or drums, CDLR is designed with heavy duty structural side frames to enable it to handle an operation required capacity.**
- **The output of the motors drive shaft delivers power to rollers at the conveyor surface. Power is then transferred to subsequent rollers via a series of chains connecting power from the driven rollers to those rollers that are powered from them.**
- **To accumulate, individual single zone powered sections can be used or longer sections with clutches that engage and disengage drive can be utilized.**



Where Automation Can Fit Into Your Operation

Drag Chain

- **Drag Chain pallet handling systems are a popular solution for when the orientation of a pallet is important.**
- **Multiple strands of chain are used to move pallets along the conveyor surfaces. A single shaft is used to deliver power from the motor to the multiple strands along the surface.**
- **These strands travel within guide tracks to keep the chains captured and vertical through their travel as they convey the pallet through direct physical contact.**



Where Automation Can Fit Into Your Operation

Transfer Cars

- **Transfer cars are used to travel in a linear path and often stop and service multiple stations.**
- **These are typically used in palletizing operations, transfer cars can have multiple load positions on the vehicle, each with its own independently driven powered sections of the conveyor.**
- **One can be used to deposit a new pallet while retrieving a completed load from a palletizing cell.**
- **Single position cars can be used in lower rate applications when needed.**



Where Automation Can Fit Into Your Operation

PALLETIZING SYSTEMS

Palletizing systems allow products to be arranged for storage or transport economically and safely on a pallet instead of by piece or by case. Selecting the right palletizing system depends on both operation requirements and business considerations, including:

- **Up front cost and desired return on investment**
- **Product geometry**
- **Production line rates or orders to be built each day**
- **Simultaneous production lines in operation**
- **Pallet patterns**
- **Speed, efficiency, and accuracy**
- **Ergonomics and safety**



Where Automation Can Fit Into Your Operation

ROBOTIC AND CONVENTIONAL PALLETIZERS

- **Robotic Palletizing System**
  - **Robotic palletizing systems use robotic arms to process either entire layers or individual cases.**
  - **Robotic palletizing systems are arranged in cells where there is a direct correlation between the number of infeed or source lines from production or picking and the number of outbound lanes.**
  - **In many scenarios, sortation systems direct cases to individual palletizing cells where the formation of a unitized load is assigned for a given SKU or order.**

Layer Picking Robots can be used to perform either palletizing or depalletizing of finished goods. Those systems operate in a rectangular area and have a robotic head that travels while attached to a beam that rides on a set of rails along the processing areas. The head can move side to side in order to position itself over the load to be processed. It essentially is a storage and retrieval device which can buffer and store large quantities of product.



Where Automation Can Fit Into Your Operation

- **Conventional Palletizing System**
  - **Conventional palletizing systems utilize a formation table to configure product cartons into rows as they flow into the palletizing area, arranging subsequent rows into a complete pallet layer formation, which is then transitioned onto the pallet.**
  - **After each layer is placed onto the pallet, another layer of cartons is arranged and, depending on the type of system, either the formation table is raised or the pallet is lowered. The new layer is then transitioned onto the pallet.**

Depalletizing functions similarly – conventional or robotic depalletizing systems remove cases or layers of cases. These devices are often used in order fulfillment operations where an entire pallet of a given SKU is not required and cases and layers can be removed and sent to an order build area. As each layer is removed, the cases are aligned and arranged in a single file using a section of the conveyor called a singulator. These cases can then be labeled with an identifying barcode so they can be disseminated to the correct area downstream.



Where Automation Can Fit Into Your Operation

SORTING SYSTEMS

Sortation is the process of identifying items on a conveyor system and diverting them to specific destinations using a variety of devices controlled by task-specific software. Different sorters are better suited for different applications depending upon the product type and the required rate of processing for an operation.
Sorters have the potential to touch nearly every part of the order fulfillment process:

- **Receiving:**
  - **Return Processing: Items can be sorted out for return to stock or putaway.**
  - **Putaway: Allows trailer loads of mixed SKUs to be received and easily broken down so that items can be palletized with one touch prior to being put in reserve storage.**
- **Picking: In split-case picking, sorters route products into the correct picking zones.**
- **Packing : Sorters can consolidate orders, direct split-case orders to the right packing tasks, and handle different shipping container types (e.g., poly bags or cartons).**
- **Shipping: Sorters optimize shipping by organizing order by carrier type or service method**
- **Sorters can also consolidate full and split-case orders onto the same lane for efficient palletization or trailer loading.**

Sorters can be categorized into two main types : Case sorters and Unit sorters

Where Automation Can Fit Into Your Operation

CASE SORTERS

Case sorters work by sorting and transferring whole cases of product from one location to another.

This could be a case containing a single product which is being put away, or it could be a tote or shipping container that is essentially a complete order.

We will go over some common pallet handling systems and their applications in the next few pages.



Where Automation Can Fit Into Your Operation

Narrow Belt Sorter (NBS)

- **NBS uses narrow strip belts to carry products, with varieties like NBS-90 (90 degree divert) and NBS-30 (30 degree divert). NBS-90 is ideal for sorting directly onto shipping containers without manual intervention.**
- **Narrow belt sorters are typically used in operations with mid-rate sortation, as they can handle faster rates than standard pop up sorters.**
- **They can commonly be found in packing areas, where totes and cartons of wide ranges need to be sorted.**



Where Automation Can Fit Into Your Operation

NBS Wave

- **Similar to NBS but with a cascading wave motion that reduces gaps between products, increasing throughout.**
- **Which results in a higher overall throughput in terms of product feet vs. gap or air required on machines that have a higher gap requirement between cartons on the machine.**



Where Automation Can Fit Into Your Operation

Pusher Sorter

- **Pusher sorters use air-actuated cylinders to “push” products off the main conveyor at specific points.**
- **Several pushers can be mounted along a belt conveyor to increase the number of sortation points.**
- **This is an economical option for minimal sortation points, used since the 1950s.**



Where Automation Can Fit Into Your Operation

Paddle Sorter (BAT)

- **Paddle sorters use air-actuated cylinders with a flat face paddle to divert products off the sorter.**
- **The cylinder face extends out at an angle, allowing the sorted item to be gently guided along the angle established.**



Where Automation Can Fit Into Your Operation

Pop-Up Wheel Sorter

- **Pop-up wheel sorters consist of a series of buckets installed along a belt conveyor, with wheels that “pop up” at precise locations to divert the products off the sorter.**
- **The Modular design allows for easy replacement and quick service.**



Where Automation Can Fit Into Your Operation

Sliding Shoe Sorter

- **Sliding shoe sorters are a high accuracy option for sorting products of many different shapes, sizes, and weights. It uses slats with attached shoes to move products diagonally onto divert lanes.**
- **The sliding shoe sorter has the ability to sort products at a high rate without causing any damage to the product, though the rate at which it can sort will depend on the size and weight of the product itself.**
- **The range for the rate may be from 20 products per minute to hundreds of products per minute, depending on the application.**



Where Automation Can Fit Into Your Operation

Bombay Sorter

- **The bombay sorter is used in high-speed operations (commonly found in direct-to-consumer distribution centers) and ideal for small, lightweight items. These items would be too small and light to be handled by a typical conveyor system and can include bagged garments, jewelry, pharmaceuticals, CDs, mail, books and other small parcels.**
- **Items fall through a trapdoor to arrive at its sorted location (hence the name).**
- **The items can be sorted into a chute for further processing or dropped directly into a carton or tote ready to ship to its customer.**



Where Automation Can Fit Into Your Operation

Cross Belt Sorter (Loop Sorter)

- **The cross belt or loop sorter consists of a chain of many transversely oriented short belt conveyors riding on a track that is on a continuous loop. Items are carried on individual belts and when the item is ready to be discharged, the cross belt will be activated and the item will divert to either side of the system.**
- **This configuration makes the cross belt sorter a highly efficient mechanism, requiring minimal space for high-volume item sortation.**
- **This particular sortation can be designed in two different configurations: horizontal sortation, which is circular, and vertical sortation, which is linear.**
- **These conveyors are an appropriate solution for operations that require a higher volume of throughput, a wide range of product shapes and sizes, or have narrow footprints and many different processing stations. (such as grocery, apparel, and ecommerce)**



Where Automation Can Fit Into Your Operation

Tilt Tray Sorter

- **A tilt tray sorter is a versatile (can be used with virtually any type of packaging) specific type of continuous loop sorter which is a highly accurate, high speed method of sortation.**
- **Specific to the tilt tray sorter, each carriage is topped by a tray, commonly made of wood or plastic, which can be individually actuated to tilt to either one or both sides. The item on the tray is then deposited by gravity onto either a chute or a takeaway conveyor.**
- **Items to be sorted can be manually or automatically, regardless of method, the item placed onto the tray is tracked by controls software and is transferred to its correct location. This arrangement allows for sortation of up to 40,000 items per hour.**
- **A tilt tray sorter can be easily reconfigured or expanded with minimal difficulty. This technology has been widely and successfully used in many different industries, including apparel, postal, publishing, and pharmaceutical.**



Where Automation Can Fit Into Your Operation

UNIT SORTERS

Where case sorters handle entire cases of product, unit sorters handle individual items throughout the different stages of order fulfillment, including order selection, packing, and outbound shipping sortation.

Many unit sorters are loop sorters, because their orientation is commonly a closed circular loop.

Three case sorters that can also act as unit sorters are Bombay sorters, cross belt (loop) sorters, and tilt tray sorters.

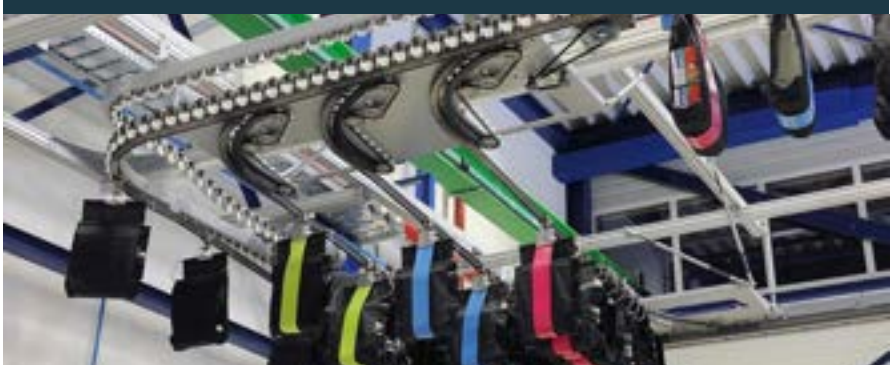


Where Automation Can Fit Into Your Operation

Pouch/Pocket Sorter

The pouch/pocket sorter is another option perfect for unit sortation

- **A pouch or pocket sorter is a type of unit sorter that adds storage and retrieval functionality.**
- **These sorters work by handling a batch of units that has been picked, products are placed in individual bags (or pouches) that are stored in a buffer until enough units are gathered for a complete order.**
- **The system retrieves and sorts these units into orders for packing stations.**



Where Automation Can Fit Into Your Operation

PICKING

Picking is often the backbone of any order fulfillment operation. As such, automation has a lot of potential to offer in making the process more efficient, allowing workers to pick more orders in less time.

Picking can be broadly split into two categories: **Split case order picking and full case order picking.**

Split Case Order Picking

Split case order picking can go by several different names, such as “each picking," "piece picking,” or “break case picking.” But whatever you call split case order picking always involves the selection of individual units for packing into a carton or a tote. Though this can be done manually, there are many different technologies that can be used to drive efficiency and accuracy.

Full Case Order Picking

Full case order picking, on the other hand, involves selecting and shipping entire cases of a product rather than individual units. This method is typically used when customers or retailers order products in bulk, making it common in wholesale distribution, retail replenishment, and manufacturing supply chains.

Unlike split case order picking, which requires picking and sorting individual items, full case order picking is generally more efficient because it involves fewer touches per order. It can be performed manually using pallet jacks or forklifts, but automated systems like conveyor belts, robotic palletizers, and automated storage and retrieval systems (AS/RS) can further improve speed and accuracy.

Where Automation Can Fit Into Your Operation

PICK TO LIGHT

Pick to light (PTL) systems use lighted displays at SKU locations in a picking area, often organized into zones with dedicated pickers per zone. The picker scans the order ID to start work, then follows digital displays that show the quantity of items picked. The picker follows the digital displays and places the correct items in the correct quantity into the correct container. The picker is required to depress a button on the Pick to Light display which confirms the pick for each container. The system records what is picked into each container and by which operator.

This information is used in accountability reporting by operators to ensure they are maintaining proper productivity and accuracy standards. PTL is ideal for selecting discrete orders from 1-4 containers at a time, especially in environments with 500-5,000 SKUs, but can work for up to 25,000 locations. It's best suited for picking random SKUs in locations like racks or carton flow racks. For batch picking, the items can be sorted later using Put to Light.



Where Automation Can Fit Into Your Operation

PUT TO LIGHT

Put to Light is used when orders typically include at least one unit of each SKU. Orders are placed on tilted shelving, which can be 1–3 levels high, with one order in each location. The SKU ID label is scanned, and the displays under the order indicate the number of units of each scanned SKU that is required for the order. The "Put" operator confirms placement by pressing a button to ensure he placed the right number of units of that SKU in the right order.

This system is highly productive for omni-channel retail environments, especially when pre-allocated inventory is pushed to the customer. It can also break down batch totes into individual orders at separate put cells, improving order cycle times.



Where Automation Can Fit Into Your Operation





Pick to Voice/ Put to Voice
Pick to Voice and Put to Voice systems use voice instructions to guide pickers, who confirm actions by speaking into a headset. This hands-free approach allows pickers to keep their eyes up and move efficiently between tasks. It can work independently or with other technologies, such as Pick to Light, to capture additional data like lot codes or serial numbers.



Radio Frequency (RF) Systems
Radio frequency systems integrate with hand or ring scanners to verify locations and SKUs in real-time. They are highly flexible and accurate, capturing information like lot codes, expiration dates, and other essential details for each pick, ensuring 100% order accuracy.

Where Automation Can Fit Into Your Operation



Goods-to-person (G2P)
G2P systems automate the delivery of SKUs to a stationary pick station for order fulfillment. These systems are highly efficient, requiring less space than traditional methods, and can reduce labor by more than two-thirds. G2P is ideal for split-case order fulfillment and can handle a wide range of volumes, especially small to medium sized products. It is most effective when product type and order profiles are carefully considered.



Horizontal Carousel
Horizontal carousel systems are one of the earliest G2P technologies. They consist of bins that move along a track, storing goods on multiple shelves. A light bar guides pickers to the right shelf for each order. The carousel spins into position to deliver the required items, which are then staged for order fulfillment.

Where Automation Can Fit Into Your Operation





Carousel-based AS/RS
Carousel based Automated Storage and Retrieval systems use horizontal carousels to store and retrieve totes or cartons. The inserter-extractor moves vertically along the carousel to pick or store products, efficiently managing inventory and reducing labor costs.

These systems, from PTL to carousel-based AS/RS, improve efficiency, reduce labor, and ensure accurate, rapid order fulfillment, making them crucial in modern automated warehouses.

Automated Storage and Retrieval Systems
Automated Storage and Retrieval Systems streamline warehouse operations by automating the movement of products to and from storage. By eliminating the need for manual retrieval, AS/RS significantly enhances efficiency, reduces labor costs, and speeds up order fulfillment. These systems are used in both split-case and full-case order fulfillment, making them ideal for a variety of distribution and manufacturing environments.

Where Automation Can Fit Into Your Operation

AS/RS shuttles are high-speed, automated systems that transport products within a racking structure using shuttles that run on dedicated tracks. They are designed to handle split-case and full-case order fulfillment. As well as order buffering and sequencing.

Shuttle systems are highly flexible and scalable, operating on single or multiple levels. They can be powered by batteries, capacitors, or power rails that supply energy as the shuttle moves. When an item is requested, the shuttle retrieves the tote or carton from its designated storage location and either delivers it directly to a workstation or transfers it onto a conveyor for further processing.



To increase throughput, additional shuttles can be added, or storage capacity can be expanded by lengthening or adding aisles. Shuttles are designed for high density storage and can accommodate a wide range of product sizes, maximizing space efficiency.

Where Automation Can Fit Into Your Operation

Shuttle configurations vary based on operational needs:

- **Single-Level Shuttles**: Each shuttle is assigned to a specific storage level.
- **Multi-Level Shuttles**: A single shuttle services multiple storage levels using an onboard mechanical lift to store or retrieve totes and cartons.
- **Roaming shuttles**: Shuttles that travel between levels via lifts to optimize efficiency in lower-rate operations.

To increase throughput, additional shuttles can be added, or storage capacity can be expanded by lengthening or adding aisles. Shuttles are designed for high density storage and can accommodate a wide range of product sizes, maximizing space efficiency.



Where Automation Can Fit Into Your Operation

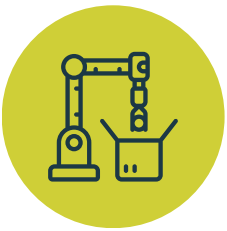
Mini load AS/RS is one of the most effective solutions for high-density, cased sized storage and order picking. This system utilizes a high-speed automated crane that moves along narrow aisles of tall racks, retrieving and storing totes or cases as needed.

Mini load AS/RS systems typically feature aisles between 20 and 60 feet high and 50 to 250 feet long, with the ability to operate in a single aisle or across multiple aisles depending on storage needs and facility size. The systems can achieve retrieval rates of up to 100 cases per hour per aisle, though actual rates vary based on the specific application.



This solution is particularly beneficial for operations that manage many SKUs but lack the floor space required for traditional carton-flow shelving. Mini load AS/RS is also ideal for buffering and sequencing orders, automatically replenishing pick locations, and optimizing product flow to picking and palletizing systems.

Where Automation Can Fit Into Your Operation



Packing is a critical step in the order fulfillment process, impacting costs, environmental sustainability, and customer experience. Since packaging is the final interaction a business has with a customer's order, poor packaging can lead to increased freight, labor, and inventory costs, as well as damaged products, lost customers, and tarnished reputation.

To improve efficiency and reduce costs, many businesses are adopting automated packaging and shipping systems, particularly in response to dimensional weight pricing imposed by small parcel carriers.

Understanding Dimensional Weight

Dimensional weight pricing considers both the size and actual weight of a package when determining shipping costs. It is calculated by multiplying a package's length, width, and height, then dividing the total by a dimensional factor (a fixed number set by the carrier). The greater of the dimensional weight or actual weight is used to determine the shipping rate.

By optimizing packaging – choosing the right sized containers, minimizing void fill, and using automation – businesses can reduce shipping costs while improving sustainability and efficiency.

Where Automation Can Fit Into Your Operation



CARTONIZATION

Cartonization is an automated process that determines the optimal container size, quality, and type for packaging an order. By analyzing product dimensions and attributes, cartonization groups items intelligently into the most efficient shipping configuration.

Key factors considered in cartonization include:

- **Product Characteristics:** The size, width and fragility of an item influence packaging decisions.
- **Packaging Material Costs:** Choosing cost-effective yet productive materials optimize expenses.
- **Labor Costs:** Efficient packing reduces manual labor and speeds up fulfillment.

Cartonization enhances packaging efficiency by focusing on:

- **Cube & Orientation**: By analyzing product dimensions and adjusting orientation, the system reduces packaging size, minimizes dunnage, and optimizes space.
- **Product Attributes:** Items are packed based on characteristics such as fragility, leakage risk, or compressibility to ensure proper handling.

Where Automation Can Fit Into Your Operation

- **Durable Goods** are sent to automatic bagging stations for quick, low cost packaging.
- **Leak-prone products** are routed to specialized stations for cap-securing and containment bags.
- **Fragile items** are directed to packing stations that use specific dunnage to prevent damage.
- **Special Handling Requirements:** Orders requiring gift wrapping, additional inspections, or customer-specific inserts are flagged for specialized processing.

Additionally, cartonization can be configured to select the least expensive container based on material and labor costs, ensuring cost-effective and environmentally friendly shipping.

By integrating cartonization with warehouse execution systems (WES), Businesses can streamline fulfillment, reduce costs, and improve order accuracy, all while enhancing sustainability and customer satisfaction.



Where Automation Can Fit Into Your Operation



AUTOMATED SHIPPING SYSTEMS

An automated shipping system streamlines the shipping process by reducing or eliminating manual tasks, replacing up to 15-20 manual checking and manifesting stations. This automation improves efficiency, reduces labor costs and minimizes shipping errors.

The process typically consists of several key stages :

Weigh-In-Motion Scale (WIM) & Dimensioning (DWS)
A weigh-in-motion scale is a conveyor system equipped with load cells that measure the weight of cartons as they move. Alongside the WIM scale, a dimensioning system captures the precise length, width, and height of each carton.

This weight and dimensioning data is essential for:

- **Rate shopping:** Selecting the most cost effective carrier
- **Avoiding dimensional weight surcharges:** ensuring shipments comply with carrier guidelines

If a carton exceeds acceptable dimensional weight ratios, it is automatically diverted to a repackaging station for resizing into an appropriate shipping container.

To ensure accurate scanning, inbound cartons must be properly spaced before entering the system. This pitch is pre-calculated and dynamically adjusted using conveyor speeds or belt separators, allowing each carton to be individually processed by the WIM and DWS systems.

Where Automation Can Fit Into Your Operation

Automated Manifesting Systems
Once a carton's dimensional weight is determined, the automated systems can perform rate shopping to select the lowest cost carrier based on:

- **Dimensional weight & actual weight**
- **Shipping service requirements**
- **Destination & carrier availability**



This ensures that businesses minimize shipping costs while maintaining service level agreements (SLAs).

At the final stage, a verification scan confirms that the correct shipping label matches the cartons ID. Once verified, cartons are sorted into designated carrier lanes for palletizing or direct loading onto trucks.

Where Automation Can Fit Into Your Operation



Print and Apply System (PANDA)
Print and apply systems automates the labeling process while cartons move continuously through the system. Once the manifesting engine determines the correct shipping method, the label string is sent to the PANDA system, for printing and application.

By maintaining product alignment and spacing from the dimensioning and weighing stages, cartons are presented accurately to the PANDA system, ensuring precise label placement.

Label applicators are configured to apply labels to the front, side, or top of cartons while they remain in motion, improving speed and accuracy in high-volume shipping operations.

By integrating weighing, dimensioning, and manifesting, and labeling into a single automated process, businesses can achieve greater shipping accuracy, lower costs, and increased efficiency, all while reducing reliance on manual labor.

PART THREE

Trends in Warehouse Automation

The order fulfillment and materials handling industries are constantly evolving to meet changing customer expectations and operational challenges. While we can't predict the future with 100% certainty, we can identify key trends shaping the industry and use them to improve strategies today.

Warehouse automation continues to advance, influenced by new technologies, changes in warehouse design, and the rapid growth of ecommerce. We will cover some of the biggest trends impacting order fulfillment now and in the future on the next few pages.



Trends in Warehouse Operations

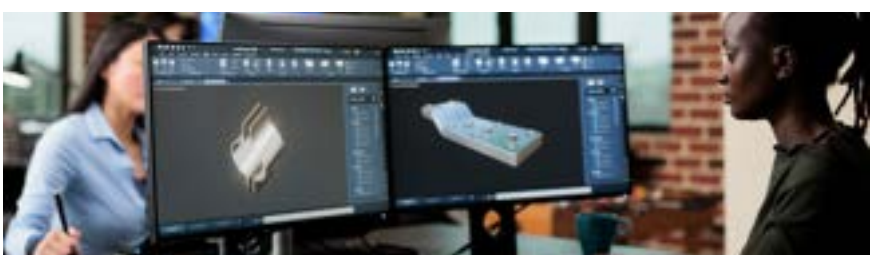
INCREASED USE OF MODELING SOFTWARE

More warehouses and distribution centers are adopting modeling and profiling software to optimize space and efficiency.

These tools help in many ways:

- **Smarter inventory placement:** products are stored based on demand trends, reducing travel time and speeding up order fulfillment.
- **Better space utilization:** Facilities maximize storage capacity, reducing the need for costly expansions.
- **Improved automation plan:** Bottlenecks and inefficiencies are easier to identify, allowing businesses to target automation where it's needed most.

These programs are no longer just for designing new warehouses, they are also being used to improve existing operations by identifying weak points and opportunities for automation.



Trends in Warehouse Operations

THE IMPACT OF ECOMMERCE

E-Commerce is driving major changes in warehouse operations. Today's online shoppers place more frequent but smaller orders, shifting the way fulfillment centers operate.

Key impacts include:

- **Higher order volume:** Warehouses must process a larger number of smaller orders rather than fewer bulk shipments.
- **Faster fulfillment speeds:** Customers expect rapid delivery, putting pressure on warehouses to optimize picking, packing, and shipping.
- **More automation**: Businesses are turning to robotics, AI, and conveyor systems to keep up with demand.

As online shopping continues to grow, warehouses must adapt by streamlining operations and investing in automation.



Trends in Warehouse Operations

THE RISE OF POLY-BAGS

With E-Commerce driving a shift toward smaller, individual shipments, many fulfillment centers are moving away from cartons and using poly bags instead.

Why?

- **Cost-effective**: Polybags can cost as little as $0.012 per bag, compared to $0.75-$1.50 for small cartons.
- **Space-saving**: They pack tightly in shipping containers, reducing dimensional weight charges.
- **Lightweight:** They help cut down shipping contests

Challenges of using poly bags

While polybags offer many benefits, they can be difficult to convey and sort because they are pliable and can get caught in machinery. Currently, belt sorters handle poly bags most effectively, but other sorting systems (like shoe sorters) are being redesigned to accommodate them.

Older warehouses originally built for bulkier packaging need to upgrade their systems to handle poly bags efficiently as ecommerce continues to reshape order fulfillment.



Trends in Warehouse Operations

GROWTH OF AUTOMATED GOODS-TO-PERSON TECHNOLOGY

As order sizes shrink and frequency increases, automated goods-to-person systems are becoming more common for precise and efficient order picking. These systems help mid-sized ecommerce fulfillment operations cut costs and improve speed in ways that manual labor alone cannot achieve.

Key Benefits of G2P Technology:

- **Reduces labor costs** by minimizing walking and manual picking.
- **Increases order accuracy** with automated retrieval systems.
- **Boosts efficiency** as newer generations of G2P technology become faster.

G2P systems are also driving advancements in sorting technology. For example, pouch/pocket sorters allow batch-picked products to be delivered directly to packing stations, eliminating extra handling and conveyor use.

As automation advances, G2P technology will continue to integrate with other systems, improving efficiency across entire warehouse operations.



Trends in Warehouse Operations

INCREASED USE OF ROBOTICS

Robots are no longer just for assembly lines, They are revolutionizing order fulfillment by handling repetitive and predictable tasks with speed and precision.

How?

- **Roaming robots** navigate storage areas using vision systems and advanced grippers to pick orders.
- **Robotic arms** assist in sorting, picking, and packaging processes.
- **Integration with G2P systems** removes the need for human intervention entirely in some areas.

As robotics technology improves and costs drop, we will see even greater adoption in warehouses looking to boost productivity while reducing reliance on manual labor.



Trends in Warehouse Operations

RISE OF AUTOMATED GUIDED VEHICLES

The demand for AGVs is growing rapidly as warehouses look for smarter ways to transport goods internally.

What are AGVs?

AGVs include robotic forklifts, carts, and shuttles that move products throughout a warehouse, following pre-programmed routes or dynamically adjusting to needs.

Why AGVs are becoming essential

- **Seamless integration** with warehouse execution software ensures inventory is exactly where it's needed.
- **Eliminates manual transport tasks**, freeing up human workers for more complex jobs.
- **Handles multiple functions**, including loading, unloading. sorting, picking, and storage.

As AGV technology improves, expect to see more warehouses adopting these systems to streamline operations and reduce costs.



Trends in Warehouse Operations

WEARABLE TECHNOLOGY IN THE WAREHOUSE

When Google Glass was introduced in 2012, industries like manufacturing and order fulfillment saw its potential for hands-free, augmented reality (AR)-assisted picking. Companies like DHL tested the technology, finding that it significantly improved order selection speed and accuracy.

While the original Google Glass is no longer available, enterprise versions are in development, and other companies, including intel and several startups, are working on similar AR-driven solutions.

How Wearable AR Technnology Improves Warehouse Operations

- **Visual overlays** guide workers directly to picking locations.
- **Real-time instructions** display product details and qualities, reducing errors.
- **Hands-free operation** increases speed and efficiency.

As AR technology advances, wearable devices will become a common tool in warehouses, helping workers navigate faster, pick more accurately, and boost productivity.



PART FOUR

Preparing for Your Warehouse Automation Project

If you think that automation has a role to play in your operation, your first step will be to find the right partner who can help you understand your options and and create a plan to put the appropriate solutions into place.
With a little preparation, you can help the process of choosing a partner go much more smoothly.

Key Steps in Preparation:

1. **Understand Your Operation** - Gather key performance metrics.
2. **Define Your Goals** - Identify what you want to achieve with automation.
3. **Choose The Right Partner** - Decide between a systems integrator (for implementation) or a consultant (for strategy and guidance).



Preparing for Your Warehouse Automation Project

CRITICAL METRICS TO ADDRESS YOUR NEEDS

Before engaging with a potential partner, it's crucial to have a clear picture of your operations performance. These key metrics will help guide discussions and decision making.

OPERATIONAL METRICS

- **SKU Base** - Total number of SKUs being currently handled.
- **Available Capacity** - Useable warehouse space for automation.
- **Volumetrics** - Typical order volume and peak surge volume.
- **Pain Points** - Key challenges (labor shortages, inefficiencies, errors).



Preparing for Your Warehouse Automation Project

CUSTOMER-FOCUSED METRICS

- **On-Time Shipping** - Percentage of orders shipped on time.
- **Total Order Cycle Time** - Time from order placement to shipment.
- **Internal Order Cycle Time** - Time from order release to shipment.
- **Perfect Order Percentage** - On-time, complete, damage-free shipments with correct documentation.



Preparing for Your Warehouse Automation Project

INBOUND METRICS

- **Dock-to-Stock Cycle Time** - Time from receiving to being available for sale.
- **Inbound Orders Processed per Hour** - Efficiency of receiving operations.
- **Line Received and Put Away**- Inbound lines processed per hour per person.



Preparing for Your Warehouse Automation Project

OUTBOUND METRICS

- **Fill Rate (Orders)** - Percentage of fully completed orders.
- **Fill Rate (Line Items)** - Percentage of fully completed order lines.
- **Orders Picked per Hour** - Fulfillment efficiency per person.
- **Lines Picked & Shipped per Hour** - Productivity of picking and shipping per person.



Preparing for Your Warehouse Automation Project

FINANCIAL METRICS

- **Distribution Cost (% of Sales)** - Cost of operations relative to sales.
- **Distribution Cost per Unit Shipped** - Cost Relative to units shipped.
- **Inventory Days of Supply** - Days of inventory coverage based on demand.



Preparing for Your Warehouse Automation Project

SKU DATA

- **Number of Active SKUs** - Current SKUs handled.
- **Projected SKU Change** - Expected increase or decrease in SKUS.
- **SKU Specifications** - Dimensions and weight affecting storage/handling.
- **Storage Requirements** - Special conditions (refrigeration, climate control)



By gathering these metrics ahead of time, you'll be well prepared for discussions with a systems integrator or design consultant. This proactive approach helps identify areas where automation can provide the most value, ensuring a smoother and more efficient implantation.

Preparing for Your Warehouse Automation Project



GOALS (AND CONSTRAINTS) OF THE PROJECT

Before automating any part of your facility, it is essential to clearly understand your operations key metrics and set well-defined goals for the project. Ask yourself: What are your primary and secondary motivations for seeking to automate all of part of your facility?

Your goals should follow the SMART framework, in that they are **Specific, Measurable, Achievable, Realistic, and Timely.** Defining your objectives in this way will help you gain a clearer sense of what you want to gain from your automation project, making it easier to articulate your goals to your automation partner. This, in turn, will allow the final automation plan to be tailored to your specific needs and objectives.

For example, if your primary goal is to address labor shortages, the solution will look very diffrent than if your main goal is to reduce overhead costs or improve efficiency.

Just as important as setting goals is identifying and communicating any **constraints**. For example, a limited budget may place certain technologies out of reach, a condensed timeline could make a complete redesign unrealistic and space constraints may require creative solutions to implement automation effectively.

By understanding both your goals and constraints, you can develop a well-structured automation plan that aligns with your business needs.

Preparing for Your Warehouse Automation Project



UNDERSTANDING YOUR OPTIONS: SYSTEMS INTEGRATOR VS. DESIGN CONSULTANT

Once you have a solid understanding of both your operation's key metrics and the goals of the automation project, the next step is selecting a partner to help determine and implement the right solutions.

In most cases, this means choosing between a **systems integrator** and a **warehouse design consultant**. While they may seem similar, there are important differences to consider before making a decision.

The main distinction lies in their focus of their work. **Systems integrators** specialize in implementing systems and technologies to make your operation as efficient as possible, On the other hand, **design consultants** are more likely to take a broader approach, considering your entire business as a whole, including business strategies, long-term corporate goals, and more.

Another important factor is vendor relationships. **System integrators often have established connections with various technology vendors**, which can be an advantage in securing cost-effective solutions. In contrast, **design consultants typically do not maintain these relationships**, meaning they may provide more independent recommendations but without the potential cost savings a system integrator can leverage.

Preparing for Your Warehouse Automation Project

While it is true that a reputable systems integrator will typically offer their unbiased recommendations on various technologies. However, it is very possible that an integrator may have preferred vendors they feel more comfortable working with. That being said, this concern is more about **the quality and reputation of individual systems integrators** rather than the profession as a whole. Ultimately, the integrators recommendations should always be made with the customers best interests in mind.

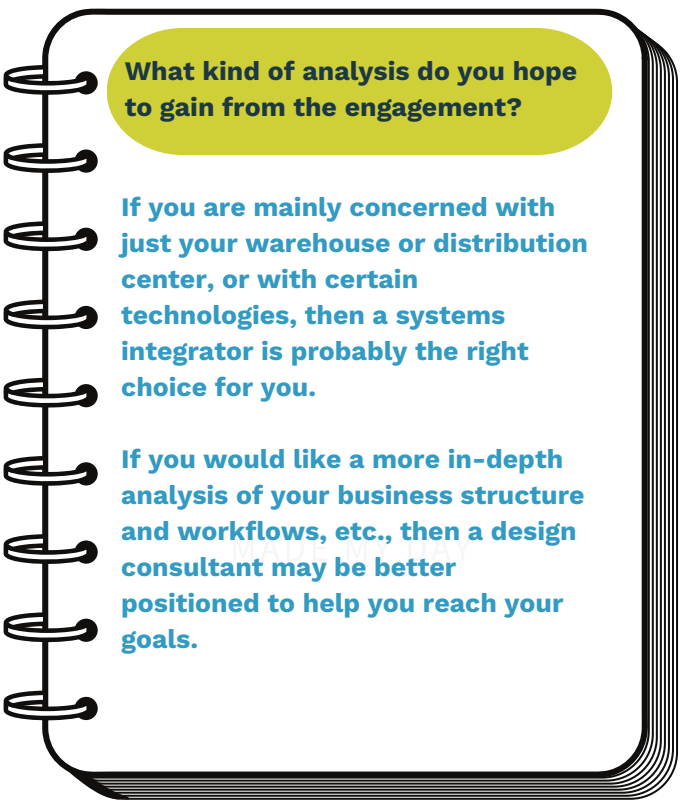
Another key difference between warehouse design consultants and system integrators is their **fee structures.** In most cases, systems integrators provide initial analysis at no cost, while design consultants typically require payment from the beginning of the engagement. This distinction can significantly impact you project budget, making it crucial to understand any financial constraints before selecting a partner.



Preparing for Your Warehouse Automation Project

CHOOSING THE RIGHT PARTNER FOR YOUR PROJECT

Not sure whether it makes more sense to work with a systems integrator or a design consultant on your warehouse automation project? Ask yourself these questions:



Preparing for Your Warehouse Automation Project

Do you have budgetary constraints?

If so, a systems integrator, who is likely to offer at least some basic analysis up front without charge, may bring more value than a design consultant, who is likely to charge you for their time from the first conversation.



Preparing for Your Warehouse Automation Project

Are you looking for a short-term or long-term partnership?

A systems integrator is responsible for the technical application of equipment and systems as well as life-cycle support, and as such they will have the best understanding to help you make adjustments and changes as time goes on and business requirements change.



PART FIVE



Protecting Your Investment

Switching to a fully or partially automated operation is a major investment, in terms not only of capital but also time, effort, and energy. That's why once your warehouse automation project is complete and your new technologies and systems are in place, it is important not to fall into a "set it and forget it" mindset.

To maximize your return on investment (ROI), your goal should be to keep your automation systems running as smoothly as possible for as long as possible. Achieving this requires ongoing maintenance and life cycle support. Typically, an effective life cycle support strategy will consist of two equally important elements: Day-to-day maintenance, and regular system audits.



10 Key Takeaways












- The four main benefits of warehouse automation are: **Reduced labor costs, increased operational efficiency, increased workplace safety, and better labor availability management.**
- Automation can **optimize** and virtually touch nearly every **repetitive, error prone, or time consuming task** in your warehouse.
- Businesses can achieve greater **shipping accuracy, lower costs, and increased efficiency**, all while reducing reliance on manual labor.
- Warehouse automation continues to advance, influenced by **new technologies**, **changes in warehouse design**, and the **rapid growth of ecommerce**.
- As **AR, robotics, and AI-driven solutions** continue to improve, warehouses that embrace these innovations will see major gains in **efficiency, accuracy, and cost savings.**
- Before engaging with a potential partner, it's crucial to have a **clear picture** of your **operation's performance**.
- By understanding both your **goals and constraints,** you can develop a well-structured automation plan that aligns with your business needs.
- It is important not to fall into a **"set it and forget it"** mindset.
- **Daily maintenance** is critical to ensuring that you are able to get the most out of your **technology, systems, and machinery**.
- Taking a look at warehouse automation can lead to **big gains** for your business.

About Conveyco

At Conveyco, we are your trusted system integration partner, dedicated to designing and implementing innovative, efficient, and reliable solutions tailored to your unique needs. With almost 50 years of experience, we specialize in creating seamless, end-to-end systems that optimize performance and deliver measurable results. Unlike OEMs tied to their own equipment, we independently select from vetted partners and technologies to deliver solutions that exceed expectations.

Our in-house software expertise ensures seamless integration and performance tailored to your operation. From system design to implementation, our industry-leading controls provide efficiency, reliability, and scalability. Led by a team of seasoned industry veterans, we prioritize building long-term relationships and delivering on our promises with the integrity of a family-owned business. Free from outside investors, we make decisions with your best interests in mind, allowing us to provide solutions without compromise.

Contact Us

Supporting Your Sustainability Goals

We understand the growing importance of sustainable practices in today's supply chain. Our systems are designed to improve efficiency, reduce energy consumption, optimize resources, and support your sustainability objectives—helping you build a greener future without sacrificing performance.

Let's Build Your Future, Together

When you choose Conveyco, you're not just gaining an integrator—you're gaining a partner committed to helping you achieve your goals. We redefine what's possible, together.

Contact Us

To learn more about how Conveyco can help transform your operations, visit www.conveyco.com or reach out to our team at conveyco@conveyco.com.

CONVEYCO | Integrated Solutions & Software