

Warehouse Automation 101: **The Basics**





Throughout the world, warehouses and distribution facilities are turning to automation solutions to modernize their facility with the goals of streamlining processes, increasing productivity, and enhancing overall operational efficiency.

In this document we will be covering:

- **Modern warehouse automation definition & benefits**
- **Software & hardware equipment**
- **When & how to automate**
- **Common challenges for warehouse automation decision makers**

Whether exploring warehouse automation for the first time or looking to dive deeper, this information will be a valuable resource to help decision-makers and end-users implement automation systems in their warehouses. Doing so can prevent organizations from falling behind their competition or becoming obsolete.

Let's get started!

Warehouse Automation, Defined

Let's begin by asking a very basic question: "What *is* warehouse automation?"

The simplest answer is: **Warehouse automation is the implementation of technology and systems to automate tasks and processes within a warehouse or distribution center.**

In other words, automated warehouse processes—by their very design—virtually eliminate human involvement within the scope of the task or process itself by using software, hardware, or a combination of both.

These processes may involve many functional areas of the warehouse, like receiving, put-away, sorting, picking, packing, shipping, and more.

WHY AUTOMATE AT ALL?

If warehouse automation sounds complicated, time-consuming, and expensive, that's because it often is. However, the benefits of warehouse automation solutions are usually worth the time and capital investment required to implement them.

These benefits include:

- **Increased operational efficiency:** Automated processes reduce the reliance on manual labor, resulting in fewer errors, improved speed and predictability, and massively enhanced throughput and productivity.
- **Improved order accuracy:** Advanced technologies such as barcode scanning, image recognition, and robotic picking systems lead to higher order accuracy rates which enhance customer satisfaction and reduce costly returns or exchanges.
- **Enhanced inventory management:** Automation provides real-time visibility and control over inventory levels. Automated systems track inventory movements, monitor stock levels, and trigger replenishment orders. This leads to improved inventory accounting accuracy, reduced stockouts, and optimized inventory turnover.

- **Labor utilization optimization:** Warehouse automation enables businesses to optimize labor allocation and utilize human resources more strategically. By automating repetitive and physically demanding tasks, workers can be redeployed to more value-added activities such as quality control, exception handling, or process improvement. This improves job satisfaction and maximizes the workforce's potential.
- **Added flexibility & scalability:** Automated warehouse systems offer immense flexibility and scalability to adapt to changing business needs. With modular designs and flexible configurations, automation solutions can be easily modified or expanded to accommodate fluctuations in order volumes, product ranges, or operational requirements. This scalability enables warehouses to remain agile and responsive to market demands and to grow the business. Often investments in automation can be justified by the volume of increased business generated.
- **Improved utilization of physical warehouse space:** Automation systems can optimize the space within a warehouse on both the horizontal and vertical planes through using an Automated Storage and Retrieval Systems (AS/RS).

Almost all these benefits can be quantified before, during, and after integrating a warehouse automation solution. This makes measuring and proving return on investment easy.

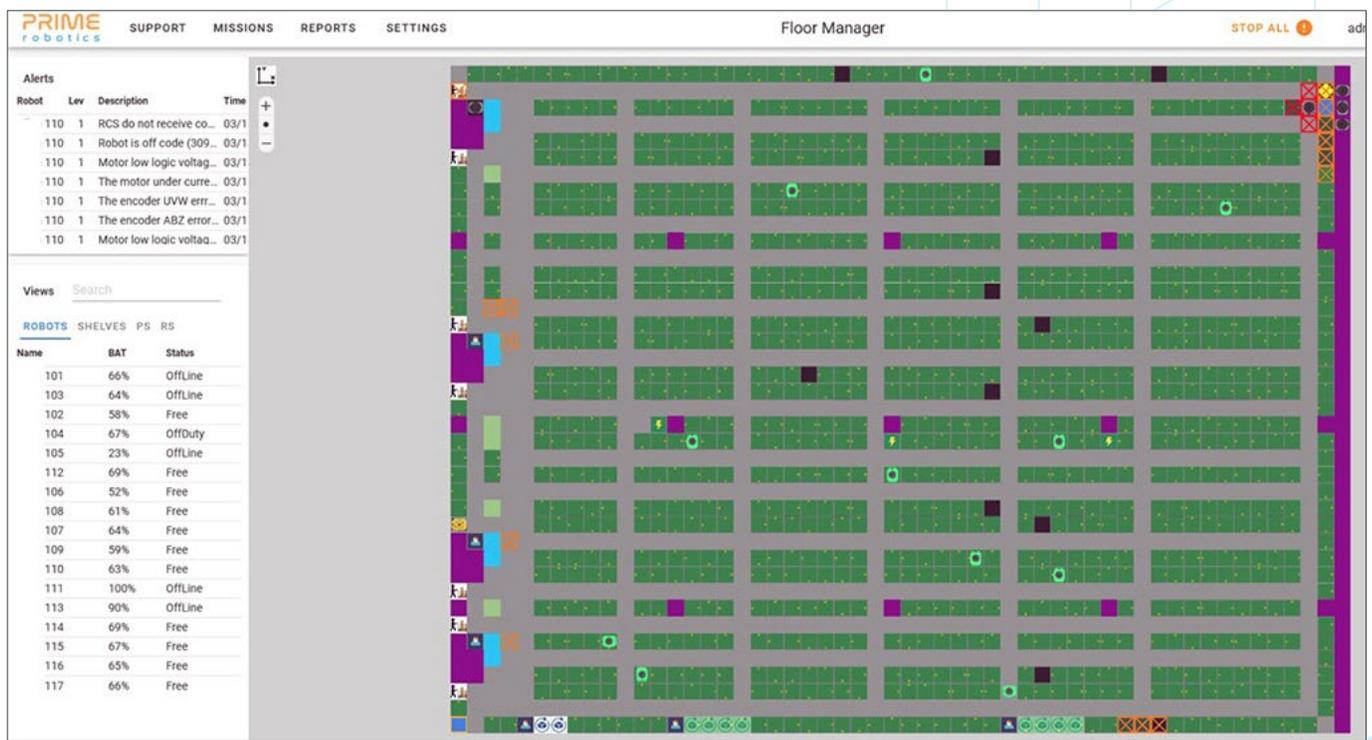
Warehouse automation is the implementation of technology and systems to automate tasks and processes within a warehouse or distribution center.



Warehouse Automation Software

ENTER THE WAREHOUSE CONTROL SYSTEM

One example of a warehouse automation-specific software component is the Warehouse Control System (WCS). The WCS is the heart of many Autonomous Mobile Robot (AMR)-based automation solutions, providing a real-time window into the health and status of the deployed AMR fleet.



The Prime Robotics WCS Floor Manager shows a real-time map of an entire warehouse, and the locations and activities of each AMR displayed on one screen.

Another important feature of any WCS is an easy-to-use management console. This console makes it possible to customize system configurations, create unique user settings, identify inbound and outbound orders, and adjust operational settings anytime.

A customized management console also enables better decision-making, allowing easy access to crucial information and optimization of operations



The Prime Management Console dashboard provides real-time visualizations of KPIs, including orders by time and customer, pallet utilization rate, and more.

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Warehouse Automation Hardware

Let's now turn to the hardware used in many warehouse automation systems. This topic is extensive compared to software, as automation hardware is more varied with nuanced functionality.

Most hardware systems used in warehouse automation fall under the following categories:

- Autonomous Mobile Robots (AMRs) or Automated Guided Vehicles (AGVs)
- Conveyor & sorting systems
- Robotic picking & packing
- Automated Storage & Retrieval Systems (AS/RS)

The required hardware technologies vary significantly based on the product or SKU type (items, cases, or pallets), the throughput volume, the hours of operation, and other factors.

AUTONOMOUS MOBILE ROBOTS (AMRs)

AMRs transport goods within a warehouse or distribution center. Equipped with sensors, navigation systems, lifting, and conveyor mechanisms, these robots navigate through predefined routes and perform various material handling tasks.

Key advantages of AMRs include:

- **Efficient material movement:** AMRs can transport goods between different warehouse zones and picking stations, loading docks and production lines, reducing manual labor and improving throughput.
- **Flexibility & adaptability:** AMRs can be programmed to handle different types of loads, making them versatile for various applications such as pallet movement, storage, and conveyor feeding. Unlike fixed hardware, they can be added or removed depending on the needs of the warehouse, allowing for changes in order volumes and/or seasonality.

- **Redundancy:** AMRs operate in a fleet configuration, where any vehicle can perform any task.
- **Safety & accuracy:** AMRs incorporate advanced safety features, including obstacle detection and collision avoidance, ensuring a secure working environment.

CONVEYOR & SORTING SYSTEMS

Historically, conveyor systems have been integral to warehouse automation, as they facilitate the continuous flow of materials between different workstations. These systems consist of stationary motorized belts, rollers, and sorting mechanisms to transport items efficiently. Conveyors are ideal for high-speed throughput conditions.

Key features and benefits of conveyor systems include:

- **Streamlined material flow:** Conveyors facilitate moving goods along predefined fixed paths, reducing manual handling, and minimizing the risk of errors or damage.
- **Sorting & merging capabilities:** Conveyor systems often incorporate sorting mechanisms, enabling automated order consolidation and routing based on destination.
- **Increased throughput:** By automating the transportation process, conveyor systems can handle large volumes of goods, improving overall warehouse efficiency.

A few AMRs also have conveyor systems—belts and rollers—that make them more versatile than fixed conveyors.

ROBOTIC PICKING & PACKING

Robotic picking and packing systems have emerged as game-changers in warehouse automation. These advanced robots use machine vision, artificial intelligence, and robotic arms to handle the intricate task of picking items from shelves, bins, or pallets and packing them into shipping boxes, totes, or building mixed pallets.

Key advantages of robotic picking and packing systems include:

- **Increased speed & accuracy:** Robots can perform picking and packing tasks much faster than manual labor, reducing order fulfillment time and minimizing errors.
- **Consistency:** Robots operate 24/7 with minimal supervision.
- **Scalability & adaptability:** Users can reprogram or configure robotic systems to handle different products, sizes, and packaging requirements.
- **Safety benefits:** Automation eliminates repetitive and physically demanding tasks, reducing the risk of injuries and improving employee well-being.

AUTOMATED STORAGE & RETRIEVAL SYSTEMS (AS/RS)

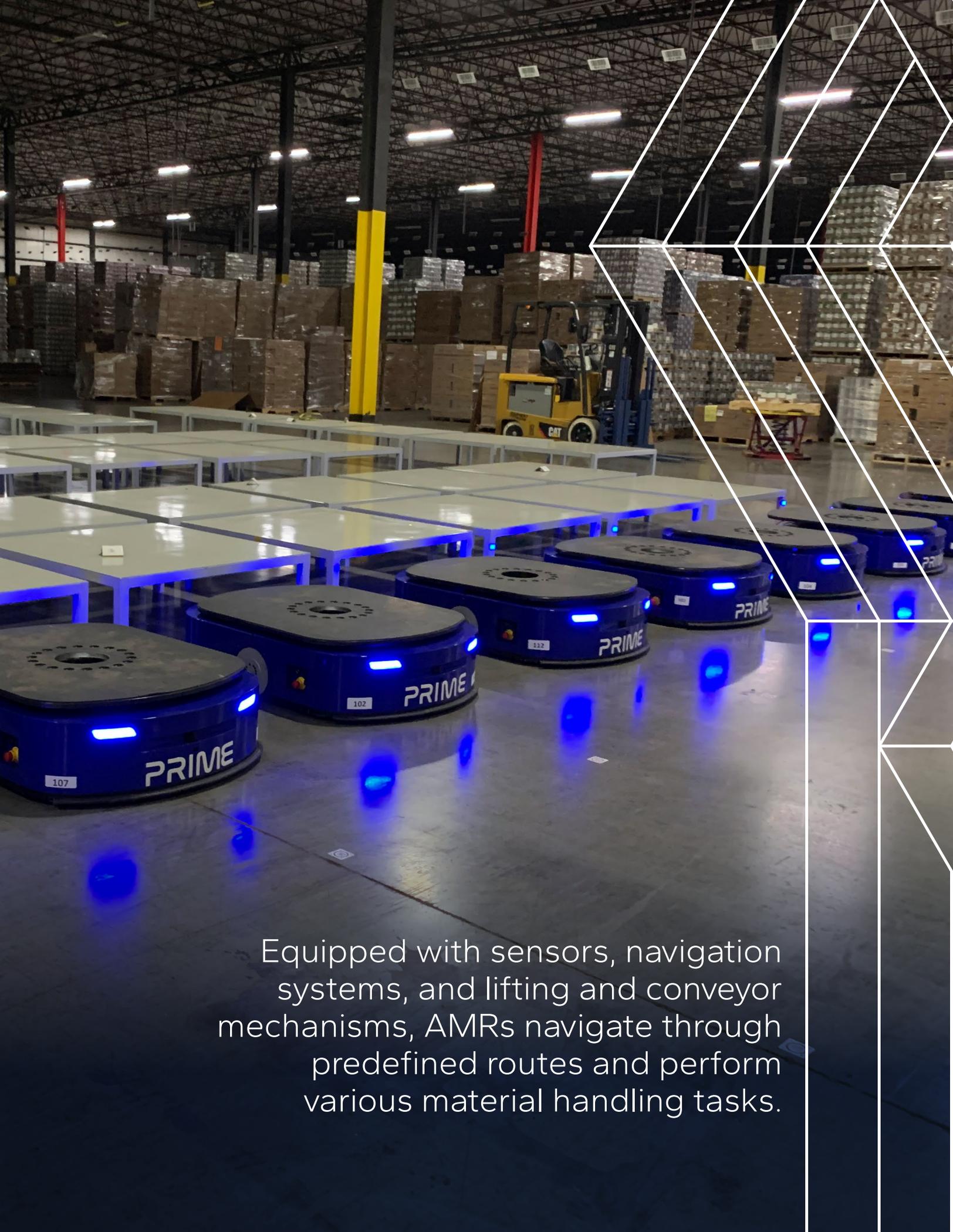
AS/RS hardware consists of specialized racking and AMRs, configured to store and retrieve goods within the warehouse.

AS/RS equipment offers several benefits, including:

- **High-density storage:** AS/RS can store many products in a compact vertical footprint, maximizing warehouse space utilization.
- **Fast & accurate retrieval:** AS/RS can quickly locate and retrieve specific items, reducing human errors and increasing picking efficiency.
- **Improved inventory management:** AS/RS can integrate with a WMS, providing real-time inventory visibility and enabling better demand forecasting.

Within the AS/RS hardware category, consider the following types, descriptions, and associated benefits provided by each:

TYPE	DESCRIPTION	BENEFITS
Vertical Lift Modules (or Vertical Carousels)	Vertical towers with trays that move along a strictly vertical axis	Space-efficient, increased picking accuracy
Carousel Systems	Rotating shelves or bins that bring items to operators	Quick access, high throughput, reduced walking distances
Automated Vehicle Racks	Pallets or trays are stored in high-rise shelving systems	Increased storage capacity, optimized space utilization
Shuttle Systems	Robotic shuttles that move in three dimensions on storage racks	High-speed picking, scalable and adaptable to changing needs



Equipped with sensors, navigation systems, and lifting and conveyor mechanisms, AMRs navigate through predefined routes and perform various material handling tasks.

When & How to Begin Investing in Automation

Taking the first step to enhance warehouses with added automation might seem daunting. A natural starting place is first to consider *when* to automate, followed by *how* to automate.

NECESSITY: THE MOTHER OF AUTOMATION

When is the right time to invest in automation? The answer: when there is a need.

The following are a few ways to begin identifying a need for automation:

- **Analyze volume & complexity:** When handling a large number of orders with complex picking, packing, and shipping processes, automation can significantly improve efficiency and accuracy.
- **Evaluate labor costs & availability:** If labor costs are high or labor shortages are impacting productivity, automation can help mitigate these challenges.
- **Examine inventory management practices:** If issues exist with inventory accuracy, stockouts, or excess inventory, automation systems can address, and in some cases resolve, these problems.
- **Evaluate growth requirements & expansion abilities:** Automation will allow higher throughputs in shorter time periods to enable the business to expand.

Once the needs have been identified, it's time to do some homework:

1. **Conduct a process analysis:** Thoroughly analyze all existing warehouse processes, identifying bottlenecks, inefficiencies, and areas prone to errors.
2. **Prioritize automation targets:** Based on process analysis, prioritize the areas that would benefit most from automation. Start with critical processes that have the highest impact on overall operational efficiency.
3. **Research available technologies:** Explore the range of automation technologies available in the market, such as robotic systems, conveyor belts, and AMRs, and how these integrate with the current WMS. Understand their capabilities, implementation requirements, and what changes will be required to the existing infrastructure.

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MOVING TO EXECUTION

Once the above due diligence is complete, it is time to take action and implement automation.

How does a team implement automation? The answer includes the following actions:



SET CLEAR OBJECTIVES

Define clear objectives for the automation project, such as reducing labor costs, improving order accuracy, or increasing throughput. These objectives will guide the entire implementation process.



DETERMINE BUDGET AND ROI

Assess the costs associated with automation implementation, including equipment, software, installation, training, and maintenance. Calculate the return on investment (ROI) to ensure the automation project aligns with the organization's financial goals.



SEEK VENDOR PARTNERSHIPS

Engage with automation vendors who specialize in warehouse automation systems. Request detailed proposals, including equipment specifications, implementation timelines, ongoing support, and maintenance agreements.



CONDUCT A TEST

Before fully committing to a large-scale automation deployment, consider piloting the technology in a specific area of the warehouse. A test allows the team to evaluate effectiveness and make necessary adjustments before scaling up.

Remember, automation is an ongoing process, so continuous monitoring and optimization are crucial to maximize benefits and stay ahead in the competitive landscape. The automation journey never completely ends, as new technologies and ways of enhancing processes evolve constantly.

Common Warehouse Automation Challenges

Virtually every warehouse automation project is going to have challenges. Anticipating these challenges and knowing how to address them will go a long way in ensuring overall success.

COST JUSTIFICATION

Determining the ROI for the automation project and convincing stakeholders of its financial benefits can be a significant challenge. This involves accurately estimating costs, including equipment, software, implementation, training, and ongoing maintenance, while considering the potential long-term savings and increased efficiency.

INTEGRATION WITH EXISTING SYSTEMS

Organizations must carefully address compatibility issues, data migration, and system interfaces to ensure seamless communication and data flow between various systems.

INFRASTRUCTURE & SPACE LIMITATIONS

The physical layout of the warehouse and existing infrastructure may pose challenges when implementing automation. Space constraints, irregular layouts, and the need for modifications to accommodate fixed equipment require careful planning and design adjustments.

WORKFORCE TRANSITION & TRAINING

Introducing automation can lead to concerns and resistance among the existing workforce. Managing the transition, addressing employee concerns, and providing proper training and upskilling opportunities are essential for successfully adopting and accepting new technologies.

CHANGE MANAGEMENT

New automation can significantly change organizational culture, job roles, and responsibilities. Effective change management strategies are necessary to navigate these changes smoothly, including clear communication, stakeholder engagement, and employee involvement.

REGULATORY COMPLIANCE & SAFETY

Adhering to industry-specific regulations and ensuring the safety of both automated systems and employees are critical challenges. Compliance with safety standards, training programs, and regularly updating risk assessments are necessary to maintain a safe and compliant working environment.

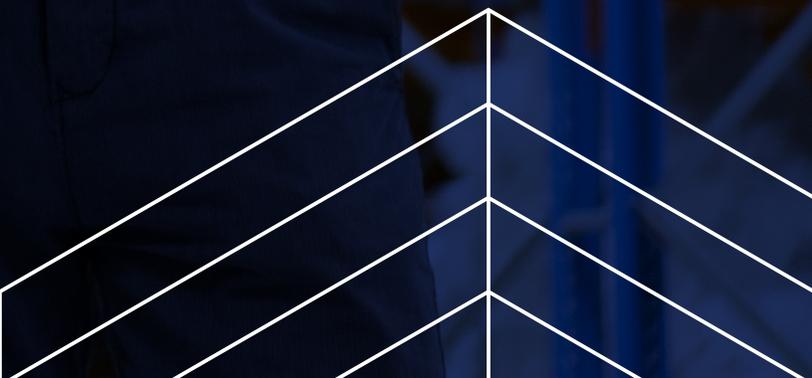
CONTINUOUS MONITORING & OPTIMIZATION

Warehouse automation is an ongoing process that requires continuous monitoring and optimization. Challenges related to system performance, fine-tuning processes, analyzing data, and implementing improvements should be addressed to maximize the benefits of the automation project over time.

The challenges are real, but the good news is that plenty of resources are available. Specialized experts can partner with organizations embarking on the automation journey to help meet challenges and resolve issues before they become serious.



Anticipating challenges and knowing how to address them will go a long way in ensuring overall success.





Looking **Beyond** the Basics

This introduction to warehouse automation aims to provide a functional understanding of the key concepts involved in many of the basic warehouse automation systems in use today.

In this document we explored the high-level benefits of warehouse automation solutions, when and how to invest in warehouse automation, software and hardware components, along with the various challenges of warehouse automation technology.

The team at Prime Robotics is available to answer questions at any time for those who have read this guide and are wondering what to do next. We are always happy to help guide those on the journey of designing, creating, and integrating efficient, effective warehouse automation solutions.

Contact us to start the conversation.

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