

How to Successfully Implement Autonomous Mobile Robots into Order Fulfillment

Considerations for why, where, and how AMR technologies – alongside proven material handling automation best practices – optimize direct-to-consumer distribution facilities



INTRODUCTION

Autonomous mobile robots (AMRs) are generating a lot of interest in the materials handling market; a simple tour of any trade show floor or flip through a trade magazine over the past 24 months makes that clear. What is less clear for many operations is how an emerging technology — a fleet of AMRs — will impact distribution and fulfillment operations.

A key reminder for facilities and operations managers evaluating AMRs as a potential warehousing and material handling solution is to maintain a holistic, system-wide perspective about how this technology will complement existing operations. Rarely does an operation rely upon a single solution applied throughout the four walls. Instead, the most optimal systems are typically built with a range of appropriate technologies, all functioning in conjunction with each other, to achieve the operation's overarching goals.

Therefore, when assessing a potential investment in autonomous mobile robots, consider how they will fit into the entire system and make its functioning, efficiency or productivity quantifiably better across one or more areas, including:

- Increased throughput
- Lower costs
- Greater flexibility
- Higher accuracy
- Decreased order processing time

Other questions to ask include:

- Why should a facility deploy AMRs?
- Where do AMRs best fit within an operation or series of processes?
- How should AMRs be implemented to ensure a successful outcome?

This white paper will answer all those questions, as well as offer insights into how AMRs navigate and function safely around other equipment and personnel.

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BENEFITS OF ADDING AMRS

When deployed as part of a materials handling system in a distribution or order fulfillment operation, AMRs are typically used for item transport — that is, they take a payload from one area to another, with or without stops in between.

Currently the vast majority of AMRs are being used to support manual picking operations. That's because, as e-commerce has exploded in popularity, customer service expectations have increased significantly. Shoppers want to buy an item online and receive it same-day or next-day. As a result, throughput and efficiency demands are constantly rising.

Customers also expect high availability and a wide variety of items to be in stock. Inventory mixes change all the time, as do item velocities and demand levels. Yet available warehousing space is at a record low and rent prices are on the rise. That means operations must maximize every square foot of their existing facility footprint.

Meanwhile, labor pools are unable to keep up with demand. Warehouses and distribution centers are struggling to attract and retain a reliable workforce. It's no longer possible to hire enough extra, or temporary, labor to ramp up productivity during peak periods. Further, minimum wage rates are rising across the country, putting additional strain on facility operating budgets — which already allocate nearly 60% of their costs to labor.

Deploying AMRs as part of a holistic materials handling system approach can address these challenges in multiple ways:

What is an Autonomous Mobile Robot?

A cousin to autonomous guided vehicles (AGVs), an AMR is a smaller mobile vehicle that moves its payload independently and flexibly through an environment.

Equipped with sensors, on-board mapping blueprints, 2D and 3D vision and other imaging technologies, they use natural feature navigation (also called contour navigation) to route their travel and avoid obstacles or pedestrians. Their operation is directed by centralized fleet management software that interfaces with the warehouse management system to assign each AMR a specific task.

AMRs typically carry payloads that are lighter in weight than AGVs and can be outfitted with a variety of attachments based on unique application requirements. These include articulated arms with grippers, conveyor belt or rollers, scissor lifts, multiple positions or cubbies for light-directed picking, scrubbers or sweepers for floor care applications, and other technologies.

They can be easily re-programmed or (in some cases) re-outfitted with different attachments as operational needs change. Additionally, as a scalable system, more AMRs can be added (or removed) at any time to match throughput objectives.

AMRs are powered by rechargeable batteries that generally take two hours to reach full charge. They can run for up to eight hours, depending on powered attachment configurations, travel distances, idle time, load weight, frequency of starts and stops, and other factors.

Increased Throughput and Efficiency

Although there are numerous potential applications for AMRs (and those will only grow exponentially as the technology evolves), in order fulfillment operations they excel in supporting low-density, e-commerce picking activities. Thanks to their inherent navigational flexibility, AMRs can visit multiple destinations (picking zones) to collect picks from associates working among different areas and travel to multiple order consolidation or pack out locations in any sequence while taking the most direct route available.

For facilities with multiple pick zones, this eliminates the need for a person to push a cart of picks from place to place, keeping pickers focused on their primary task instead of spending time walking through the facility. This increases both throughput and efficiency.

Greater Facility Flexibility and Capacity

Because AMRs are primarily used in order fulfillment operations to transport products, they can replace fixed conveyor. This opens up a tremendous amount of floorspace that can be reclaimed for additional inventory or reallocated to value-added services, expanding operational capacity. Aisles without conveyor between can be moved closer together, enabling the addition of more pick faces or storage.

In contrast to conveyors and other fixed transport technologies, AMRs do not need dedicated areas in which to operate. Rather, as AMRs easily navigate to any location and around obstacles — as well as can be quickly and easily reprogrammed to work in different areas or support different tasks — facility flexibility is greatly enhanced. During peak periods, additional AMRs can be inducted into the fleet to help handle more picks without having to hire as many temporary staffers.

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Enhanced Labor Productivity and Accuracy

With AMRs handling the movement of picks and totes from zone to zone for order fulfillment — instead of workers pushing carts — labor productivity increases. Not only are personnel no longer spending time traveling, but also more workers can be assigned to picks or to value-added tasks. Alternately, a single picker can be assigned to building and unloading pick carts on AMRs, which then travel to their assigned zones.

Unlike workers, AMRs do not take breaks or get tired, nor are they at risk of ergonomic injuries caused by lifting heavy loads, repetitive lifting activities, or pushing or pulling wheeled carts. Integrated, on-board safety systems detect obstacles and personnel, triggering the AMR to slow or stop, and minimizing risk of injury to workers (as opposed to the risks associated with forklift-based load transport).

Further, because AMRs can be programmed to retrieve and deposit their payloads in a specific orientation, operations that require totes to be fed into other equipment attain 99.9% accuracy. That's because the chance of human error has been eliminated from the process.



AMR ORDER FULFILLMENT APPLICATIONS

There are numerous potential applications for AMRs within distribution and order fulfillment centers (and there likely will be many more as the technology continues to evolve). The next section covers existing applications where AMRs, in a range of configurations and attachments, work in conjunction with other automated materials handling technologies as part of a complete order fulfillment system.

Tugger (Cart Pulling)

Certain AMR configurations allow for the towing of an individual cart or several picking carts in a train. Each cart can be deposited at a pick zone and later retrieved by the vehicle once all picks are completed for transport to consolidation or pack out.



Put Wall (Put-to-Light) with Robotic Arm

AMRs equipped with robotic arms can be used to decant picks into discrete orders at put walls. These systems include a vision system to identify each item, then direct the robotic arm to place it in the appropriate cubby for consolidation of multiple picks into a single order.



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AMR-Assisted Order Picking

In this application, AMRs work with pickers to help them complete their order filling assignments. Pickers are assigned to specific zones and the AMRs bring orders — either on a table-top with a shipping container or with a cart configured with multiple cubbies (potentially with integrated light-directed picking) — to each zone that has the required picks. The AMR enters the zone, the picker completes the picks to the AMR, the AMR departs and heads to the next zone, and the process repeats until all picks are complete. This solution is ideal for e-commerce order fulfillment operations where picks are either far apart, or orders have very few lines, as it eliminates pickers' walk time.

AMR-Assisted Order Sortation

Similar to the previous application, AMRs can be used to sort items to multiple packing stations as directed by the order management system. Packers await picked items delivered by the AMRs, remove them from the AMRs and send the AMRs back to retrieve more picks. Again, this reduces travel time associated with manually transporting picks to specific, discrete packing areas.

Conveyor AMRs

Used for transportation from one point to another, this AMR is outfitted with a conveyor on top. The AMR travels to a conveyor or sorter, the PLC tells the conveyor to divert a tote or carton onto the AMR, then the AMR transports the box to another location and drops it off. The deposit point could be onto another conveyor system or, in some cases, direct loading of other machinery or out-bound vehicles.

Because the AMR adapts to serve fixed conveyor, the conveyor top AMR is ideal for applications where it would be undesirable to block traffic aisles, or to transport over long distances that would be expensive to cover with fixed conveyor, or to serve multiple destination points located in different areas. Additionally, should the load need to be fed in a certain orientation, the source conveyor can be equipped with a right-angle transfer, or the AMR can turn in different directions to ensure the correct feed. Likewise, scissor or other lifting mechanisms can be integrated into the AMR to accommodate different loading and unloading heights.

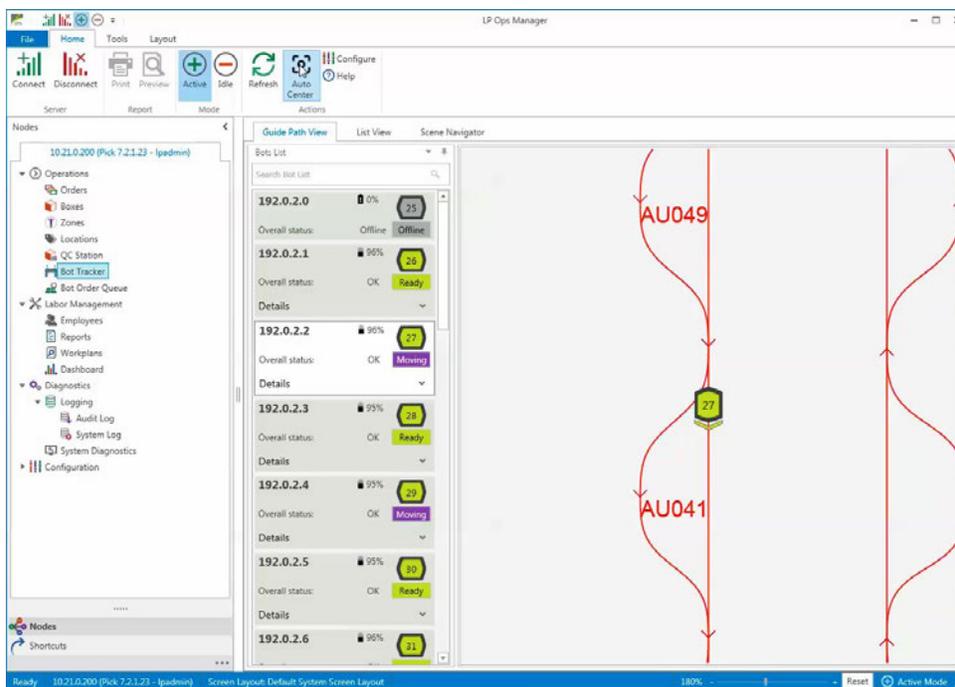


SOFTWARE AND AMR INTEGRATION IS CRITICAL

AMR operation is directed by centralized fleet management and control software that interfaces with the overarching warehouse management system to assign each AMR a specific task. That means it is critical for the AMR system's software to integrate with the facility's operational software, like a warehouse management system (WMS) or warehouse execution system (WES).

The WMS or WES tracks and manages all tasks associated with order fulfillment while orchestrating the operation of equipment and workflow throughout the building. It directs the AMR fleet management system to assign AMRs to the tasks, then verifies their completion. Without a comprehensive and streamlined integration, there is an increased risk that the entire operation's workload will become unbalanced and flow interrupted.

That's why it's important to work with a solutions provider who understands the criticality of a successful integration between the two under a single host interface. Be sure to discuss software and system integration capabilities with any potential AMR supplier.



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TIPS FOR A SUCCESSFUL AMR IMPLEMENTATION

To ensure a successful integration of an AMR solution into an operation and its existing materials handling system, there are a few key steps to follow.

1. **Know the organization's change management strategy.** Corporate culture may guide the speed at which an AMR implementation project will progress. Each organization has a unique set of milestones that must be completed during the planning, piloting, and implementation phases of an automation project.
2. **Take a holistic view of how AMRs will fit into the overall operation.** To ensure a successful system implementation that quantifiably improves order fulfillment processes, do not consider AMRs to be a stand-alone solution. Instead, they should be implemented in the areas where their function will deliver the greatest improvement in throughput, flexibility or accuracy — or yield cost reductions or decreased order processing time.
3. **Define goals and document requirements.** Understand the target outcome of an AMR implementation project, then configure the solution to fit the existing operation.
4. **Simulate.** Computer simulations are a great, low cost way to test different robot layout configurations across a variety of variable parameters: number of pickers, number of totes per AMR, add or remove AMRs, and so on. Alternative installation or process approaches are often uncovered via simple computer simulations.
5. **Start small.** Deploy one or two AMRs first as part of a pilot project to gain a better understanding of how a larger fleet will fit into the operation. This also gives management, associates, maintenance technicians, and other key personnel an opportunity to acclimate to the new technology. Then, measure the initial results and make adjustments accordingly.
6. **Adopt an implementation strategy.** Once a decision has been made about where and how the AMRs will be used (and how many), mapping out the project and each of its different phases ensures the project remains on track. It also minimizes surprises before, during and after installation and commissioning.

Depending on the supplier, these steps might include:



Consultation and Site/AMR Strategy



Application and Site Survey



**Warehouse Layout Discussion
Map of your Facility**



Site-Specific AMR Simulation



Hardware/Software Plan



Integration Testing



Site Integration & Installation



**User Training
Go-Live Support**

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CONCLUSION

In summary, AMRs offer direct-to-consumer order fulfillment operations several strategic advantages, including:

- Higher overall throughput and efficiency, as well as flexible and scalable to accommodate changes in the business and periods of peak demand
- Greater facility flexibility and inventory capacity by replacing permanent conveyor for material movement
- Free workers to do the challenging, value-added jobs that can't be easily automated, while enhancing warehouse safety and ergonomics

Ultimately, to ensure a successful AMR implementation, consider their use to be part of the operation's gradual evolution. By leveraging robotics selectively in areas where processes can be improved while complementing existing manual and automated materials handling equipment, they will become a valuable part of the overall holistic order fulfillment system. They'll also make a significant contribution to the bottom line.

To learn more about how AMRs can improve your operations, contact Dave Remsing (dremsing@matw.com) at Matthews Automation Solutions, or visit matthewsautomation.com.

ABOUT MATTHEWS AUTOMATION SOLUTIONS

Global brands partner with Matthews Automation Solutions to increase distribution and order fulfillment speed, accuracy and efficiency. Matthews' broad portfolio of best-of-breed solutions—including leading material handling automation brands Compass, Lightning Pick and Pyramid—offers warehouse execution software, controls, pick-to-light, put walls, order finishing systems, autonomous mobile robots and more. Combined with 25 years of industry experience and proven integration with other material handling systems, Matthews delivers agile and scalable applications throughout the supply chain. Matthews Automation Solutions is a Matthews International company, servicing customers from two North American locations.

Let's talk about your application.

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