OPTIMIZE WORKFLOWS WITH MOBILE ROBOTICS

How Autonomous Mobile Robots Are Driving Warehouse Productivity

Honeywell Intelligrated®

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SUMMARY

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Autonomous mobile robots (AMRs) are among the most significant robotics advances available to the logistics and manufacturing industry today.

Thanks to innovations in vision, mapping, safety and other technologies developed for self-driving vehicles, AMRs have overcome traditional barriers to automation in distribution centers (DCs) and complex manufacturing operations. They're smart enough to "share the road" with human co-workers and other vehicles, find a different route if their original path is blocked, and respond to rapid changes in orders or logistics needs — all without human intervention. AMRs are also highly cost-effective, requiring minimal information technology (IT) or infrastructural changes and only a short integration period to learn their surroundings.

AMRs have often been characterized as a "wave of the future" or "next-generation" solution. But the reality is they're already in practical use today. Proactive DCs and manufacturing operations are using them to ease labor burdens, improve productivity, reduce or eliminate errors, lower operational costs, and stay nimble in constantly changing market conditions.

Mobile robots deliver many of their benefits by taking on some of the most labor-intensive warehouse jobs. These range from moving pallets, carts or totes full of goods to assisting human co-workers with pick and put operations. While AMRs handle these low-skilled, repetitive and often time-consuming jobs, increasingly scarce labor resources can be shifted to higher-value jobs. This alone delivers multiple benefits, such as boosting worker satisfaction while reducing injuries and turnover rates.



AMRs also provide much-needed versatility to any logistics-driven operation. New or modified workflows, sudden changes to consumer buying habits, peak buying seasons, facility expansions and other changes can easily be handled by these smart, mobile robots. AMRs can adapt quickly to these scenarios and many more, learning new skills and scaling up or down to meet the operational needs of the moment.

To show how these benefits are being achieved in real-world operations, this report details some of the most effective AMR scenarios in use today. While many of these applications are relatively recent developments, each has already been proven to deliver measurable results and fast return on investment (ROI).

Any of these use cases can easily be replicated or adapted — and quickly deployed — in virtually any operation. Their uses and benefits, however, are by no means limited to the examples in this report. New applications are regularly being developed to address the unique needs of individual operations. This report concludes with a brief summary of the advanced simulation tools and other areas of expertise that maximize the success of mobile robotics solution development.

WHY MOBILE ROBOTS?

2

E-commerce is a primary factor driving the trend toward automation in many of the examples covered in this report.

Many DCs were designed to move goods primarily to retail operations, typically in pallet-sized loads. The growing convenience of online ordering, however, has gradually resulted in more direct-to-consumer orders, which require more handling and are typically less profitable. And the exploding diversity of SKUs makes these challenges even more complex.

To make matters worse, distribution operations are caught between two demanding factors. Vendors demand increasingly strict service level agreements (SLAs), ramping up the pressure for greater throughput and accuracy. At the other end of the supply chain, consumer expectations continue to grow, e.g., fast and free delivery — often on the same day.

All of these trends were already underway before the outbreak of the COVID-19 pandemic, which generated a quantum leap forward for e-commerce. By the fourth quarter of 2020, 63% of consumers reported they were avoiding stores and buying more online, with pandemic health concerns driving that decision for 81%. In the first 10 days of the holiday shopping season alone, U.S. consumers spent $21.7 billion online — a year-over-year jump of 21%.

In the entire history of the logistics industry, DCs have never faced this level of demand. And the challenges of the "new normal" can't be handled simply by adding more labor. This is partly because exploding demand requires greater levels of efficiency, accuracy and throughput than any number of human workers can hope to achieve. At a more basic level, however, there simply aren't enough people available. Worker turnover in the industry is more than 33%, and a sizable percentage of the workforce is older than 55. Even before the pandemic, there were only enough workers to fill one in six available positions.

In this environment, automation is neither a luxury nor is it a costly and advanced strategy, available only to the largest high-end operations. In the coming years, it will become essential to the survival of any DC operation that needs to keep pace with this rapid market evolution.

While there are many solutions from which to choose, mobile robotics enable cost-effective automation to be deployed on-demand — often in as little as a few hours — with very little risk. And with no tape, markers or wires needed for navigation, minimal infrastructural changes are required to get up and running. Mobile solutions also offer the benefit of easy growth at whatever pace your operation requires. And as the following examples will show, AMRs offer some of the simplest automation strategies for increasing reliability, improving flexibility, and maximizing the productivity of people and processes — throughout your facility and across your supply chain.

ARE MOBILE ROBOTS SAFE?

All of the state-of-the-art AMRs shown in this report were designed with an uncompromising approach to safety, leveraging many of the same technologies developed for self-driving vehicles.

Advanced sensor and camera technologies allow the robots to navigate safely in dynamic environments, giving the right of way to workers and vehicles, and independently re-routing around obstacles if necessary.

AMRs leverage multiple technologies common in self-driving vehicles, including:

- 360-degree vision with no blind spots
- 3D cameras
- Light detection and ranging (LiDAR) sensors
- Inertial measurement units (IMUs)
- Time-of-flight (ToF) sensors
- Industry-leading, obstacle-detection and avoidance technology with more than 4 million hours of accident-free driving

In addition, workers and equipment are protected by hardware-based safeguards, ensuring safe navigation around operators and vehicles.

Choosing the right robotics integrator is also critical to ensuring the safety of any AMR solution. Don't settle for anything less than a partner recognized as a Certified Robot Integrator by the Association for Advancing Automation (A3). Only these organizations have demonstrated the high levels of skill, experience, safety and other exacting requirements of A3's rigorous independent certification process.

PALLET CONVEYANCE

3

Moving goods in warehouses requires a significant amount of labor. In most operations, this is still accomplished primarily with forklifts and conveyor systems. While both of these long-established methods have their advantages, their drawbacks are increasingly difficult to overcome in today's accelerating marketplace.

While forklifts are capable of moving heavy loads, qualified drivers require training and certification — and can be hard to come by in today's tight labor market. Forklifts are also one of the leading causes of warehouse injuries, causing an average of 85 deaths, 34,900 serious injuries and 61,800 minor injuries each year, according to the Occupational Safety and Health Administration (OSHA). That's at least one accident per year for 11% of all forklifts currently in use in the U.S.

Conveyors can reduce the need for human labor, but they're also a fixed asset. They lack the flexibility to respond to changing market conditions or workflows and aren't always practical for factory floor plans. In addition, modern e-commerce trends are driving the creation of smaller facilities like micro-fulfillment centers (MFCs). Designed to take up as little floor space as possible in high-population markets where real estate is both limited and expensive, these mini DCs don't have room for miles of conveyors.

Pallet conveyance AMRs offer attractive alternatives to both of these traditional solutions. Capable of transporting payloads of up to 1,900 kg (4,200 lbs.)*, they can be loaded directly with a forklift, or transport loads independently between compact pick-up and delivery (P&D) stands.





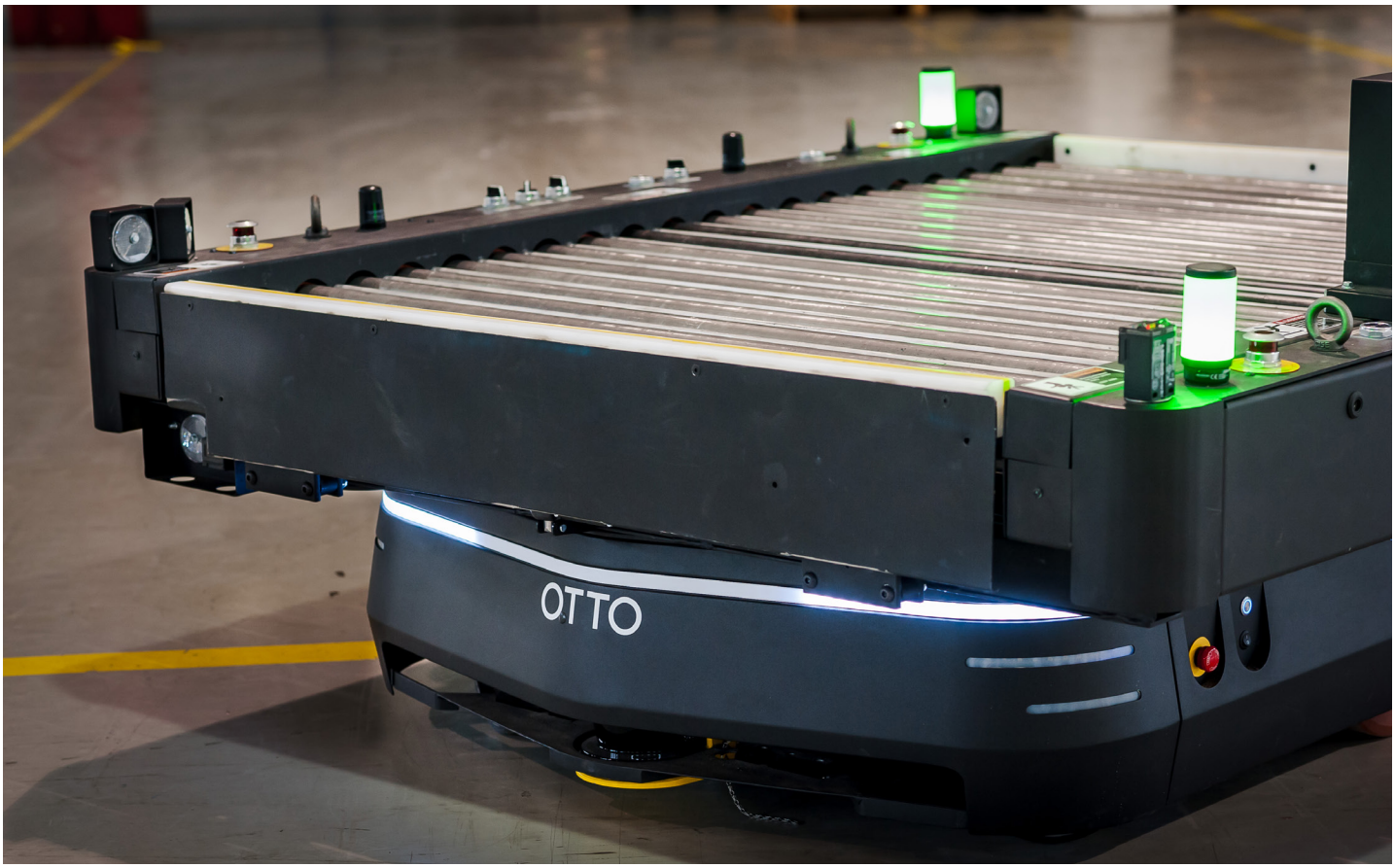
* Gross payload without attachments. Maximum payload is 1,500 kg (3,300 lbs.) with hydraulic lift or in-line conveyor attachment options.

Connection with a warehouse management system (WMS) or manufacturing execution system (MES) enables coordinated and optimized movement of goods, eliminating manual errors and human wait times. Robot movement can also be triggered with push-buttons or tablets.

Common pallet conveyance applications include:

- **Warehouse Transport —** AMRs move palletized products to storage locations after unloading.
- **Cross-docking —** Robots carry pallets routed from inbound trailers or containers directly to the respective outbound trailer.
- **Palletizer/Wrapper/Pallet Crane Load Transport —** Completed pallet loads are transported from various warehouse operations to specific destinations.
- **Empty Tote/Pallet Return —** Automates the collection and transport of empty totes and pallets to refill stations.
- **Trash Removal —** Robots collect and transport corrugate, dunnage and recyclables to processing areas.

In addition to the benefits detailed above, strategies like these increase operational savings by reducing the number of forklifts and operators needed for transport, enabling them to be repurposed for other value-added operations.



PICKING AND CART TRANSPORT

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As e-commerce continues to grow, small shipments of individual orders to consumers are also on the rise — often accounting for half of all orders or more. Autonomous mobile robots (AMRs) can help workers to stay focused on skilled picking tasks while robots handle the low-skilled jobs of transporting items to pack-out and shipping areas.



Workers typically spend much of their time unproductively moving carts from place to place. In large warehouse environments, these workers may have to walk up to 15 miles per day. By transferring responsibility for moving completed bundles to AMRs, this burden can be relieved, reducing average pick times by nearly 50%.

This solution is ideal for zone picks and rush orders, and can also be used when processing returns. A variety of interfaces can be used to call the nearest available robot to pick up the cart and deliver it to its destination.



In a similar way, manufacturing operations can streamline the workflow of kitting processes. Using AMRs for transport eliminates many of the delays or errors that can occur when workers have to wait, don't move to the right locations, or have other responsibilities in addition to moving goods.

In either environment, AMRs offer dramatic productivity benefits by automating cart movement, enabling you to redeploy workers to higher-value activities. As with pallet conveyance AMRs, the robotics solution can connect directly to a WMS or MES system.

AMRs can travel over any floor surface smooth enough to handle a conventional cart pushed by a worker. Instead of spending nearly half the day walking, workers can simply park carts in designated pickup locations and call robots to come pick them up. In this way, carts can be transported virtually anywhere in a facility with little or no human intervention.

KITTING APPLICATIONS

In manufacturing environments, the MES can instruct robots to pick up and transport items. Fabricated, assembled or kitted items are placed onto a cart beside the workstation. A signal is sent to the fleet management system indicating the next destination for the items. The robot then arrives, connects to the cart, and delivers it to the designated location.

AUTOMATED MACHINE TENDING

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While many manufactured goods are fabricated and assembled by automated equipment, parts or works in progress must often be moved from one machine to another. And since destinations can vary depending on the current workflow, this transport is usually a manual process.



To keep production moving, many manufacturing operations need a sizable portion of their staff to move formed or assembled parts from one process to another. In some cases, these tasks can require as much as 20–25% of the entire workforce.

Although the transport process is repetitive, the workflow is generally intermittent. As a result, workers must sometimes wait for parts to be transported or delivered. In addition, transporting parts is often one of multiple roles workers fulfill, causing unproductive and wasted time.

BRIDGING THE GAPS IN MANUFACTURING

AMRs that thrive in environments like these are equipped with in-line conveyors or custom attachments that enable efficient, zero-touch material transport of loads up to 1,500 kg. In a typical machine-tending workflow, AMRs bridge gaps in the manufacturing process, keeping production moving by easily managing variations in workflows that traditionally required manual heavy load transport.

AMRs offer a more energy-efficient solution than traditional conveyor systems. Workers also benefit from their extremely quiet operation, easy startup and low maintenance.

OTHER APPLICATIONS

- **Replenishment —** Mobile robots can be used in DCs to perform tasks such as replenishment and delivery to and from automated storage and retrieval systems (AS/RS).
- **Conveyor Bridging —** AMRs can serve as a versatile robotic "bridge" between different conveyors in virtually any facility.
- **Empty Tote or Pallet Returns —** When not preforming other tasks, mobile robots can collect empty totes or pallets and return them to refill stations.

In all of these applications, AMRs handle the seamless movement of goods between locations, enabling full and continuous equipment utilization.

OPTIMIZING MOBILE ROBOTICS SOLUTIONS

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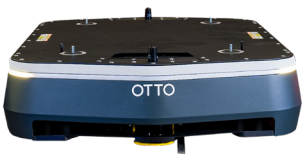
Many suppliers can claim to customize robots for specific jobs. But few have the end-to-end knowledge of the logistics ecosystem necessary to recommend robotics applications that will deliver the full promise of mobile robotics to today's DCs.

This is an important consideration, because the process of deploying AMRs inevitably raises questions that will have unique answers based on your operation. How many robots will you need? What IT changes — if any — will be needed to integrate AMRs? How quickly will you see ROI? How can you ensure the robots will make a smooth transition to future expansions or reconfigurations? All of these variables must be considered when deploying any AMR solution.

Honeywell Robotics can help you to explore how AMR technology can be applied to your unique challenges, whether you're implementing one of the use cases detailed in this report or creating an innovative new application of your own. Our Robotic Solution Design Services gives you access to some of the industry's top robotics and logistics experts backed by a robust pool of advanced tools, including simulation, physics-based emulation and more.

In this way, you can optimize AMR solutions to meet the unique needs of your operation. You'll get highly accurate throughput and performance estimates *before* you begin site integration. You'll also benefit from the full breadth of Honeywell Intelligrated's decades of expertise in materials handling, ensuring that all your operational requirements will be met via the best and most economical solution.







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