VANDERLANDE

WHITE PAPER

Combat Labor Scarcity in Your Warehouse with Reliable Robotic Solutions

MOVING YOUR BUSINESS FORWARD

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Introduction

Whether picking cases for store replenishment or picking items for e-commerce fulfillment, today's robots are dependably delivering value in workforce challenged operations.

Warehouse labor statistics are grim. According to the U.S. Bureau of Labor Statistics, at the end of the first quarter 2022 there were 11.5 million open jobs and 6 million unemployed Americans.[1] That partly explains why 73% of omni-channel retail, e-commerce, and grocery warehouse operators can't find enough labor, according to a report in *FreightWaves*.[2] Other reasons include the longstanding and widespread perception that warehouses are dark, dirty, and dangerous places. Thanks to the negative publicity surrounding working conditions at major retailers, more prospective hires are aware that the work is often boring, repetitive, and physically strenuous.[3]

They're not wrong. Many warehouse jobs include manual handling of heavy cases and intense pressure to meet productivity goals. The work is demanding, and often comes with a high risk of repetitive stress injuries and other musculoskeletal disorders. Indeed, warehouse workers suffer injuries at more than double the average rate of other jobs.[4]

1. Bureau of Labor Statistics, U.S. Department of Labor. (2022, May 9). The Economics Daily: Number of unemployed people per job opening is 0.5 in March 2022 at https://www.bls.gov/opub/ted/2022/number-of-unemployed-people-per-job-opening-is-0-5-in-march-2022.htm (visited December 13, 2022).
2. Straight, B. (2022, February 18). Survey: 73% of warehouse operators can't find enough labor. FreightWaves. https://www.freightwaves.com/news/survey-73-of-warehouse-operators-cant-find-enough-labor (visited December 13, 2022).
3. Hanbury, M. (2021, October 13). Retailers struggle to hire warehouse workers ahead of the holidays, with brutal hours and poor working conditions taking their toll, a report says. Business Insider. https://www.businessinsider.com/labor-shortage-warehouse-jobs-workers-put-off-hours-conditions-2021-10?international=true&r=US&IR=T (visited December 13, 2022).
4. Long, K. (2022, October 19). Amazon workers say minor aches suddenly became debilitating as they raced to meet speed targets. Business Insider. https://www.businessinsider.com/warehouse-injuries-amazon-chronic-pain-speed-risk-productivity-targets-employees-2022-10 (visited December 13, 2022).

That's not a surprise, considering it's expected that warehouse employees will handle up to 500 cases per hour. Cases can weigh anywhere from a few pounds to more than 100 pounds. Even workers whose employers adhere to Occupational Safety and Health Administration's (OSHA) recommended limit of 35 pounds or less still expose their warehouse employees to physical injury.[5] Further, it's an occupation that keeps workers on their feet for eight to 10 hours per shift, increasing fatigue and injury risks.

Meanwhile, consumers' preference for the convenience of online retail and grocery shopping continues to grow. U.S. e-commerce revenue in 2022 was approximately $905 billion and forecast to exceed $1.7 trillion by 2027.[6] Online shoppers expect a wide selection of stock keeping units (SKUs) to be in stock, at low prices, and delivered fast and free.

Implementing either case picking or item picking robots (or both) in these operations can supplement the lack of available workers while increasing overall productivity and throughput.

Whereas even ten years ago, an operation could simply hire additional temporary labor to keep pace, today that's no longer a possibility due to the labor shortages noted above. Without enough available labor, it's become incredibly difficult — if not impossible — for omni-channel, e-commerce, and grocery warehouses and distribution centers to maintain productivity levels that meet the service level agreements necessary to keep customers happy.

The answer to the labor scarcity in the face of overwhelming productivity demands?

Robots.

Implementing either case picking or item picking robots (or both) in these operations can supplement the lack of available workers while increasing overall productivity and throughput. Moreover, the addition of robots to a warehouse or distribution center improves working conditions. Employees who previously picked cases and built pallets for retail and grocery store replenishment no longer have to handle the heavy, repetitive lifting. Workers picking items for e-commerce order fulfillment spend less time walking the aisles to locate products. Both groups can shift to more interesting, value-added tasks.

5. Occupational Safety & Health Administration, U.S. Department of Labor, Safety and Health Topics, Warehousing Hazards and Solutions: Ergonomics and Musculoskeletal Disorders. https://www.osha.gov/warehousing/hazards-solutions#accordion-82316-collapse1 (visited December 13, 2022).
6. Statista. (2022, November 11). Retail e-commerce revenue in the U.S. 2017-2027. https://www.statista.com/statistics/272391/us-retail-e-commerce-sales-forecast/ (visited December 13, 2022).

Further, warehouse workers want to work with automated solutions. According to a survey conducted by Accenture and published by Harvard Business Review[7] of warehouse workers' sentiments toward automation, respondents feel technologies like robots:

› improve their ergonomic safety,
› increase their productivity, and
› help them perform their jobs better.

In spite of these benefits, some retail and grocery companies hesitate to invest in robotic solutions to augment their workforce. There's a lack of understanding about what is — and what isn't — possible with case pick and item pick robots, as well as how to ensure a successful implementation. Additionally, some organizations have concerns that robots aren't capable of running continuously. They may also need additional cost justification points as they work to calculate the business case for a robotic investment.

This white paper provides details that address all three concerns and demonstrates how today's case pick and item pick robots dependably deliver value in workforce challenged operations.

Case and Item Picking Robots: Implementation Success Factors

The key to a successful implementation of a robotic solution in grocery or retail operations — either for case picking or item picking — is to first start with an automated storage and retrieval system (AS/RS) outfitted with goods-to-person (GtP) workstations. Then, when transitioning to a robotic picking system, it is imperative to match the robot to the products handled. There are several factors that contribute to ensuring the optimal outcome of each installation.

Case Picking Robots

For grocery operations with labor constraints, the ideal robotic handling application is to augment an AS/RS/GtP system with case picking robots. Through a manual teaching process conducted during installation, this well-established technology uses integrated vision sensors and end-effectors (either vacuum-powered suction cups or a gripping mechanism).

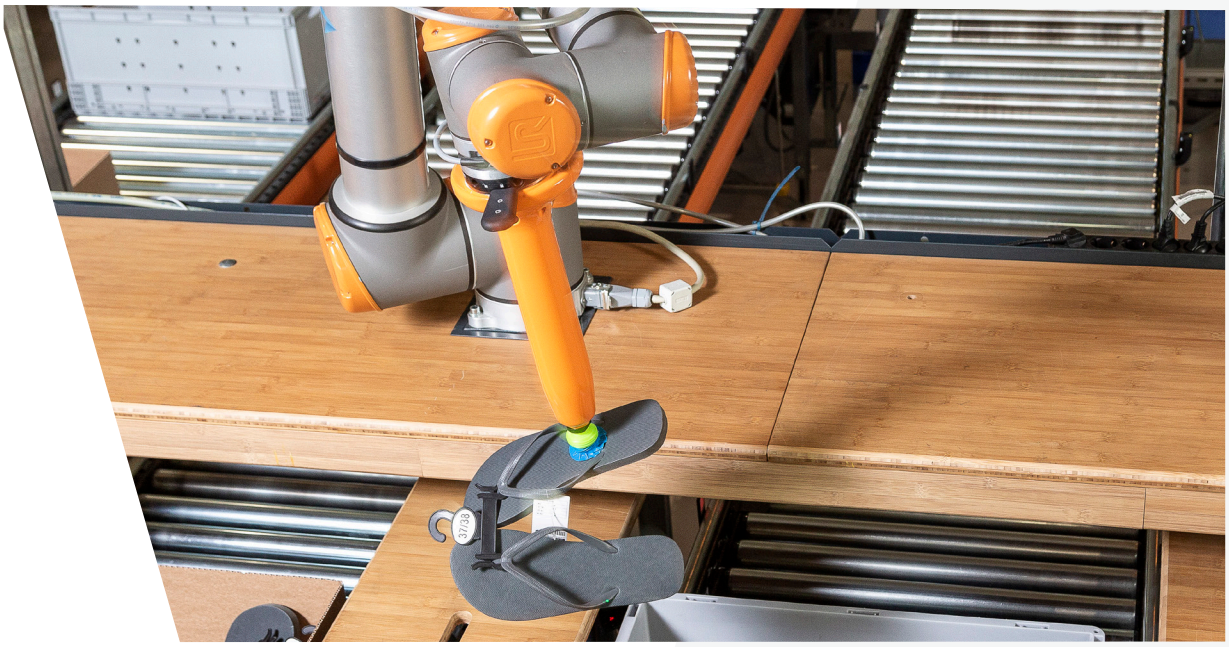
7. Lui, J., Narsalay, R., Afzal, R., Sharma, I. N., & Light, D. (2022, February 11). Research: How do warehouse workers feel about automation? Harvard Business Review. https://hbr.org/2022/02/research-how-do-warehouse-workers-feel-about-automation (visited December 13, 2022).

The robots use these systems to learn to identify, pick, and orient cartons that match a set of key characteristics. These include medium load weights, regular and consistent dimensions, and sealed packages (as opposed to individual items).

Case picking robots build aisle-ready pallets for faster in-store replenishment. Their control software utilizes sophisticated algorithms that feed the products to the robot in a continuous, pre-planned flow. This specific sequencing ensures that items stocked in proximity to each other in a store aisle are stacked together on the pallet. Organizing the cases this way saves store associates time as they dismantle the pallet load while restocking shelves.

Additionally, the robotic control algorithms eliminate product damage commonly associated with manual pallet building. They prevent product damage or crushing caused by improper stacking, as well as ensure that cases are properly balanced on the pallet to prevent the load from collapsing. Removing workers from this strenuous, time-consuming process increases efficiency and productivity. It also eliminates employees' risk of repetitive stress injuries or becoming fatigued. Using case picking robots to build pallets further reduces the amount of time it takes to get product shipped. They also support more efficient use of the trailer cube, reducing both transportation costs and environmental impact.

Not only can case picking robots automatically build pallets, but they can also load rolling containers. These transport and delivery carts are often used to replenish shops with smaller footprints, such as those located in metropolitan areas.



Item Picking Robots

For picking items, nothing is as dexterous, versatile, or adaptable as the human hand. That made AS/RS with GtP workstations an ideal solution for boosting throughput and productivity. When labor was easy to hire and retain, there was less incentive for suppliers to develop item picking robots. However, thanks to the increase in e-commerce and the current workforce challenges, suppliers have introduced a host of new solutions for robotic item picking. When integrated correctly, stationing item picking robots at GtP workstations can yield great results.

Compared to the relative consistency of cases that makes case picking robots so effective, there is much greater variety among individual items. Products come in a broad range of shapes, sizes, weights, dimensions, and packaging — all of which change regularly for marketing or promotional reasons. Their availability also often shifts throughout the seasons. And, with customers' increasing expectations for choice, the proliferation of SKUs across virtually every consumer-packaged goods (CPG) category equates to hundreds of thousands of individual items a warehouse must stock. Because of the sheer number of products, manually teaching an item picking robot to identify, recognize, and automatically handle each item is impossible.

With the significant advancements made in artificial intelligence (AI) and machine learning (ML), however, item picking robots no longer need manual teaching of the characteristics of individual products. Instead, AI and ML embedded within the robot's control algorithms enable it to determine how to pick an item it's never encountered previously.

This advanced capability allows item picking robots to accommodate packaging changes, the introduction of new SKUs, and product diversity with a high degree of accuracy and reliability. It also has enabled the practical deployment of robotics to item pick applications.

That said, there are certain product characteristics that contribute to the greater likelihood of a robot successfully picking an individual item. These factors include the packaging type, weight, and dimensions. For example, health and beauty products are frequently ideal candidates for item picking robots; traditional two-part shoeboxes are not, as the robot picks the lid but leaves the rest of the product behind.

Additionally, no single robot exists that can pick the same range and variety of individual items that a human can grasp. Robotic suppliers are increasingly introducing suction cup and gripper exchangers that allow one robot to pick a broader selection of items. However, this increases complexity as the robot needs to know which end effector or gripper to use.

Different brands of robots perform better with certain product ranges. Some systems are ideal for handling apparel, but not general merchandise — and vice versa. This means that an operation primarily fulfilling apparel orders will potentially choose a different robot vendor than a facility handling general merchandise. In either case, the key to successful item pick robot implementation is to manage the inflow of products. The robot should only receive items that is can handle.

Further, the item picking robots must be integrated into the operations' overarching warehouse control software. This ensures that each robot receives only the products it is configured to pick. With onboard AI and ML, the right mix of robotic solutions, and proper configuration, the number of orders that item picking robots can fill will steadily increase. That's why it's important to work with a vendor capable of integrating multiple types of robots from a broad range of suppliers into a complete, end-to-end solution.

Case and Item Picking Robots' Reliability Hinges on End-to-End System Design

Key to ensuring continuous uptime and reliable operation of case and item picking robots is understanding that these technologies do not work in a vacuum! Rather, to function dependably, a reliable, finely tuned, fast, automated storage system must feed both case and item picking robots the products they are configured to handle. Additionally, sophisticated software directs the entire solution.

The algorithms noted above integrate with an AS/RS. There are a broad range of AS/RS designs and configurations in the market. For apparel, CPG, and general merchandise storage, roaming shuttle-based systems are ideal. These AS/RS provide highly dense storage across multiple, closely spaced levels. Inside, designated locations hold totes of items or full cases of product.

As directed by integrated control software and the facility's overarching warehouse management system (WMS) or warehouse execution system (WES) software, the roaming shuttles store or retrieve item totes or cases on demand. These powered, robotic shuttles travel independently forward, backward, and side to side upon rails. The shuttles are not restricted to specific levels or areas within the AS/RS, making them highly available and ensuring continuous operation.

Each shuttle utilizes an integrated mechanical extractor to insert or remove the necessary container of product into or out of its storage location. When a case or item is needed, the roaming shuttle closest to the storage location travels to that position, removes the item storage tote or case, and travels to a product lift platform. The shuttle deposits its payload onto the platform, which then lowers it for routing to its next destination.

Cases destined for robotic palletizing then travel by conveyor to case picking robots in the proper sequence for building highly dense, stable, and store-ready pallets or rolling carts to a picking workstation. Likewise, the software routes totes of individual items to specific picking robots configured to handle products with a specific set of characteristics. The system routes any cases or items that fall outside of the case or item picking robots' handling capabilities to manual picking stations.

An additional advantage of integrating roaming shuttle AS/RS to feed case and item picking robots is that the overarching system is highly modular and redundant. Further, to accommodate changing business needs, it is possible to expand the AS/RS structure, induct more shuttles, and add more robots for even higher throughput rates.

The Business Case for Case and Item Picking Robots

There are at least three different ways to justify an investment in case and item picking robots: operational reliability, increased productivity, and reduced dependence on labor.

Operational Reliability: Case Picking Robots Run at 120% Capacity

A major supermarket chain invested in five case picking robots in one of its regional distribution centers. Implemented in separate cells for building store-ready pallets to replenish their retail outlets, the robotic solution was deployed prior to the emergence of the COVID-19 pandemic.

Designed to handle a maximum of 65,000 cases per day total (approximately 13,000 cases per case picking robot), the operation found itself extremely shorthanded for an extended period of time during the pandemic due to illness-related absences. Yet, at the same time, lockdowns prompted consumer demands for products in-store, for curbside pickup, and delivery to increase dramatically as people stocked their own pantries and spent considerably more time at home.

Unable to supplement their robotic case picking robots with additional labor, the facility opted to increase the systems' operating speeds. To compensate for the extra order volumes, the facility handled a significant number of additional cases over a four-week period. On its busiest day, the robotic case picking system palletized just under 75,000 cases, 120% higher than the capacity design.

Operations managers reported "shattering their records in terms of weekly volumes out the door" with no problems. This demonstrates that even when faced with the unpredictable — pandemics, hurricanes, market volatility, SKU proliferation, shifting c ustomer preferences, and more — robotic systems are capable of running both reliably and far above their expected capacity with no downtime or operational interruptions.

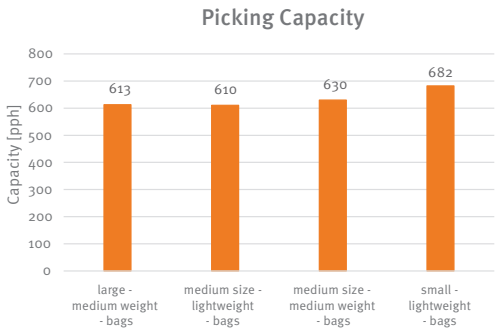
Increased Productivity: Item Picking Robot Picks More Than 600 Poly-bags/Hour at 100% Accuracy

An American clothing brand seeking to increase productivity — yet faced with recurring staffing availability issues — pilot tested an item picking robot. The test picking cell combined a robotic picking arm, sophisticated vision system, and a vacuum gripper with three suction cups. The test presented the robot with a broad selection of polybagged small, medium, and large sample products of both light and medium weights in plastic totes. The goals of the test included determining:

- If the system could successfully and consistently transfer an item in a storage tote to a different destination tote.
- The overall pick capacity, as well as pick capacity for individual sizes and types of products.
- The rate of pick success (the number of successful picks divided by the number of total picks in a 10-attempt limit).
- The pick accuracy rate, meaning no multi-item picks, no item damage caused by the robot, and no unidentified items lost.

The SKU Pick Test with items showed excellent results: capacity ›600 and 99.9% pick success rate, 100% accurate picks

KPI	Description	Specification	Results
Capacity	Successful picks per hour [pph]	Transfer of an item from pick- to place target with the system reporting a successful pick	Average: 634 pph Range: 610-682 pph
Pick Success Rate	#successful picks / # total picks	10 attempts allowed before pick has failed	99.9%
Picking Accuracy	(1 - # undetected errors) / # total picks	Multi pick, damaged item by robot, unidentified item lost	100%

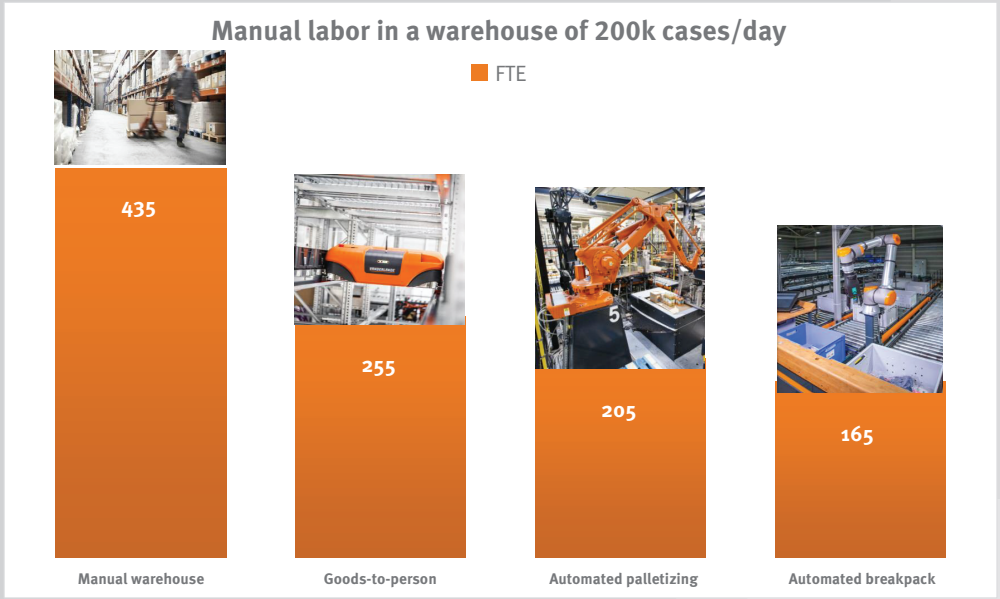


The results of the pilot test, as shown in the graph above, note that the item pick robot achieved a pick capacity range from 610 to 682 picks per hour, depending on the size and weight of each item. Average picking capacity was 634 picks per order with a pick success rate of 99.9%. The system also produced 100% picking accuracy.

Reduced Dependence on Labor: Pairing Automation and Picking Robots

Quantifying the loss in revenue associated with not having enough workers to maintain the throughput necessary to meet customers' expectations depends on factors specific to each company. However, it is possible to demonstrate a reduction in labor dependence by implementing case and item picking robots fed by an AS/RS, as shown in the figures below.

How step-by-step implementation of warehouse automation technology reduces the need for manual labor by 60% (from 435 to 165 FTE)



Example system:
› 7days x 20hr Operation
› 10,000 Cases per hour
› 125 Pallets in/out

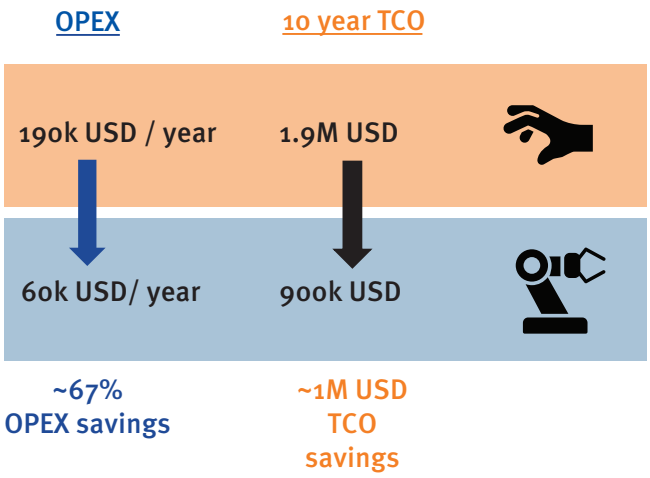
Implementing a case picking robot to palletize cartons for outbound shipping at a rate of 10,000 cases per hour for 20 hours a day, 7 days a week creates 125 pallets per day. To achieve that level of productivity in a manual operation would typically require 336 full-time employees; deploying an AS/RS to feed case pick robots enables the same throughput volume at roughly half the headcount: 172 full-time employees. Adding an item picking robot to select individual products to fill orders for outbound shipping further reduces dependence on manual labor by an additional 10%, to 152 full-time employees.

Additionally, when compared to manual picking as shown in the figure below, robotic picking solutions deliver a two-year payback and yields approximately 67% savings in overall operational expenses.

For example, consider a $500,000 case picking robot capable of handling 500 cases per hour and running for 20 hours/day. Purchasing four (the typical installation) is a $2 million investment. To maintain four robots costs $75,000/year (a base cost of $45,000 for the first robot, plus $10,000 to maintain each additional robot). For four robots, that's a $2 million investment plus $75,000 in annual maintenance costs.

For double shift operations, a robot pick station has ~2 year payback period and enables ~67% OPEX savings

› Double shift	3 FTE
› Fully burdened employee cost	60k USD/year
› Operational robot cost	60k USD/year
› Robot workcell cost	265k USD



Conclusion

It is unlikely that the labor shortfalls currently experienced by omni-channel, e-commerce, and grocery retailers will improve anytime soon — if ever. Even a leaked research report from Amazon noted that the company is likely to run out of people to hire to work in its U.S. warehouses by 2024. Meanwhile, while labor continues to remain scarce, its cost will continue to rise. Further, stores have begun to make a comeback with attracting shoppers, and consumers have continued to embrace the convenience of e-commerce. Therefore, demand for case and each picking will continue to rise.

Further, case picking robots are well established in retail warehousing; item picking robot development has reached a point where they are very reliable, with additional improvements over the next two years likely to be incremental. Costs have come down for both solutions, and there are many examples across the broader supply chain industry of successful implementations. An investment in these solutions is a safe way to remain on the leading edge.

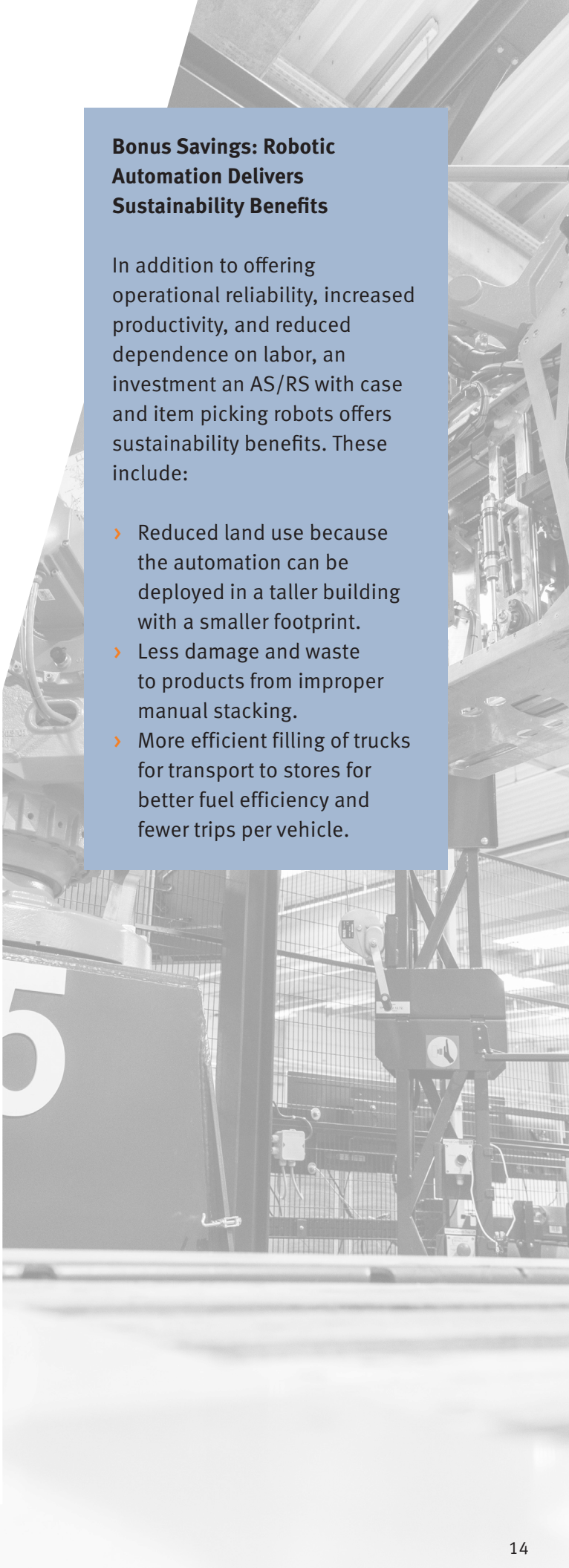
Now's the time to investigate implementing a complete solution — including reliable robotic case and item picking — from Vanderlande. With more than 1 billion cases picked over past five years, Vanderlande can provide a complete, end-to-end system. This includes roaming shuttle AS/RS, overarching control software, and implementation of a broad range of case and item picking robots from all leading suppliers. Because Vanderlande partners with multiple robot manufacturers, each application incorporates the best-fit robots for an operation's unique handling needs.

To learn more about how Vanderlande can help your omni-channel, e-commerce, or grocery warehouse and distribution operations successfully address today's labor shortage and position your company for the future, connect with us at info.us@vanderlande.com.

Bonus Savings: Robotic Automation Delivers Sustainability Benefits

In addition to offering operational reliability, increased productivity, and reduced dependence on labor, an investment an AS/RS with case and item picking robots offers sustainability benefits. These include:

- Reduced land use because the automation can be deployed in a taller building with a smaller footprint.
- Less damage and waste to products from improper manual stacking.
- More efficient filling of trucks for transport to stores for better fuel efficiency and fewer trips per vehicle.



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