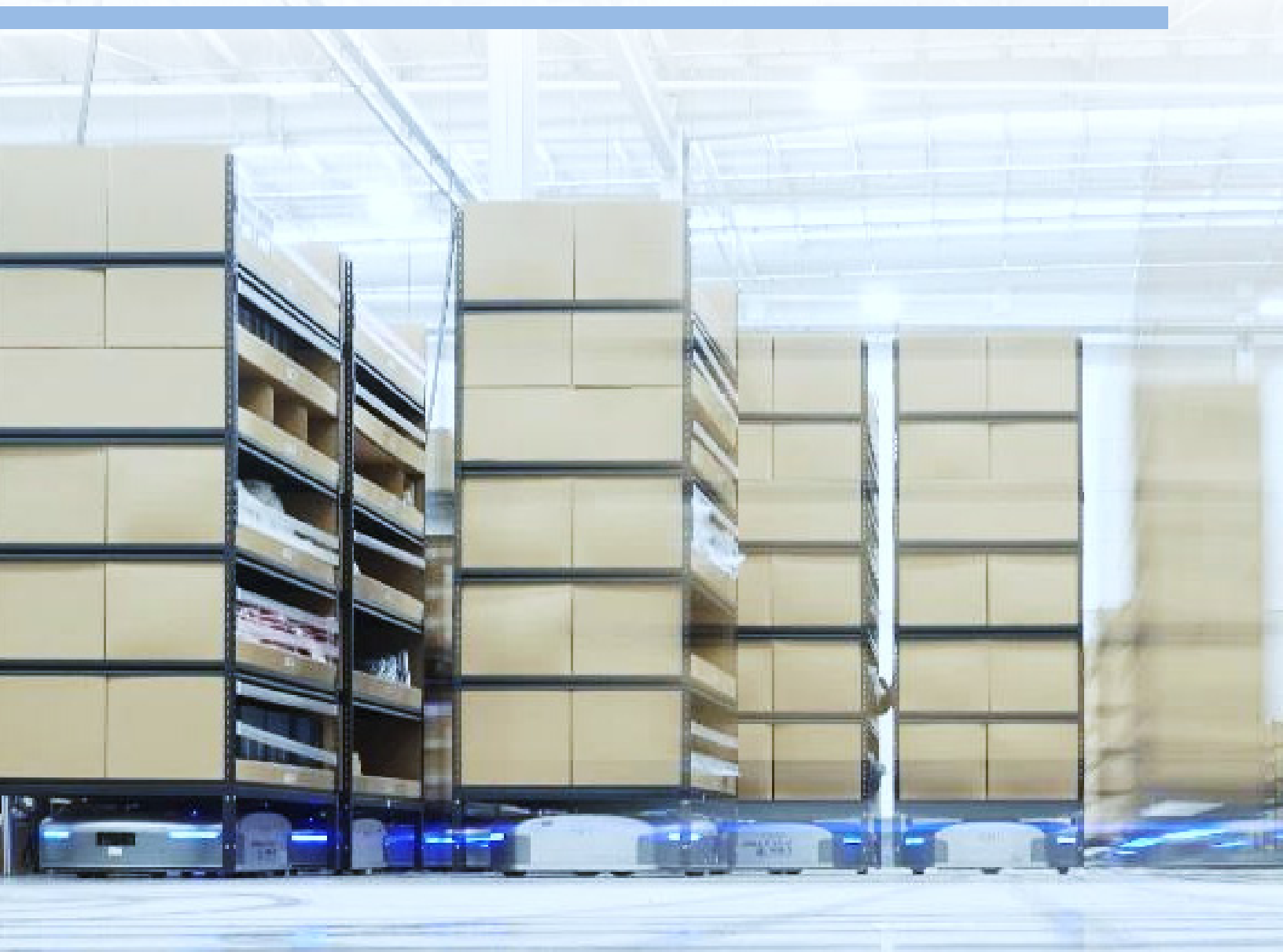




How Growing E-Commerce Demand is Driving Growth in Mobile Robotics

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HOW GROWING E-COMMERCE DEMAND IS DRIVING GROWTH IN MOBILE ROBOTICS

Flexible solutions and multiple designs are improving efficiency and addressing labor shortages for e-commerce fulfillment warehouses and other logistics companies around the world.

By Phil Britt

As e-commerce continues to grow beyond traditional shopping habits, and as warehouse efficiency demands grow for e-commerce and traditional commerce, companies are relying more on automation to meet market needs.

In this whitepaper, we will examine the state of current robotic and automation usage at warehouses and third-party logistics providers (3PLs); the drivers behind expected growth and some of the different types of robots used in these facilities; and examine some successes that facilities have in reducing their labor costs, and improving productivity.

CURRENT STATE OF WAREHOUSE AUTOMATION

By 2025, [more than 4 million commercial robots](#) will be installed at more than 50,000 warehouses, according to ABI Research. This is up significantly from just under 4,000 warehouses with robots in 2018.

The company cites the need for flexible, efficient and automated e-commerce fulfillment; increasing affordability and return on investment (ROI) of a growing variety of infrastructure-light robots as growth drivers.



“Flexibility and efficiency have become primary differentiators in the e-commerce fulfillment market as retailers and Third-Party Logistics (3PLs) struggle to cope with volatile product demand, seasonal peaks, and rising consumer delivery expectations.” said Nick Finill, Senior Analyst at ABI Research. “Robots enable warehouses to scale operations up or down as required while offering major efficiency gains and mitigating inherent challenges associated with labor and staffing.”

Though the figures and timeframe different slightly, research firm [Tractica's Warehousing and Logistics Robots report](#) also forecasts tremendous growth with the number of robot shipments growing to 620,000 by 2021, up from 40,000 in 2016.

“Warehouse and logistics industries are looking for robotics solutions, more than ever before, to remain globally competitive, [leading] to widespread acceptance and ‘presence of robots in warehouses and logistics operations,” the report said.

WHERE GROWTH LIES

Human workers can put in only so many hours a day. Even if their time working in the facility isn't limited by labor laws, the reality is that physically, there is only so much a human worker can do in a single shift. Additionally, there isn't a sufficient workforce to meet the demand for product movement in major cities, let alone the facilities located outside major population centers. Automation removes those constraints.

That's not to say that robots will be working in fully automated environments, at least not any time soon. While it is true that some facilities that have added robots have reduced their workforces, other facilities have added human workers alongside the robots. Both humans and robots are needed to meet the growing demand caused by increased e-commerce usage.

“ Robots enable warehouses to scale operations up or down as required, while offering major efficiency gains and mitigating inherent challenges associated with labor and staffing. ”

– Nick Finill, ABI Research

Though many warehouses rely on conveyors and other fixed machinery, autonomous mobile robots are driving the growth in automation. They come in various sizes and configurations to move and pick materials and handle other repetitive, sometimes dangerous, warehouse tasks. The newer, smaller robotics systems can be quickly moved, stored and redeployed to handle seasonal surges in orders, Finill points out. As a result, modern robotic systems are replacing older kinds of automation, or to make workers more productive and not to replace workers.

ECONOMIC BENEFITS OF ROBOTS IN WAREHOUSES, LOGISTICS

Robots enable the optimization of space in expensive warehouse facilities and can reduce the need for new and costly green field fulfillment centers. While new centers are still being built, they are being built with robots and other automation in mind.

Mobile robotic systems also offer major flexibility advantages. Robot vendors enable additional robots to be added to or removed from a fleet as operational demands require, ABI Research added. They also allow easy and relatively rapid reconfiguration of entire workflows and operations if product lines or fundamental operational requirements change. This is a major advantage in the unpredictable and dynamic e-commerce market.

Advances in artificial intelligence, deep learning and robotic mechanics are enabling robots to do more than ever before. In addition, advances in manipulation capabilities enable a wider variety of individual items to be automatically picked and placed within a fulfillment operation.

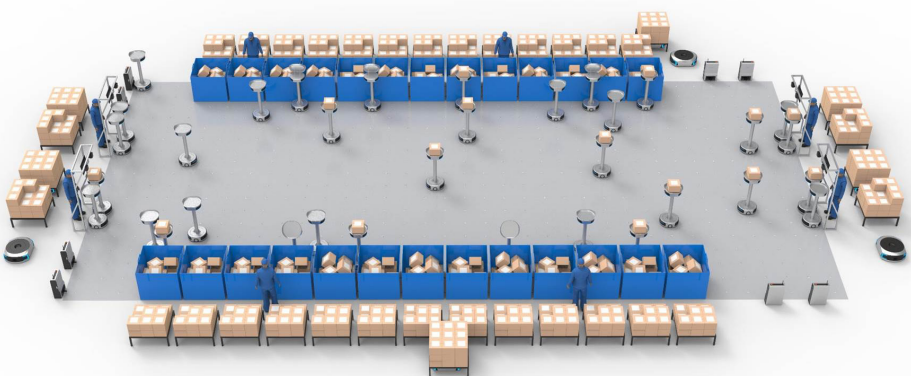
Picking robots, controlling systems, charging stations, mobile robots, automated guided vehicles (AGVs) and other automated systems are essential

New warehouses are being designed with mobile robots in mind.

elements of state-of-the-art warehouse systems. However, we're still seeing a large percentage of warehouses trying to meet the demands of e-commerce with human workers – either they have yet to realize the benefits of adding robots, or their warehouses are not designed for automation, and retrofitting is prohibitively expensive.

Other facilities are in some early state of automation, but have yet to go beyond the initial stages.

The ABI report acknowledges the economic challenges, which robot manufacturers have recognized as well. Robot manufacturers and integrators will typically meet with facility managers to ensure smooth initial deployment, and to ensure that the user gets maximum benefit from the unit(s) they deploy. The hope from the robot providers is that smooth initial implementation and quickly realized benefits will result not only in that customer purchasing more units, but also that the news about the benefits will get out quickly so others in warehouses and other facilities will see the value of the automation.



The prices of the robots themselves are also expected to drop, [according to ARK Investment Management](#). According to ARK's research, industrial robot costs (fixed and mobile) will drop by roughly 65% by 2025. Combined with advances in machine learning and computer vision, the investment firm said the drop in costs should cause an inflection point in the demand for robots as they infiltrate new industries with even more provocative use cases.

To further ease the economic challenges of adding automation, several robot providers are offering flexible pricing options. Robotics-as-a-Service models enable companies to replace large capital expenditure costs with more accessible operational expense costs. The latter are directly proportional to the consumption of technologies or services, improving the affordability of robotics systems among the mid-market, further driving adoption.

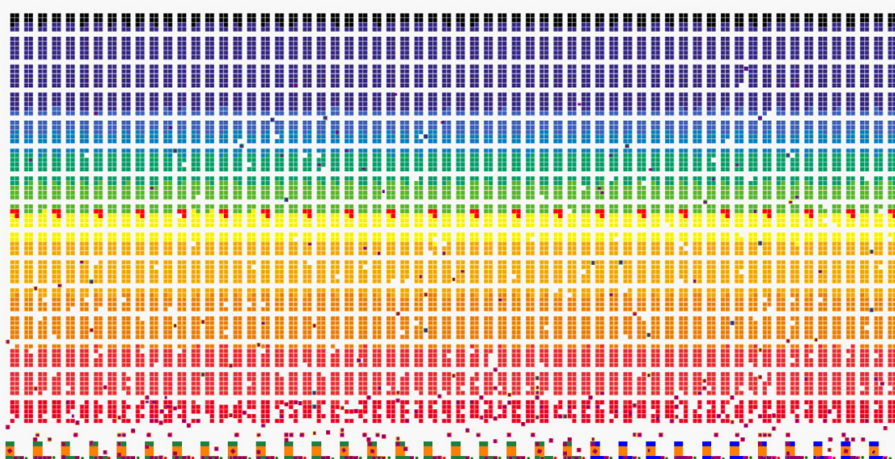
“By lowering the barriers to adoption for robots in the warehouse, vendors are disrupting the wider logistics value chain,” explained Finill. “If advanced automation becomes possible for mid-size e-retailers, they will be able to fight back against the dominant players and also bring fulfillment operations back in-house, disrupting the relationship between retailers and 3PLs.”

ARTIFICIAL INTELLIGENCE

Beyond hardware advances, robots are now leveraging AI and deep learning to deliver more value to users than ever before. No longer does a robot need to be taught every little nuance, the robots learn as they perform tasks to become even more accurate.

By combining AI in a robot with a facility's warehouse management system, for example, goods can be stored and located based on the frequency of purchase. Fast-selling goods can be stored where the robot can most easily pick them, with less commonly ordered items stored “in the back.” Such a storage and retrieval system maximizes an already efficient automated warehouse operation.

A BIS Research report on the Global Robotic Market points out that AI, machine learning and advances in software enable robots to handle tasks that were once the purview of humans alone, such as picking different types of items with increasing accuracy, and adjusting routes through the plant “on the fly” to maneuver around unexpected obstacles, while the complexity and costs of automating tasks continue to go down.



Simulation and artificial intelligence are helping mobile robots become more efficient within a warehouse operation.

Combined AI and warehouse management in supply chains is becoming a reality through deep learning, which combines physical properties of products and psychological concepts to make informed decisions, adding a level of consciousness to the operation. By 2030, it's predicted that one-third of workers in the U.S. will need to switch occupations due to the increased use of robotics as AI matures.

Therefore, those warehouses and other facilities that have yet to adopt robots can do so more affordably, and those facilities that have already deployed robots are likely to deploy more units as the work grows during the next few years.

Warehouses, 3PLs and other facilities need a variety of robots and automation systems to deliver on the growing e-commerce demand.

The demand will be met by older, well-known robots companies, as well as by newer companies growing in their own countries and that will be expanding into international markets.

"The next five years will be a period of significant innovation in the space, bringing significant opportunities for established industry players and for startups alike," said Manoj Sahi, a Tractica research analyst, in the company's report.

According to Sahi, the biggest drivers in the market will likely be "mobile robot platforms and industrial robot manipulators." Sahi also expects shuttle-automated storage and retrieval systems, as well as gantry robots, to have significant impact, but behind those of mobile robots and industrial robot manipulators.

ROBOT USAGE IN FACILITIES

PICKING

Picking is the centerpiece of e-commerce order fulfillment. It is a necessary, often repetitive task that moves products from sitting on a shelf in a warehouse to the pre-delivery stage. Manual item picking is a labor-intensive and tedious task, and can [consume as much as half of a logistics provider's operational costs](#). In a fully manual facility, the time spent traversing through a warehouse fulfilling orders can consume as much as half of a worker's time. As e-commerce grows in popularity and as delivery time expectations continue to shrink, a human workforce can no longer meet these demands. Therefore, automating item picking is essential to maximize efficiency and save costs for e-commerce businesses.

By minimizing the amount of motion that a human worker needs to complete their tasks, picking robots increase warehouse efficiency by as much as 80% while reducing the human labor force, resulting in the systems paying for themselves in as little as two to three years.



The picking robots not only limit the motion of the human workers, but can also handle heavier loads, move faster than humans when it is safe to do so and can work several hours (depending on the robot and the battery) before needing to be recharged. Recharging time differs from robot to robot. Since the robots don't

tire and the machine learning improves their performance from one operation to the next, their accuracy continues to improve. Even the best, most disciplined human workforce is challenged to meet the accuracy level that many robots now achieve.

MOVING

Warehouse workers in a typical facility can walk 10 or more miles a day. That wastes time, not only due to the time it takes to traverse the distance, but even an occasional “quick” conversation in passing with a co-worker further slows the time it takes to get goods from point A to point B. Mobile robots move more quickly than a human typically does, although there are safety routines built into the software to slow a robot down when nearing congestion, as well as to come to a complete stop rather than running into a human or non-human obstruction.

SORTING

Sorting systems can quickly and accurately read bar codes, enabling them to be much more efficient and accurate than humans performing the same task. Companies have reported saving as much as 80% of labor costs, have had systems up and running in as little as two months, achieved positive return on investment in as little as one year, and have enjoyed several other benefits, as discussed in the examples below.



WORLDWIDE IMPROVEMENTS ACROSS INDUSTRIES

Worldwide, warehouses that have added robots have shown tremendous improvements in productivity in a variety of different industries. Below are just a few examples:

- **Apparel:** Decathlon, the world's largest sports retailer, deployed a Geek+ picking system in their Shanghai and Taiwan warehouse in 2018 and 2019, integrated with RFID technology for picking and put-away. The combined warehouses had 2,302 square-meters of space, with 559 units of shelves, supporting 25,000 SKUs. After the deployment, picking efficiency is up to 350 pieces per hour per picking station, equal to three to four times of labor productivity. The warehouses are also available to keep a 24x7 operation.



- **Apparel:** Alpen Co., Ltd., an apparel group, deployed a goods-to-person picking system in 2018, using a fleet of 56 robots for multi-batch picking, order picking and pallet picking. With only eight people working in the warehouse, the picking rate increased 70%, plus the warehouse is now operating around the clock. Picking efficiency grew 400 pieces per hour per station, tripling what it was with a fully human workforce.

- **Manufacturing:** Aiming to meet the high-frequency, long-distance materials handling needs, manufacturer Yanfeng used robotic automation in its production lines, including intelligent system

integration, process configuration and task management; unmanned warehouse management and implementation and operation monitoring.

- **Parcels:** China Postal Express & Logistics Co., Ltd., adopted full AGV sorting technology, using 3D modules for collaborative operations and for simultaneous sorting of various-sized parcels. Using sorting robots, the warehouse can now sort up to 20,000 parcels per hour, saving 80% of the labor costs compared to the pre-robot days. The labor savings led to a positive ROI within the first year.





GEEK+ ROBOTS

The robots from Geek+ enable warehouses, industrial users and 3PLs to meet today's e-commerce demands.

"We think the market potential is quite high," said Zheng Yong, Geek+ founder and CEO. "We hope in the next five years to deliver more than 20,000 to 50,000 robots annually to e-commerce, manufacturing and other companies. We provide only robotics solutions to our customers, but also logistics systems."

"Our customers gain from the data we provide from the breadth and depth of our operational experiences," Yong added. "That provides our customers with a long-term advantage."

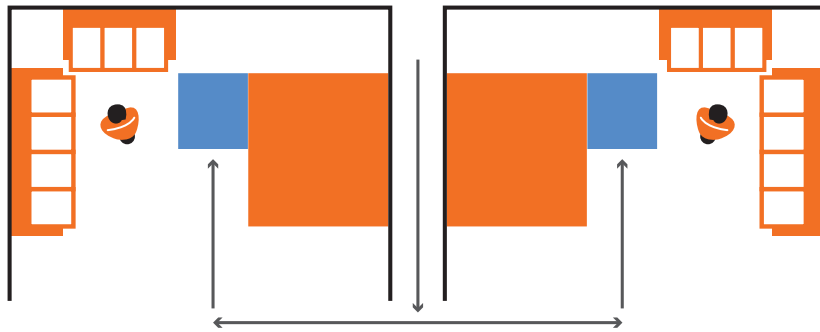
PICKING ROBOTS

The company's goods-to-person picking system utilizes robots to carry shelves, sharply minimizing the distance a human worker needs to travel, meaning faster, more accurate and highly efficient order delivery, tripling the picking rate that users achieve using people alone. The robots leverage machine learning algorithms to improve their performance from order to order.

The robots can be deployed in as little as 1 to 3 months, and will pay for themselves in 2 to 3 years. In addition, the Geek+ robots have no single point of failure, meaning high availability, even when used in a 24x7 operation.

Geek+ robots can work with different workstation configurations, including:

- **Standard Workstation:** The standard workstation has a queuing area that can contain server robots to queue, so the worker can perform his or her work without needing to walk anywhere else. Such a configuration minimizes human movement in order to maximize efficiency. A rack turning area enables the robot to turn the rack safely. The robot can work with an E-shaped or U-shaped workstation layouts.

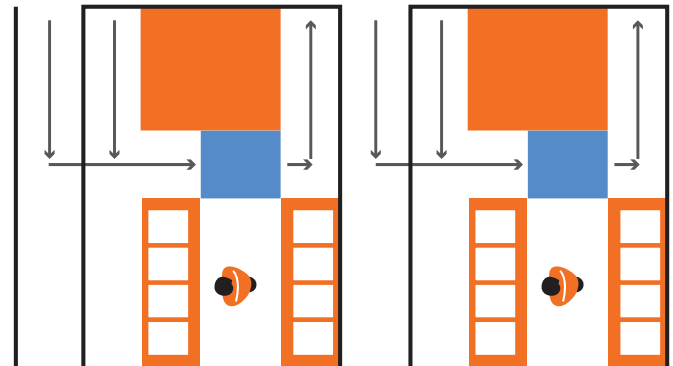


E-shaped Workstation

1. A middle road is allowed robot to come in with 2 workstations besides.
2. This layout is good for high volume operation as it allows 9 robots for waiting to pick in the zone.

U-shaped Workstation

1. 2 rows for robots entering in the working stations
2. Less robots could wait at the working stations area for picking



- **Single-cell Workstation:** The single-cell workstation occupies only a single rack, so there is no queuing area. When the robot picks the rack into the single-cell workstation, it drops the rack to go on to the next task. When the work finishes the operation with the rack, the host system can send a task request and the robot management system (RMS) will select a robot to fetch the material and place it into a stock location. Since there is no robot queuing in such a system, a human worker can take care of multiple single-cell workstations, avoiding waiting for racks, but now has to take the time and effort to walk between stations.

MOVING ROBOTS

The Geek+ M100 moving robot leverages advanced SLAM laser navigation to identify the facility's environment and independently schedule routes, delivering the pallet or rack to the destination flexibly and smoothly. By automating material handling, the M100 robot improves production flexibility. Grippers, rollers, tools and other special equipment enable the M100 robot to handle a variety of light loads. The M100 robot also includes a programmable logic controller (PLC) that can integrate with a variety of machinery systems. The multi-sensor system ensures

safety when working in a facility with barriers, moving around objects and humans. The M100 has no single point of failure, so it is highly available and optimal for 24x7 operations.



SORTING ROBOTS

The Geek+ S20 sorting system uses QR code navigation, scanning the code to determine where a parcel belongs. The robot can automatically sort quickly, sending parcels to the corresponding shipment port.

The sorting system can handle 10,000 to 12,000 pieces per hour with 99% accuracy, saving companies as much as 80% on their labor costs, resulting in a full ROI within 12 months.



FORKLIFT ROBOT

The Geek+ automated forklift automates storage and retrieval, using SLAM navigation and self-driving capabilities to measure and position products on shelves, pinpoint pallet slots, and accurately carry goods to the proper area using instructions from the scheduling system.

The automated forklifts reduce labor, maximize space utilization and cater to complex working environments, providing users with higher efficiency, safety and lower risk than with human workers and traditional forklifts. By quickening movement of materials within facilities and helping with a labor shortage to perform these chores, the automated forklifts provide safer, more efficient storage and retrieval processes.



AI COMPONENTS

Customers maximize the use and ROI for the above robots through Geek+ Artificial Intelligence (AI) system, which integrates simultaneously with the Geek+ system and various Warehouse Management Systems (WMS) to optimize warehouse operations, enabling facilities managers to dynamically locate and store goods based on the frequency of purchase.

AI is also an essential element for the sorting robot, which uses the AI algorithm and flexible system scheduling to determine the most effective convergence with fixed and moving (other robots, facility personnel) objects.

ROBOTS, AUTOMATION AND HUMANS WORKING TOGETHER

To meet the demands of the growing e-commerce environment, as well as expected faster shipments to brick-and-mortar stores and other more traditional supply chain uses, warehouses, 3PLs and other facilities will continue to invest in mobile robots and other automation.

They will be looking for solutions that can be flexible, not only in the number and types of units that are available, but also that include AI, machine learning and integration with warehouse management systems that maximize efficiencies and minimize the time for full ROI to be realized.

About the author: *Phil Britt is the owner of S&P Enterprises, and a technology writer who lives in the greater Chicago area. His work has appeared in several national technology, financial services and business publications, including magazines, newsletters, conference dailies and online sites.*