Robotics247

SPECIAL FOCUS ISSUE
NOVEMBER 2022

# Mobile Robots Address Constant Peak Demand

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# CONTENTS



# EDITOR'S NOTE

Even before the COVID-19 pandemic, retailers had difficulty finding workers during the holiday shopping season. Now, labor shortages, rising e-commerce, and other supply chain challenges make automation a must-have.

However, simply adding robots to the approximately 70% of North American warehouses that aren't yet automated isn't the solution. Users, suppliers, and integrators alike have to find the right mix of technologies for a particular process or environment.

This Special Focus Issue looks at maturing capabilities such as data collection and the management of growing fleets. In addition, mobile robots can even help businesses retain employees because they can augment existing staffers rather than replace them.

We share key takeaways from A3's recent AMR and Logistics Week. Leading robotics operators and vendors discuss their observations and goals. Whether you're looking to adopt automation for the first time or scale deployments, mobile robots can improve throughput and business agility.

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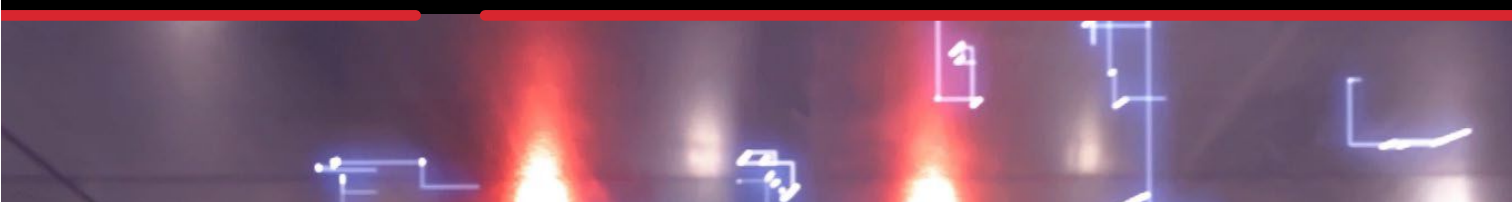
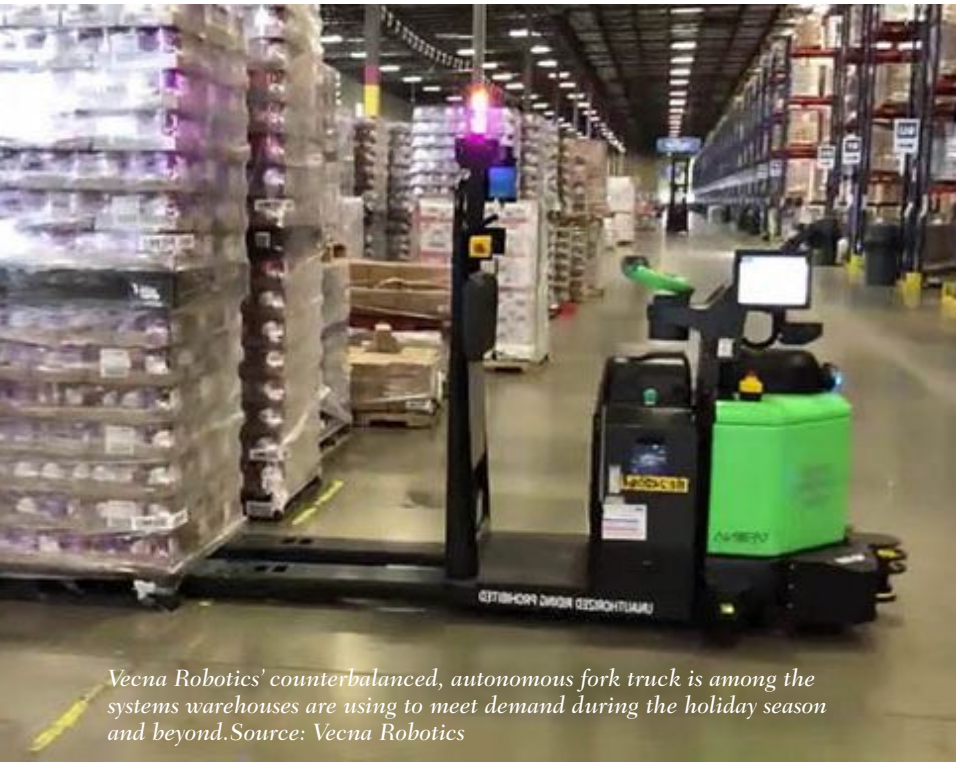


# Autonomous Mobile Robot Makers Answer the Call During Holiday Rush

The holiday season is typical a busy one for 3PLs and other e-commerce-focused businesses. How are AMRs helping address demands?

BY CESAREO CONTRERAS



*Vecna Robotics' counterbalanced, autonomous fork truck is among the systems warehouses are using to meet demand during the holiday season and beyond.Source: Vecna Robotics*

Warehouses and distribution centers are in the rush of the holiday season, working long hours to fulfill orders. While e-commerce sales aren't at the all-time highs they were at last year and throughout 2020, the market still demands strong, flexible, and resilient operations to meet peak demand.

Robots can help answer the call in response to labor shortages and as the underlying technologies powering these autonomous systems continue to improve. Last month, the International Federation of Robotics (IFR) reported that more than half a million robots were sold globally last year.

Autonomous mobile robots (AMRs) are being used for a variety of tasks, and suppliers say they see an increased interest in more flexible systems that can carry higher payloads and adapt to changing workflows.

## Recession worries loom over industry

OTTO Motors CEO Matthew Rendall told *Robotics 24/7* that he is interested to see how this holiday season plays out. There are a lot of different variables at play, he noted, from the state of the pandemic to supply chain concerns.

"This really is the first post-COVID holiday season, so it'll be revealing to see what actually happens," Rendall said. "There are a lot of differing opinions out there whether we are going to see a blockbuster holiday season, because people feel confident that that the pandemic is in the rearview mirror. Or maybe they'll be a bit of a whipsaw because manufacturers have been experiencing a tremendous amount of supply chain pressure."

Those same manufacturers have been stocking up on inventory to prepare themselves, he noted. But with rising interest rates and the threat of a recession on the horizon, Rendall said


"demand could soften, and you'll see a glut of inventory as supply chains become normalized."

### Flexibility a high priority

From now on, customers are going to demand materials handling systems that offer supply chain flexibility, noted Rendall.

"If there is one thing I think that people can easily agree on, in spite of all the different opinions, is that the world is unpredictable," he said. "Therefore, having automation that is flexible to that uncertainty and that high degree of change will prove itself as one of the single biggest drivers of a return on investment."

"Because if you don't have that flexibility, when something comes out of left field, your automation will not be able to respond to it," Rendall added.

### OTTO Motors extends AMR life via software updates

OTTO Motors views its robots as "software-enabled pieces of hardware," Rendall said. The Kitchener, Ontario-based company equips its AMRs with more powerful hardware components then they currently need to accommodate future software updates in the years to come.

"We believe over the life of an asset, you should be able to receive software updates, and the value of your assets increase over time as your software becomes powerful, more capable, and more feature-rich," asserted Rendall. "That's a very different way of thinking about an automation investment because traditional capital equipment thinking is – purchase the asset up front, and it becomes less performant and less valuable over the wear and tear and the lifetime of that asset."

Earlier this year, OTTO Motors launched its OTTO Lifter, an autonomous forklift with a payload capacity of 1,200 kg (2,640 lb.). The new robot has been "doing tremendously well" and has exceeded expectations, said Rendall.

"We're seeing a healthy demand for truly autonomous forklifts," he said.

### Vecna robots handle mixed cases

Vecna Robotics wrapped up deploying its systems to its customers in late October in anticipation of the holiday season, said Matt Cherewka, director of strategy at the Waltham, Mass.-based company. Vecna's customers mostly work in upstream distribution centers, he said.

"We see our volumes going up because those facilities are supplying both replenishment of all those stores getting ready for the Thanksgiving and Christmas rush, but also a lot of the retailers that we work with have implemented a really solid omnichannel strategy," he said.

"A lot of their e-commerce volumes actually get fulfilled out the stores, or they get shipped from the stores for the last-mile perspective instead of coming out of like an Amazon mega fulfillment center," Cherewka added.

He acknowledged that e-commerce volumes are down a bit compared with last year and 2020, but volumes remain high overall.

"I think one of the 3PL [third-party logistics] sites we're at, their peak volumes goes up 6x around this time of the year, so it is still as crazy as ever, maybe not just as crazy as last year," said Cherewka.

### Autonomous forklifts grow in popularity

Like OTTO Motors, Vecna's counterbalanced forklift has been very popular. It has become the company's most popular lift truck, Cherewka said.


"We just announced an upgrade for that," he said. "Part of the upgrade for that was driven by the amount of packaging workflows that we're running into."

As a result of the holiday rush, facilities are seeing more frequent shipments of mixed orders. That creates complexity, observed Cherewka.

"So the final leg of that: 'How do I do get all these orders consolidated and wrapped together and out to trucks?' That's where we've done a lot of work recently."

Vecna's robots have also been useful in helping facilities move around special product displays and stands for the holiday season, Cherewka said. "There are a lot of warehouses that get those shipments in the summer, so they have to pull them all out of the back corner of the warehouse and create these giant assembly lines of people to build these displays and then ship them to all the stores they need to go to," he said. "That's a lot of back and forth, and so we do a lot of workflows around that."

### Holiday season is coming sooner, says Locus

The holiday season continues to start earlier and earlier, commented Kary Zate, senior director of marketing communications at Locus Robotics in Wilmington, Mass. Companies used to start gearing up right after Halloween. These days, they are preparing much sooner than that, he said.

Finding workers continues to be a real challenge, so robots are being bought in to compensate during the holiday rush, Zate added. "At this time of year, a lot of our customers order additional robots as part of their contract to add into their staff," he said. "So instead of finding human labor, they're just adding more robots and getting more productivity out of the existing labor force that they currently have."

Like many robotics companies, Locus Robotics uses a robotics-as-a-service (RaaS) business model. That means companies can request more robots being brought in during a certain time of a year and return them once they are done. These autonomous systems are often called "surge robots" or "peak robots," Zate said.

### Despite slowing economy, online shopping drives automation

While e-commerce has slowed a bit, it will continue to greatly influence how supply chain operates, said Zate. That theory is helped by the fact that during the pandemic, more industries began offering their products online, he added.

"I don't think we are going to see a complete return where the vast majority are going to be in-store and online is going to take a back seat," Zate said. "I think online is going to still hold a very significant portion of that equation."

Customers are used to the convenience of ordering their groceries, meals, and more online, he said.

"Industrial companies, business-to-business companies, and others are now seeing the advantage of being able to provide online catalogs for their customers where they don't have to have somebody coming in the store," said Zate. •

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***Cesareo Contreras*** *is associate editor at* Robotics 24/7.

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# MassRobotics, Partners Demonstrate Interoperability Standard at AMR and Logistics Week

Attendees at A3's AMR and Logistics conference could see both the MassRobotics AMR Interoperability Standard and VDA 5050 in action.

BY EUGENE DEMAITRE AND CESAREO CONTRERAS


*InOrbit successfully demonstrated both the MassRobotics interoperability standard and VDA 5050 in October. Source: InOrbit*

In 2019, Aaron Prather, then senior technology advisor at FedEx Express, challenged autonomous mobile robot, or AMR, vendors to work on interoperability at the Association for Advancing Automation's first AMR Conference in Louisville, Ky.

He said that either suppliers cooperate to get their robots "to play well together," or major users such as FedEx would look elsewhere.

Interoperability was once again a key topic of discussion at this year's AMR and Logistics Week in Boston.

*Interoperability panel at A3's AMR and Logistics Week, from left: MassRobotics' Tom Ryden, Vecna Robotics' Daniel Theobald, InOrbit's Florian Pestoni, and Locus Robotics' Jason Walker. Source: Cesareo Contreras*

In a session on "Standardization Efforts for Mobile Robot Interoperability," panelists outlined the progress they have made on the MassRobotics AMR Interoperability Standard, which was first published in May 2021. Panelists included Tom Ryden, executive director of MassRobotics; Daniel Theobald, co-founder of MassRobotics, Vecna Robotics, Twisted Fields, and Mekable; Jason Walker, vice president of marketing development at Locus Robotics; and Florian Pestoni, CEO of InOrbit and co-founder of the nonprofit Robot Operations Group.

## MassRobotics standard provides common frame of reference

The MassRobotics standard enables mobile robots to share their location and capabilities with one another, but it does not require vendors to share proprietary maps, explained Theobald during the panel.

"It allows a robot to share its operational status and information about location, speed, direction, etc.," he said. "Pre-competitive collaboration is crucial to industry growth."

As part of the AMR and Logistics Conference put on by the Association for Advancing Automation (A3) in 2021, Prather hosted a demonstration of the standard at FedEx's DART center in Memphis, Tenn. It involved a shared map that showed systems from Vecna Robotics, Waypoint Robotics, and WiBotic.

"If you're working in any industry with robotics, interoperability will come up," said Prather, who is now director of the Robotics & Autonomous Systems Program at ASTM International, at this year's event.

Compliance with the MassRobotics standard is voluntary, but it can help with robotics adoption, said Ryden. At the same time, the effort is open to interested parties and is working to complement existing standards, he said.

"The standard can help influence adoption, but it does not affect or duplicate safety standards," Ryden added. "About 30 organizations are currently participating, with about a dozen actively involved."

A senior engineer at Rockwell Automation asked about real-world deployments of v1.0 "in the wild."

"We've seen some, but no large-scale deployments yet," said Ryden. "InOrbit enables deployment. Some customers are starting to deploy robotic floor cleaners and forklifts together."

## How other standards efforts compare

While MassRobotics, A3, the ARM Institute, and others have collaborated, other interoperability efforts are also under way. Most noteworthy are the OpenRMF free modular software and reference platform and the German VDA 5050 standard.

"Open Robotics has been a great contributor to the industry," acknowledged Theobald. "OpenRMF is more of an implementation than a standard. It was designed to work in a hospital in Singapore, but another company couldn't just adopt it. We are in partnership discussions."

"There has been extensive proof ... that Open-RMF is an open-source initiative that enables interoperability and is available for use by anyone that wants to use it," said Open Robotics in an e-mailed response to this article. "Singapore was but the first deployment, but certainly not the only one."


"VDA 5050 is primarily for the automotive market in Europe and is more focused on the details of interactions among equipment, machines, and PLCs [programmable logic controllers]," Theobald continued. "There's no conflict with the MassRobotics standard."

"Many companies will implement multiple standards," said Pestoni. "InOrbit supports MassRobotics, VDA, and open-source ROS 2. We went from 'Why should we work together?' to now 'How should we work together?'"

### V2.0 of interoperability standard in the works

As the International Organization for Standardization (ISO) begins to adopt Version 1.0, MassRobotics and its partners are working on Version 2.0, which came out of an Advanced Robotics for Manufacturing (ARM) Institute project led by Siemens and FedEx, Theobald noted.

Version 2.0 establishes a mission communication application programming interface (API). It is intended to prevent too many robots from trying to use a single optimized route at the same time. Other features are left to fleet management software, said the panelists.

After years of talk about the need to manage heterogeneous fleets, why are standards efforts moving forward now?

"We believe a rising tide will lift all boats," replied Walker, co-founder of Waypoint Robotics, now part of Locus Robotics.

"Locus has deployed more AMRs than almost anyone," noted Ryden. "The more companies that are involved, that hopefully means they will buy in."

"We're not writing code and are open to feedback," he said. "With an upper-level system that understands where robots are, you can plug in any robot, making integration easier."

### Charging is up next

Version 2.0 of the MassRobotics AMR Interoperability Standard will address charging and power, among other things.

"There's a lack of common chargers for AMRs—both physical and software," said Ryden. "Now's the time to avoid conflict between standards."

"Cars get gas in the same way – charging and batteries should be just as reliable," Walker said. "If you have picking robots and AMRs, most facilities can't have multiple chargers taking up space."

One charger for a mix of AMRs would be desirable, noted Matthieu Ebert, account manager for North America at Wiferion, during a session on wireless charging.

The ARM Institute project used a WiBotic wireless interface, and the onboard charger and air gap interface allowed it to serve different form factors, said Ryden.

"That project started out as somebody trying to answer a customer request for a fleet manager for all things, but we don't expect to compete," said Walker in response to a question from investment firm Cowen about proprietary software versus standards efforts.

### MassRobotics, VDA 5050 standards shown

Attendees at this year's AMR and Logistics event got to see two of these interoperability standards

in action. InOrbit worked with several robotics vendors and organizations to demonstrate the MassRobotics AMR Interoperability Standard and VDA 5050.

The demonstrations were broken into two sessions. The first one featured the MassRobotics standard and AMRs from Mobile Industrial Robots (MiR) and Locus Robotics.

On two TV screens near the demo area, InOrbit's software displayed a bird's eye view map of the confined area. Markers on the map showed the location of each mobile robot.

While Locus Robotics' AMR has its own fleet management capabilities, mapping software, and more, the interoperability standard enabled it to share key details with robots from other vendors, said Walker.

"For folks who have worked in the AMR world for a long time, this is really a big deal," he said. "But if you haven't, it might not look like much."

### Shared map easy to set up

Walker noted that the map on display was not made by the robot with simultaneous localization and mapping (SLAM). Instead, InOrbit created the map in Microsoft PowerPoint to illustrate where the robots were.

The internal map the MiR robot used was different than the one the LocusBot used, said Walker. "All of these are different independent systems, and you have this visualization software that InOrbit has made with this graphic design map," he said.

Walker added that the status of each robot could also be seen in InOrbit's software. He claimed that it was a pretty easy processs, taking the three companies only about 20 minutes to set up the whole demo.

"Once the interoperability standard is implemented as we have it on the [Locus mobile robot], then it's just a matter of turning it on," Walker added. "That's the kind of thing that a couple of years ago would have taken months of development of proprietary code."

The MassRobotics standard acts as a "common language" allowing vendors to share important details, he said.

### European standard demonstrated

For VDA 5050, InOrbit partnered with OTTO Motors and Mobile Industrial Robots. Ángel Hernández, strategic business advisor at InOrbit, led the demonstration. He said MIR's robot was acting as an AGV for the demo, while OTTO's was acting as a typical AMR.

Hernández said the biggest difference between the MassRobotics AMR Interoperability Standard and the VDA 5050 is that the latter can be used to issue specific commands. The MassRobotics standard is used for monitoring, he said.

### Standards makers look to a shared future

"We've been trending on this idea of sharing what works and creating an informational hub where companies can share solutions to common problems," said Theobald during the panel. "MassRobotics has been a facilitator of this conversation, helping businesses adopt what has already been proven. We encourage people to get involved."

A scientist from the National Institute of Standards and Technology (NIST) asked about whether MassRobotics has plans for its standard to include factory equipment beyond AMRs.

"Think of it like GPS," said Locus Robotics' Walker. "Once people realize what it enables, they'll find new applications."

"Users don't want interoperability," InOrbit's Pestoni said. "It's just a stepping stone to orchestration of their facilities and greater efficiency." •

### More on A3's AMR and Logistics Week

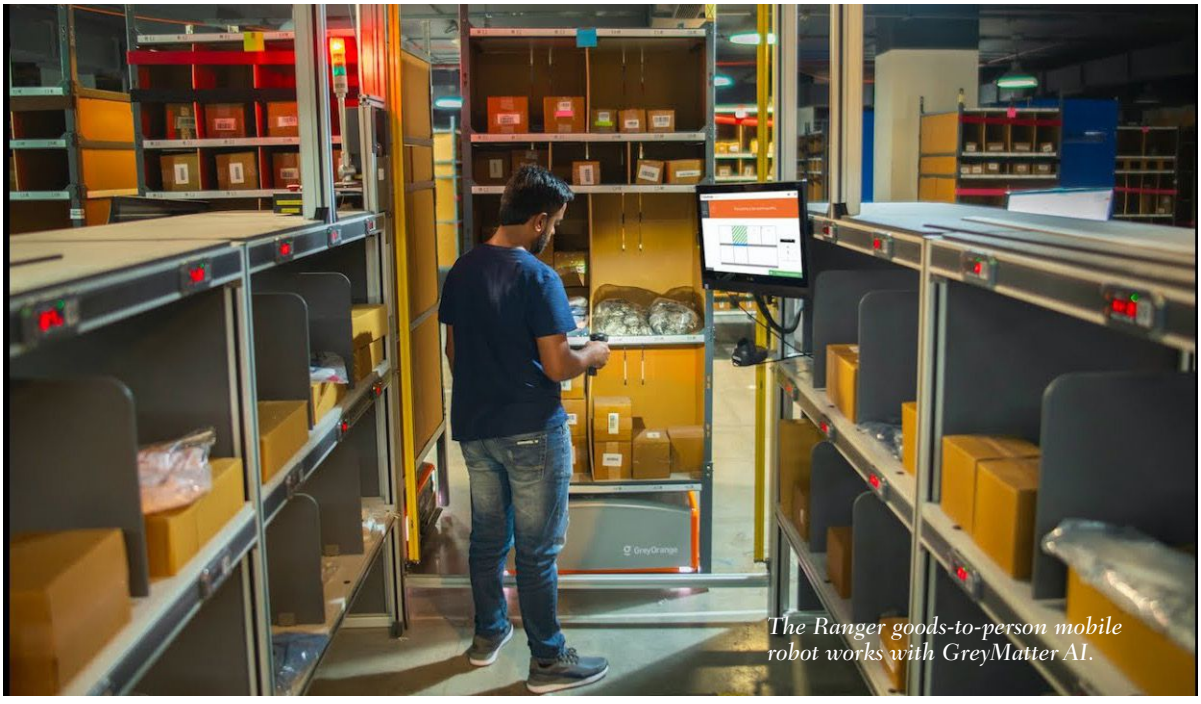
AMR and Logistics Week was produced by A3 and was co-located with The Vision Show. Visit *Robotics 24/7*'s special coverage page for more from the events.

Also, check out our Robotics Applications Conference, which is available on demand. Prather delivered the keynote address.

# GreyOrange CEO Explains How and Where Mobile Robots Can Add Value

Samay Kohli, CEO of GreyOrange, discusses how its Ranger mobile robots and GreyMatter orchestration software can optimize operations.

BY EUGENE DEMAITRE



*The Ranger goods-to-person mobile robot works with GreyMatter AI.*

From the growth of e-commerce during the COVID-19 pandemic to persistent labor shortages, there have been plenty of reasons for supply chains to adopt mobile robots. However, understanding the need to automate and getting a return on one's investment are two different things, noted Samay Kohli, co-founder and CEO of GreyOrange Inc.

The key is whether robots are adding value as part of a holistic approach, said Kohli. The Roswell, Ga.-based company provides automation for warehouses, distribution centers, and fulfillment facilities.

Kohli recently spoke with *Robotics 24/7* about how robots such as GreyOrange's Certified Ranger Robots (CRN) and software such as its GreyMatter fulfillment orchestration platform can meet growing and shifting market demand.

## Labor and automation

**While e-commerce demand accelerated earlier in the COVID-19 pandemic, has it subsided now, or is it still a strong driver for adopting automation?**

*Samay Kohli,CEO, GreyOrange*

**Kohli:** It's still a driver. Automation helps hedge against labor shortages, growing demands on the warehouse, and the need for greater safety within the warehouse.

For us, the demand has much more to do with labor availability than the effects of COVID. Unemployment rates are back at pre-pandemic levels. The industry is short 1.4 million people. GreyOrange doesn't just support e-commerce; we support many more channels.

There are some companies that have grown 5X and will stabilize. E-commerce has passed a threshold after which you can't keep it as a separate channel. You can't just duplicate the inventory.

**With the holiday shopping season upon us, what pain points are your customers experiencing? How does GreyOrange address them?**

**Kohli:** Labor shortages, inflation, and return management. Average turnover is high as people retire or move to other industries, and the seasonal labor shortage is even worse. We have a client that's an outdoor fashion retailer. It said it will have to shut down three plants for two months to move 500 people to fulfillment because it can't get seasonal labor.

For returns management, labor rates are also higher. In Pennsylvania, people are averaging $4.50 extra per hour between day shifts and weekday night shifts. It has never been this high.

We have another site in Maine, where the average age of the workforce has gone up by 10 years because younger workers left during COVID-19.

**How can autonomous mobile robots (AMRs) help with recruitment and retention?**

**Kohli:** Automation improves worker efficiency and decreases the likelihood of workplace injuries. Automation also goes hand in hand with improved worker satisfaction and retention, since they can spend more time on high-skill work.

Across the board, we've seen massive increases in retention after robots come in. It's not about replacing people, and job satisfaction goes up drastically. Go into any warehouse without automation, and pickers walk 13 to 15 miles per day. Once robots come in, it's point-to-point movement, and walking goes down to half a mile. It's the difference between being a laborer versus a career, like working on a farm versus operating a farm.

The salary gap between people who just started compared with pickers with 30-year tenures is less than 25 cents. New people make more money because of retention bonuses.

## Managing multiple agents

**How does GreyMatter Autonomy take into account entire processes on the floor—including human workers?**

**Kohli:** The GreyMatter Fulfillment Orchestration Platform treats any robot, human being, software process, or automation—everything that logs in—as an agent. Workflows are built at an orchestration level, not at the level of robot operations. If robots need secondary intelligence to decide what to do, it runs on the cloud.

GreyOrange uses the "crawl, walk, run" strategy. Some of our clients start without robots at all. You can just get our workflows in place and start training.

For example, in fulfillment, there might be 100 exceptions that a human can handle and that are not automated processes. We see that as part of GreyMatter, meeting clients where they want to meet, and then they can increase the use of it over time.

The system starts auto-optimizing. Change management can typically take as low as two weeks or as high as two months.

**How much do you rely on simulation?**

**Kohli:** We run a digital twin of the warehouse for months or weeks before a site goes live so optimization doesn't happen at the cost of operations. The workflow data structures are defined to be extremely extensible. The WMS [warehouse management system] or WES [warehouse execution system] already has a defined structure.

GreyMatter is built on a modern compute platform and can handle eaches and cases. We have one site with 1 million SKUs, but there's no limitation with basic fungibility.

A customer study found that our software is better. Nobody in supply chain or robotics writes in that language, but it runs Internet routers, telecommunications, stock exchanges, and national health services.

**How important is interoperability to you?**

**Kohli:** We do heterogeneous fleets. We are hardware-agnostic. Our software supports it, but it takes time to get optimization right.

One of our oldest sites in Chile has four robots and was built over four years. There are 350 AMRs, three robotic arms placing pallets, and close to 100 intralogistics systems running in manned zones.

It also has one to two miles of conveyors, and 30 elevators in four stories. The elevators are completely automated, and the facility runs GreyMatter at the core. The system runs online order processing and cross-dock operations.

## Funding, partnerships, and industry challenges

**GreyOrange obtained growth financing earlier this year; how are its expansion and partnerships in the Americas going?**

**Kohli:** We're growing quite fast, and North America is a core market for us. We're also doing well elsewhere, with Sodimac in South America and Apotek Hjärtat in Sweden. Our partnership with Sistemo is expanding, and we just announced another partnership with Dafiti in Chile.

**Speaking of partnerships, truck unloading is a new frontier for robotics, as seen in GreyOrange's collaboration with Technica. When will iTLS—Powered by GreyMatter be available?**

**Kohli:** It will be available soon. We're taking our first site live early next year. When we announce partnerships, vetting technical capabilities will take anywhere from three to nine months before they're certified. The solution improves dock efficiency and speed. It makes a very labor-intensive part of the fulfillment process safer for workers by enabling smart robots to complete the manual tasks of loading and unloading.

Boston Dynamics, Honeywell, and others have been trying to solve this big problem, but their solutions are not yet used at scale by industry. iTLS has gotten ahead. The space still needs maturation, but we've had a massive pull from our clients.

**Returns processing is another challenge for retail and e-commerce—how does GreyOrange help with that?**

**Kohli:** Usually, returns typically don't get merged back with the main inventory. A retailer may sell 10 shirts and get five back, but they go to different places [in the facility]. Then it gets new orders, and more come back.

Pulling orders from returns is really expensive because it needs way more processing time. Our average turnaround for inventory is one day, and it's available to ship and in the same flow—not a different area. GreyMatter manages the workflow, and it's almost seamless.

**Where do you see the next wave of innovations?**

**Kohli:** First, we're trying to get more and more agents. We've innovated in replenishment, managing human operators and nine third-party robots. Customers want more end-to-end solutions—they want robots but can't adopt bespoke solutions.

Second, because of all the edge cases in omnichannel, we're looking at how to manage workflows autonomously.

Third, we run really large systems—our average number of robots per site is 200 robots. We want to get more into how to decide what to do with automation, so if 30 out of 40 people show up, the planning software can say, "You need to move forward pickers to packing jobs, or you need to move to putaway people to picking because you're going to breach your SLA [service-level agreement]."

People started realizing that with analytics, optimization, and AI, we can get average productivity up, which is huge for clients. •

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***Eugene Demaitre*** *is editorial director of* Robotics 24/7.


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# Amazon Robotics Details Development of Proteus Mobile Robot at A3's AMR and Logistics Week

## Mikell Taylor delivered the opening keynote at the Association for Advancing Automation's event in Boston.

BY CESAREO CONTRERAS

BOSTON—As the head of Amazon.com Inc.'s autonomous mobility technology and product development program, Mikell Taylor understands what it takes to make robotic systems that scale.

She was a key figure in the Seattle-based company's development of the Proteus industrial autonomous mobile robot (AMR), which was unveiled earlier this year. It's the first AMR to come from the team at Amazon Robotics, and it will be used in-house and not sold in the commercial market. The robotics team was formed after the e-commerce giant bought Kiva Systems in 2012.

Taylor spoke last month at the Association for Advancing Automation's (A3) AMR and Logistics Week event at the Hynes Convention Center. She outlined her team's vision in creating Proteus and the design and logistical considerations they thought about when developing the mobile robot.

### Warehouses need more than just a robot

Amazon Robotics' team understood that it needed to build a robot that could be deployed at scale in Amazon warehouses around the world.

Taylor said one of the biggest insights her team discovered while working on Proteus is that the robot itself is not the most important part of the system. It's just one part of a greater whole that involves many components.

*Mikell Taylor, principal technical program manager at Amazon Robotics, delivers the opening keynote for A3's AMR and Logistics Week*

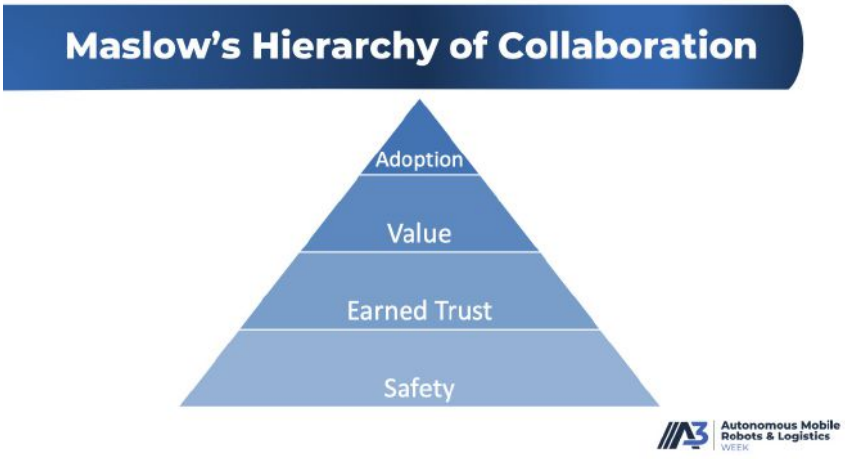
"If we narrow our focus on just the stuff on the robot, we lose sight of all the other elements in the system that makes things work," Taylor said. "And if we do that, you cannot succeed at Amazon scale."

Taylor and her team were able to take advantage of the technologies that Kiva Systems had developed in building Proteus. One of Kiva Systems most "game-changing" innovations wasn't its drive unit; it was the pod shelf, she said.

"The virtual and physical infrastructure of your payloads is part of your infrastructure," said Taylor. "You can do more and scale faster when you influence that part of your system and even co-design that along with the robot."

### Understanding dynamic environments

Another important consideration is that the Proteus robots do not exist within static environments. "The upstream and downstream processes keep evolving," Taylor said. One way to address this concern is to co-design and build relationships with those




*A slide from Taylor's presentation "Building Collaborative Robotic Systems at Scale." Source: A3*

in charge of other parts of the process, she noted.

"That way, even if you start with a simple API and input assumptions, as all the disparate systems change and evolve over time, you already have mechanisms and relationships in place to grow and evolve with them, and have your system evolve with them," explained Taylor.

### Amazon Robotics focuses on key areas

Amazon Robotics decided to focus on four key topic areas when developing Proteus – adoption, value, earned trust, and safety, Taylor said.

For Proteus to be truly adopted within a facility, Taylor said she knew that she and her team needed to make Proteus enjoyable to use.

"We don't want people to just be tolerant of Proteus," she said. "We want it to be actively welcomed in these environments. And the hope is that if we get all these other building blocks right, adoption will come naturally."

### Safety is foundational

That starts with building a safe robot, Taylor said. She noted that Proteus is compliant with the voluntary safety standard R15.08. The hardware was designed to calculate "a safety bubble for mobile speed and separation monitoring," she said. "It also has "'Safety-aware' trajectory planning software."

"In effect, we know where our safety bubble is so when we have a choice of trajectories to take, we can choose to take the one that is least likely to trigger a bubble violation based on what we can see around us," said Taylor. "If we really do our jobs right, the vast majority of time, our movement software should reroute us around an obstacle before the safety bubble is even triggered." She said safety was as important to the team as the autonomy technology stack.

### The importance of 'endpoint automation'

When considering the automated tasks that Proteus would need to complete, Taylor and her team decided that Proteus would be designed for "endpoint automation."

"What does that mean?," she asked. "It means it's not enough to make something autonomous from Point A to Point B."

Taylor added that "any interaction with your payload from the start to the end of the mission has to be executed autonomously."

That was an important design tenet for the team, as it wanted Proteus to be capable of succeeding in parallel collaborative workflows. That means designing "seamless work sharing between people and automation," Taylor said.

"We're designing for parallel collaborative work with Proteus, not for collaborative work where people have to be in process with the robots," she said.

Workers will continue to be an important part of Amazon's warehousing and supply chain infrastructure for years to come, Taylor noted. We are decades away from having fully 'lights-out' facility—if ever—and we should continue to invest in training and employing human workers.

"If all my years of building robots has taught me anything,


it's that humans are amazing, and human brains are amazing, and that we don't understand that stuff anywhere well enough to create artificial versions of it."

### What went into Proteus' looks?

There was whole other set of considerations Taylor and her team had to keep in mind when designing Proteus' outward exterior. They knew they needed the robot to appear somewhat friendly, disarming, and distinctive. That's why they decided to make Proteus green.

"We want to make sure that there was no question that when somebody is looking at a Proteus drive, which is safe for them to be around, it's a Proteus drive," she said.

They knew they also had to give the robot some character, said Taylor. They avoided making the robot appear human and instead drew some inspiration from the greater animal kingdom. The front of the robot features eyes at the front of it, for example.

"By characterizing Proteus that way, we were trying to create this vibe that you can trust Proteus and figure out what it is going to do and how it's going to behave and how you should behave around, just like you would a horse or a dog, or any other kind of animal." •

**Editor's note:** *Check out* Robotics 24/7*'s special coverage page for A3's AMR and Logistics Week and The Vision Show.*

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***Cesareo Contreras*** *is associate editor at* Robotics 24/7.

# 4 Reasons Why Your Supply Chain Suffers and 5 Ways to Make It Better

Here are ways in which robots can address common challenges.

BY JAKE RHEUDE


*Collaborative mobile robots such as 6 River Systems' Chuck can help supply chains overcome disruptions. Source: 6 River Systems*

A supply chain is the business function that serves as the circulatory system for organizations. Like the human circulatory system, a supply chain transports goods and materials for operations including product creation and order fulfillment. It is critical to have a robust supply chain for smooth operations and maintaining healthy profits.

Healthy supply chains are essential for business success. However, many organizations suffer from anemic ones that are prone to breakdowns. This is because it is not an easy feat to effectively manage a complex supply chain. You must overcome some common challenges to achieve that.

## 4 supply chain challenges

### 1. Dynamic markets

The uncertainty due to dynamic markets is the major challenge faced by supply chain practitioners. Customer requirements are constantly evolving. For a product to reach the customer, businesses need lead time for procurement of materials, manufacturing, and shipping.

When consumer preferences change before your organization is able to pivot to accommodate them, it can incur huge losses. Due to this, you need to identify future consumer demand accurately to deliver the right products to your customers.

The challenge is not just from the demand side. Fluctuating raw material costs, transportation costs, labor costs, and shifting geopolitical situations

also pose a threat to the stability of supply chains. This forces organizations to take costly anticipatory measures or risk a broken supply chain.

### 2. Fulfillment woes

Order fulfillment includes picking, packing, shipping, and delivering accurate orders to the customer. This leg of the supply chain alone has various touch points from picking to delivery.

There are many things that could go wrong in this leg of the supply chain. Even something as simple as packing ordered products could be challenging when there's a mismatch between the size of boxes and product sizes. This could lead to wasteful packaging practices.

### 3. 'Black swan' events

Unexpected events happen that were not factored in while designing and managing supply chains. These "black swan" disruptions can destabilize supply chains forming bottlenecks or other forms of supply constraints.

Supply chain executives did not anticipate the spread of coronavirus in 2020 and the subsequent lockdowns across the world. Yet a novel virus wreaked havoc on global supply chains, which are still in recovery mode. Such unplanned scenarios are always a threat to a robust supply chain.

### 4. Skilled labor shortages

Skilled and experienced employees are required to handle various supply chain functions. This ranges from supply chain executives to warehouse employees. The shortage of supply chain professionals is increasing the hourly wages for available personnel.

According to the Bureau of Labor Statistics, a warehouse employee needs to be paid $22.23 per hour on average. Wages for other employees are on an upward trend. This raises operational costs for the supply chain and makes it difficult to maintain resilient supply chain operations.

In the robotics space, the skilled workforce is both a threat and an opportunity. Internally, companies will need technicians to develop and maintain this equipment.

As a provider, robotics can help companies maintain operations when the available labor pool is small. The concerns you face in your supply chain are often mirrored in customer and partner supply chains, giving you insight into developing broader company protections.

## How to build a robust supply chain

Many things could go wrong in a complex supply chain, hampering business continuity. Building a strong, resilient supply chain involves anticipating failures and pre-empting such instances from occurring. Some of the potential benefits are:

- High efficiency
- Reduced cost
- Business continuity
- Increase profits
- Reduced bottlenecks and delays
- Better relationship with supply chain stakeholders

These benefits make obvious the need for a healthy supply chain. Here are some steps you can adopt to build more robust supply chains.

### 1. Build redundancies

A complex supply chain will have failures; it is unavoidable. Strong

supply chains are not built by completely eliminating failures, but by working around them.

Supply chain management should have redundancy and backup plans for failure events. You need to have multiple suppliers for the same parts. This way, if one supplier is not able to deliver the requirements, you can rely on the remaining supply partners.

Another redundancy that should be in place is alternative shipping partners for when one of the partners is not able to deliver the expected output. Similarly, you need to have backup plans for all elements in your supply chain that have the potential to go wrong.

## 2. Involve stakeholders

The supply chain of your organization has many stakeholders. This includes customers, suppliers, vendors, warehouses, third-party logistics providers (3PLs), transportation partners, etc. For smooth operations, you need to have a strong collaboration with these partners.

To foster collaboration, you need to align with the goals of your partners. The incentive structure in place should also foster strong, stable partnerships. Robust data sharing with partners is also needed to help them grow with your organization.

## 3. Consider cobots

Mobile robots and collaborative robots are new additions to many supply chains. They can help in a range of activities, from picking products on distribution center shelves and sorting to delivering them to end customers.

Automated guided vehicles (AGVs) are widely used for transportation in limited spaces. Robots and cobots can be introduced to many parts of the supply chain for faster execution of tasks. The use of automation can reduce dependence on employees to perform various tasks.

With decreasing costs and improving technology, AGVs, autonomous mobile robots (AMRs), and cobots can increasingly help improve supply chain operations.

In a recent Zebra Technologies survey, 62% of industry participants reported that human error from manual process management is the top reason for inventory fulfillment problems. This includes picking errors, errors handling equipment, lack of information, etc.

Such errors cause returns of products by customers, which increases the time and resources consumed in warehouses. The use of collaborative robots for picking can reduce picking errors by 67%. The study also cited technologies such as pick-to-voice, pick-to-light, and RFID (radio frequency identification).

## 4. Mobile robots can improve materials handling

Lockheed Martin implemented AMRs from 6 River Systems Inc. to improve material handling. The defense contractor is in an industry with very limited players and unique requirements.

Lockheed has an autonomous systems roadmap to achieve full automation by 2035. While the company is rigorously automating its products, it did not have any autonomous solutions for its internal warehouses. Lockheed Martin faced the following challenges:

- Complex and dynamic supply chain
- Stringent security requirements
- Lack of qualified personnel and high personnel turnover
- High wages for employees
- Non-standard warehouse processes
- Limited productivity

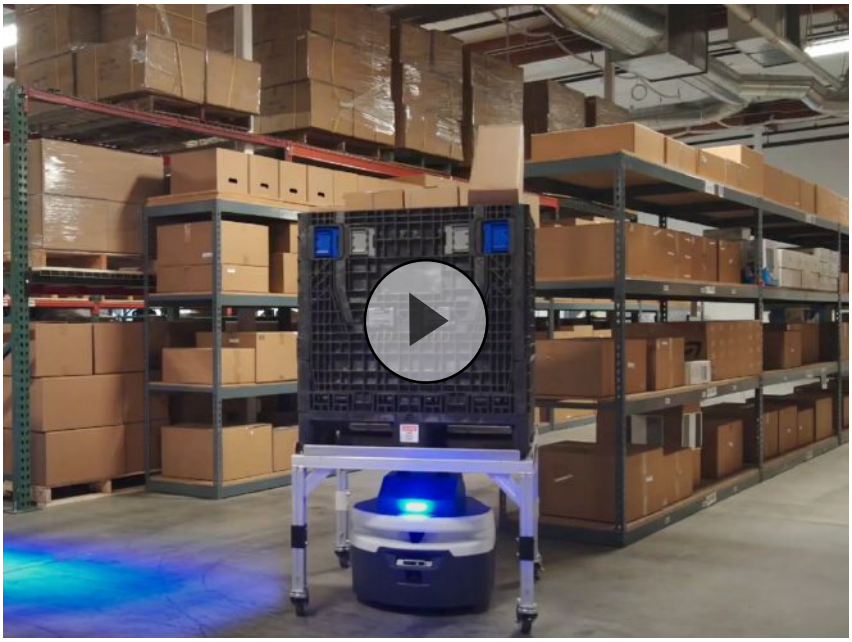
Lockheed Martin introduced collaborative picking carts from 6 River Systems. This is much more flexible than conventional automation methods like conveyors at a much lower cost.

6 Rivers' Chuck robots and software also help break up the capital investment into smaller chunks. This allows Lockheed to automate sections that need it without putting in a sizable investment to overhaul its whole warehouse.

Collaborative mobile robots helped Lockheed deploy smaller capital for small productivity improvements. The company is now able to have a decade-long supply chain automation roadmap that is flexible and cost-effective.

## 5. Supercharge fulfillment for customers

Fulfillment is the customer-facing leg of the supply chain. It needs to function without a hitch to ensure customer delight. This



includes bringing down shipping costs, reducing delivery times, strong relationships with transport partners, having backup plans, and using automation.

Done well, fulfillment can bring customers delight and make them repeat customers.

Consumers always expect more from e-commerce fulfillment. Previously, two-day delivery used to be a luxury, but some people today are not satisfied with even same-day delivery. Your strong fulfillment network and capability can give your business a competitive edge.

All other things being equal, consumers will likely choose the service with lower costs and minimal hassles. You need to streamline your e-commerce fulfillment with a leaner product mix that is suitable for faster shipping and delivery.

However, that isn't possible in all instances. For such instances, you should rely on package consolidation to optimize boxes, shipping, and the delivery of multiple products to a single customer.

### Use new technology effectively

Many forms of technology are used in different parts of the supply chain. This ranges from robots to various information technologies. This can range from warehouse management systems (WMS) to artificial intelligence.

Anyone can buy some technology and implement it in their supply chain. But you should not be doing so just because something is in vogue. The technologies you implement should align with your overall strategy and bring value to the bottom line.

Let us consider an example of how to use technology effectively in your supply chain. AI can be powerful, and you can incorporate it into supply chain software to analyze data collected and generate insights. Such a broad implementation of AI is not going to yield significant results, as there is no specific goal for the implementation.

But consider another AI implementation that is bound to generate results. AI can be used for package consolidation. This helps to minimize packaging used in shipping products to customers. This saves the company transportation and packaging costs.

Such consolidation is a specific use of AI with actionable and measurable results. Similarly, any technology to be added to supply chain operations must address a specific need and provide measurable results.

Robust supply chains have the potential to improve all business metrics, ranging from efficiency to customer satisfaction. The road to building such a supply chain is arduous, and very few organizations succeed in that.

The recipe for resilient supply chains is not too complex, but these steps can determine how well your organization fares in the next crisis. •

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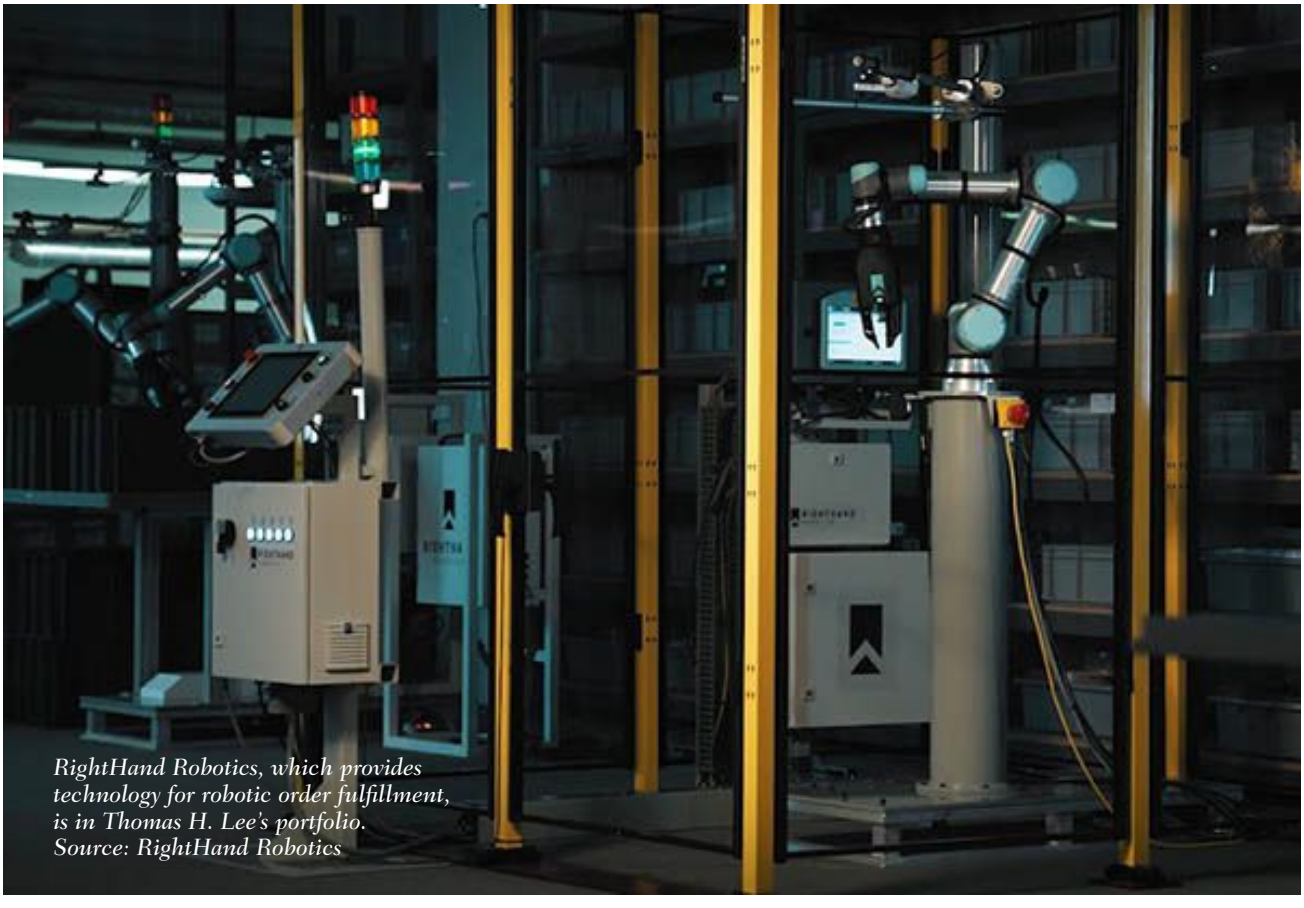
***Jake Rheude*** *is vice president of marketing at Red Stag Fulfillment, a fulfillment warehouse that was born out of e-commerce. He has years of experience in e-commerce and business development.*

# Robotics and Automation Help Companies Through Economic Challenges, Says Thomas H. Lee Partners

## The private equity firm's technology and business solutions vertical is active in the growing industry.

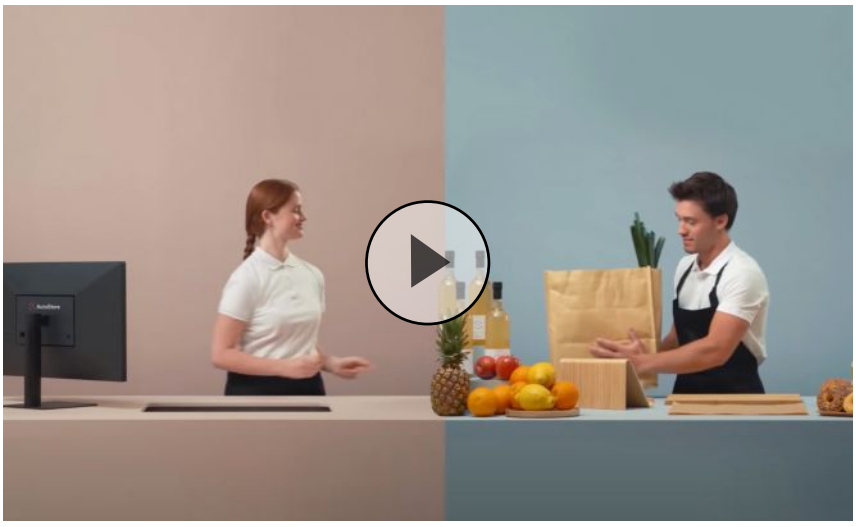
BY EUGENE DEMAITRE



*RightHand Robotics, which provides technology for robotic order fulfillment, is in Thomas H. Lee's portfolio. Source: RightHand Robotics*

In 2020, Thomas H. Lee Partners L.P. raised $900 million for its THL Automation Fund. Since then, the Boston-based company has helped automated storage provider AutoStore go public, acquired the Semiconductor Solutions Group of Brooks Automation for $3 billion, and invested in freight-tracking software firm FourKites.

In February 2022, THL participated in robotic picking provider RightHand Robotics' Series C round. In April, the private equity (PE) firm oversaw the merger of MHS Global and Fortna to create an e-commerce and logistics services leader.



### THL expects automation to transform industries

Mike Kaczmarek, managing director at THL, spoke with *Robotics 24/7* about his outlook for robotics. "We invest in healthcare, financial, technology and services, and broader technology businesses," he said. "We've spent close to a decade as one of the larger PE firms interested in automation. We've invested approximately $5.5 billion in the robotics sector and across 20 businesses touching a range of end markets."

"Our thesis is that automation is a global force that will transform industries over the next 30 to 50 years," said Kaczmarek. "Robotics and automation could represent up to half of global GDP [gross domestic product] growth. It could have an impact similar to that of the Industrial Revolution."

Several long-term trends are driving interest in robotics, noted Kaczmarek. The first is demographics—populations around the world are aging, leading to worker shortages that were already growing before the COVID-19 pandemic, he said.

"Second are ROI [return on investment] and the savings that companies see," Kaczmarek added. "Automation can reduce costs, lower error rates, and maintain higher uptimes in less than a year, which is attractive payback."

Third are environmental, societal, and governance (ESG) factors, as governments and companies in Europe and worldwide set sustainability goals.

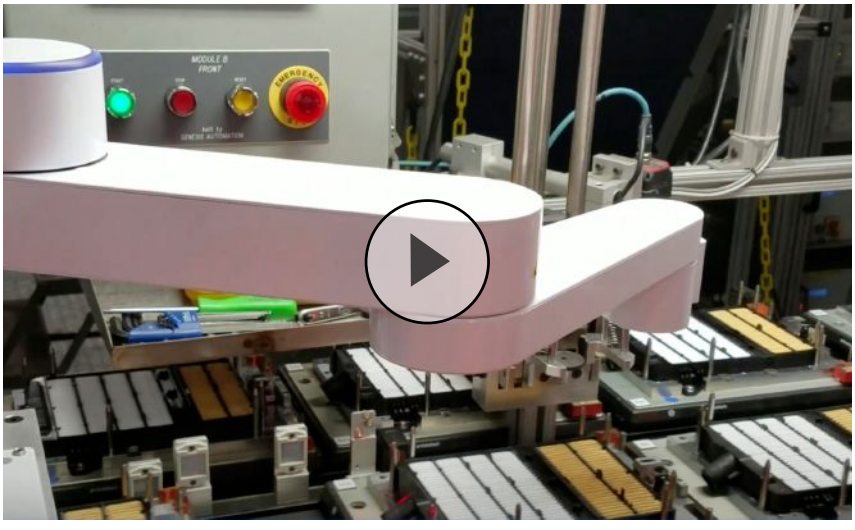
"ESG continues to be an important trend," said Kaczmarek. "Robots can reduce waste, particularly on the transport side. An AutoStore robot consumes less electricity than a vacuum cleaner, for example."

"Lastly, automation can help fuel revenue growth, which is often not what people think of first," he said. "Companies that automate could be six times more likely to generate greater than 15% growth than those that don't."

### Robotics to ride out 'headwinds'

*Robotics 24/7* has tracked more than $19.2 billion in robotics-related transactions so far this year. Even though the International Federation of Robotics (IFR) and the Association for Advancing Automation (A3) continue to report record robotics industry growth, there are significant challenges.

The COVID-19 pandemic and its aftermath have altered consumer habits, and trade disputes and worker shortages have disrupted global supply chains. In addition, the conflict



in Ukraine has affected food and energy markets, while concerns about inflation and recession have sparked debates in Silicon Valley, Wall Street, and Washington, D.C.

Technology companies have not been immune to layoffs and shutdowns, and about 75% of North American warehouses have yet to add robotics.

Still, Kaczmarek is bullish about automation. "The growth has been strong in many categories on a percentage basis," he explained. "Five years ago, the amount of warehouses that were automated was less than 10%, and today, it's approximately 15%. It's exciting how much more we have to go, and it could get to 60% to 70%."

"The macro environment, in some senses, is unprecedented—low unemployment rates, attractive home-price appreciation, but with high inflation and rising interest rates," he acknowledged. "We haven't seen this in the past 30 to 40 years. Despite massive labor shortages and supply chain constraints, consumers are still spending money, causing demand challenges across the supply chain."

"Given market conditions, we're being cautious in the short term," Kaczmarek said. "There could be pullback in certain areas, but long-term growth is still very attractive. For example, the ASRS [automated storage and retrieval systems] market could have a 15% CAGR [compound annual growth rate]."

"Current penetration rates are single-digit, but all industries—even arts and entertainment, real estate, utilities, and mining—could see double-digit adoption," he noted.

### Technologies to watch

THL sees promise across the robotics space and enabling technologies, said Kaczmarek. He cited the following categories:

- Physical automation—robotics
- Process automation—software, artificial intelligence, and machine learning
- Hybrid—"Where mechanical meets software, the Internet of Things [IoT], and orchestration."

"We think all of these segments are exciting," Kaczmarek said. "Within robotics, we're looking at collaborative robots, end effectors, ASRS, and mobile robots."

"We believe these segments will continue to demonstrate strong growth characteristics," he added.

### RaaS could help SMEs automate

Can the robotics-as-a-service (RaaS) model help with adoption? "Over time, we'll see more, but it's still early days," Kaczmarek replied. "We've surveyed customers, who generally still want to make an upfront purchase of automation technologies."

"It's analogous to the software market, where there were on-premise licenses in the late 1980s and early '90s," he continued. "That's where robotics is today. For a small maintenance fee, software moved to software as a service. It could start with smaller customers."

Speaking of smaller companies, most small and midsize enterprises (SMEs) are just getting started with automation.

"We're seeing adoption, but midsize and larger enterprises have led the way," said Kaczmarek. •


***Eugene Demaitre*** *is editorial director of* Robotics 24/7.

# FORTNA Emerges From MHS Global and Fortna Merger for Materials Handling Automation, Integration

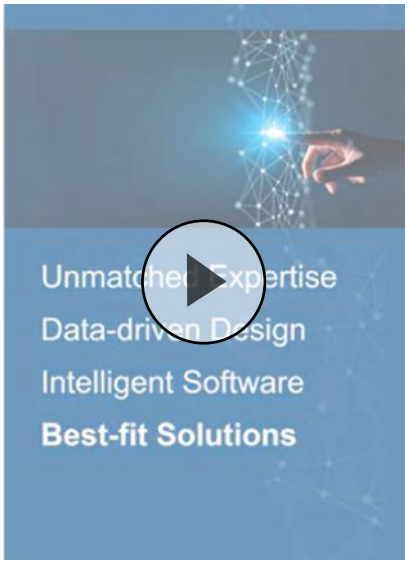
FORTNA claimed that it is a global leader in "transformative omnichannel and parcel distribution solutions."

BY ROBOTICS 24/7 STAFF

*FORTNA said its software, services, and tools can optimize distribution operations. Source: FORTNA*

In April, MHS Global, a materials handling automation provider and systems integrator, and Fortna Inc., a warehouse distribution software provider, announced their intention to merge. The combined entity will be known henceforth as FORTNA.

The former MHS and Fortna said they combine decades of experience in the design, development, and delivery of omnichannel and parcel distribution solutions. The Atlanta-based company claimed that it gives customers "a uniquely versa-




tile end-to-end path forward to optimize operations in the face of continual upheaval."

FORTNA said it has the scale and capabilities to help customers and partners meet increasing consumer demands as they face continued supply chain disruptions and other challenges. The company claimed that it works with leading brands to "transform omnichannel and parcel-distribution operations."

### FORTNA brand represents supply chain resilience

"The decision to retain the legacy Fortna name was the result of careful consideration," stated Rob McKeel, CEO of FORTNA. "We chose the name FORTNA not only for the great reputation the name already has in the market, but [also] because of the strength and resilience embedded within it."

"The notion of fortitude, of resilience and strength—it speaks to what our customers need in today's climate and what they can expect from our partnership – the ability to weather the ever-changing market conditions and come out thriving," he added.

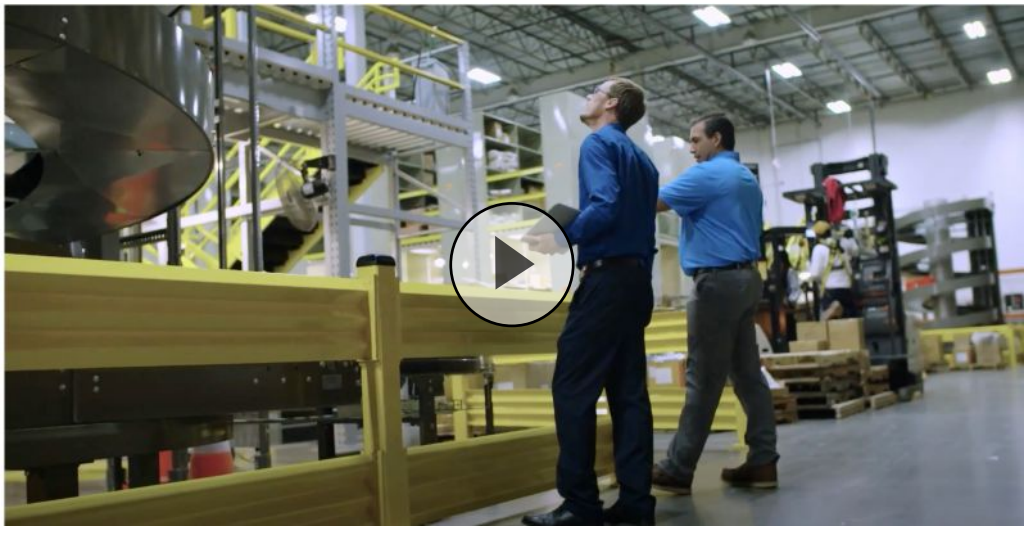
FORTNA said it designs and delivers systems, powered by intelligent software, to optimize fast, accurate, and cost-effective order fulfillment and last-mile delivery. The company said its staff, innovative approach, and proprietary algorithms and tools can ensure optimal operations design and material and data flow.

### Automation part of combined capabilities

In addition, FORTNA offers network strategy, distribution center design and implementation, materials handling automation, robotics, and a suite of lifecycle services.

"At the end of the day, our customers need to know they are ready for anything," said McKeel. "That means operations that run at the speed of change—and the intelligence to anticipate what is next. We are thrilled to be able to provide the ability for our customers to create scalable, cost-efficient operations through automation."

Customers will increasingly see the new FORTNA brand as it is rolled out globally over the coming weeks and months, said the company. It said customers will be able to improve performance thanks to the combined capabilities of two industry-leading omnichannel and parcel distribution solutions providers. •



# Generation Gap in the Warehouse Can Be Closed With Robotics, Finds Berkshire Grey Survey

## Hanover Research found that nearly three-quarters of chief supply chain officers say automation can help address a growing generation gap in warehouse jobs.

BY EUGENE DEMAITRE

*Berkshire Grey said its intelligent automation, shown here picking grocery items, can help relieve a growing generation gap in warehouse workers. Source: Berkshire Grey*

The warehouse worker shortage is well-known, but technology can help mitigate demographic shifts, according to Berkshire Grey Inc. The Bedford, Mass.-based supply chain automation provider in August announced its 2022 "State of Retail & eCommerce Fulfillment Report."

Hanover Research conducted the research with Berkshire Grey, surveying 200 chief supply chain officers at retail and e-commerce businesses on topics including labor, costs, pain points, and automation. They found that 64% of executives expect generational differences to have a long-term effect on worker availability.

Challenges include warehouse workers leaving the industry because of the COVID-19 pandemic, retiring Baby Boomers, a low U.S. birth rate, and a generational shift in what employees are looking for in their careers and workplaces, said Berkshire Grey. Turnover rates as high as 43% cost warehouses $8,500 to replace each worker, according to Kane Logistics.

"Labor is a real challenge for retailers and 3PLs [third-party logistics providers]," said Kishore Boyalakuntla, vice president of products at Berkshire Grey. "More than 10 million jobs are available, but the reason for turnover is the nature of certain jobs."

"A human sorter has to move more than 1,000 things per hour, or two people have to unload a truck in one-and-a-half hours,"

he told *Robotics 24/7*. "All kinds of things come out of semi trucks—kayaks, food, tires. I've seen people three levels high manually pushing things on fast conveyors. These are not jobs people want to do."

"Unlike the temporary shortages seen in other industries, continued e-commerce growth and shifts in generational employment preferences are uniquely impacting the fulfillment industry," stated Steve Johnson, president and chief operating officer at Berkshire Grey. "[They could] lead to long-term labor shortages that will only compound in the coming years."

## Supply chain execs want to close generation gap

Labor shortages have hindered organizations' ability to meet demand, said 57% of executives surveyed. Seventy-six percent of respondents said they'll need to raise wages, and 63% said they will need to increase bonuses to attract and retain younger workers.

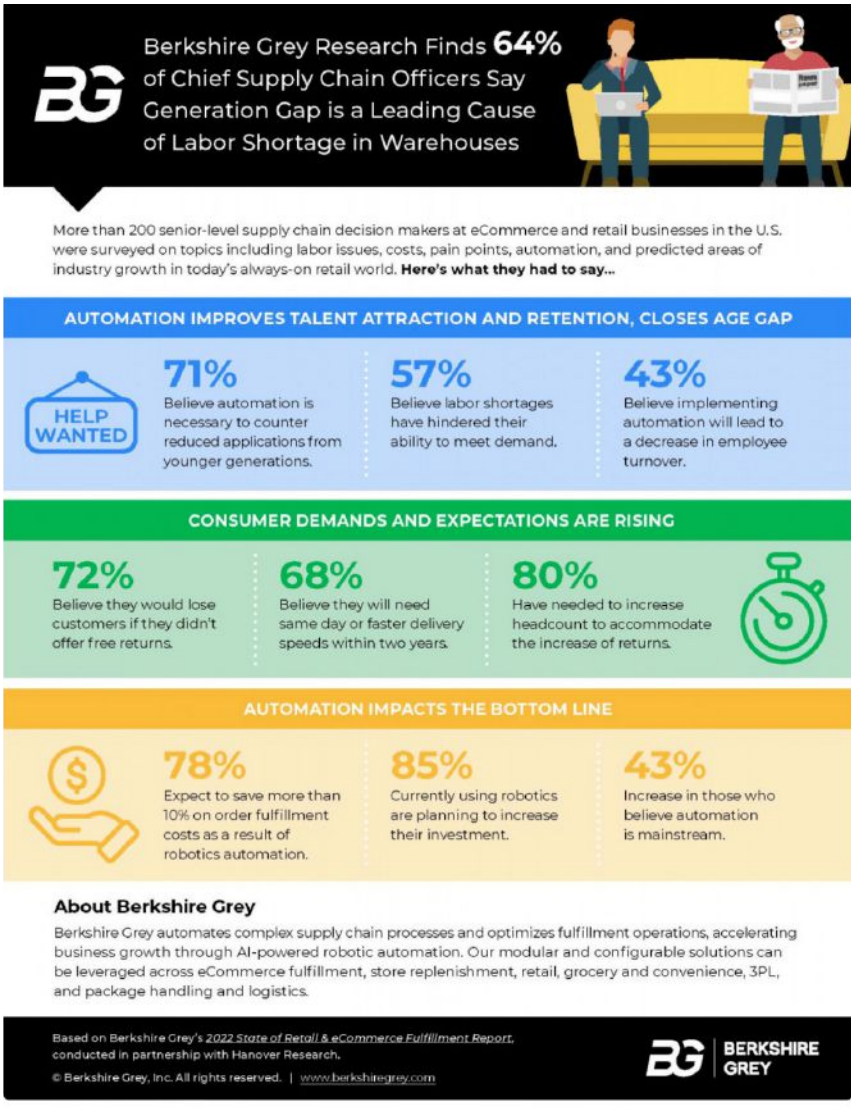
"The challenge for businesses in e-commerce or retail is how to make jobs enjoyable for people to stay in warehouses for 15 to 20 years," Boyalakuntla said. "For Gen X and later, everybody is steeped in technology, so the answer to making companies profitable and sustainable is intelligent automation and robotics."

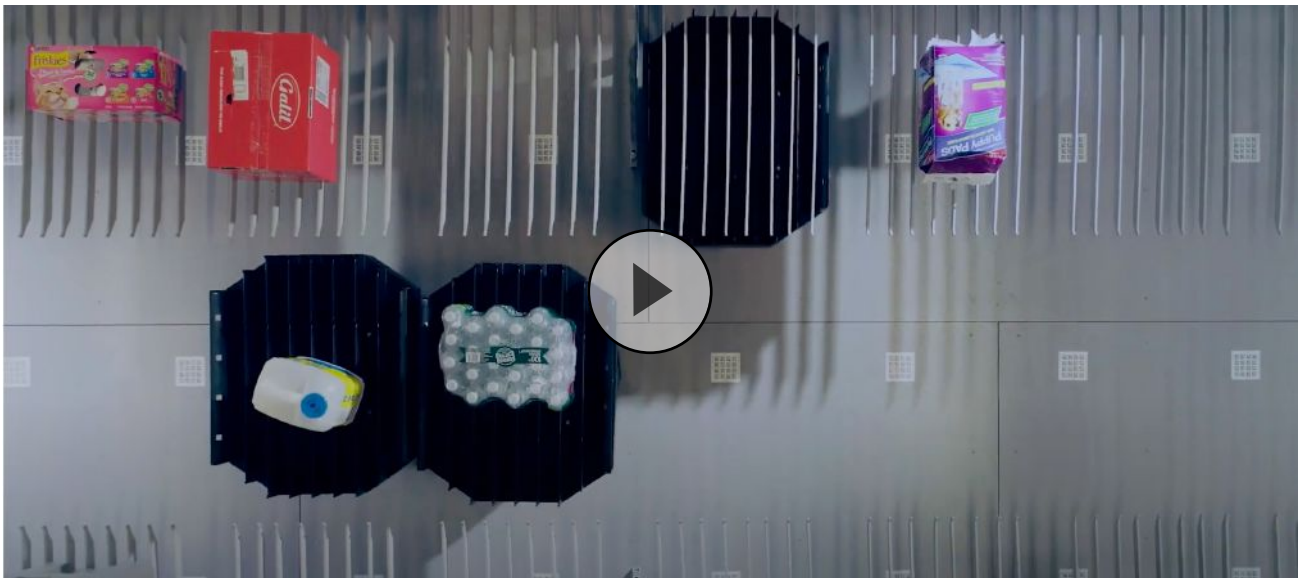
Although only 13% of respondents said they are currently using automation, 51% are adopting or plan to adopt robotics, said Berkshire Grey. In addition, 71% of chief supply chain officers said robotics is necessary to address the generation gap in job applications.

About half (51%) of those polled said they expect automation to increase employee satisfaction, and 43% said they believe it would reduce staff turnover.

"Line operators are now robotics experts," said Boyalakuntla. "They absolutely love their jobs, which are higher-paying. At Berkshire Grey, we feel happy when customers tell us how automation has changed their lives."

"We've heard anecdotally from vice presidents at two customers that employees are attracted by robotics," he added. "At one major retailer, we installed a system with a packout





station for one person with multiple robots. Every 45 seconds, a box comes. The worker just removes the cap, closes the lid, puts on a label, and puts the box in a crate to complete the shipment."

"Next to that is a manual station," Boyalakuntla said. "A lady told me that her work quality has improved so much—she formerly walked 30,000 to 40,000 steps per shift—that she can now take a break. People are already at their physical limits."

### Robotics to meet rising demand, consumer expectations

The e-commerce market could grow from $3.3 trillion in 2022 to $5.4 trillion in 2026, predicted Morgan Stanley. Consumers increasingly expect faster deliveries and free returns, noted Berkshire Grey.

More than two-thirds (68%) of executives said they will need same-day or faster deliveries within two years, according to the report.

As for returns, 72% of executives said they believe they'd lose customers if they didn't offer free returns, and 80% said returns increased in 2020, requiring an increase in headcount.

In response to these challenges, the percentage of executives who say automation is "mainstream" has increased by nearly 43%, said Berkshire Grey. They said they expect to use automation to support packaging and labeling (62%), item sortation (59%), returns (58%), and goods retrieval (58%).

Companies that turn to automation can benefit in multiple ways, Johnson said. "Not only is it a huge attractor for young talent due to the increased safety and specialized upskilling it enables, it is also a game changer in terms of cost reduction, throughput, and ROI," he claimed.

### ROI drives robotics investments

Return on investment is a major motivator for adopting automation, said Berkshire Grey. Robotics could help save 10% on order-fulfillment costs, said 78% of executives, and 85% plan to increase existing investments in robotics.

"We designed our systems to be very flexible and to adapt to changing SKU mixes and business conditions," noted Boyalakuntla. "Retailers don't have a lot of capacity to pass on the cost of inflation in a hypercompetitive environment."

"With intelligent robotics, we reduced one customer's cost per pick by 18 cents," he said. "Imagine four to six such touches in a warehouse. With a lower cost per pick and happier workforce, companies can improve productivity and reduce the impact of the generation gap and inflation." •

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***Eugene Demaitre*** *is editorial director of* Robotics 24/7.

# Avidbots Adds Intelligence to Automated Cleaning, Sees a Future With Multifunction Mobile Robots

Mobile robots can help alleviate worker shortages and turnover, as well as offer visibility and value, says Avidbots CTO Pablo Molina.

BY EUGENE DEMAITRE

The need to move materials, clean surfaces, and collect data in factories, warehouses, and other facilities has only grown. Despite fears of robots replacing workers who are scarce in many industries, most of the automation spreading today is meant to improve efficiency and safety. Avidbots Corp. is an example of a robotics supplier rising to the challenge with multifunction systems.

The Kitchener, Ontario-based company has designed, manufactured, sold, and serviced autonomous floor-cleaning robots since 2014. Its Neo 2 system combines artificial intelligence, cameras, sensors, and software to clean and provide data on where it cleaned.

Neo 2 users can create a custom cleaning plan, and the robot then monitors, measures, and reports on that cleaning, explained Pablo Molina, chief technology officer of Avidbots. He spoke with *Robotics 24/7* about the autonomous mobile robot (AMR) market, where automation can be most useful, and his company's plans.

## Avidbots addresses pain points

**How has the growth of omnichannel retail since the COVID-19 pandemic affected demand for Avidbots' robots?**

**Molina:** There has been growth in demand for our products. People saw robots being able to help in difficult times, and trust in robotics has improved.

CEOs from large incumbent cleaning companies expect 20% to 30% of sales in cleaning equipment to be fully autonomous by 2025. We're executing in engineering and sales.

**With labor shortages and capital concerns, how do you address industry needs?**

**Molina:** For all automation, including cleaning robots, we shouldn't forget there's an ROI [return on investment] play. The


other benefits are becoming important for business owners.

Absenteeism is a big issue in cleaning, and turnover averages 300%, or about every three months. Robotics brings new levels of accountability and reporting, so the level of service can be higher.

We also clean in warehousing, where forklift operators often have to stop to jump on manual cleaning machines. They're getting paid quite a bit to do that, and they don't like it.

**How have facilities operators and staffers reacted to Neo 2? What are some examples of customer expectations and training requirements?**

**Molina:** The majority of deployments we do are received positively. People like to give the robots nicknames. We work hard not to change how facilities operate.

First, we make sure we understand the needs of the customer and that they know how to use the robots and our command center. Not every cleaning robotics company does this.

We send a team to each site for training, deployment, and customer success. Deployment takes between two and five days, and it may take a little bit longer for some larger places.

**Do robots actually help with recruitment and retention?**

**Molina:** You may be surprised to learn that in 95% of our deployments, people don't lose their jobs. There's a lot of cleaning that needs to be done, and people often end up cutting corners.

When you ask facilities managers how clean their places are, most will say they wish they could do more. Our robot gives them the visibility to increase service levels and provide better-quality service.

Robots are time-saving tools, freeing humans to do higher-level tasks. Ten to 20 years from now, the penetration will be 50% to 60%, and buildings will be better environments to be in.

## Multifunction robots mature

**How does Avidbots Autonomy manage machines and people for "multifunction, intervention-free operation"?**

**Molina:** The majority of times that robots get stuck, it's sensor data from shiny obstacles or angles that give "noise." A lot is easy to correct remotely.

In really tight spaces where robots can't turn, like when boxes are left in an aisle during restocking in retail, we're working with customers to explain to them what they can do to help with interventions.

We provide 24/7 support, and it takes only 10 to 30 seconds to connect with a technician. We're working on minimizing that time, but a lot of data is involved, and the customer interface is important.

**Are you seeing demand grow across commercial, industrial, and retail sectors?**

**Molina:** Retailers are interesting because they're working to improve the experience for their customers and are under threat from e-commerce and delivery services.

We have some robots in a Walmart supercenter near our headquarters that run in the mornings. I'm excited about the future of what robots can do.

**Most robots can do only one or two things well. How mature are multifunction systems, which promise to save time and money?**

**Molina**: Multifunction robots are already here, such as Tennant and Brain Corp's shelf-scanning and floor-cleaning model. We have a disinfection add-on.

There's no doubt that's where the future is going—robots are getting smarter, and you can do more at the edge. We'll be seeing a lot more startups offering concierge robots, taxi robots, and shelf-scanning systems.

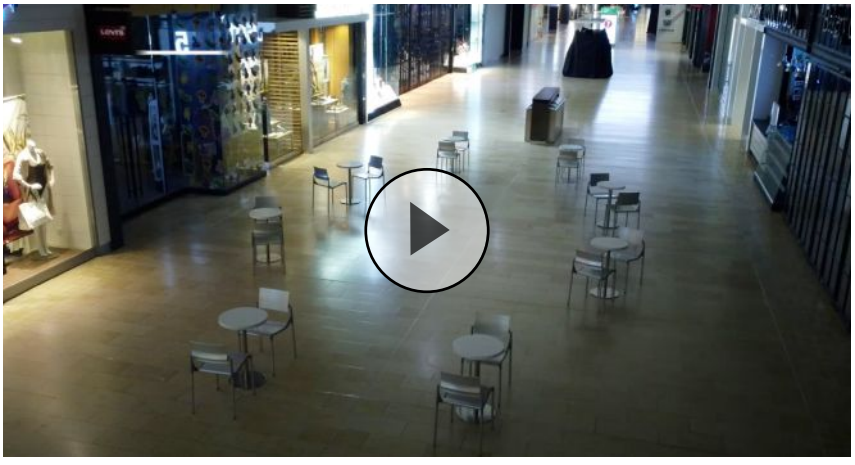
**On the flip side, specialized robots from multiple vendors could soon coexist in the same spaces. Are you following interoperability standards efforts?**

**Molina**: Functional safety is very important, so we're involved in every committee for functional safety. We want robots to be seen as companions or tools.

We clean many different types of locations, like airports and retail stores. The need for interoperability is higher in manufacturing and warehouses. We don't run into other robots in a lot of our other verticals.

It's still early, and there is no conclusive standards effort yet. Different groups have different requirements—for example, German automotive or in a very busy hospital. We have yet to see one that covers everybody.

I hope they'll eventually go to the ISO [International Organization for Standards], as MassRobotics is doing. With an international body, you can have more open discussion. Right now, there are many efforts with a few people in pockets.



## Funding, partnerships, and industry challenges

**Avidbots recently raised $70 million in Series C funding. How is its market expansion going?**

**Molina:** We'll soon expand our product portfolio and add-ons, and we're also expanding to new geographic areas.

We're at a beautiful inflection point for robotics. We're still at the beginning, but be aware that with commoditization lowering the costs of robots, there will be explosive growth. It opens up so many more avenues.

**Avidbots has partnered with PTC Onshape to cut development time for your robots. How has it resulted in 50% savings?**

**Molina:** It been a very helpful tool to connect mechanical engineering work. PTC has done a good job of unifying the development world with supply chain and change tracking.

While the resurgence of U.S. manufacturing could add up to 1.5 million jobs, according to McKinsey, 64% of manufacturers have difficulty finding candidates with specific knowledge or skills, reported PTC. Design engineers spend up to a third of their time on non-design tasks.

Avidbots' file-based CAD system slowed communications, so we switched to Onshape, which provides a "single source of truth" for product designs across the organization through real-time data management.

**Looking ahead, what is your company working on?**

**Molina:** Avidbots is building a portfolio of products of different sizes and types. For example, since we have a focus on warehousing, we're working on some hardware improvements for facilities with a lot of debris.

We're figuring out how to correct for things like pieces of wood and to make the experience better. We'll solve problems with deep learning, and I expect we'll add more intelligence to our robots in the next two quarters.

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***Eugene Demaitre*** *is editorial director of* Robotics 24/7.

# Robots Continue to Permeate the Modern Supply Chain

## Inch by inch, robots and automation are moving forward to help supply chains.

BY JIM ROMEO


*Robots promise to provide flexibility and throughput for supply chains of all kinds. Source: Getty Images*

Rewind the tape of the global economy by a few decades, and you'd seldom hear the term "supply chain," which has been all over the news lately. Labor shortages, limited shipping and trucking capacity, and growing e-commerce demand have put logistics at the forefront of business profitability discussions. Robotics is part of the solution for global supply chains.

Universities and research institutions have been working on making robots more capable and easier to use. Meanwhile, progress is continuing, slowly but surely, in autonomous trucks and robotic deliveries. From factories, warehouses, and truck yards to loading docks and last-mile logistics, automation efficiency is welcome at each link in the supply chain.

Inflation, the aforementioned supply chain challenges, and a return to brick-and-mortar retail may slow investment in robotics. However, attendance at this year's trade shows and the move from pilots to full-fledged deployments suggest that more robots than ever will be in use during his year's holiday shopping season.

### MIT develops smarter robots to find things

Walk into a physical store, and the product you want may not be on the shelf. You can ask a sales associate to "check in the back." Similarly, a busy commuter might be ready to walk out the door but must first sift through clutter to find car keys.

Researchers at MIT have created a robotic system that uses RFusion. It consists of a robot arm with a camera and radio frequency (RF) antenna attached to its gripper. By fusing or combining signals from location signals and visual camera images, it's almost able to find the proverbial needle in a haystack.

For a supply chain model, many products have RFID tags attached that can communicate with a robot. MIT's RFusion prototype can detect RFID signals just about anywhere—even if buried under a pile of rubble.

RFusion uses machine learning to enable the robotic arm to zoom to the object's exact location. It then verifies that the item is correct. RFusion integrates data from a camera, an antenna, and an arm programmed with artificial intelligence.

MIT's system is versatile and rugged enough to work in many different environments. It could help stores "check in the back" or locate missing shipments.

### Automation anxiety affects labor unions

Supply chain managers must prepare for resistance from labor unions and those who fear losing their jobs to a new wave of technology. Businesses must explain to anxious workers and consumers that robots can actually create jobs.

Last year, the International Longshoremen's Association (ILA) warned that its members would not work with automated machinery at marine terminals, will not work with automated machinery at seaports. Harold Daggett, president of the ILA, told the Journal of Commerce that automation projects around the world threaten job security in the maritime workforce.

"Workers around the world are under assault from the threat of automation by greedy companies only interested in making money and eliminating workers who helped them build their success and companies," Daggett said. "It's got to stop, and my ILA will do what it needs to do to save our jobs and the jobs of maritime workers around the world."

Such opposition marks the beginning of a new chapter in labor relations, in which automation can be viewed as either a job killer or a tool for workforce recruitment, retraining, and retention.

### The 'great resignation' and micro-fulfillment

Not only is there a shortage of drivers in the trucking industry, but there's also a shortage of logistics workers. Again, automation can perform certain tasks to augment existing staffs, noted Nada Sanders, a distinguished professor of supply chain management at Northeastern University.

In a Northeastern news article, she cited three examples. Micro-fulfillment centers, a step toward fully automated "dark stores," can provide orders for nearby customers.

Amazon Go stores use cameras and intelligent software to track purchases and charge customers as they leave the premises, replacing cashier kiosks. Boston Dynamics' Spot quadruped can perform dangerous surveying tasks at construction sites.

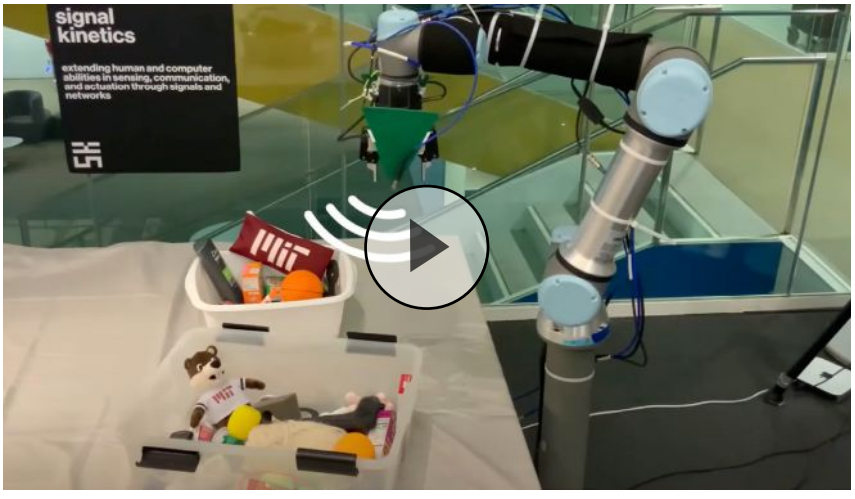
As Sanders said, robots can perform the tasks that people don't want to do, supporting fulfillment in spite of workforce shifts.

### Logistics picks up on robotics

Warehouse operators and third-party logistics providers (3PLs) are making healthy investments in automation for materials handling. For instance, shipping giant Maersk last year acquired Visible Supply Chain Management (SCM) for $838 million.

The deal followed Maersk's strategic goal of serving 75% of the U.S. direct-to-consumer market within 24 hours and to deliver to 95% of the U.S. market within 48 hours. The company gained nine fulfillment centers, accounting for more than 20 million sq. ft., to its distribution network.

In addition, Maersk said it expects Visible SCM to have synergy with its 2020 acquisition of Performance Team for $545 million. Performance Team focused on providing larger customers with robotics for distribution centers.




### Japan a model for last-mile logistics

With robots and sophisticated routing, goods can avoid bottlenecks in distribution centers and loading docks when demand surges. Last-mile logistics automation could also mitigate urban congestion and help stores get products on shelves faster.

In Japan, delivery robots help to reduce costs and environmental impact while increasing collaboration, according to a McKinsey & Co. report.

"The surge in e-commerce volumes has put huge pressure on the last-mile delivery system, the process by which products are transported from distribution centers to final consumers," the research firm said. "E-commerce sales worldwide grew sixfold in a decade, from $572 billion in 2010 to some $3.5 trillion at the end of 2019."

McKinsey focused on Japan because it is "at the forefront of having to grapple with societal challenges such as labor shortages resulting from population decline and a hyper-aging society—something many developed countries will face in the future—exacerbating pressure on last-mile deliveries."

Delivery robots that can transport packages weighing about 220 lb. or less at a maximum speed of 3 mph would be ideal, found the study. In fact, McKinsey said such robots can reduce carbon emissions and costs while responding to labor shortages.

### Drones offer remote deliveries

In addition to long-haul autonomous trucks and last-mile robots, drones are becoming useful for more than consumer photography. A full-fledged delivery network hasn't been realized yet, but they can provide medicines in remote or underdeveloped areas.

Zipline has used drones for remote deliveries of lightweight medical supplies in Rwanda and Ghana, noted the Brookings Institute. The company worked with Pfizer and Ghana's drone infrastructure to demonstrate how technology firms and policy makers can collaborate to improve the health of a region or nation.

### Supply chains enter a new age

Robots, drones, and autonomous vehicles are rapidly addressing the complexities of the modern supply chain. Fortunately, technology advances have coincided with a labor drought and global supply chain strains.

The global market for logistics automation could expand from $48.4 billion in 2020 to $88.9 billion by 2026, at a compound annual growth rate (CAGR) of 10.6%, according to Markets and Markets. It attributed that growth to e-commerce demand, advances in robotics, and the need to ensure worker safety.

Similarly, Research and Markets predicted a CAGR of 12.87%, with growth from $58.65 billion in 2021 to $121.27 billion by 2027, experiencing a compound annual growth rate of 12.87%. Market acceptance is even more important than the technology.

But we're seeing only the tip of the iceberg. More technology, including AI and robotics as a service (RaaS), is yet to come to provide agility and resilience to supply chain and logistics operations. •

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***Jim Romeo*** *is a freelance writer and contributor to* Robotics 24/7.

# Sarcos Successfully Demonstrates Robotics for Shipyard Maintenance, Inspection, and Repair

## Sarcos Guardian DX/XT, Sapien 6M,Sapien Sea Class, and Guardian S robots show potential for teleoperation in field trials.

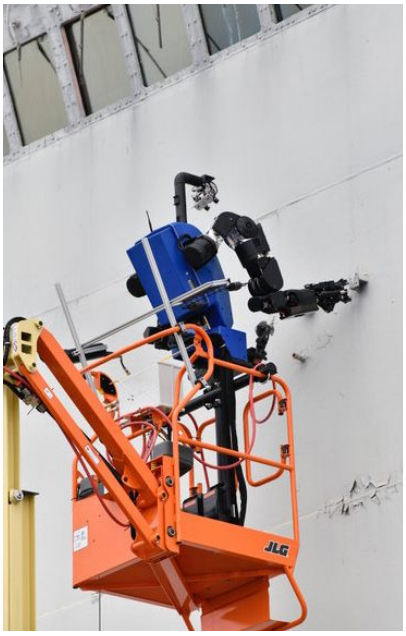
BY ROBOTICS 24/7 STAFF

*The U.S. Navy has worked with Sarcos to develop the Guardian teleoperated dexterous robot. Source: Sarcos*

Sarcos Technology and Robotics Corp. recently announced that it successfully completed a field trial of robotic systems for maintenance, inspection, and repair activities for the U.S. Navy. The company said it "has made significant strides in developing robotic technologies to usher in a new era of improved worker safety and productivity for shipyard operations."

Sarcos performed field tests at the Repair Technology Exercise (REPTX) at the Naval Base Ventura County in Port Hueneme, Calf. The company said that robots can improve the efficiency of sailors and shipyard workers.

"It is imperative for the U.S. Navy to find solutions that will enable us to maintain mission-readiness, particularly while at sea," said Janice Bryant, expeditionary and sustainment



*The Guardian DX teleoperated robot removes flaking paint from a vertical surface on the bow of the Self Defense Test Ship at REPTX. Source: Sarcos*

technology manager at Naval Sea Systems Command.

"The technologies demonstrated at REPTX for ship inspection, sustainment, and repair using tele-operated, at-height capabilities will have a significant benefit to increase Navy readiness," she added. "We look forward to continuing our work with solution providers to rapidly field for effect."

### Sarcos proves systems on the ground and at height

Sarcos said its suite of systems performed successfully on the ground and at height. It includes the Guardian DX teleoperated dexterous robot for defense, the Sapien 6M dexterous robot, the Sapien Sea Class underwater robot, and the Guardian S remote visual inspection robot.

The company noted that its robots can perform the following shipyard tasks:

- The Sapien 6M and Guardian DX robots can be teleoperated and safely use a variety of tools while working at height aboard ship or pier side. They can be mounted to a mobile lift platform to perform visual inspections, remove rust and paint with off-the-shelf tools, laser ablation, and repairs using cold spray.
- The Sapien Sea Class underwater robot, integrated with a remotely-operated vehicle (ROV), is designed for both shallow and deep underwater use up to 1 km and can perform inspections on a ship's hull, propeller shaft, and propeller shaft tube, along with recovering unidentified objects from a ship's hull.
- The Guardian S visual inspection robot, which can traverse ferromagnetic vertical surfaces and access confined spaces, can be deployed inside and outside a ship to identify foreign objects.

"Working at height in dynamic environments, such as shipyards, is extremely dangerous work," said Kiva Allgood, president and CEO of Sarcos. "Sarcos' portfolio of teleoperated robots improves shipyard operations by solving critical pain points including human resource constraints, productivity, and safety."

### Portfolio includes teleoperation, mobile manipulation

Other Sarcos products for civilian use include the Guardian GT, a tracked mobile manipulator, the Guardian HLS pneumatic heavy-lift system, and the Guardian XT teleoperated dexterous manipulator.

The company is also known for its Guardian XO industrial exoskeleton, and it added Pittsburgh-based RE2 Robotics' Sapien robot arms to its portfolio in April.

The company, which recently moved to new headquarters in Salt Lake City, serves the aerospace, construction, defense, energy, and medical industries. Sarcos recently appointed experienced financial executive Drew Hammer as chief financial officer. •