



GUIDEBOOK 101

Putting Full-Body, Powered Exoskeletons to Work in Fulfillment Operations

There is plenty of automation to help move goods, but when heavy, bulky items need to be handled, it often comes down to brute force and risk of injury for hard-to-find industrial workers. This creates a need for agile lifting solutions that don't pin your process down to a fixed spot. Find out how a new solution type—full-body, powered exoskeletons—is stepping in to fill this gap.



We're in the midst of challenging times in logistics execution. E-commerce fulfillment pressures are skyrocketing, and busy distribution centers (DCs) struggle to find and retain labor. Amidst all of this imbalance, DCs need to get a high volume of goods out the door, and some of these items are going to be heavy and hard to handle.

Equipment including lift trucks, lift assist devices, and warehouse automation like conveyors can help. Still, in many cases, it takes human labor to handle goods that are strenuous to lift, like many non-convoyable goods such as furniture, or awkward to manipulate items like tires.

The reality of material handling, even with advanced automation, is that people often have to do plenty of heavy lifting. The upside is that people-based processes are highly adaptable, but there are downsides too.

For one, positions that involve manual material handling are physically demanding jobs that remain challenging to fill. And with companies looking to follow safe social distancing in DCs, legacy best practices such as having multiple people lift heavier items need to be revisited for methods that don't place workers in tight proximity of each other. These same dynamics impact numerous industries in addition to warehousing, including many manufacturing sectors and construction.

Labor-related pressures on DCs have been building for several years, tied closely to the rapid growth of e-commerce. According to MHI's 2020 Industry Report, a survey-based study of the materials handling industry done in collaboration with Deloitte,¹ the top industry challenge in warehousing and supply chain operations was hiring and retaining qualified workers, followed by customer demands for lower cost and customer demands for faster response times.

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Other surveys, such as an annual Warehouse/DC Operations study conducted by Peerless Research Group and published in Modern Materials Handling,² also found that managers see finding enough workforce as the top industry issue.

While the labor market is being disrupted in new and troubling ways, it's likely that long-term, companies with warehousing, manufacturing, and other operations involving materials handling will continue to struggle to find enough workers. The work is tough, and many developed countries have aging demographics.

Companies with extensive logistics operations agree that automation, which makes the life of workers easier and safer, is increasingly important, given how hard it is to find workers who do material handling.

"There is a growing labor shortage," says Aaron Prather, Senior Technical Advisor at FedEx Express. "And even now, with unemployment high due to COVID, when all this goes away, and hopefully, one day, it is all going to go away, labor shortages are going to return. There are not enough people to feed the logistics industry for everything that is needed going forward."

With e-commerce growth factored in, companies can no longer rely on being able to ramp up manual processes. "There are not enough people to throw at that growth, to speed that up, so you're going to need robotics and automation," says Prather.

Not every process in a DC lends itself to full automation or the use of lift trucks. Inbound shipments typically arrive in full pallets and can be efficiently and safely moved by lift trucks to storage. But at some point, those pallet-loads need to be broken down to individual cases to keep order picking zones topped off with goods.

This replenishment of picking areas involves manual handling of products. Many DCs also require warehouse associates to lift bins filled with goods during order picking or to lift and place large non-conveyable packages onto tow-tractor carts or pushcarts.

Additionally, there is often manual lifting involved in kitting operations in DCs or materials replenishment in warehouses that serve a manufacturing operation. During demand surges, it's also not unusual to bring a full pallet of goods to an order processing area on the floor to fill orders directly from open cases or items on the pallet.

In short, conventional automation and lift trucks can do much of the bulk material handling in a DC, but there is still plenty of heavy lifting to do manually. As a result, back injuries, shoulder problems, and other costly wellness issues arise.

According to the Bureau of Labor Statistics (BLS), back injuries accounted for nearly 40% of all work-related musculoskeletal disorders, with materials handlers being one the highest risk occupations.³ When you consider a workers' compensation claim for a back injury average in the \$40,000 to \$80,000 range,⁴ the cost of injuries can quickly accumulate.

Conventional equipment has its place. Lift trucks are widely used to transport and lift full pallets, while automation, such as conveyors and palletizers, can

also help automate part of the material flow. For lifting bulky items, cranes and lift assist equipment are sometimes used, but the downside to these products is that they are typically fixed to a work-center and can be time-consuming or costly to reconfigure.

Fortunately, there's a new option for protecting worker wellness and easily moving heavy loads, without tying workers and material flow to a fixed location. This solution type is a full-body, powered exoskeleton that augments operator strength to boost productivity while dramatically reducing injuries.

Powered exoskeletons use robotics, sensors, and software to help workers lift and move loads of up to 200 pounds. And they can be donned quickly when needed, explains Kristi Martindale, Chief Customer Officer and head of product strategy for Sarcos Robotics, a provider of proven products including powered exoskeletons that augment, rather than replace, humans.

"A full-body, powered exoskeleton can reduce the risk of costly injuries, particularly for difficult-to-automate, manual processes," says Martindale. "With powered exoskeletons, you not only have a system that can do away with the need for ad-hoc team lifts, you also have a solution that reduces strain and fatigue caused by repeated lifting and material handling tasks. Think of this technology as a way to protect workers by augmenting their strength and stamina, while meeting the throughput needs of the operation in a flexible manner."

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What exoskeletons do

Sarcos Robotics has been developing complex robotic systems for more than 25 years designing, manufacturing, and deploying systems that combine human intelligence and judgment with the strength, endurance, and precision of machines. Its solutions are used in multiple industries, including manufacturing, warehousing/logistics, construction, military, and oil and gas operations.

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The Guardian® XO® exoskeleton is a full-body, battery-powered industrial robot that augments human strength and stamina to boost productivity and reduce occupational injuries. Because the robotic suit can be quickly stepped into and responds to the operator's natural movements, it aligns perfectly with material handling tasks that are dynamic.

The Guardian XO robot deploys quickly whenever and wherever heavy items need to be handled—rather than forcing the material flow into one spot.

Various modular “end effectors” that lock into the ends of the Guardian XO arms are used to secure and hold loads. With the ability to “hot swap” rechargeable batteries in the field, the exoskeletons can be used for an entire work shift or longer.

For the operator, explains Martindale, wearing the Guardian XO robotic suit feels like wearing a light backpack. When it comes time to manipulate heavy items, the power of the suit takes over - augmenting human strength without adding physical strain from the weight of the load or the suit. The movements are intuitive for the operators—they simply walk, position their arms, and make a normal lifting motion to engage and lift an item.

With the power of the suit, a 100-pound load feels like it weighs just five pounds. The system's design allows a single human operator to safely and intuitively lift heavy objects that, in the past, would require a team of workers to lift safely, or would force work to be routed to a specific location with fixed lifting gear.

“With the Guardian XO exoskeleton, we’re augmenting the strength of humans in the workforce, not replacing them,” says Martindale. “They can stay injury-free and avoid fatigue. It’s also intuitive, which makes it easy to learn how to operate the robot. With more than 120 sensors integrated throughout each suit, the operator doesn’t need to overthink the suit’s operation—it adapts to the operators’ natural workflow, making it easy to learn and use from the onset.”

Another unique feature of the Guardian XO exoskeleton is a “hands-free” mode that allows the operator to lock the suit’s arms to hold a heavy object in place while using their hands to perform a task like tightening a fastener with a hand tool. This feature is ideal for maintenance, light assembly, or construction tasks that, without a powered exoskeleton, would take two or more people to complete.

“The ability to have one person lift a heavy item using a powered exoskeleton helps a facility do more with fewer people,” says Martindale. “But in the post-pandemic world, operations are required to practice social distancing, making proximal tasks like team-lifts problematic. Facilitating social distancing by allowing one worker to handle the tasks of many is an area of benefit for powered exoskeletons, beyond avoiding physical strains and injuries.”

Common Misconceptions about Robotic Exoskeletons

They are a type of collaborative picking arm. This is incorrect. A full-body, powered exoskeleton such as a Guardian® XO® robotic suit is worn by an operator to augment their strength by a factor of up to 20x, safely lifting up to 200 pounds. Think of powered exoskeletons as directly augmenting the capability of a human worker, rather than only collaborating.

The Guardian XO exoskeleton, by Sarcos Robotics, integrates more than 120 sensors into the robotic suit and uses advanced algorithms to provide intuitive control. Simply put, the suit reacts to an operator's natural movements, making the exoskeleton easy to learn and use.

While "cobot" picking arms have sensors that allow them to function safely next to humans without safety caging (they stop when they sense a worker is in the way of the arm's movement), most robotic arms aren't mobile. They can't be easily moved for use at a new location.

They are futuristic and unaffordable. This is no longer the case. Sarcos Robotics is a company with over 25 years of experience providing robotics and exoskeleton solutions to industry and the military. The Guardian XO suit is currently being field-tested and is

expected to be commercially available early 2021. Additionally, the robot is provided under a Robot-as-a-Service model (similar to a lease program) that includes service and support.

They are power hogs that cannot be used for a full shift. Thanks to hot-swappable batteries and rapid charging, the Guardian XO exoskeleton can easily be used for an entire shift or longer. Over the last decade, the growing maturity of the robotics industry has led to better power management and less expensive sensors, reducing the cost of the hardware, while improving functionality.

They have to be trained to lift specific items. False. The beauty of a full-body, powered exoskeleton is that it augments human thinking and cognition with the strength and precision of mechanization, so there is considerable flexibility in what can be lifted because operator experience and reasoning are used.

It's the person wearing the suit that decides how to move to an item, position for the lift, and initiate the lift motion. Various end-effectors can be quickly attached to a Guardian XO arms, making it possible for it to be used for many types of loads, from heavy crates with handles, to corrugated boxes, to automotive tires, to lumber or pipes.



The exoskeleton market

Industry needs in multiple verticals should mean rapid growth for the powered exoskeleton market. According to analyst firm ABI Research, the total value of the global powered exoskeleton market will exceed \$11.5 billion by 2030, with full-bodied, powered exoskeletons comprising \$4.9 billion in that same time.

Industries such as warehousing, e-commerce fulfillment sites, and manufacturing will inevitably turn to robotics and automation to be more productive and hold down costs, as well as to cope with issues such as aging workforces and tightening of labor markets, according to Rian Whitton, a senior analyst at ABI.

The powered exoskeleton market growth, in particular, will be driven by challenges such as aging workforce demographics and the need to achieve production objectives as labor markets tighten up as expected over the next several years.

“Major demographic pressures, plus the need to improve productivity in a changing global environment, is the key ‘push’ driver for automation in manufacturing,” says Whitton. This gets applied to a lot of other verticals like logistics as well. For e-commerce to grow at the same rate and to meet consumer expectation, vendors need to deliver a wider variety of goods with greater speed – this requires big improvements in productivity.”

Practical applications

Full-body, powered exoskeletons may seem futuristic—more Tony Stark (aka Iron Man) invention rather than a proven product for a warehouse—but the suits are in late-stage trials and will be commercially available early 2021.

Sarcos offers the Guardian® XO® robot under a Robot-as-a-Service or “RaaS” model, which means the system is available as an operational cost instead of a capital expenditure. The RaaS arrangement also includes support and service on the units, so that facilities don’t have to acquire specialized knowledge to maintain the suits.

There are multiple uses for Guardian XO exoskeletons in DCs. The suits are ideal for lifts that are too heavy for one worker to handle manually without the heightened risk of injury. When it comes time to do the heavy lifting, Sarcos estimates that the exoskeleton multiplies the productivity of a single worker several times over.

For example, depending on the task, one worker in the exoskeleton can do the work of four to 10 workers. When you also consider that the Guardian XO robot can be deployed quickly without workflow redesign or relocating of fixed equipment, the practical applications are many.

*According to
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Guardian® XO® in Action

3 Warehouse Fulfillment Scenarios

A full-body, powered exoskeleton is ideal for warehouse lifting tasks that fall into the gap between full pallet loads that can be handled by lift trucks or automation, and smaller items that can be processed via regular manual order picking methods.

Much of the lifting in this gap involves repeated, heavy lifts of awkwardly shaped items like tires or non-conveyables such as furniture or sporting equipment that would fatigue and possibly injure workers.

HERE ARE THREE USE CASES

Placing heavy non-conveyables onto carts or conveyors at a sporting goods distribution center (DC). At this operation, recent additions to product lines and changing consumer tastes have resulted in more orders for heavy, non-conveyable items, including treadmills, basketball backboards, and other heavy items.

The existing method for moving these items from storage to pack/ship was to have warehouse associates manually lift the items onto a cart, or onto a trailer to be pulled by a tugger. However, this method puts workers in close proximity and still led to worker fatigue.

By using a powered exoskeleton to lift these bulky, heavy items, the workforce is protected from injuries, and no team lifts are required in keeping with social distancing best practices.

Additionally, because no fixed equipment needs to be repositioned, the operation has more flexibility in terms of where it

will store and receive non-conveyables since the Guardian XO exoskeleton can quickly be deployed at the point where goods need to flow.

Work in process (WIP) replenishment at a warehouse serving an automotive industry supplier's manufacturing site. At this DC, heavy components and materials are received from upstream suppliers on a just-in-time basis and need to be quickly moved to the WIP materials location at each work cell. While some goods can be brought to these locations in full pallets, other heavy items need to be unpacked and sequenced for assembly.

By deploying Guardian XO exoskeletons, workers doing the materials drop-offs can do the final WIP materials unpacking and staging using the suit. At the same time, the suit can also be used as needed for certain assembly operations.

By using the Guardian XO robotic suit, these heavy WIP materials can be handled when and

where needed. There is no need to install or reconfigure fixed lift assist equipment at these WIP locations, and the industrial engineering team can quickly change processes in an agile manner without worrying about the need for fixed lift-assist gear.

Order picking and pack out of heavy items at third-party logistics DC for aftermarket auto parts. 3PLs face the challenge of constantly taking on new customers, which makes it imperative to have efficient but flexible processes. At a 3PL DC that has begun servicing aftermarket automotive and light truck parts, the Guardian XO exoskeleton is used to assist in the lifting of heavy items like tires and suspension parts during order picking and pack out.

The powered exoskeleton allows workers of modest size and strength to process picking and packing of heavy items, without the need to position fixed lift equipment or call for a lift truck with a specialized attachment to be deployed to the point of need.

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For example, consider a DC for a third-party logistics (3PL) firm that has just taken on a new customer that supplies aftermarket auto and truck parts. Some of these parts, like filters and fasteners, aren't heavy and can be stored, picked, and packed by the DC's established systems. However, this DC also needs to fill orders for items like tires, rims, and suspension parts that can easily exceed 50 pounds.

Under a manual approach, lifting parts and tires would require multiple workers, which goes against social distancing best practices, and adds physical strain and risk of injury to the work tasks. In some instances, a lift truck with a specialized attachment could be used, but this eats into the capacity of the lift truck fleet.

By deploying Guardian® XO® exoskeletons, this DC operation can handle the picking and packing of orders with heavy line items without having to create special processing zones with fixed lift-assist equipment. The suits can be quickly leveraged in multiple areas of the operation where heavy items need to be manipulated. This not only adds flexibility in terms of not having to reposition fixed lift-assist equipment, but it also allows more flexibility where heavy items are slotted and stored.

Augment your workers

Given that employee turnover in warehousing can top 35%,⁵ and that long term, skilled workers will be hard

to find and keep, it makes sense to provide operations with systems that help keep the workforce safe and productive. With full-body powered exoskeletons, DC operations can get more out of the workers they can find, reduce worker fatigue, and enable older, smaller, or less physically strong workers to take on heavier lifts.

"We call it opening the aperture of the worker pool," says Martindale. "With the Guardian XO exoskeleton, you greatly augment the strength and stamina of any worker wearing the suit, even persons of smaller stature, which in effect extends the size of the available labor pool."

Realistically, explains Martindale, most fulfillment operations will continue to use automation such as conveyors, sorters, mobile robots, or lift truck equipment to move and process many types of materials. But for those lifts that fall into the gap between full automation and safe manual lifts by workers, or to meet dynamic needs, full-body, powered exoskeletons can be the right answer.

"There will continue to be the need for people to be a part of the mix in materials handling, and a big part of that reason is the dynamic flexibility that you have in allocating people to work tasks," Martindale says. "But if you can augment the strength of those workers, and allow them to have safer, better working conditions, that is going to help your operations, and allow you to address those gaps that exist when full automation isn't possible."

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Footnotes:

- 1: MHI 2020 Annual Industry Report: Embracing the Digital Mindset. See page three, "company challenges" chart.
- 2: Modern Materials Handling, November 2019 issue, "2019 Warehouse/DC Operations Survey: Tight Labor and Space Pressures Drive a Technology Surge."
- 3:TED: The Economic Daily, "Back injuries prominent in work-related musculoskeletal disorder cases in 2016," BLS website, Aug. 28, 2018.
- 4: Spine Research Institute, "Addressing the High Corporate Costs of Back Pain."
- 5: Kane Logistics website, Consumer Goods Logistics Blog, "Want to Reduce Warehouse Labor Costs: Think Warehouse Labor Management."



ABOUT US

Sarcos Robotics is revolutionizing the future of work across the private and public sectors through its advanced line of robotic products that augment, rather than replace, humans. By combining the intelligence, instinct, and judgment of humans with the strength, endurance, and precision of machines, the result is a workforce that is not only safer but significantly more productive.

Sarcos Robotics is headquartered in Salt Lake City, Utah.

360 Wakara Way
Salt Lake City, UT 84108
(1) 888-927-7296
www.sarcos.com

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