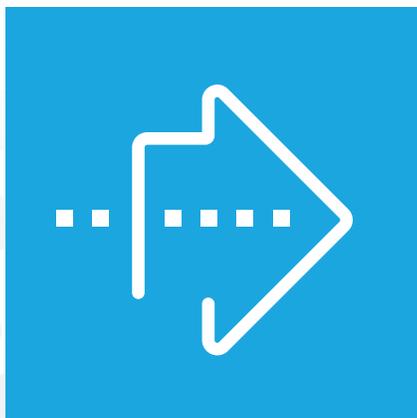




LOCUS



Finding Your Perfect Warehouse Robotics Fit





Contents

3-4	Executive Summary
5	Finding the Right Solution
6-7	A Post-Pandemic World
8-9	Robotics & Automation Market Update
10	Case Study
11-12	Sold on Robotics? What are the Options?
13-15	How to Scope a Robotic Solution
16	Brownfield and Greenfield Considerations
17	Labour Availability Considerations
18	Which AMR Solution is the Best Option?
19-20	The ROI Model
21	Conclusion
22	About Locus Robotics





Executive Summary

Recognition of the ability of robotics to improve warehouse fulfillment performance is becoming more widespread amongst supply chain leaders as the technology evolves and efficiency rates improve.

The Global Warehouse Robotics Market (2020-2025) report¹ estimates the robotics market was valued at \$23.67bn in 2020 and pre-pandemic predictions were this could rise to \$74bn by 2026 and register a CAGR (Compound Annual Growth Rate) of 20.4% over the period 2021-2026.

The pandemic may have skewed predictions, but the upward trajectory remains the direction of travel as robots continue to grow beyond simple automated workhorses to collaborative, autonomous associates working alongside their human counterparts.

Traditional automation solutions, while effective in helping to increase productivity, have been costly options for warehouse operators looking for significant improvements in their fulfillment performance.

Unsurprisingly, the Return-on-Investment period was considerably longer than today.

The 2019 Global Warehouse Robotics Market (2020-2025) report suggests

new alternatives, such as collaborative robots, are priced to offer businesses a return on investment in a matter of months, compared with years – even decades – previously.

Additionally, collaborative robotic solutions also offer the operator greater flexibility when it comes to scaling operations to meet demand, as well as the benefit of faster deployment.

Adoption rates suggest that traditional, capital-intensive automation systems have failed to deliver the flexible solution enabling organizations to adapt and digitize their warehouses quickly, cost effectively, and in a scalable manner. As a result, most warehouses are not automated.

The ideal solution to this problem, therefore, is a flexible solution that coordinates human labor and robots to optimize productivity and warehouse/fulfillment throughput in the fastest, most economical and scalable way.





Executive Summary (continued)

But the deployment of robotic solutions is not limited to the warehouse/fulfillment sector. Many other industries have adopted commercial robotics solutions because of the benefits they offer to their operations, whether this be to improve productivity or, in the case of the medical and defense sectors, the protection of human life.

According to the Commercial Robotics Market – Growth, Trends, COVID-19 Impact, and Forecasts (2021 - 2026) report², the

deployment of military robot automation within the defense sector is set to be the next wave of military evolution, with North America set to dominate the market due to the widespread acceptance of the infrastructure required for the deployment of commercial robotic systems.

The technological advances made within the healthcare sector in North America suggest the United States will also be the major adopter of medical robots moving forward. It is seen as

a pioneer in the adoption of surgical robots, which is a primary factor influencing the growth of the market.



The commercial robotics market is highly fragmented, as expenditure on commercial robots is rapidly increasing due to their superior benefits. The increasing investments, especially in the medical robotics segment, coupled with technological innovations and product launches by the industry players, are expected to drive the commercial robotics market.

Commercial Robotics Market - Growth, Trends, COVID-19 Impact, and Forecasts (2021 - 2026) Mordor Intelligence. 2019





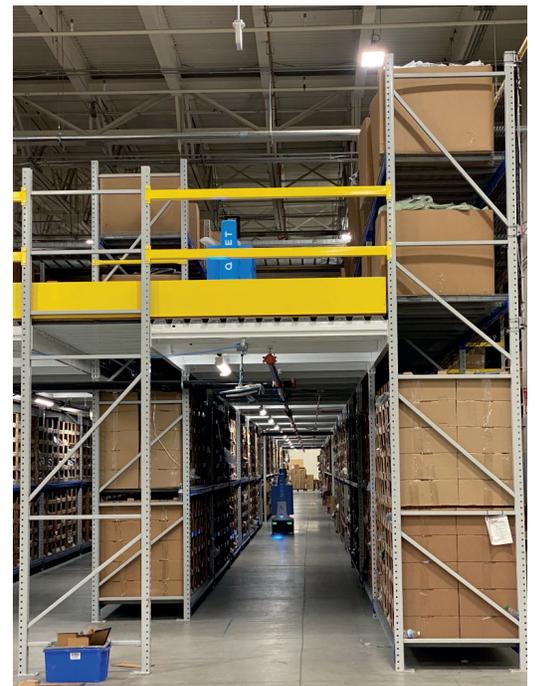
Finding the Right Solution

As with many things in life, there is no *one* robotics solution that fits all requisites. Therefore, finding the right solution for an operator's specific needs is not an easy decision; there are many requirements to factor in.

- Will it increase productivity and throughput?
- Will cycle times match customer expectations on delivery times?
- How long before I see results?
- How much will it cost?
- How quickly will I see a return on my investment?
- How do I know how many robots I'm going to need?
- Will I require new systems to integrate the robots into my warehouse?
- Will workers accept the new technology?
- Will installation cause widespread disruption to existing operations?
- How are solutions different from one another?

These are just some of the many things to consider and if you are asking yourself these questions, do not worry, you are not alone.

The issues tackled within this paper are intended to provide an overview of all the factors a buyer should consider when evaluating robotics vendors.



These include:

- **Flexibility** – how easily does the robotic solution scale to meet periods of surge demand?
- **Time to value** – how soon will operators see a return on their investment?
- **Performance** – what will be the impact on key metrics?
- **Experience** – is the solution proven to optimize warehouse workflows?
- **Trust** – is the vendor committed to customer success?





A Post-Pandemic World

The deployment of commercial service robots in industries around the globe has – and continues to have – a profound effect on the ability of operators to meet rising levels of demand during the COVID-19 pandemic.

The pandemic has created a sense of uncertainty amongst many businesses and sector. Within the e-commerce sector, there is an urgency to address fulfillment needs as orders increase dramatically. This has helped to demonstrate that warehouse operators do not have the luxury of taking months or years to plan and/or deploy a solution - nor can they afford to do so.

Recognising how the fulfillment industry was being transformed, savvy operators had begun planning ahead. In many cases, accelerating investment decisions. Plans to automate processes which may previously have formed part of a five-year, even a ten-year business plan were brought forward so upgrades could be made straight away and the technology installed to enable productivity improvements that could keep pace with growing order volumes.

Automation is helping fulfillment warehouses maintain the efficiency of their operations, which has been crucially important in managing peak demand periods during the

pandemic. The range of solutions varies from fixed infrastructure options such as conveyors, to alternatives such as robotics, which can be easier to scale and more flexible.

The fulfillment sector has not been alone in having to implement changes. Manufacturing, healthcare and other industries have all been forced to examine their operational models when tasked with having to maintain – even escalate – current productivity levels with fewer staff available, either due to illness or the need to enforce social distancing requirements.

In worst case scenarios, businesses lacking foresight or the necessary funding to make capital investments have been forced to shut down altogether, crippled by their complete inability to operate normally due to factors including coronavirus outbreaks, labor retention challenges due to fear, and compulsory quarantines.

The successful adoption of robotics solutions, as well as other forms of

automation, and their proven ability to improve performance in the most difficult of circumstances is now set to lead a surge in the adoption of such systems over the next five years.

The ability of the e-commerce sector to adapt and provide for people in lockdown – especially for essential needs – has been one of the positive aspects to come out of the pandemic.

And while US e-commerce sales rose 44% to \$861.12bn in 2020,³ global demand in 2021 and beyond will continue to increase as consumers become more comfortable with online ordering.





A Post-Pandemic World (continued)

This represents an increase in online spending as a percentage of total retail sales of more than 5% - up from 15.8% in 2019 to 21.3% in 2020.

This is the largest year-on-year increase in US e-commerce sales ever recorded.

Businesses adapting fastest to the changes in demand during the

pandemic have tended to be the ones to thrive. With new patterns of demand likely to continue beyond the pandemic, businesses will need to insulate themselves from future uncertainties by improving their operational methods.

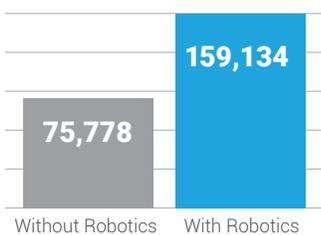
Many are applying the lessons learned during the pandemic to

improve the resilience of their supply chain.

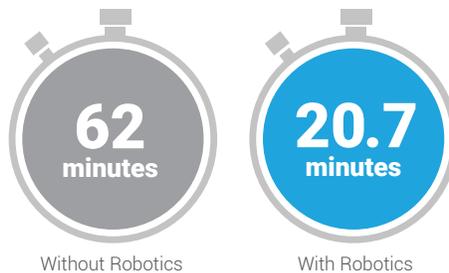
It is the ability of automated solutions, including robotics, to meet – and overcome – the challenges generated by changing patterns of demand that will be key to the success of businesses operating in the post-pandemic world.

GREATER PRODUCTIVITY

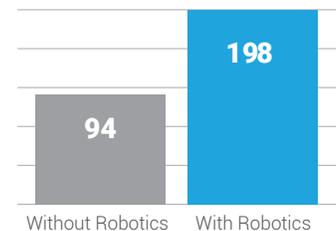
2X UNITS PICKED PER DAY



3X FASTER CYCLE TIME



2X UPH



Illustrative example based on Locus Robotics's experience deploying collaborative robotics solutions across 100+ sites.

Automation offers benefits in other ways, not all of them productivity related. Effective automated solutions will free existing workers of the burden of undertaking repetitive, mundane tasks. In the case of fulfillment warehouses this includes

the need to haul around heavy carts for long periods.

With the ability of automated solutions, such as autonomous mobile robots, to enter dangerous working environments, the risk

of injury to existing workers is dramatically reduced.

Freed from the need to complete routine tasks, existing workers can also be redeployed to more value-added roles.

BENEFITS OF THE AUTONOMOUS ROBOTIC SOLUTION

- Increased Productivity
- Enhanced Revenue
- Reduced Reliance on Traditional Labor
- Collaborative Working
- Less Supervision
- Freeing Staff for Added Value Work
- Reducing the Need for Staff to Work in Dangerous Environments
- Actionable Business Intelligence

The ability of the robots to collect and analyze data, feeding it back into a system to provide actionable insight can also improve decision making and operational efficiency.

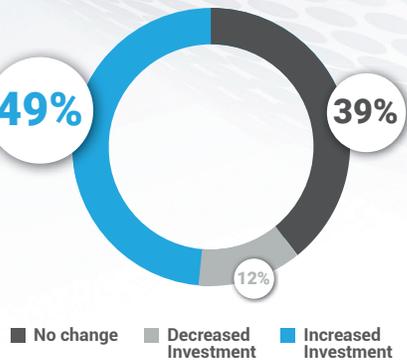


Robotics & Automation Market Update

The 2021 MHI survey⁴ concludes that 49% of supply chain leaders accelerated their investment in digital technologies to overcome the challenges imposed on their operations due to lockdown.

In many instances, spending decisions forming part of five-year, even ten-year plans were fast-tracked so that changes could be

introduced immediately. Usage of digital technologies is only set to increase, with adoption levels for Inventory & Network Optimization



Tools, Robotics & Automation and Sensors & Automatic Identification all set to double over the next five years as businesses look to insulate themselves from future disruption.

TOP FOUR INVESTMENT AREAS IN THE SUPPLY CHAIN



1
Inventory & Network Optimizations Tools



2
Cloud Computing & Storage



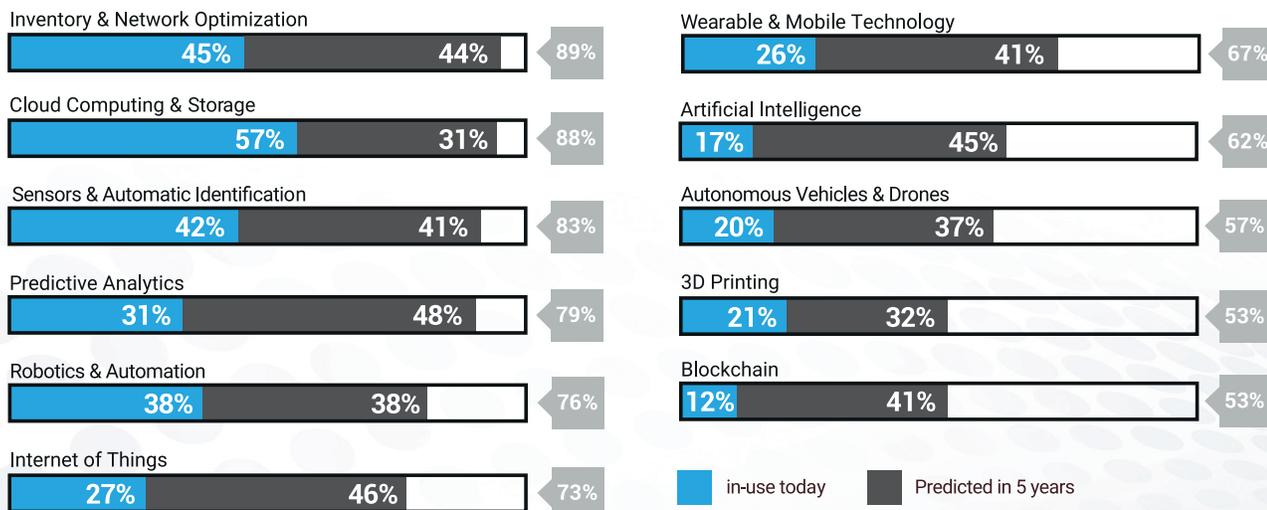
3
Robotics & Automation*



4
Sensors & Automatic Identification

*Robotics & Automation are set to see the highest levels of substantial investment in the next five years.

ADOPTION TRENDS PREDICTED USE | Technologies that are in-use today and their predicted use in 5 years.

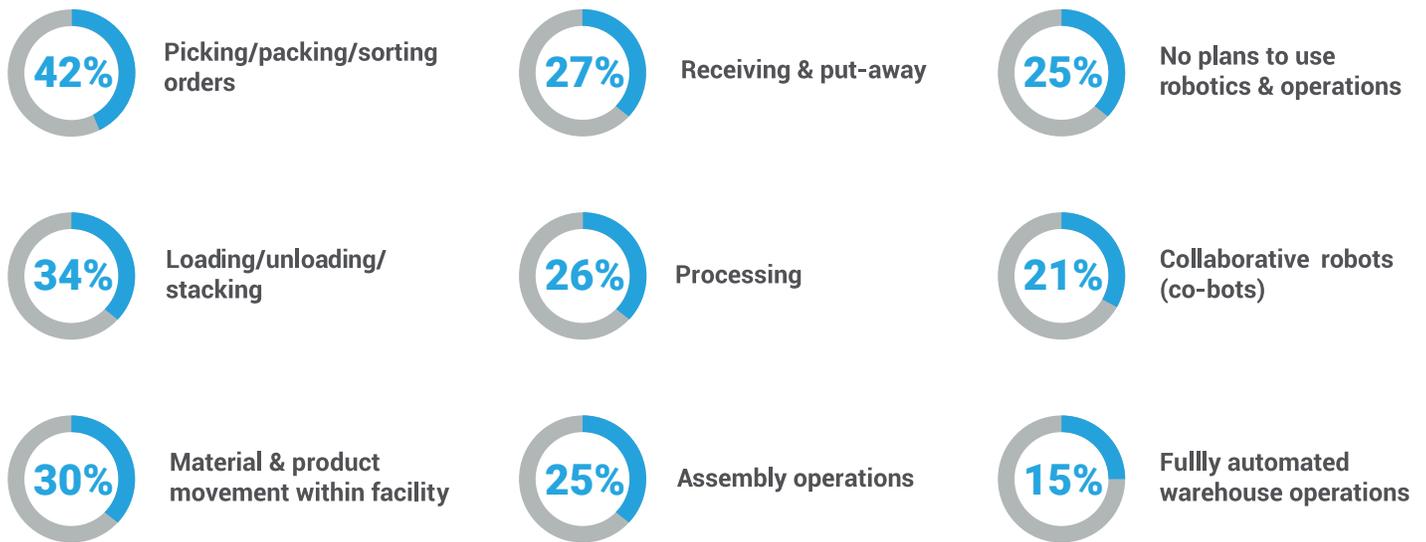


Source: 2021 MHI Annual Industry Report – Innovation Driven Resilience



Robotics & Automation Market Update (continued)

Survey respondents also identified the likely top uses for robotics & automation in their warehouses, with picking and packing efficiency top of their list.



Source: 2021 MHI Annual Industry Report – Innovation Driven Resilience

Conclusions to be drawn from this are that the use of robotics & automation in the warehouse is set to escalate significantly – with double-digit growth likely – as supply chain leaders look to digital technology to resolve fulfillment challenges.

Early adopters of digital technology are the businesses which have seen the greatest resilience during the pandemic and this approach is likely to position their businesses for future growth in the post-pandemic world.

Failure to heed these trends is likely to render non-adopters obsolete, within a very short space of time.

While this is an inconvenience for fashion retailers, for other sectors

such as healthcare and medtech it can literally be a matter of life or death.



It's very important we get every order out on a daily basis because we're in the business of saving lives.



Ralph Green, Operations Supervisor, DHL Supply Chain, North America

Case Study

DHL Supply Chain is the largest 3PL in the world and runs contract logistics operations for a who is who of non-financial Fortune 500 companies. Quite simply, it cannot afford to miss cut-off times.

The company acts as a 3PL for a global leader in musculoskeletal healthcare. The firm supplies time-critical medial implants for trauma victims, as well as other devices for the healthcare sector.

Put simply, it is a life and death situation where ensuring delivery times can mean the difference between saving a patient or losing them.

Integrating the supply of its Reconstructive Products and Surgical Products divisions within a single distribution center, the

healthcare company appointed DHL Supply Chain to be its logistics provider.

The advanced warehouse management system used in the center has improved cycle times to the point where DHL can accept overnight orders much later in the day. This has also meant a greater number of orders can be fulfilled in a single day, helping to save more lives.

Adopting an AMR solution has therefore been of critical importance to the logistics provider.





Sold on Robotics? What are the Options?

Begin by identifying which part of your operation needs to improve. This will help to determine which style of robot you need.

The options are varied – here are some of the choices:

■ Load Carrying & Pulling Robotics

Carrying robotics include:

- **Forklifts** – these are all types of forklift – VNA (Very Narrow Aisle), pallet trucks, reach trucks etc.
- **Mobile pallet conveyors** – used for point-to-point pallet movements, these either tunnel underneath pallets and lift them or use a staging station to carry pallets. Typically, these robots have payloads in the range of 500-1500kg and are unable to lift pallets above what is needed to make a horizontal move.
- **Other conveyors** (AGVs, AGCs, AMRs) – these are used for point-to-point product movement. These robots can be based on almost any navigation sensor. They typically carry loads between 20kg through to 500kg. This category excludes G2P, pallet conveyors or cart towing robots.

Pulling robotics include:

- **Tuggers / Tow Tractor** – these are used to move wheeled loads but exclude single carts and are typically, for pulling large loads and trains.
- **Cart towing** – these robots are used to move wheeled carts. Typically, they drive underneath the cart and attach via an arm or hook to pull the cart.





Sold on Robotics? What are the Options? (continued)

■ Person-to-Goods (P2G)

- These AMRs are used to support order picking in warehouses.
- They direct human workers to picking locations and collaborate with them by assisting in product selection as well as transporting it.
- Many other functions and capabilities are now offered by these AMRs.

■ Goods-to-Person (G2P)

- Often compared to the Kiva Systems model, these are largely used for moving racks of inventory on a QR code-based grid to a human picker.
More recently, these have been used in manufacturing environments for lineside supply.
A number are now available with SLAM (Simultaneous localization and mapping).
- Other approaches will pick totes rather than move entire racks.

■ Sortation Systems

- Items are identified on a conveyor system and then diverted to specific locations using a variety of devices controlled by dedicated software.
- These AMRs are used for sortation of various items and parcels.
- They may either be used to move products to assigned totes or chutes and for parcel sortation.
- These robots can be implemented to assist in other functions including returns and replenishment.

■ AMRs & Robotic Arms

- These are AMRs with an integrated articulated/moveable arm (often supplied via a third party).
- In some cases, the arm may not be fully articulated but can move in several directions to pick, place and carry a load.

PERSON-TO-GOODS



STANDARD GOODS-TO-PERSON



OTHER GOODS-TO-PERSON



SORTATION



AMR + ROBOTIC ARM





How to Scope a Robotic Solution

Choosing which robotic system offers the best solution to a particular set of challenges is an important decision for any business. Much will depend on individual requirements.

The main requirement is ease of fulfillment, i.e., how quickly and easily orders can be turned around and goods dispatched. Good design

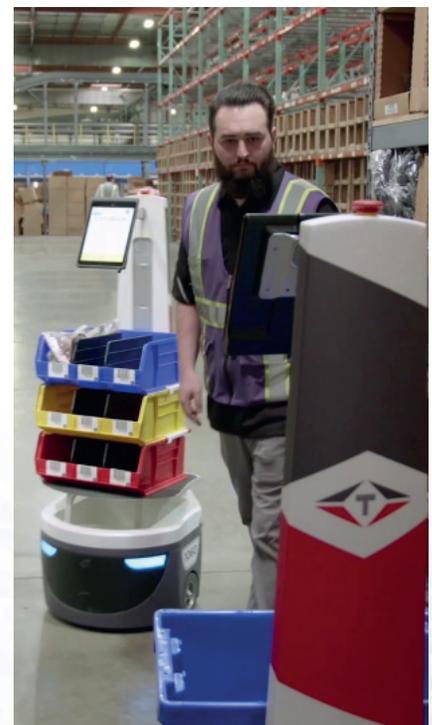
of the warehouse layout will speed up this process, as well as free up existing labor to be relocated to where it will be most productive.

■ Assessing volumes

- Facilities processing low order volumes – under 2,500 lines per day – may not require a robotic solution as these numbers can be managed using traditional manual labor methods.
- However, the higher the volume of orders, the faster cycle times will need to be to achieve acceptable delivery targets.

■ Product/SKU⁵ characteristics

- The weight and size of a product will determine which type of storage unit is required by the robot. Small items can be safely stored in totes, but bulky items and cases will require a different configuration. Understanding this will be key to designing an efficient solution.
- Pallet-based picking solutions can also be utilized here, depending on the weight and dimensions of the product.



■ Cycle time/SLA⁶

The ability to effectively manage cycle times is a crucial KPI collaborative robotics solutions can help deliver. It can have a significant impact on the performance of a fulfillment operation in various ways.

- Increase in units picked per hour
- Faster order fulfillment – important for dispatch of time-sensitive items
- Increased throughput
- Better productivity
- Greater profitability
- Faster ROI

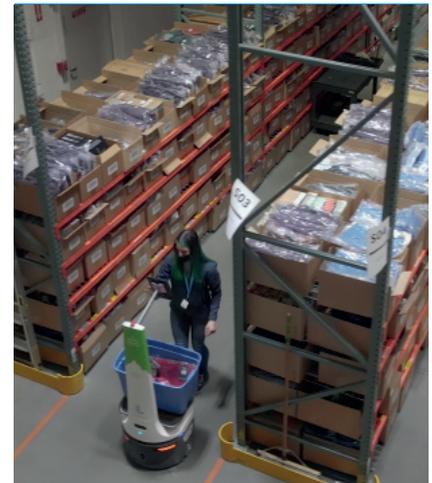


■ Warehouse layout

An efficient warehouse layout will enable robots to navigate the route between picker and packing station far more effectively, helping to improve cycle times.

Factors to consider when looking at a layout include:

- **Aisle width** – there has to be sufficient space for humans and robots to work in safe collaboration. The agility of the robot will dictate its ability to go around obstacles and adapt to one-way systems and narrow aisles.
- **Picking area** – maximizing storage space is vital for an efficient warehouse and every square foot of usable storage space should be utilized. However, the picking areas must be accessible to both picker and robot.
- **Racking** – many AMR solutions can work with existing racking, although some will require specific racking. Storage-based, G2P systems require the installation of locked grids where bins are stored, which can present issues with accessibility to the product should the system go down for any reason.
- **Mezzanines/levels** – while AMRs are efficient, they have not yet learned how to climb stairs! However, some solutions can be configured to work effectively within different floor levels, enabling tasks to be assigned by zone, and pick-and-pass configurations.



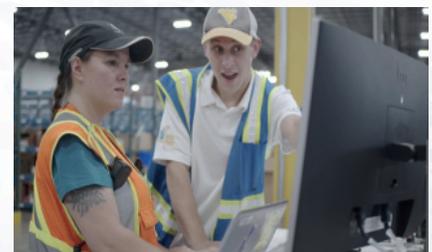
■ Fulfillment model

Take care to assess the different fulfillment models that may be in operation, as these will influence which AMR solution meets your requirements.

- **Omnichannel** – increasingly, industries are adopting a multi-faceted approach to selling their goods, incorporating a traditional bricks and mortar offering with an online (e-commerce) provision.

This model may also incorporate an element of stock replenishment.

Omnichannel fulfillment requires a solution that offers flexibility in pick methodologies, including discrete, batch and case picking.



How to Scope a Robotic Solution (continued)

■ Fulfillment model (continued)

- **E-commerce** – The e-commerce sector grew dramatically during lockdown with sales up 44% in 2020⁷ – an increase in online spending as a percentage of total retail sales of more than 5% and the largest year-over-year increase in e-commerce sales for US retail ever recorded.

There is every reason to believe the grow in this sector will continue as the shopping trends of lockdown carry over to the post-pandemic world, with the trend extending into the B2B sector.

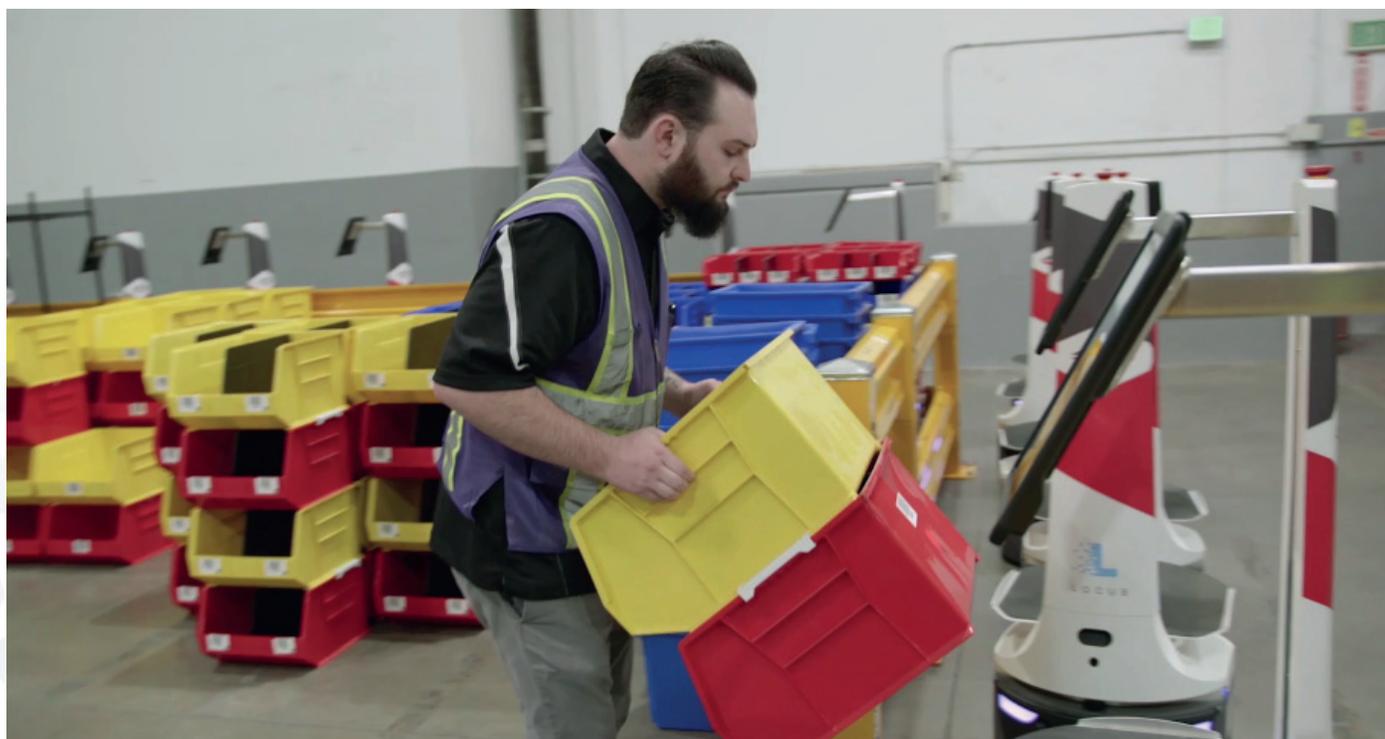
Making adequate provision for an e-commerce operation will require a solution that can fulfill single to multi-line orders at a very fast pace to accommodate ever-shrinking delivery times.

- **Wholesale** – if the fulfilment model is for a wholesale operation, then it is likely that workflows will have to be adapted to suit market requirements.

This model requires flexibility in picking methodologies as vendors require more direct-to-consumer fulfilment options from their suppliers.

- **Manufacturing support** – just-in-time manufacturing models will require a constant stream of components to keep assembly lines moving. Fulfillment models here will operate in a similar way to FMCG⁸ with high demand products being stored ready for easily dispatch. In this way, efficiency is maintained throughout the supply chain.

This model often requires a solution that can offer sideline delivery, kitting and point-to-point transport, in addition to picking capabilities.





Brownfield and Greenfield Considerations

Brownfield or greenfield facilities can have a bearing on which type of fulfillment solutions to adopt. If the warehouse is within a brownfield site, then there may be an element of retrofitting required.



Whether you are building from the ground up or in an existing facility, choosing the right solution is key. The type of environment may have cost implications due to changes in the infrastructure of the warehouse to properly deploy the solution.

Some solutions require only minimal infrastructure and can adapt more easily and cost-effectively to an existing warehouse layout design. In this case, the deployment of the robots can proceed relatively quickly, probably within a matter of weeks and the integration with existing systems is usually seamless.

New-builds on a greenfield site offer a blank canvas and the layout of the warehouse can be purpose-designed to accommodate an AMR solution.

The fewer infrastructure requirements, the faster the deployment!

The sooner operations are running to maximum efficiency, the sooner operators will see a return on their investment.

Operators also need to consider if they want to automate picking, putaway, transport, or other related workflows.

Last, you will need to evaluate whether to select one solution that addresses multiple use cases or work with multiple vendors who specialize in certain workflows and use cases.



Labor Availability Considerations

Having access to sufficient labor to meet the needs of any fulfillment operation will be a primary consideration for operators when identifying new warehouse locations.

Conversely, existing sites may be in industrialized areas where labor is hard to come by.

However, given the realities of the current labor market, labor availability cannot be guaranteed. An AMR solution might be the best option for improving operational efficiency and offsetting manpower shortages.

Fulfillment operations require a constant stream of labor if they are to function efficiently and any warehouse, regardless of sector, will still require a human workforce – no matter what robotic solutions it decides to adopt.



Which AMR Solution is the Best Option?

While many robotics solutions address multiple use cases, an operation can successfully leverage many types of robotics and automation, including fixed infrastructure systems such as conveyors, as well as mobile robots.

Likewise, workflow optimization is not always just about identifying the best hardware design that allows the robot to be agile and nimble. The workflow optimization logic and business intelligence inherent in any automated solution will impact efficiency.

Therefore, operators should always ask vendors:

- **What type of DC environment and workflows has your robotics solution been most effective in, and why?**
- **How does your solution optimize workflows?**

What else should I consider when selecting a vendor?

There are various factors to consider, including:

- **Industry experience** – is the vendor a technologist or roboticist, or does it have a thorough understanding of the operational requirements for an efficient warehouse?
- **Why this matters**
 - There needs to be clear evidence to show they have the necessary knowledge to solve real-life problems.
 - Warehousing and supply chain experts don't just think about making your workflows slightly more efficient, nor do they have a technology-first perspective. It is because they know the ins and outs of operations, that they can develop effective ways to automate and optimize workflows.

Operators should also ask:

- What's the vendor's background?
- Do they understand how warehouses work?
- Do they understand warehouse workflows?
- Do they know how other warehouse systems, such as WMS, WES, WCS, LMS⁹ work?
- Do they understand material flow?



⁹ Respectively – Warehouse Management System, Warehouse Execution System, Warehouse Control System and Labor Management System





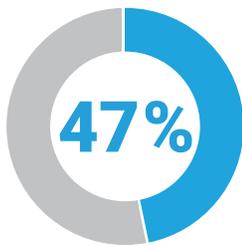
The ROI model

How soon an operator will see a return on their investment is a major determining factor in the solution they choose. Generally, there are more factors to consider than a fast implementation. Providing operational efficiency depends on pricing models, cost savings and how quickly optimal throughput levels can be achieved after deployment.

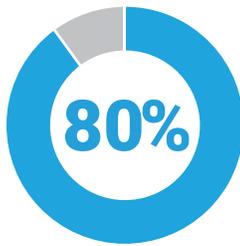
Different vendors follow different frameworks to forecast the impact on metrics that can be achieved by implementing their solution, as well as the time to ROI.

ECONOMIC IMPACT

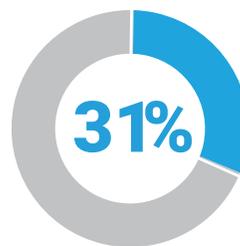
A recent Forrester Total Economic Impact™ study examined the return on investment of deploying a multi-bot solution as it relates to labor costs and savings.



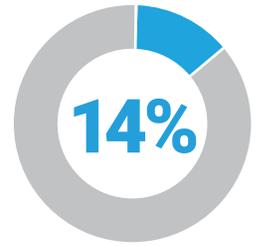
NONPEAK LABOR SAVINGS



REDUCED TRAINING HOURS



PEAK SEASON LABOR SAVINGS



AVOIDED OVERTIME PAY

What are the costs and pricing models?

CapEx – this has been the traditional option for businesses looking to buy, maintain or improve its fixed assets, of which robots could be one. Solutions that align with this model usually require a large substantial investment in addition to organising maintenance and support fees.

OpEx – an operating expense is a means of funding the purchase of new equipment and assets on an ongoing basis.

RaaS¹⁰ – this is useful alternative to traditional funding options and provides businesses with greater

flexibility when deploying a robot fleet. As a subscription model, it requires little in the way of upfront investment allowing operators to easily scale the size of their robot fleet as their needs change. They simply pay for what they need, when they need it.



The operator needs to secure from the vendor :

- What steps will they take to understand our operation, and what we are trying to accomplish?
- Will they understand our cost analysis?
- How do they arrive at their numbers?
- Can they back up their claims on the impact on metrics, and ROI timeframes?
- How often do their customers achieve forecasted levels of productivity?
- How quickly can I expect a ROI, and how do they determine this timeline?



How easily does the solution scale?

Identifying the flexibility of a system is key to choosing the right solution.

Therefore, the operator should challenge the vendor on:

- The flexibility of a system to quickly adapt to changing fulfillment models, environments, physical space, product mix, and inbound and outbound workflows.
- The ability of the solution to scale up and down to meet spikes in demand.
- The effectiveness of the solution in combatting issues such as a shortage of labor.



The operator should ask:

- How easily can your robotics solution scale to handle my volume peaks then adjust to normal levels?
- For third-party logistics warehouses, how does the robotics solution accommodate multi-tenancy?
- How can a single fleet of robots support picking or other tasks on behalf of multiple clients?



The experience of others

Finding an independent voice will assist due diligence and stop you from relying too much on a vendor's promises. Therefore, ask to speak to other customers about their experience, what ROI they have experienced, and what it is like to work with the vendor.



Conclusion

It is clear why supply chain leaders look to implement effective robotics solutions to improve the efficiency of their fulfillment operations.

However, selecting the right solution for their needs is not so straight forward. The onus is on the operator to conduct due diligence before making any decision.

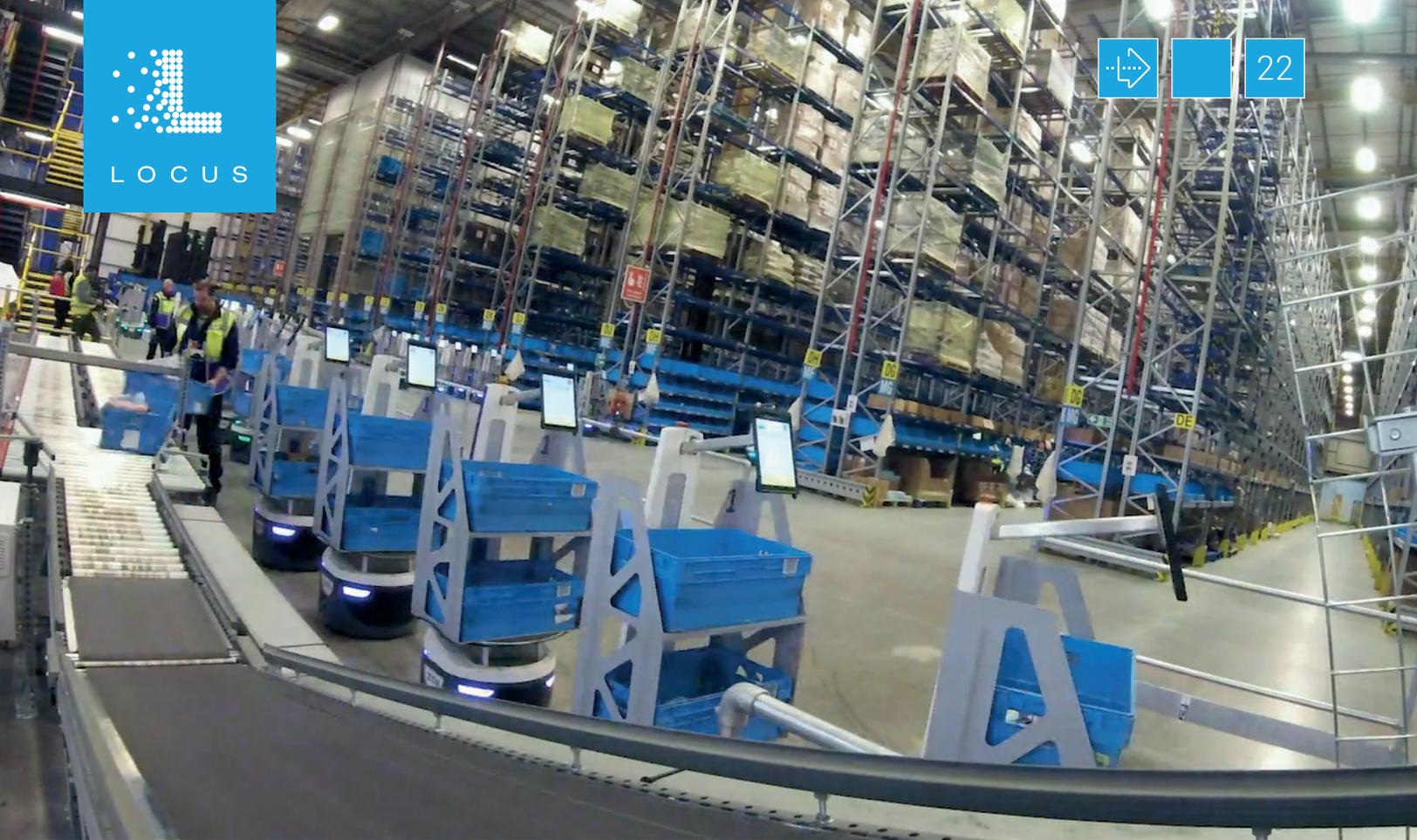
Developing a trusted relationship with a vendor will take time but research of all the options available prior to entering into any agreement will help avoid problems further down the road.

REMEMBER TO ASK STRATEGIC QUESTIONS

- Will the solution increase productivity to the point required to meet customer expectations on delivery times?
- How long before I see improved results?
- What is the cost of deployment?
- When will I see a return on my investment?
- Is the solution flexible enough to scale to my needs?
- Will I need to make wholesale changes to my warehouse to accommodate the robots?
- How accepting are workers of the robots?
- Will installation offset any labor challenges I might encounter?



Only when you are satisfied that all your concerns have been addressed, should you proceed.



About Locus Robotics

Locus Robotics is the market leader in Autonomous Mobile Robots (AMR) for fulfillment warehouses. The company has quickly become the leading warehouse robotics solution provider for retailers and third-party logistics (3PL) operators, industrial/automotive, and healthcare companies worldwide that are looking to meet the shifting demands of the booming e-commerce and fulfillment market.

Locus's collaborative robots work safely with human employees, driving productivity to ensure that retailers and 3PL providers can match higher order volumes with increasing consumer demand, despite the widespread scarcity of warehouse labor.

Typically, Locus customers see a Return on Investment of an average 129% in less than six months and the deployment can be completed in as little as four weeks, keeping disruption to a minimum.

For more information visit
www.locusrobotics.com





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