



WHITE PAPER

THE WAREHOUSE OF THE FUTURE

- How will warehouses be designed in the future?
 - Who will work in warehouses in the future?
- How will warehouses be sustainable in the future?

01	Executive Summary	03
02	Introduction	04
	1. Introduction to Warehouse Automation	
	2. The Warehouse of the Future	
	3. Purpose of this report	
03	Warehouse Design	06
	1. What will the Warehouse of the Future look like?	
	2. The Challenge	
	3. The Agile Solution	
	4. Take-aways: All Shapes and Sizes, for all customers	
04	Workforce	09
	1. How will work in the Warehouse of the Future?	
	2. The Challenge	
	3. The Robotics Solution	
	4. Human-Robot Partnership	
	5. Case Study: Maersk Contract Logistics	
	6. Take-aways: A Safe and Stimulating Place of Work	
05	Sustainability	12
	1. How will the Warehouse of the Future be sustainable?	
	2. The Challenge	
	3. Effective Measurement	
	4. Digitisation of the Warehouse	
	5. Case Study: Best Supply Chain (Shanghai Warehouse)	
	6. Case Study: Maersk Contract Logistics	
	7. Efficiency in energy use and space	
	8. Take-aways: Efficiency is key	
06	Conclusion	15



Executive Summary

The following White Paper seeks to paint a picture of the ideal warehouse of the future and highlight how the warehousing and automation industries can unite to overcome challenges and achieve positive advancements for the entire warehouse sector. Based on insights from CEOs, CTOs, Country Managers, Directors, and academics with expertise in the fields of warehouse management, logistics, and robotics, Hai Robotics will explore answers to the key questions facing the sector:

- **How will warehouses be designed in the future?**
- **Who will work in warehouses in the future?**
- **How will warehouses be sustainable in the future?**

The report finds that the warehouse of the future will be more tailored and efficient at meeting the needs of customers through the use of agile robotics solutions. Experts predict that scalable automation processes will be implemented across the market to achieve greater capacities, increased storage density and improved putaway rates, particularly as the e-commerce boom continues.

Experts in the warehousing industry noted that several workforce challenges are constraining the sector, including an aging population, employee retention issues and migration changes. The report finds that experts agree that robots will be able to complement human labour, rather than replace it, filling in gaps where necessary and making warehouses a safer and more stimulating place to work by enabling workers to take on more technical roles supervising automation. It is recommended that the upskilling of workers should be a priority for the industry going forward. The warehouse industry currently lacks an agreed-upon way to measure emissions and energy use, limiting the potential ambition to decarbonise warehouse operations. It is recommended that the industry work together to establish firm standards for sustainable operations, in order to better observe the positive impacts that automation can have. These include efficiency in energy use and space and savings on paper use, by digitizing processes. The key challenges identified by Hai Robotics' research will be building multi-channel, cross-network software solutions which integrate different processes together into one seamless supply chain, and tackle institutional aversion to new technologies. Robotics companies and warehouse managers can work together to ease the transition to automated warehouses, by engaging with workers, investors and new business prospects on the benefits of these systems.



Introduction

1. Introduction to Warehouse Automation

Since the invention of the forklift in the early 20th century, the warehouse industry has been trying to find more efficient ways of picking and transporting goods from Point A to Point B. Increasing stock turnover and reducing delivery times has been the goal of managers for decades, but has become a necessity with the advent of e-commerce from the late 1990s onwards. Vendors can now reach more consumers and offer more choice, meaning warehouses need to keep more goods in stock at any one time. This has been accelerated by the COVID-19, as online shopping became a necessity. The increase in online returns policies has also created new pressures on picking and sorting activity, and the need to implement sophisticated stock management systems. The development of automated technologies has accelerated to meet this challenge.

Several companies design, engineer and manufacture a wide variety of self-contained, goods-to-person, automated storage and retrieval systems (ASRS). With the focus shifting from picking pallets and cases to picking individual items or “eaches”, there has been an explosion of types of ASRS technologies available in the market to help warehouse, distribution and manufacturing operations make this change.

ASRS technologies can be broken down into three major categories based on how they deliver goods:

- **Shelf-based picking:** including Vertical Carrousel Modules, Horizontal Carrousel Modules, and Vertical Lift Modules (VLMS).
- **Bin-based picking:** including Crane-Based Mini-Load ASRS and Vertical Buffer Modules (VBM).
- **Robotic picking/delivery:** including Robotic Shuttle Systems, Robotic Cube Storage, and Floor Robots (AGVs/AMRs).

The e-commerce boom has seen a proliferation of various types of robotics picking/delivery technologies capable of handling different volumes, types, and velocities of non-palletised inventory. The type of technology that organisations choose will ultimately depend on the specific operation, the storage density needed, the throughput goals, and the budget.

One example is the emergence of autonomous mobile robots (AMRs), which can move entire shelves to workstations so pickers can pick the required item. They can understand and move through their environment independently, using advanced technology. This is a significant help for transporting stock within a warehouse, as its smart features can increase flexibility and safety.

Another example is collaborative mobile robots, which are flexible, safe and easily programmable. They are specifically designed to assist human employees as they perform various order fulfillment and warehouse activities. This easy programmability is ideal for warehousing operations, which tend to be dynamic.

The latest solution involves Autonomous Case-handling Robots (ACR) that can store and retrieve several cases at the same time in narrow storage aisles. These robots are agile, scalable and easy to integrate with existing infrastructure and systems.

Hai Robotics has developed the first such ACR system, incorporating HaiPick robots, workstations and a HaiQ software platform to perform picking, sorting, and transporting operations. HaiPick robots have a small footprint and a vertical reach of up to 10 meters high (over 30ft), which can reduce a facility's storage footprint by up to 75%.

Technology is evolving very quickly, as robots can now pick, sort and transport stock in record time, even with sensitivity to different shaped and sized products. Warehouses are thus becoming more intelligent and efficient, as these solutions are put into practice in Third-Party Logistics (3PL), e-commerce, fashion/apparel, automotive, retail, healthcare and electronics sectors. However, the industry has been impacted by misconceptions that the expansion of warehouse robotics means that warehouse workers will lose their jobs and be 'replaced' by more efficient machines. Such a dystopian vision of the future of warehousing has clouded the public's hopes for further advancements and created unnecessary worries for workers. This is not a view shared by the industry itself, as we will outline in this White Paper, but it is nonetheless a powerful misconception.

In addition, the story of Amazon, as a leader in warehouse automation, has also been a significant influence on perceptions. The purchase of Kiva is widely considered to have opened up a gap in the market and paved the way for a boom in development activity, raising the bar for robotics companies around the world. China's dominance in this market is also remarkable. In 2021, the country installed 268,200 robots, across a wide range of industries. 52% of all newly deployed robots in 2021 were installed in China. Other countries leading the way include Japan, at 49,900 annual installations, the United States, at 33,300 annual installations, and Germany, at 20,500 annual installations.

The question now is: where does warehouse automation go from here?

2. The Warehouse of the Future

As this industry develops, there are several key questions that must be answered:

- How will warehouses be designed in the future?
- Who will work in warehouses in the future?
- How will warehouses be sustainable in the future?

Exploring these areas in more detail will provide insights into the challenges and opportunities which warehouse managers and robotics developers must face together.

3. Purpose of this report

This report seeks to paint a picture of the ideal warehouse of the future, based on insights from industry experts. We have interviewed CEOs, CTOs, Country Managers, Directors, and academics with expertise in the fields of warehouse management, logistics, and robotics. We asked them about their view of the future of warehouse automation, the impact it would have on workforces and sustainability, the risks facing the industry, and the potential avenues for collaboration to drive forward progress. The purpose of the report is to highlight how the industry can unite to overcome challenges and achieve positive advancements for the entire sector.





Warehouse Design

1. What will the Warehouse of the Future look like?

As the use of robotic solutions across the warehouse sector grows, companies of all shapes and sizes and right across the supply chain are considering the benefits of automated solutions. There is little consensus within the industry on what form the warehouse of the future will take, due to the wide range of uses for automation in different operations. Therefore, accommodating flexibility in warehouses will be the key focus for the industry, going forward. Our research shows that agility is essential. The warehouse of the future will not be designed to accommodate robots, but rather robots will be designed to blend quickly into existing operations.

2. The Challenge

To date, innovation in the warehouse automation industry has come from the top players such as Amazon, who have the resources to invest in bespoke custom solutions in gigantic purpose-built compounds. To these lucky few, with almost endless resources, designing and implementing an entirely automated warehouse – from the ground up – is a feasible endeavor. However, the cost of such a solution is prohibitive to some parts of the wider industry.

Despite the numerous robotics solutions on offer, and although it is improving, the logistics industry still lacks the general awareness of what automation can currently do for individual warehouses. Coupled with the lack of understanding, is an institutional aversion holding companies back from investing in a robotics future. New technologies are still perceived as costly and time-consuming to implement in existing operations. The reality today is that the capital expenditure needed to implement a robotics solution is significantly lower than it was a few years ago. The challenge faced by the warehouse robotics industry is to educate logistics companies on what robotics solution is most practical to implement and how such investment could seamlessly fit into their existing ecosystem for little cost.

The COVID-19 pandemic, the explosion in online retail and the interconnected nature of the modern global economy has and is already shaping the face of the warehouse and logistics industry. The nature of ‘just-in-time’ supply chains or the ever-growing expectations of consumers – accustomed to next-day or even same-day deliveries, has seen enormous investment in logistic networks in recent years. Ever larger regional hubs (typically above 9.2k square meters or 100k square feet) linked to smaller, more localised distribution centres in urban areas are increasingly becoming the norm. Yet the workers needed to staff such sites are in short supply, as countries like the UK, US and even China are having to contend with.

3. The Agile Solution

The advances in warehouse robotics, coupled with rising labour costs, difficulties finding workers and the declining cost of robotics solutions, has created a watershed moment for the logistics industry. Companies that don't have the capital investment required to build a custom warehouse from the ground up, can invest in robotic solutions to enhance their operations and efficiency. As such, the industry in general – led by companies like Hai Robotics – is designing and implementing much-needed solutions that can blend quickly into existing operations and can evolve to suit the changing needs of potential customers, based on an agile design.

In recent years, an emerging class of warehouse robots designed to augment operations and work collaboratively with humans has come to market. From collaborative robots known as cobots – that work together with employees, with no safety equipment needed – to autonomous mobile robots or automated guided vehicles, the diversity of technology solutions on the market today allows for precise, cost-effective options to suit any need.

The agile solution offered by companies like Hai Robotics enables warehouse operators to pick and choose what solution would work best within their existing operations. It targets components of operations, rather than an entire system overhaul. This approach means companies reluctant to invest vast sums of money into an entirely automated warehouse can test the water by deploying a few robots to automate a specific process. It can also alleviate bottlenecks for those who want to improve efficiencies without disrupting workflows and making large capital investments. In some cases, governments will support the introduction of automation into companies. For example, the UK government launched a scheme in 2021 allowing companies to claim 130% capital allowances on qualifying plant and machinery investments. In China, advanced robotics is one of the key areas targeted by the Made in China 2025 plan, ensuring support for robotics is part of the national economic strategy.

Recently we have seen new alternatives to large capital investments such as Robot as a Service (RaaS), a subscription-based model where customers pay for in-demand services of a robotics solution. Companies using this service model provide total solutions that include operation, maintenance, and management services, in addition to the robotic system

for sustainable and scalable productivity. As confidence in automation grows, additional robotic solutions can be deployed to cover increasingly more complex aspects of the warehouse pipeline.

"The good thing about these kinds of agile solutions is that they're scalable and modular, you don't have to spend a ton of money upfront. You can get a few robots in to automate a process in the warehouse and then develop it from there if it works."

Simon Duddy, Editor, Handling & Storage Solutions

When we spoke to industry experts, they marveled at the wide array of companies now taking advantage of their ability to deploy small fleets of robots to meet specific, smaller-scale needs. One expert noted that as the robotics industry developed and costs dropped, the type of companies investing in robotics solutions would also change, now including SMEs, as well as large companies

This diverse range of customers should be front-of-mind for robotics developers, particularly as smaller companies' decisions to invest will look very different from the big players. Return on Investment will be a more immediate concern for SMEs, who can't afford to make big investments that will only come to fruition five or six years down the line. Therefore, cost and speed of deployment will be key to unlocking this market.

"I cannot imagine even a small company not keeping an eye out [on robotics] because eventually the technology is going to progress, and they will be left behind."

Vaggelis Giannikas, Associate Professor, University of Bath

Larger companies are also increasing their robot fleets to meet the challenges of increased e-commerce. In order to stay competitive, vendors must offer a wide range of stock, flexible returns policies and speedy delivery times. Robots can help vendors to upgrade their capacity and capability to handle increased turnover, particularly those with sophisticated technology like the HaiQ software.

"E-commerce companies are holding more stock and offering more choices to consumers, increasing the complexity of handling activities. Picking and packing goods to send them to a consumer's home address takes more space than preparing them to send to a retail outlet. Returns activity is also quite space hungry."

————— Clare Bottle, CEO, UK Warehousing Association

4. Take-aways: All Shapes and Sizes, for all Customers

Robotics and automation present an amazing opportunity for warehouses to improve their speed and efficiency. In the not-too-distant future, human pickers might have less time on their hands, but there will need to be a lot more investment in developing and testing warehouse automation systems, maintaining warehouse robots, and improving automated logistics workflows.

Warehouse design will be impacted less by the robots themselves, and more by the realisation that when implemented correctly, a robotics solution combined with the creativity, judgment, and agility of human workers, will create a far more agile and productive logistics network for a wide range of customers.

With any new technology, there will always be some who have an aversion to the unknown. There is a psychological barrier that individuals and even companies as a whole need to get past before adopting automation. The agile approach will help to ease this transition.



Workforce

1. Who will work in the Warehouse of the Future?

Some ideas of the warehouse of the future envisage the eventual elimination of human labour within warehouse operations, assuming that automation will outgrow the need for human supervision entirely. This is not the view shared by the majority of those in the warehousing and automation industry. Our research shows that most view automation as an assistant to humans, rather than a replacement for them. Robotics offers an opportunity for a safer, more stimulating environment for warehouse workers and a bright solution for pressing demographic issues facing the workforce.

2. The Challenge

A variety of global crises have exposed vulnerabilities in international labour markets over the past decade, leading to worker shortages in key sectors such as logistics, healthcare, transport and hospitality.

Britain's exit from the EU and the end of free movement of EU citizens to the UK caused sectors such as hospitality, logistics, transport and healthcare to suffer a steep rise in unfilled vacancies, due to the loss of EU workers. The COVID-19 pandemic also disrupted the free movement of people, and forced workplaces to reckon with the regular

absence of workers due to self-isolation requirements and illness. This squeeze on the workforce coincided with the continued boom in e-commerce, as isolating households relied on rapid online deliveries for essentials, placing particular pressure on the logistics industry. In countries like the US, the difficulty of retaining workers is often attributed to the quality of the work itself, with swathes of employees seemingly quitting to seek more satisfying and flexible jobs. Industries that rely on in-person work, rather than work that can be done from home, have suffered the most severe shortages. For instance, the US Chamber of Commerce calculated that the leisure and hospitality industry, in particular, has experienced the highest quit rate since July 2021, consistently above 5.4 percent. Wholesale and retail trade isn't far behind, with a quit rate of 3.3% in June 2022. Employers are under pressure to offer better working conditions and opportunities for development, if they are to attract and retain workers.

"There is a recruitment problem with warehouse workers, due to the fact that it traditionally depends on hard labour. That is a factor impacting potential employees."

— Vassilis Pandis, Chief Technology Officer, Logidot

China faces a similar labour shortage, partly due to an emerging 'demographic gap' caused by an aging population, low birth rate and low level of immigration. In particular, the aging population poses issues for traditionally physical jobs like warehousing, as the ability to lift heavy units and stand up for long periods is important. The trend of an aging population is being experienced in several countries, including the UK, where 22% of the population will be aged 65 and above in ten years. Employers have learned that they cannot rely on a supply of young workers to take on these physically intensive roles, so should consider how older workers can be supported to fill in the gaps. Those with disabilities and health conditions limiting their capacity for manual labour should also be accommodated and given equal opportunities to their able-bodied peers. This will have wider societal benefits and bring a diverse range of talent into warehouses.

3. The Robotics Solution

The further integration of automation and robotics into warehouse operations offers a solution to all of these pressures. By utilizing robots' ability to pick and sort goods on the warehouse floor, the shortage of young, skilled labour will be felt less acutely. They will be able to perform the ergonomically challenging roles that older or disabled workers cannot do, allowing employers to better utilise those workers for other key tasks. Relying on robots for labour-intensive tasks will also ensure that workplace injuries are less common, particularly when it comes to repetitive tasks that often cause strain. This is a vital step that employers should take to protect and attract a diverse array of workers.

"There shouldn't be any excuses for finding ways of making the workspaces a lot more inclusive, inclusive and open to pretty much everyone."

————— Andrei Danescu, CEO, BotsAndUs

"Robotics can make warehouse jobs more interesting, safer, less tedious and less strenuous for humans."

————— Clare Bottle, CEO, UK Warehousing Association

Robots will also take on the roles in a warehouse that are more dangerous and uncomfortable for workers, such as picking heavy goods from shelves. This will help to reduce the amount of 'hard labour' that warehouse work entails, leading to a more appealing workplace and enticing workers back. Industry experts agreed that automating the processes in warehouses would lead to a better working environment and enable workers to benefit from the assistance of robotics.

4. Human-Robot Partnership

Far from being replaced entirely, human labour will be vital to the smooth running of automated warehouses in the long-term. However, the roles that humans will play will undoubtedly change, as automation expands. The human supervision of operations will become more technical and grounded in the more mentally stimulating work of discerning and fixing problems in warehouse processes. This will require workers with the skills to carry out data analysis, use software systems and repair robots when they break down. The systems of automation in place within warehouses are increasingly complex and advanced, requiring project managers, project engineers, software engineers and controls engineers to keep everything moving along smoothly.

"The human ability to judge the situation is going to be absolutely critical. Humans should be able to focus on bringing the most value with their skills, while autonomous systems enhance and complement that."

————— Andrei Danescu, CEO, BotsAndUs

These skills are not easily adopted by robots and must be supplied by workers, but there will need to be attention to ensure that the existing workforce can be upskilled where necessary. The industry should band together to achieve a smooth transition for the workforce and encourage more young people to train in engineering and consider a career in logistics.

5. Case Study: Maersk Contract Logistics



Maersk Contract Logistics provides third-party logistics services to its partners, more than 400 world-famous casual wear companies. Before Maersk Contract Logistics decided to deploy Hai Robotics' customised Autonomous Case-handling Robot systems at its distribution centre in Shenzhen, China, managers were worried about how the sector was going to cope with ongoing labour shortages, particularly as there was a skills gap among the available workers. Kuang Jianfang, 50, had been unemployed for the past 20 years and was concerned about having the necessary skills to work in a modern warehouse in Shenzhen. After spending six months working with the Autonomous Case-handling Robot (ACR), Kuang found things were different in the warehouse. Working with robots was actually much easier and less intense than she thought. "They don't speak, but they are crystal clear about everything, and are my most reliable partners," Kuang said, talking about her robot co-workers. With the help of robots, warehouse work is no longer a young person's game, workers no longer have to walk 16km a day or climb up and down ladders to retrieve stock.

Hai Robotics works with its clients to provide training and resources for operators. Warehouse workers at Maersk Contract Logistics received a day of training, covering how to operate Hai Robotics' HaiQ System and maintain the robots in optimum conditions for longer and smoother operations, as well as the safety measures and procedures.

6. Take-aways: A Safe and Stimulating Place of Work

The Warehouse of the Future will not be fully 'dark', there will always be a role for humans. The uptake of automated solutions will transform the warehouse from an often dangerous and gruelling workplace, into a safe and stimulating environment, in which workers work alongside robots. External demographics challenges have stretched the sector to its limits but advances in robotics offers an opportunity not only to fill in the gaps, but to make warehouses a safer, more stimulating and appealing place to work, for a wide range of workers.

To achieve this transformation, the industry should take the necessity of upskilling the workforce seriously. Interviewees emphasised that changes should happen in dialogue with workers and unions, to ensure that worries about 'workers stealing jobs' are quashed and countered with the opportunities that increased automation can offer for training, wages and job satisfaction.

As the case study at Maersk Contract Logistics demonstrates, robots are reliable and welcome co-workers in the warehouse sector. We anticipate that the increase in automation will be a positive, rather than negative, force in global labour markets, enabling workers to take on more fulfilling roles and increase productivity overall.



Sustainability

1. How will the Warehouse of the Future be sustainable?

The logistics industry, alongside a myriad of other industries, will increasingly come under scrutiny and pressure to reduce its environmental footprint. Increasing digitisation of the warehouse space can increase efficiency but to calculate the sustainability of the warehouse of the future, experts argue we should be looking at the whole life cycle of a product or the whole supply chain in and out of the warehouse. Our research found a consensus around the belief that robotics and automation would benefit sustainability, primarily by increasing the efficiency of the warehouse. However, it also highlighted the lack of an agreed industry measurement on the sustainability of warehouse automation.

2. The Challenge

Warehouses are a crucial part of many businesses but can also be a major drain on the environment as supply chains are a significant contribution to global carbon emissions. As outlined above, globally, warehouses are still reliant on human operatives and expend significant energy on heating and lighting.

As such, warehouses should evolve to play a stronger role in making the world's economy sustainable, and ensure that

automation helps to reduce its impact on the environment rather than make the problem worse. Yet very little official data exists to measure the exact impact of automated warehouse solutions. Individual case studies do suggest that automated and robotic solutions do offer notable sustainability improvements, however.

New warehouses are typically built to the sustainability standards of recognised green-rating systems such as LEED (Leadership in Energy and Environmental Design) or are 'sustainability-ready', having the structural integrity to support adding sustainability features such as rooftop solar panels. However, until the industry fully understands the positive impact of automation, such as reducing a warehouse's carbon footprint or drastically reducing paper usage through digitisation, it will be a challenge to convince the Warehouse of the Future that automation is a valuable tool in the push for a more sustainable future.

"There is now pressure on warehouses from consumers to reduce their environmental footprint. Technology certainly helps with that. If you can minimize the movement of pickers and save on distance travelled, you will save on your carbon emissions"

Vassilis Pandis, CTO, Logidot

3. Effective Measurement

To ensure mainstream acceptance of automation as a tool to deliver sustainable processes, the warehouse industry needs to agree upon an effective strategy for measuring the benefits of automated solutions. This should be a holistic measurement that seeks to capture the entirety of a warehouse's functions.

Researchers, Peterson and Gonzalez, at the Massachusetts Institute of Technology propose a carbon emissions calculator, based on energy expenditure. In their analysis, they determine that automation is an energy-efficient option for e-commerce fulfillment, by comparing the carbon footprint of the additional workers required. In their model facility, they find that 7 additional employees would be needed, generating around 43 MT of CO₂ per year by commuting 55 minutes to work. This is more than the 30MT of 28 CO₂ generated by the core automation technology.

An agreed-upon measurement of emissions and energy use would help to set the standard within the warehouse industry and allow companies to be compared on their contribution to energy efficiency.

4. Digitisation of the Warehouse

Automation and robotics within a warehouse allow for greater oversight of the systems and processes that go into its operation. The integration of technologies like the Industrial Internet of Things (IIoT), and big data into the warehouse floor – through automation – provides clarity of how people and materials move around a warehouse. With such data, the operations and processes can be improved or refined to increase efficiency as every movement, package handled or item used can be recorded and records updated in real-time. One of the key benefits of digitisation is the reduction of paper delivery orders, which helps to reduce deforestation.

5. Case Study: Best Supply Chain (Shanghai Warehouse)



Before deploying Hai Robotics' solution, workers at the Best Supply Chain's Shanghai warehouse used to take an average of 40,000 steps a day in what was a fully human staffed warehouse. After Hai Robotics deployed an automated system, the average daily steps for pickers dropped down to 10,000 steps. Furthermore, after the automated warehouse went online in March 2022, paper delivery orders were no longer required. Since March, the warehouse has received 1,106,529 pieces of delivery data (one piece of data equals to one label paper), which is equivalent to saving 1,106,529 sheets of A5 paper. This is equivalent to saving 55 trees. Partnering with Hai Robotics is part of Best Supply Chain's strategy to create a greener, low-carbon supply chain system.

6. Case Study: Maersk Contract Logistics

Automation and robotics within a warehouse allow for greater oversight of the systems and processes that go into its operation. The integration of technologies like machine learning, the Industrial Internet of Things (IIoT), and big data into the warehouse floor – through automation – provides clarity of how people and materials move around a warehouse. With such data, the operations and processes can be improved or refined to increase efficiency as every movement, package handled or item used can be recorded and records updated simultaneously. One of the key benefits of digitisation is the reduction of paper delivery orders, which helps to reduce deforestation.

7. Efficiency in energy use and space

While our research shows that human labour will always be a part of warehouse operations, automation can reduce some need for electricity, with certain sections of a warehouse handed over to robotic solutions – becoming dark zones void of the need for light or heat, save for periods where repairs need to be made. Furthermore, the advances in energy-efficient robotics, can also result in significant energy bill savings, particularly where diesel or petrol-powered vehicles can be replaced by electric automated guided vehicles.

One of the main challenges facing the logistics industry is meeting the market's increased demands. For fully manual and human-operated warehouses, this demand can only be met by increasing the physical footprint of warehouses. Automation provides companies with the chance to maximise existing space, reducing the need for investing in additional properties and contributing to lower energy usage.

8. Take-aways: Efficiency is key

Automation can help to improve warehouses' carbon footprint in three ways: cutting down on paper waste, improving energy efficiency and improving space efficiency. However, more research and discussion is needed to establish metrics for the sustainability of warehouses and automation. While efficiency is key, renewable energy sources should be utilised where possible, in order to fully decarbonise the warehouse as soon as possible.



Conclusion

The Warehouse of the Future

Warehousing has undergone a transformation as the age of automation has advanced. New advanced technology has expanded companies' ability to provide customers with a wide range of stock, rapid delivery and efficient returns processing. The advancement in technology is increasing the sophistication of software systems, contributing to more efficient processes within the warehouse. Robotics has also enabled the industry to tackle several serious threats to supply chains, by supporting understaffed warehouses, all while ensuring more efficient use of space and energy.

We hope that more and more companies consider utilizing these benefits in their warehouses and invest in advancing the technology further. There is still work to be done to maximise the potential of warehouse automation and ensure that the technology is accessible across the market. Further funding for research and development will support robotics providers to build ingenious solutions. While already popular among venture capitalists, there is always more that the robotics community could achieve with robust funding for new projects.

For companies considering implementing Automatic Storage and Retrieval solutions in their operations, there are several places to start.

- Self-inspections to assess where robotics would be most useful in operations is an excellent first step towards building the warehouse of the future.
- Evaluating your long-term human resources recruitment plan can help to identify future changes in the workforce, including supporting ageing staff and mitigating shortages.
- Developing a sustainable business model, with attention to energy efficiency can also provide insights into where robotics solutions can reduce the environmental footprint of the warehouse.

Among the robotics and warehousing industries, the key challenges identified by our research will be building multi-channel, cross-network software solutions which integrate different processes together into one seamless supply chain, and tackling institutional aversion to new technologies. Robotics companies and warehouse managers can work together to ease the transition to fully automated warehouses, by engaging with workers, investors and new business prospects on the benefits of these systems.

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