The information presented in this section, unless otherwise indicated, is derived from various government publications and other publications, and from the CIC Report prepared by CIC commissioned by us. The information derived from official government sources has not been independently verified by us, the Joint Sponsors, the [**REDACTED**]*,* [**REDACTED**]*,* [**REDACTED**] *and* [**REDACTED**]*, any of the* [**REDACTED**]*, any of our and their respective directors, supervisors, officers, representatives, employees or advisers, or any other persons or parties involved in the* [**REDACTED**]*, and no representation is given as to its accuracy.*

SOURCE OF INFORMATION

We commissioned CIC, an independent market research and consulting company, to conduct detailed research on and analysis of the global warehouse automation solution market and the global AMR market. We have agreed to pay a fee of RMB810,000 to CIC in connection with the preparation of the CIC Report. We have extracted certain information from the CIC Report in this section and elsewhere in this Document to provide our potential [**REDACTED**] with a more comprehensive presentation of the industries where we operate. Except as otherwise noted, all of the data and forecasts contained in this section and elsewhere in this Document are derived from the CIC Report.

During the preparation of the CIC Report, CIC performed both primary and secondary research using various resources, and obtained knowledge, statistics, information, and industry insights on the industry trends of the target markets. Primary research involved interviewing key industry experts and leading industry participants. Secondary research involved analyzing data from multiple publicly available data sources, including the National Bureau of Statistics of China, Ministry of Industry and Information Technology of PRC and other Chinese government releases, Mobile Robot and AGV/AMR Industry Alliance, Modern Materials Handling, annual reports published by relevant industry participants and industry associations, and CIC's own internal databases.

The CIC Report was compiled based on the following assumptions: (i) the overall global social, economic, and political environment is expected to maintain a stable trend over the next decade, (ii) related key industry drivers are likely to continue driving the growth of the AMR market during the forecast period, and (iii) there is no extreme force majeure or industry regulations which may dramatically or fundamentally affect the market situation.

GLOBAL WAREHOUSE AUTOMATION SOLUTION INDUSTRY OVERVIEW

The Evolution of Warehouse Automation Solutions

Warehousing is a critical part of logistics, serving far beyond simple storage functions within the supply chain. It acts as a central hub for precise supply chain management, using modern technology to streamline processes such as goods receiving, storage, sorting, packaging, distribution, and information flow — ultimately enabling seamless connectivity between supply and demand. As a key element in the supply chain, the number of warehouses

globally has continued to rise, with facilities also increasing in size. In 2024, there were approximately 180,000 warehouses globally, increasing more than 50% over the past decade, and the average size of these warehouses increased by over 30% in the same period. Warehousing efficiency has become a critical factor in a company's ability to control costs and respond quickly, making it a key metric for both service performance and operational cost efficiency.

However, the traditional labor-intensive warehousing model has faced significant challenges due to the aging population and rising labor costs. Human error remains a persistent risk, and the ongoing increase in labor costs continually drives up operational expenses. Moreover, reliance on manual labor introduces inefficiencies such as slower processing during peak periods and handling errors that disrupt operations. Traditional warehouses also require wide aisles and large workspaces to accommodate manual tasks, which significantly limits space utilization. As warehouses expand and the variety of goods increases, traditional management methods struggle to handle complex inventory control and precise logistics coordination.

At the same time, growing consumer demand for personalized products and shorter product lifecycles has disrupted the traditional production model where companies manufacture products in advance and then sell them (i.e., the so-called "produce first, sell later" model). This shift means companies can no longer rely on mass production and stockpiling; instead, they must quickly adapt to changing consumer preferences and adjust production volumes accordingly, making real-time inventory management and flexible logistics critical. The rapid development of global and cross-border e-commerce has further compounded this complexity. In this new environment, companies must be able to respond quickly to orders from around the world, making fast and accurate fulfillment a competitive advantage. Given these challenges, traditional warehousing can no longer meet the demands of modern logistics. As a result, warehouse automation has become a universal development trend in the global warehousing industry, representing a crucial step in improving supply chain efficiency and meeting the evolving needs of the marketplace.

What Are Warehouse Automation Solutions, and How Do They Create Value?

Warehouse automation solutions refer to the integrated systems that automate various logistics operations such as storage, handling, sorting, and picking. These solutions encompass a broad spectrum of technologies and approaches, which not only automate repetitive manual tasks but also introduce advanced capabilities for data analytics and process optimization. They seamlessly combine hardware and software, encompassing a range of technologies including AMRs, AS/RS, conveyors, and sorting belts.

- **AS/RS.** AS/RS, mainly for storage, are used for automatically storing and retrieving goods in a warehouse. These systems improve storage density and enhance operational efficiency by automating the process of storing and retrieving items from shelves or racks. In 2024, the market share of AR/AS accounts for approximately 26% in the global warehouse automation market.

- **Conveyors.** Conveyors, mainly for transporting, are common equipment in warehouse logistics systems, used to transport goods quickly and continuously within a warehouse. Conveyors can be integrated with other automation equipment to achieve automated sorting, handling, and loading of goods. In 2024, the market share of conveyors accounts for approximately 19% in the global warehouse automation market.

- **Sorting belts.** Sorting belts, mainly for sorting, are automated systems that classify and direct products or items to specific locations based on predefined criteria (e.g., destination, size, or type). These systems are used to sort packages or items before they are packed or shipped. In 2024, the market share of sorting belts accounts for approximately 18% in the global warehouse automation market.

- **AMRs.** AMRs, equipped with advanced autonomous navigation technology, are used for various operational tasks, including storage, picking and sorting. AMR represents a more advanced evolution of AGV (Automated Guided Vehicle) with enhanced technological capabilities and greater flexibility in application, steadily replacing AGVs and gaining increasing preference among downstream industries. In 2024, the market share of AMRs accounts for approximately 8% in the global warehouse automation market.

Applicable across a wide variety of scenarios, these solutions introduce automated devices and intelligent systems to facilitate fast material handling, dense storage, efficient inventory and picking, and precise sorting. This significantly enhances operational efficiency and space utilization, reduces labor costs, and minimizes inventory backlogs. Furthermore, automation solutions are scalable and flexible, allowing businesses to quickly adjust to changing market demands or fluctuations in order volumes, all while maintaining operational consistency. To maximize the benefits of automation, downstream end customers typically tailor their warehouse automation solutions by selecting a single type of solution or a combination of multiple solution types, based on the characteristics of their operational scenarios.

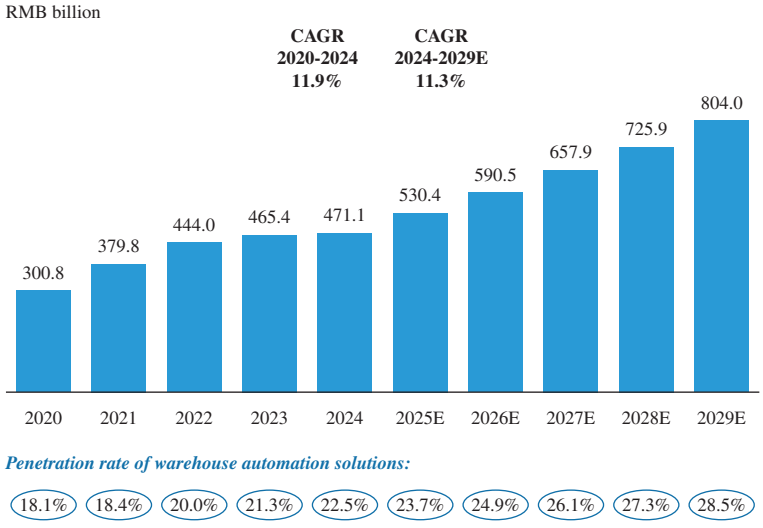
By lowering overall operational expenses and improving management capabilities, warehouse automation enables smart management through real-time information sharing and collaborative operations across the supply chain. This interconnectedness allows for seamless communication between different warehouse systems and other elements of the supply chain, such as suppliers, transportation networks, and customers, creating a more responsive and agile logistics framework. This optimization supports data-driven decision-making and enhances overall supply chain efficiency. As a result, adopting warehouse automation solutions and transitioning to automated warehousing has become one of the key strategies for companies to enhance their competitiveness and meet the demands of modern supply chains.

Growth and Future Potential of the Warehouse Automation Solution Market

Amid the global shift towards digitization and rapid advancements in automation technologies — driven by the expansion of global trade, the rise of e-commerce, and increasing demands for environmental sustainability — the global market for warehouse automation solutions has seen substantial growth. This growth is further fueled by the need for businesses to respond quickly to changing consumer expectations and a growing focus on minimizing environmental impact through more efficient operations. The market expanded from RMB300.8 billion in 2020 to RMB471.1 billion in 2024, representing a CAGR of 11.9%. This growth is expected to continue, with projections estimating the market to reach RMB804.0 billion by 2029, with a CAGR of 11.3%. As companies globally continue to invest in automation to enhance operational efficiency, reduce errors, and support sustainable practices, the demand for advanced warehouse automation technologies and solutions is expected to increase significantly.

The following chart illustrates the significant growth of the global warehouse automation solution market from 2020 to 2029:

Global Warehouse Automation Solution Market Size, 2020-2029E



Note: The penetration rate of warehouse automation solutions is defined as the proportion of warehouses globally that have adopted any automation solution, relative to the total number of warehouses worldwide.

Source: Modern Materials Handling, CIC

Warehouse automation solutions have brought significant transformation and value to the traditional warehousing industry. These solutions enable more efficient operations by automating manual tasks, improving accuracy, and reducing operational costs, thus optimizing supply chain management. However, due to the high upfront capital investment required and certain technological barriers, the global adoption rate of warehouse automation remains relatively low. In 2024, approximately 80% of warehouses worldwide had yet to adopt automation solutions. This low penetration is due in part to challenges such as high integration costs, lack of skilled labor to manage advanced systems, and the need for substantial infrastructure changes. As automation technologies continue to mature and gain wider acceptance, and with growing market demand and supportive government policies, more warehouses are expected to undergo automation upgrades. In 2024, the total addressable market size*(Note)* for warehouse automation solutions exceeded RMB2 trillion.

GLOBAL AMR SOLUTION INDUSTRY OVERVIEW

The Evolution of AMR Solutions

As a key driver of warehouse automation, AMR solutions are transforming the industry with their flexibility and efficiency. AMRs are equipped with advanced navigation devices and onboard control systems, enabling them to operate independently in mapped environments and perform a wide range of complex logistics tasks such as material handling, storage, picking, and sorting. Integrated with cutting-edge algorithms and technologies, AMRs can autonomously navigate, plan paths, avoid obstacles, schedule tasks, and make real-time decisions.

With continuous improvements in navigation technology and ongoing innovation, AMRs have evolved from simple material movers to sophisticated solutions capable of handling more complex scenarios. Their ability to integrate with warehouse management systems and enterprise resource planning systems enhances overall operational visibility, leading to more informed decision-making. They are also becoming essential tools for enterprises aiming to achieve automation and intelligent transformation in their warehousing operations. Compared to traditional warehouse automation systems, AMRs offer distinct advantages in managing orders of varying sizes, quickly adapting to changes in operations, and providing greater customization, scalability, and faster return on investment. In fast-paced industries, AMRs can be rapidly deployed and reconfigured to accommodate shifting demands, making them especially valuable for e-commerce, retail, and manufacturing sectors. In addition to reducing costs and increasing efficiency, AMR solutions also address deeper operational challenges for enterprises through their ability to continually evolve with technological advancements.

Note: The total addressable market size is calculated based on the total number of warehouses worldwide and the average spending on warehouse automation per warehouse, assuming the penetration rate of warehouse automation solutions is 100%.

Comparison of workflow in traditional manual warehouse and warehouse with AMR solutions

Warehouse workflow	Traditional manual warehouse	Warehouse with AMR solutions	
Unloading	Workers drive forklifts to unload goods	AMRs autonomously unload goods	✓ Minimizes the need for manual labor and accelerates the flow of goods into the warehouse
Storage	Workers put away parcels into storage	AMRs bring the shelves to person's put-away station	✓ Reduces the time and effort workers spend moving items ✓ Increases overall efficiency and accuracy in inventory management
Picking	Workers spend much time walking to shelves to pick items	AMRs bring items to workstations	✓ Significantly cuts down on walking time and allowing workers to focus on selecting and packing items quickly
Sorting	Workers sort the parcels	AMRs sort the parcels	✓ Streamlining the process and ensuring that items are organized for efficient loading into trucks
Shipping	Workers transfer parcels onto transportation vehicles	AMRs autonomously transfer parcels	✓ Minimizes the time and effort workers spend moving parcels

Source: Expert interviews, CIC

Supply Chain of the AMR Solution Industry

There are key players and stakeholders at each level of the supply chain in AMR solution industry. At the upstream level, raw material suppliers provide critical components. In the midstream, AMR solution providers and integrators emerge as key players, collaboratively addressing the automation needs of downstream industries. In the downstream, end customers across various industries are adopting AMR solutions.

In particular, AMR solution providers focus on robot manufacturing, software development and product portfolio design, efficiently integrating resources from both ends of the supply chain while driving technological innovation. Their ability to design modular, scalable solutions allows them to meet the needs of a wide range of businesses, from small warehouses to large, complex distribution centers. Additionally, integrators play a vital role in the industry with their expertise in system integration, enabling end customers to better coordinate project execution. Particularly in large-scale projects involving multiple solutions or cross-regional operations, integrators leverage their collaboration with AMR solution providers and other warehouse automation industry players to achieve more efficient system integration and project delivery. It is a common practice within the industry that AMR solution providers collaborate with integrators in reaching end customers and delivering projects. These integrators act as intermediaries, facilitating the deployment of AMRs by providing integration services for comprehensive warehouse automation solutions, ensuring that the products are optimized for customers' specific use cases. Typically, these integrators do not manufacture

products directly. This seller-buyer dynamic is inherently collaborative, as integrators rely on AMR solution providers for high-quality products and technical support. Solution providers and channel partners function as ecological partners, jointly delivering integrated solutions to meet customers' intelligent warehousing needs.

In the development of the AMR solutions industry, a well-established collaborative ecosystem has emerged between AMR solution providers and integrators, fostering a mutually beneficial relationship that drives industry growth. To maintain a healthy and competitive market environment, AMR solution providers typically implement effective management strategies for their partnering integrators. A well-structured channel management system ensures that business opportunities are allocated efficiently, preventing competition among integrators for the same end customer, while also promoting fair and transparent processes.

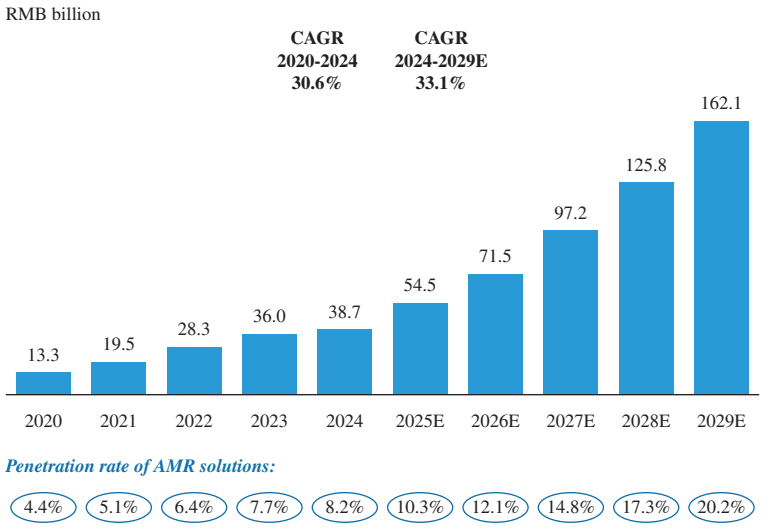
Growth and Future Potential of the AMR Solution Industry

As technology continues to advance and its applications expand, AMR solutions are becoming increasingly intelligent, flexible, and widely applicable across industries. They are particularly beneficial for industries with high-volume, high-velocity operations, such as e-commerce, where rapid order fulfillment is critical. The growing recognition of AMR solutions' importance has driven rapid market penetration globally. The global AMR solution market expanded from RMB13.3 billion in 2020 to RMB38.7 billion in 2024, representing a CAGR of 30.6%. As more companies acknowledge the value of AMRs in enhancing efficiency, reducing costs, and improving service quality, there is a growing willingness to invest in these technologies.

Furthermore, as technology continues to evolve, companies are pursuing more advanced and efficient AMR equipment to maintain a competitive edge, creating a virtuous cycle of demand for upgrades. This trend is expected to accelerate as innovations in technologies further enhance the capabilities of AMRs, allowing for even more precise and autonomous operations. Looking ahead, the global AMR solution market is projected to grow to RMB162.1 billion by 2029, with a CAGR of 33.1% from 2024 to 2029. The penetration rate of AMR solutions within the overall warehouse automation sector increased from 4.4% in 2020 to 8.2% in 2024 and is expected to reach 20.2% by 2029, establishing AMR solutions as an indispensable force in warehouse automation.

The following chart illustrates the growth in both the global AMR solution market size and penetration rate from 2020 to 2029:

Global AMR Solution Market Size and Penetration Rate, 2020-2029E



Note: The penetration rate of AMR solutions is defined as the proportion of the global AMR solution market size relative to the total global warehouse automation solution market size.

Source: Mobile Robot and AGV/AMR Industry Alliance, CIC

Amid the ongoing rapid advances in automation globally, AMR solutions have become a key enabler of more efficient warehouse operations, lower labor costs, and greater logistical flexibility. Driven by the rise of global trade, e-commerce, and the digital transformation of manufacturing, AMR adoption is accelerating across major international markets, including North and Central America, Europe, Latin America, and the Middle East and Africa.[1]

1. The penetration of AMR solutions in North and Central America grew from approximately 4% in 2020 to nearly 7% in 2024, and is projected to reach around 19% by 2029. As a pivotal trade hub connecting North and Latin America, Mexico's nearshoring strategy has attracted numerous multinational corporations. Alongside its expanding manufacturing sector and the growth of e-commerce, Mexico is poised to lead the region in the adoption growth of AMR solutions. In Europe, the penetration of AMR solutions exceeded 4% in 2020, surpassed 8% in 2024, and is projected to reach around 22% by 2029. Georgia, a key Europe-Asia transport link, is set to lead European developing nations in AMR adoption, fueled by economic growth, logistics development, and rising trade volumes. In Latin America, the penetration of AMR solutions increased from approximately 1% in 2020 to roughly 2% in 2024, and is projected to accelerate to around 5% by 2029. As the largest economy and e-commerce market in the region, Brazil sees mainstream e-commerce platforms continually setting up new logistics and distribution centers, which in turn creates high demand for AMR solutions. It is expected that the penetration rate of AMR solutions in Brazil will continue to lead the regional development. In the Middle East and Africa, the penetration rate was below 0.5% in 2020 and is projected to increase to approximately 4% by 2029. Driven by free-trade policies and international trade growth, South Africa is anticipated to remain the most advanced AMR market in the Middle East and Africa region, with its penetration rate continuing to rise ahead of the regional average.

Main Drivers and Development Trends

- ***Strong Demand from Downstream Industries and Rapid Digitalization:*** The rapid global expansion of e-commerce and new retail models has dramatically increased the demand for logistics services. To meet the growing expectations for fast, accurate deliveries from both consumers and industries, companies are increasingly adopting efficient and intelligent AMR solutions. According to CIC, in 2024, approximately 10% of the global AMR solutions deployed are dedicated to e-commerce use cases. This trend is particularly evident in cross-border logistics, where complex challenges such as varying regulations, customs procedures, long-distance transportation, and diverse consumer needs heighten the demand for automated and flexible warehousing and distribution solutions. Additionally, the digital and intelligent transformation of the manufacturing sector has set new, higher standards for logistics operations. AMR solutions have become essential in automating precise material handling and enabling smart warehouse management, improving operational efficiency while significantly reducing costs. These technologies provide strong support for the modernization and upgrading of the manufacturing industry.

- ***AMR Solutions Reduce Costs and Improve Safety:*** AMR solutions are highly effective in replacing repetitive, labor-intensive tasks, significantly reducing the share of labor costs in warehouse operations while offering greater operational stability and sustainability for enterprises. In addition to lowering costs, AMRs reduce the risks associated with human errors and workplace accidents, contributing to safer and more reliable operations. As AMR technology continues to advance and with supportive government policies, the production costs of AMR solutions are expected to gradually decline over time. Standardization and large-scale manufacturing will further enhance production efficiency, leading to even broader adoption of AMR solutions across various industries.

- ***Rapid Technological Advancements Fuel AMR Solution Development:*** The integration of cutting-edge technologies such as robotics, the Internet of Things ("**IoT**"), and big data continues to inject powerful momentum into the growth of AMR solutions. These technologies enable AMRs to become more autonomous, adaptive, and efficient, responding to real-time changes in warehouse environments. These advancements significantly enhance the intelligence and performance of warehouse automation systems.

- ***Green and Sustainable Development Concepts Further Drive AMR Solution Development:*** As global attention on carbon emissions grows, the application of AMR solutions in energy conservation and emissions reduction is becoming increasingly important. AMR solutions enable businesses to achieve substantial gains in energy efficiency, cost reduction, and operational effectiveness, while minimizing the environmental impact of logistics operations and improving overall workforce quality of life. Moreover, leading AMR solution providers are placing

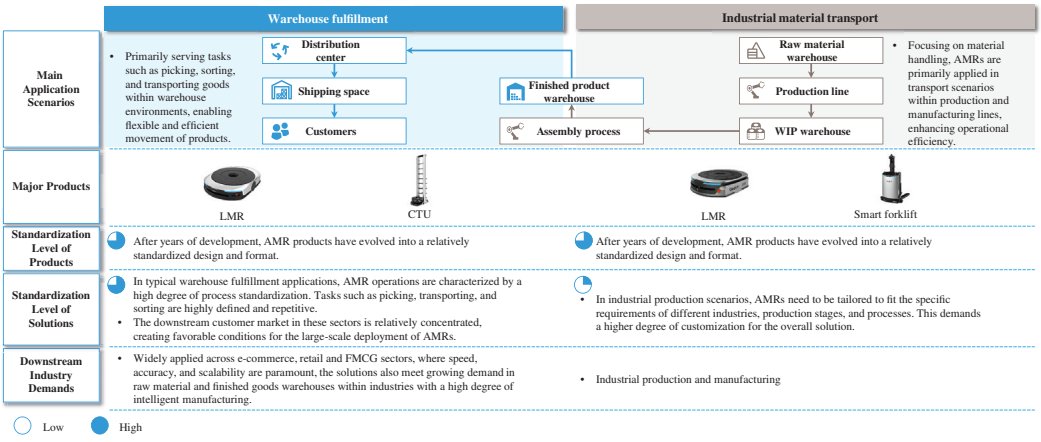
greater emphasis on sustainability, focusing on energy conservation, emissions reduction, and resource recycling in their design and manufacturing processes. This not only aligns with global sustainability trends but also enhances corporate social responsibility and offers businesses long-term cost advantages.

Global Warehouse Fulfillment AMR Solution Industry

Two Main Categories of AMR Solutions: Warehouse Fulfillment AMR Solutions & Industrial Material Transport AMR Solutions

AMR solutions are highly versatile and designed to meet the diverse needs of various industries. Based on core application scenarios, AMR solutions are generally categorized into warehouse fulfillment AMR solutions and industrial material transport AMR solutions. Warehouse fulfillment AMR solutions focus on automating internal warehouse processes such as picking, sorting, and transporting goods. These solutions are widely applied in the e-commerce and retail sectors, where speed, accuracy, and scalability are critical. By implementing warehouse fulfillment AMR solutions, businesses can significantly improve fulfillment efficiency, reduce operational costs, and enhance warehouse management capabilities while increasing flexibility and adaptability.

This comparison chart below highlights the primary application scenarios, major products, standardization levels, and downstream industry demands for warehouse fulfillment AMR solutions and industrial material transport AMR solutions:



Source: Expert interviews, CIC

As e-commerce continues to expand and retail models evolve, the demand for warehouse fulfillment AMR solutions has surged, making them a key driver in transforming and modernizing the warehousing and logistics industry.

Market Size of the Global Market for Warehouse Fulfillment AMR Solutions

Driven by rapid technological advancements, the global demand for automation and intelligence has surged dramatically. In response, downstream end customers, particularly in e-commerce and retail, are actively pursuing transformation strategies to improve operational fulfillment efficiency and reduce costs. This has led to significant growth in the global market for warehouse fulfillment AMR solutions. In 2024, demand for warehouse fulfillment AMR solutions accounted for approximately 60% of total AMR solution demand. The market size expanded from RMB7.9 billion in 2020 to RMB24.3 billion in 2024, representing a CAGR of 32.4%. The market is expected to continue growing, reaching RMB105.3 billion by 2029, with a CAGR of 34.0%.

Major Categories of Warehouse Fulfillment AMR Solutions

To address the diverse needs of various warehousing environments — including storage density, handling speed, picking efficiency, and operational flexibility in sorting — leading AMR manufacturers continuously innovate and refine their solutions. Current mainstream solutions include shelf-to-person, tote-to-person, pallet-to-person, and smart sorting systems, which are applicable across a wide range of industries.

Comparison of Key Categories of Warehouse Fulfillment AMR Solutions

	Shelf-to-Person	Tote-to-Person	Pallet-to-Person	Smart Sorting
Typical Workflow	• Transport entire shelves to the workstation, where staff assist with picking and packing.	• Transport the totes on shelves to the workstation, where staff assist with picking and packing.	• Transport entire pallets to the workstation, where staff assist with picking and packing.	• Automatically sorts goods according to orders by AMRs.
Value Creation	• Optimize the efficiency of tasks like shelving, picking, sorting, and inventory management • Boost picking efficiency by up to more than three times	• Optimize the efficiency of box-based picking operations • Significantly optimize storage space utilization, enabling higher single-level storage density	• Ideal for scenarios with high pallet storage demands • Efficiently handle cross-docking, full pallet dispatch, and order execution, ensuring smooth and streamlined operations	• Without installing any fixed equipment, maximize warehouse space utilization and increasing sorting throughput • Boost sorting efficiency by up to more than ten times

Source: Expert interviews, CIC

Main Drivers and Development Trends

- ***The Rise of E-commerce Creates Significant Growth Opportunities for Warehouse Fulfillment AMR solutions:*** In 2024, global e-commerce transaction value surged to over RMB30 trillion. The rapid expansion of the e-commerce sector has made fast and accurate delivery a key factor in the consumer experience. This has pushed companies to significantly increase their investments in warehouse automation and intelligence to reduce order processing times and enhance delivery efficiency. Faced with surging orders during e-commerce promotions and the growing variety of order types, automation solutions centered around warehouse fulfillment AMRs, with their flexible navigation and efficient material handling capabilities, are proving highly effective in addressing peak demand challenges. These solutions help minimize human errors and boost overall warehouse operational efficiency. U.S. trade policy continues to pose potential implications for cross-border e-commerce, although the overall policy environment remains uncertain. Nevertheless, there are increasing signs that the U.S. administration is considering reducing tariffs on Chinese imports. Meanwhile, cross-border e-commerce companies are proactively implementing a range of strategies to adapt to the shifting trade landscape, such as building overseas warehouses. This trend toward localized storage is further driving demand for AMR solutions to enhance warehouse efficiency.

- ***Leading Companies Drive Innovation, Enabling Product Upgrades and Diverse Applications:*** The thriving AMR industry has been fueled by continuous innovation from leading companies. These players are consistently introducing more intelligent products, utilizing modular and scalable designs that can flexibly adapt to the diverse needs of the market. By offering tailored solutions for various industries and specific scenarios, they have accelerated the adoption and advancement of warehouse fulfillment AMR solutions. With China's strong foundation in artificial intelligence and robotics technology, Chinese AMR providers excel in areas such as navigation, positioning, obstacle avoidance, and material handling, positioning themselves as global leaders in AMR technology and applications. In 2024, Chinese AMR solution providers accounted for approximately 50% of the global AMR solution market. Leading Chinese companies have emerged as industry frontrunners, setting the pace for innovation and development in this rapidly evolving sector.

- ***Flagship Customer Success Stories Lead the Wave of Warehouse Fulfillment AMR Transformation***: Leading companies that have successfully implemented warehouse fulfillment AMR technologies have become industry benchmarks due to their exceptional performance. These success stories not only highlight the vast potential of AMR solutions in improving fulfillment efficiency and optimizing order management but also provide practical examples for other businesses to follow. As these flagship cases gain wider recognition, more companies are realizing the urgency and necessity of intelligent transformation, joining the automation movement. This shift, led by top companies, is expected to grow the AMR market and drive sustainable industry growth, creating a cycle of innovation and adoption.

- ***Top Companies Strengthen Their Industry Leadership:*** As demand from sectors such as e-commerce and new retail continues to surge, leading warehouse fulfillment AMR solution providers are leveraging their extensive industry experience, robust technological capabilities, and strong resource integration to swiftly respond to market needs and expand their scale advantages. These top manufacturers are not only focused on breakthroughs in core technology but also on combining advanced technology with exceptional customer service, providing tailored, integrated solutions. This leadership fosters a competitive environment that encourages further growth and innovation within the AMR industry.

Cost Analysis of AMR Core Components

The rapid growth of the AMR industry is closely tied to the strength and development of its core supply chain. Key components that form the backbone of AMR functionality include LiDAR, 3D vision sensors, reducers, motors, drive wheels, controllers, and power batteries. The performance of these components directly affects the intelligence, efficiency, battery life, and safety of AMRs. Among these key components, the expenses associated with LiDAR, 3D vision sensors, and controllers are relatively higher. LiDAR and 3D vision sensors are essential for navigation and obstacle detection, allowing AMRs to operate autonomously in dynamic environments, while the AMR controller integrates navigation algorithms and obstacle avoidance strategies, enabling AMRs to navigate autonomously and avoid obstacles in complex environments.

The AMR supply chain has significantly strengthened over time, supported by advancements in component technology and increased industry collaboration. As the market matures and production scales up, the costs of these essential components are expected to decrease further, making AMRs more accessible and affordable for a broader range of industries. For instance, the costs of AMR controllers have progressively declined, allowing AMR solution providers to harness economies of scale effectively. Simultaneously, AMR controllers are evolving towards higher integration, enabling more sophisticated functionalities and enhanced performance through the incorporation of additional modules and algorithms. Additionally, ongoing innovations in power battery technology are expected to extend the operational lifespan of AMRs, reducing the need for frequent recharging and further enhancing their overall efficiency. These cost reductions, coupled with performance improvements, are anticipated to accelerate the adoption of AMRs across various sectors and drive the continued growth and advancement of the industry.

Global Warehouse Automation Solution and AMR Solution Market Competitive Landscape

Market Ranking and Market Share

The warehouse automation market is highly competitive, with solution integrators serving as major participants. In 2024, the top 20 players in the warehouse automation market accounted for approximately 50% of the market share, including Daifuku, Dematic, Honeywell, Vanderlande, SSI Schaefer Group, Murata Machinery, Knapp, Interlake Mecalux, Fortna, Witron Integrated Logistics, Symbotic, and AutoStore. The warehouse automation sector exhibits distinct competitive landscapes across different technology domains, with integrators predominating in AS/RS, conveyors, and sorting belts solutions with variations among leading players. Within the AS/RS segment, two predominant player archetypes emerge — traditional heavy-duty system integrators and specialized high-density storage providers. The latter concentrate on optimizing storage density and operational efficiency, while the former leverage their comprehensive capabilities in hardware integration and system optimization. Global leading players include Murata Machinery and AutoStore. The conveyor domain is dominated by integrators with profound industrial automation expertise, especially their advanced electromechanical technologies, including Daifuku and Dematic. The sorting belts market, primarily serving e-commerce and logistics applications, features leading market participants being integrators specialized in providing automation solutions for specific fields, including Honeywell and Vanderlande. Due to the concentrated demand from downstream applications, the sorting belts market exhibits high market concentration. As a critical technology in warehouse automation, AMRs demonstrate a market structure characterized by high specialization and technological barriers. AMR solution providers maintain market leadership through strong technological innovation capabilities.

Global leading warehouse automation solution providers, 2024

Company	Founding Year	Headquarter	Business Overview
AutoStore	1996	Norway	• Global leading warehouse automation company that develops order fulfillment solutions to help businesses achieve efficiency gains within the storage and retrieval of goods, offering both hardware and software of its automated storage and retrieval system (AS/RS).
Murata Machinery	1935	Japan	• Global leading integrator of material handling systems that provides warehouse automation and logistics systems centering on the automated storage and automated transportation systems.
Daifuku	1937	Japan	• Global leading integrator of material handling systems that provides warehouse automation solutions, encompassing multiple aspects including the planning, design, manufacturing, installation, and maintenance of automated logistics systems.
Dematic	1819	USA	• Global leading integrator of material handling systems that provides warehouse automation solutions, encompassing multiple aspects including the planning, design, manufacturing, installation, and maintenance of automated logistics systems.
Honeywell	1905	USA	• Global leading industrial goods and machinery company that provides products and services in industrial automation, building automation, aerospace and energy transition.
Vanderlande	1949	Netherlands	• Global leading integrator of material handling systems that provides warehouse automation solutions, primarily supplying for airports, warehousing and the parcel distribution industry.

Source: CIC

The global AMR solution market remains relatively fragmented, with the top four players accounting for only approximately 23.5% of the total market share by revenue in 2024, according to CIC. This fragmentation is largely due to the rapid pace of technological advancements and the varied application requirements across industries such as e-commerce, manufacturing, and logistics, leading to a diverse range of solutions. In this highly competitive landscape, Geek+ emerged as one of the largest provider of AMR solutions globally in terms of revenue for 2024.

Below is a summary of the leading four players in the global AMR solution market:

Competitive Landscape of Global AMR Solution Providers, 2024

Rank	Company Name	AMR Solution Revenue, RMB Billion, 2024	Market Share, 2024	Warehouse Fulfillment AMR Solution Revenue, RMB Billion, 2024	Market Share, 2024
1	Company A[(1)]	2.8	*7.2%*	0.5	*2.0%*
2	Geek+	2.4	*6.2%*	2.2	*9.0%*
3	Company B[(2)]	2.2	*5.7%*	2.0	*8.1%*
4	Company C[(3)]	1.7	*4.4%*	1.4	*6.0%*

Notes:

(1) Founded in 2016 and headquartered in China, Company A is a global leader in machine vision and mobile robotics products and solutions, primarily serving industrial transport applications. It is a subsidiary of a company listed on the Shenzhen Stock Exchange.

(2) Founded in 2015 and headquartered in France, Company B is a global leader in mobile robotics solutions. Its primary product is a compact robotic system for logistics and warehousing, primarily designed for fulfillment operations. Company B is a privately owned company.

(3) Founded in 2014 and headquartered in the United States, Company C is a leading provider of mobile robotics solutions. Its primary product is an "order-to-person" robot offered through a RaaS subscription model, primarily targeting warehousing and fulfillment operations. Company C is a privately owned company.

Source: Expert interviews, CIC

In the critical field of warehouse fulfillment, Geek+ has built a strong and solid advantage in scale. In 2024, Geek+ became the world's largest provider of warehouse fulfillment AMR solutions, generating RMB2.2 billion in warehouse fulfillment AMR solution revenue, representing 9.0% of the global market. Geek+ has shown remarkable market penetration and technological innovation, consistently leading the industry forward with its leading position. Between 2019 and 2024, Geek+ held the top market share position among global warehouse fulfillment AMR providers for six consecutive years, further cementing its leadership in the industry.

Entry Barriers and Key Success Factors

- ***First-Mover Advantage Establishes Strong Brand and Scale Barriers:*** Companies that entered the AMR market early have built solid partnerships with customers, cultivating brand loyalty through continuous technological innovation and high-quality service. These early movers benefit from scaling their production quickly and managing costs efficiently, setting industry benchmarks and securing a leadership position. Their scale provides resilience against market risks, allowing them to reduce unit costs and enhance competitiveness. Continuous technological leadership and product innovation raise barriers for new entrants and ensure these companies' long-term success.

- ***Extensive Industry Experience and Broad Customer Resources:*** The technical complexity of AMR solutions requires providers to have high visibility, strong project management skills, and a portfolio of successful projects. A deep understanding of market demands, combined with rich application experience, enables providers to anticipate trends and deliver customized solutions for various industries and scenarios. Offering reliable products and long-term support builds extensive customer loyalty and trust, which are essential for expanding market share.

- ***Comprehensive Product Portfolio and Leading Product Performance:*** A diverse product line that spans different payload capacities, speeds, navigation methods, and application needs, supported by compatible software systems, allows providers to offer one-stop solutions and efficiently integrate various AMR types. Superior product performance, such as higher operational speed, precise navigation, greater payload capacity, and longer battery life, enhances a company's market competitiveness and attracts customer preference.

- ***Cutting-Edge Technology and Modular Development Capabilities Based on Deep Industry Insight:*** Companies with deep technical expertise and continuous innovation capacity can achieve breakthroughs in core areas such as sensing technology, navigation algorithms, and motion control, delivering efficient, stable, and intelligent AMR solutions that meet diverse market demands. Efficient software and hardware integration ensures seamless coordination among robotic systems for optimal performance. Modular development improves product maintainability and scalability while reducing production costs and development cycles. Companies capable of high hardware standardization and software modularization can lower production complexity and error rates while enhancing product flexibility and customization.

- ***Flexible Deployment, High-Quality Service, and Efficient Supply Chain Management:*** Successful AMR deployment requires tailored solutions for diverse customer environments. Companies must rapidly develop integration plans that ensure seamless incorporation into operational workflows. High-quality service — such as timely after-sales support, technical assistance, and training — plays a crucial role in building customer satisfaction and trust. Moreover, efficient supply chain management is key to optimizing resources and controlling costs. Close partnerships with suppliers and distributors help companies ensure stable material supplies, improve product quality, and speed up delivery times.