China Insights Consultancy

Industry Report on Global Autonomous Mobile Robot Solution Industry

CIC introduction, methodologies, and assumptions

China Insights Consultancy was commissioned to conduct research, provide an analysis of, and produce a report on Global Autonomous Mobile Robot Solution Industry. The commissioned report has been prepared by China Insights Consultancy independent of the influence of Geek+ and other interested parties.

China Insights Consultancy is an investment consulting company initially established in Hong Kong. Its services include industry consulting services, commercial due diligence, strategic consulting, and so forth. Its consultant team has tracked the latest market trends in consumer goods, healthcare, marketing and advertising, culture and entertainment, energy and industry, agriculture, chemicals, finance and professional services, TMT, and transportation. It possesses the most relevant and insightful market intelligence regarding these industries.

China Insights Consultancy undertook both primary and secondary research using various resources. Primary research involved interviewing key industry experts and leading industry participant. Secondary research involved analyzing data from multiple publicly available data sources, including the National Bureau of Statistics of China, Chinese government releases, annual reports published by relevant industry participants and industry associations, China Insights Consultancy's own internal database, etc.

The market projections in the commissioned report are based on the following key assumptions: (i) that the overall global social, economic, and political environment is expected to maintain a stable trend over the next decade; (ii) that related key industry drivers are likely to continue driving growth in on the industry during the forecast period; and, (iii) that there is no extreme force majeure or set of industry regulations in which the market situation may be affected either dramatically or fundamentally. All forecasts concerning market sizes are based on the general economic conditions as of the Latest Practicable Date.

All statistics are reliable and based on information available as of the date of this report. Other sources of information include those from the government, industry associations, and market participants, such as 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. These various entities may have provided some of the information on which the analysis or its data is based.

All the information about Geek+ has been sourced from Geek+'s own audited report or management interviews. China Insights Consultancy is not responsible for verifying the information obtained from Geek+.

Terms and abbreviations

AI: Artificial Intelligence 人工智能

AMR: Autonomous Mobile Robot 自主移动机器人

AR: Augmented Reality 增强现实

ASP: Average Selling Price 平均售价

AS/RS: Automatic Storage & Retrieval System 自动化立体仓库

CAGR: Compound Annual Growth Rate 复合年均增长率

COVID-19: Coronavirus Disease 2019 新冠病毒肺炎

CTU: Carton Transfer Unit 料箱机器人

GDP: Gross Domestic Product 国内生产总值

IOP: Intelligent Operations Platform 智能操作平台

IT: Internet Technology 互联网技术

LMR: Latent Mobile Robot 潜伏式机器人

MRO: Maintenance, Repair, and Operations 维护、修理及运营

QR Code: Quick Response Code 二维码

RMB: Renminbi 人民币

RMS: Robot Management System 机器人管理系统

R&D: Research and Development 研发

SLAM: Simultaneous Localization and Mapping 即时定位与地图构建

U.S./US: The United States 美利坚合众国

VR: Virtual Reality 虚拟现实

WES: Warehouse Execution System 仓库执行系统

WIP: Work in Process 半成品

WMS: Warehouse Management System 仓库管理系统

Table of contents

The warehouse automation solutions integrate automated equipment and software systems, including AMR, AS/RS, conveyor and sorting belt solutions.

- **Definition of Warehouse Automation Solutions**
- 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, Automated Storage and Retrieval Systems (AS/RS), conveyors, and sorting belts.

Main Solutions	Applications Stage	Main Devices		
AMR	**Flexible and widely applicable** for scenarios such as handling, picking, and sorting	 Latent mobile robot (LMR)	 Carton transfer unit (CTU)	 Unmanned forklift
AS/RS	**Storage** Can increase space utilization, with much higher storage capacity per unit area than traditional warehouses	 Automated storage	 Shuttle car	 Stacker crane
Conveyor	**Transporting** Continuous transport, reducing operation time and speeding up material turnover	 Roller conveyor	 Belt conveyor	
Sorting belts	**Sorting** Continuous and large-scale sorting of goods, with efficiency much higher than manual sorting	 Cross-belt sorting system	 Wheel sorter system	

Software Components

WMS

Warehouse management system(WMS) is a software that **manages and optimizes warehouse operations, such as inventory tracking, picking, packing, and shipping**.

- ✓ Enhances inventory accuracy, operational efficiency and order fulfillment speed
- ✓ Reduces labor costs
- ✓ Provides real-time data for better decision-making

WES

Warehouse execution system(WES) is a software that **manages real-time warehouse operations, coordinating automation systems like robots, conveyors, and sorting systems.**

- ✓ Optimizes real-time task execution
- ✓ Coordinates multiple automation systems
- ✓ Increases operational efficiency and throughput
- ✓ Provides better control and visibility over warehouse processes

RMS

Robot management system(RMS) is a software that **manages and coordinates the activities of a fleet of robots within a warehouse or factory.**

- ✓ Enhance large-scale robot fleets efficiency, robot task allocation and path planning
- ✓ Ensures real-time coordination and traffic control
- ✓ Supports multiple robot navigation methods

Notes: Except for the main solutions, other solutions primarily include maintenance, repair, and operations (MRO) services, palletizing and depalletizing equipment, and overhead systems.

Source: CIC

Traditional warehouses face numerous challenges and is no longer able to meet modern demands. The shift toward automation has become a global trend in warehouse operations.

Pain points of traditional warehouse operations

1 Rising labor costs

Labor shortages are driving up human resource costs

+

- Incorrect picking
- Operational errors
- Accidents
- ……

Increased pressure on operational cost control

- Amidst aging populations and escalating labor costs, the drawbacks of traditional labor-intensive warehousing are becoming increasingly apparent. The risk of human error remains unavoidable, and rising labor expenses are driving up operational costs.

2 Limited space utilization

Traditional warehouse

- Wide aisles
- Limited shelf height
- Low storage density

VS

Automated warehouse

- Narrow or no aisles
- High shelf
- High storage density

- Traditional warehouses require wide aisles and large workspaces to accommodate manual tasks, significantly limiting space utilization.

3 Increasing demands for warehouse efficiency and accuracy

2013

30+%

2024

- The average size of warehouse has increased by more than 30% compared to a decade ago.

- 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.

4 Increasing complexity of supply chains

Demands from cross-border E-commerce

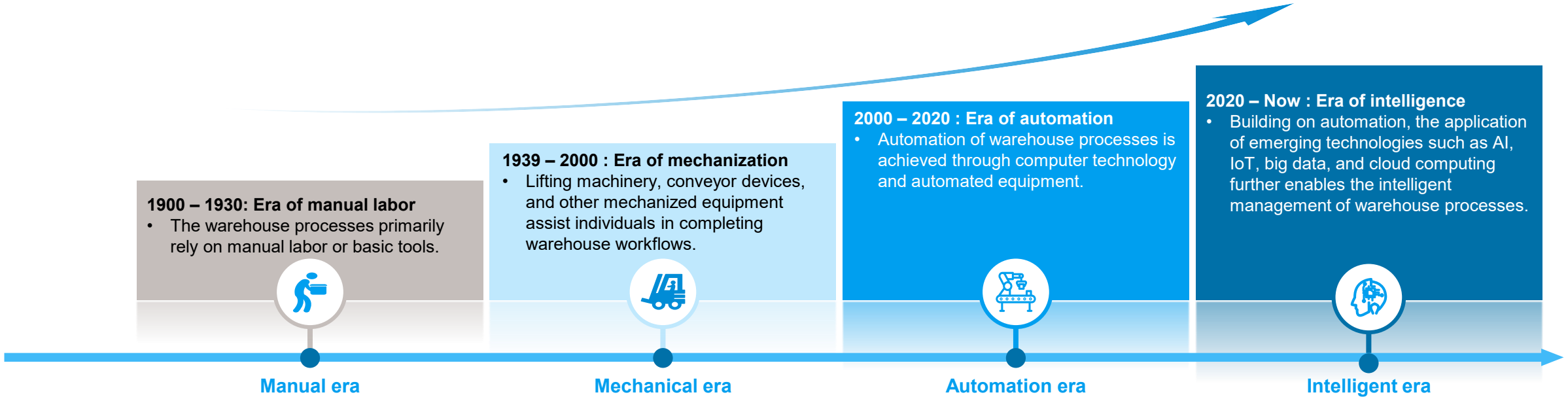
- Increasing number of SKUs
- A broader range of product portfolio
- A growing number of destinations
- Longer logistics distances
- ……

- Rising consumer demand for personalization and shorter product life cycles are disrupting the traditional "produce first, sell later" model. The rapid growth of global and cross-border e-commerce is exponentially increasing the complexity of supply chains.

Source: CIC

Evolving from manual operations to autonomous and intelligent systems, the global warehouse automation solution industry has seen continuous advancements.

Development history of global warehouse automation solution industry

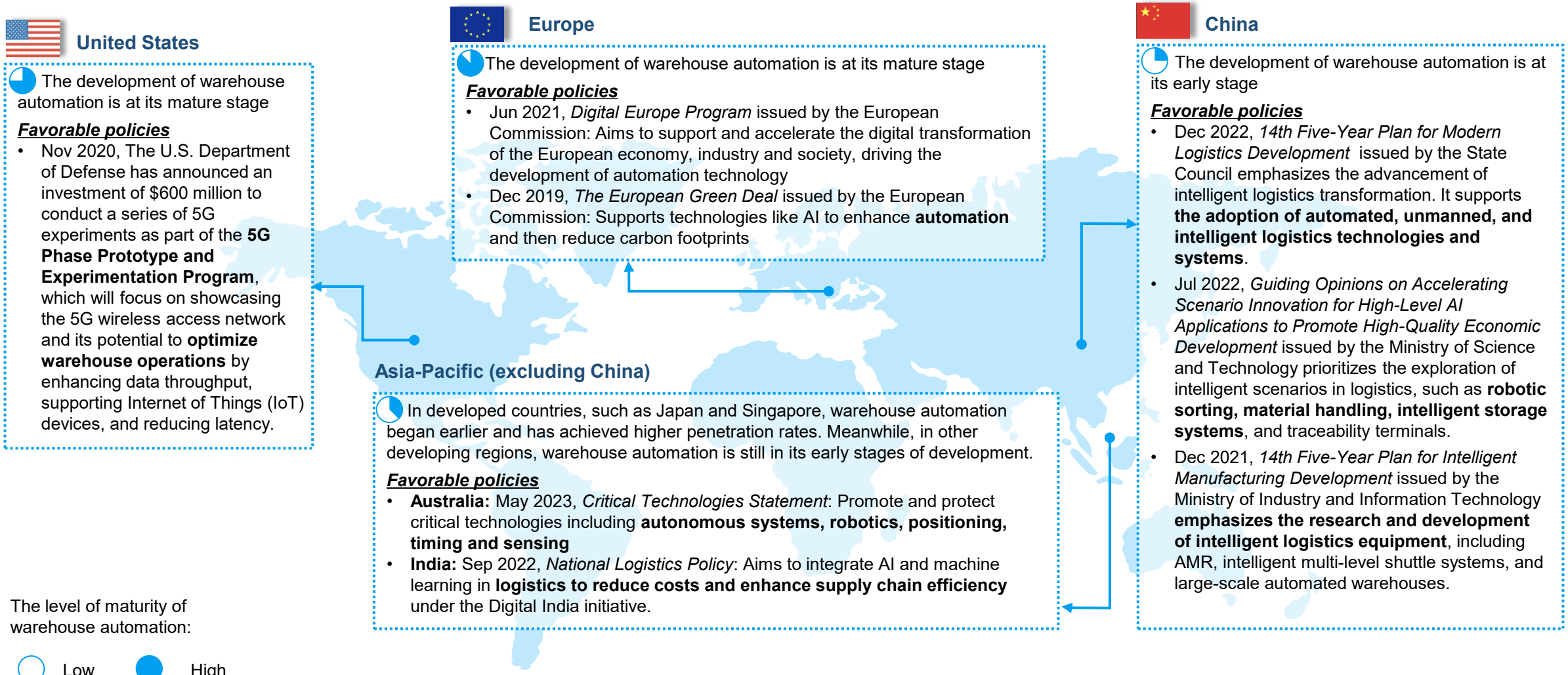


	Manual era	Mechanical era	Automation era	Intelligent era
Main driving factors	• Human labor dominance	• The introduction and application of mechanical equipment	• The emergence of computer and automation technologies	• **The development of IoT, big data, and AI technologies**
Landmark technological breakthroughs	• Operations are primarily manual, with no specific technological breakthroughs	• The widespread application of mechanized equipment such as lifting machinery and conveyor equipment	• Automated warehouse systems, such as automated goods storage, sorting, and inventory management systems	• **The application of emerging technologies such as AI algorithms, 5G communication, and intelligent robots in warehouse processes**
Development trends	• Transitioning from manual labor to equipment assistance	• Transitioning from manual operation of mechanized equipment to automated operation of machinery	• Transitioning from equipment automation to equipment intelligence, driving devices to achieve autonomous decision-making	• **Promoting devices to achieve high levels of autonomy and intelligence, moving towards complete automation with no human intervention**

Source: CIC

The development stage of warehouse automation solution industry varies across countries and regions, with each receiving strong policy support to drive growth.

Development of warehouse automation solution industry in major countries and regions



United States

The development of warehouse automation is at its mature stage

Favorable policies

- Nov 2020, The U.S. Department of Defense has announced an investment of $600 million to conduct a series of 5G experiments as part of the **5G Phase Prototype and Experimentation Program**, which will focus on showcasing the 5G wireless access network and its potential to **optimize warehouse operations** by enhancing data throughput, supporting Internet of Things (IoT) devices, and reducing latency.

Europe

The development of warehouse automation is at its mature stage

Favorable policies

- Jun 2021, *Digital Europe Program* issued by the European Commission: Aims to support and accelerate the digital transformation of the European economy, industry and society, driving the development of automation technology
- Dec 2019, *The European Green Deal* issued by the European Commission: Supports technologies like AI to enhance **automation** and then reduce carbon footprints

China

The development of warehouse automation is at its early stage

Favorable policies

- Dec 2022, *14th Five-Year Plan for Modern Logistics Development* issued by the State Council emphasizes the advancement of intelligent logistics transformation. It supports **the adoption of automated, unmanned, and intelligent logistics technologies and systems**.
- Jul 2022, *Guiding Opinions on Accelerating Scenario Innovation for High-Level AI Applications to Promote High-Quality Economic Development* issued by the Ministry of Science and Technology prioritizes the exploration of intelligent scenarios in logistics, such as **robotic sorting, material handling, intelligent storage systems**, and traceability terminals.
- Dec 2021, *14th Five-Year Plan for Intelligent Manufacturing Development* issued by the Ministry of Industry and Information Technology **emphasizes the research and development of intelligent logistics equipment**, including AMR, intelligent multi-level shuttle systems, and large-scale automated warehouses.

Asia-Pacific (excluding China)

In developed countries, such as Japan and Singapore, warehouse automation began earlier and has achieved higher penetration rates. Meanwhile, in other developing regions, warehouse automation is still in its early stages of development.

Favorable policies

- **Australia:** May 2023, *Critical Technologies Statement*: Promote and protect critical technologies including **autonomous systems, robotics, positioning, timing and sensing**
- **India:** Sep 2022, *National Logistics Policy*: Aims to integrate AI and machine learning in **logistics to reduce costs and enhance supply chain efficiency** under the Digital India initiative.

The level of maturity of warehouse automation:

Low High

Source: CIC

The major warehouse automation solutions are at different stages of development, and each have distinct influencing factors and trends.

Development of major warehouse automation solutions

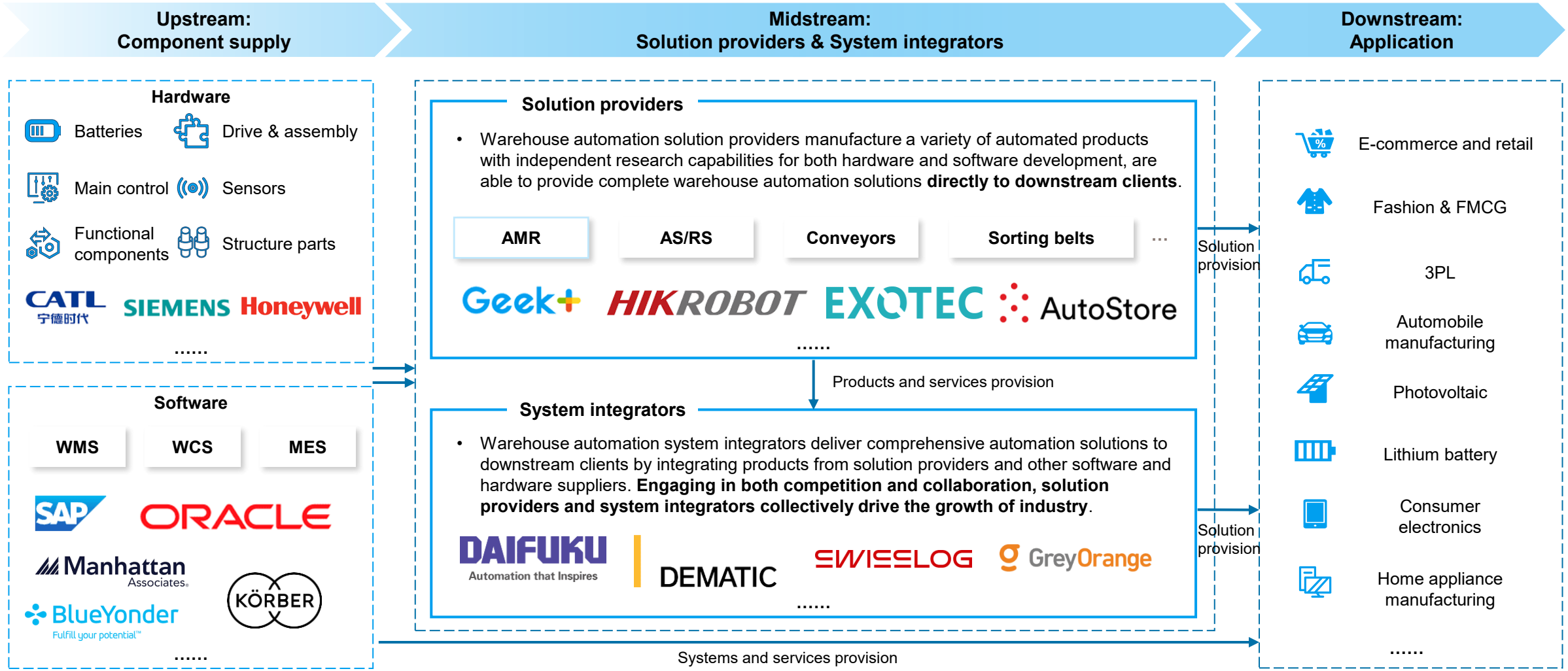
Solution	Development stage	Driver factors	Development trends
AMR	**Currently in a rapid development stage, the technology is gradually maturing**	• The warehousing environment is complex and dynamic, **requiring highly flexible automated equipment** • With the continuous development of technologies such as AI and IoT, **the performance of AMRs is also continually improving**	• **Intelligence:** Development of intelligence by integrating AI algorithms to achieve more complex task planning and autonomous optimization • **Collaboration:** Collaboration with AS/RS, conveyors, and other equipment to enhance overall efficiency
AS/RS	**Relatively mature** • Efficiently utilizing warehouse space and increasing storage density, it has been widely applied across various warehousing scenarios	• The demand for **warehouse space utilization has increased**, necessitating high-density storage equipment	• **Diversification:** Developing AS/RS systems that are adaptable to various types of goods and scenarios
Conveyors	**Highly mature** • With efficient, continuous, and stable transmission characteristics, conveyors have become an essential component of warehouse automation	• The demand for automation in production lines has increased, necessitating **continuous and efficient goods transportation** equipment	• **High speed:** Increase conveyor speed to meet the demands of efficient logistics • **Intelligence:** Integrate sensors and control systems to enable adaptability and remote monitoring
Sorting belts	**Highly mature** • Having achieved a high level of automation, the sorting belts is capable of quickly and accurately sorting and categorizing goods	• The rapid **development of the E-commerce and express delivery** industries has led to an increase in sorting demands • The **diversification of goods** requires more intelligent sorting systems	• **Intelligence:** Integrate technologies such as AI and machine vision to enhance sorting accuracy and efficiency • **Modularity:** Develop modular sorting systems that adapt to various types of goods and sorting requirements

○ Low ● High

Source: CIC

Solution providers play a key role in the warehouse automation solution supply chain, leveraging their specialized research and development capabilities and service expertise to deliver advanced solutions.

Supply chain of global warehouse automation solution industry



Source: CIC

Among major warehouse automation solutions, AMR solutions offer advantages in many aspects including stability, compatibility, efficiency, customization, and ROI.

Comparison of major warehouse automation solutions

Solution	Workflow	Product Features	Stability	Compatibility	Operation Efficiency	Customization	ROI
AMR	• Use sensors and algorithms for autonomous movement and task execution	• Highly flexible, adaptable to various scenarios, no fixed infrastructure needed	High stability in dynamic environments	Highly compatible with other systems and platforms	High, especially in dynamic and flexible operations	High, leading companies can develop solutions on modular platform	Fast, AMR solutions are quick and easy to deploy with limited investment
AS/RS	• Maximizes space utilization by automated storage and retrieval	• Much higher storage capacity per unit area than traditional warehouses	Stable • Ideal for long-term storage management	Moderate compatibility with traditional warehouse systems	Moderate to high • Ideal for high-density storage	Moderate to high • The height and storage density can be customized	Moderate, requires longer deployment cycle
Conveyors	• Continuously moves goods to reduce processing time	• Speeds up material flow, reducing turnaround times	High stability for continuous operations	Low, limited to systems designed for conveyor use	High • Efficient for continuous material flow	Moderate, large-scale fixed equipment tends to have limited flexibility in terms of configuration and adaptability	Moderate to slow, requires longer deployment cycle and maintenance costs
Sorting belts	• Automates sorting of large volumes of goods at high speed	• Much more efficient than manual sorting	High stability for large-scale sorting	Compatible with various sorting systems	High • Designed for large-scale sorting operations	Moderate, large-scale fixed equipment tends to have limited flexibility in terms of configuration and adaptability	Moderate to slow, requires longer deployment cycle and maintenance costs

○ Low ● High

Source: CIC

Generally, AMR solutions offer greater flexibility, scalability and customization compared to non-AMR alternatives.

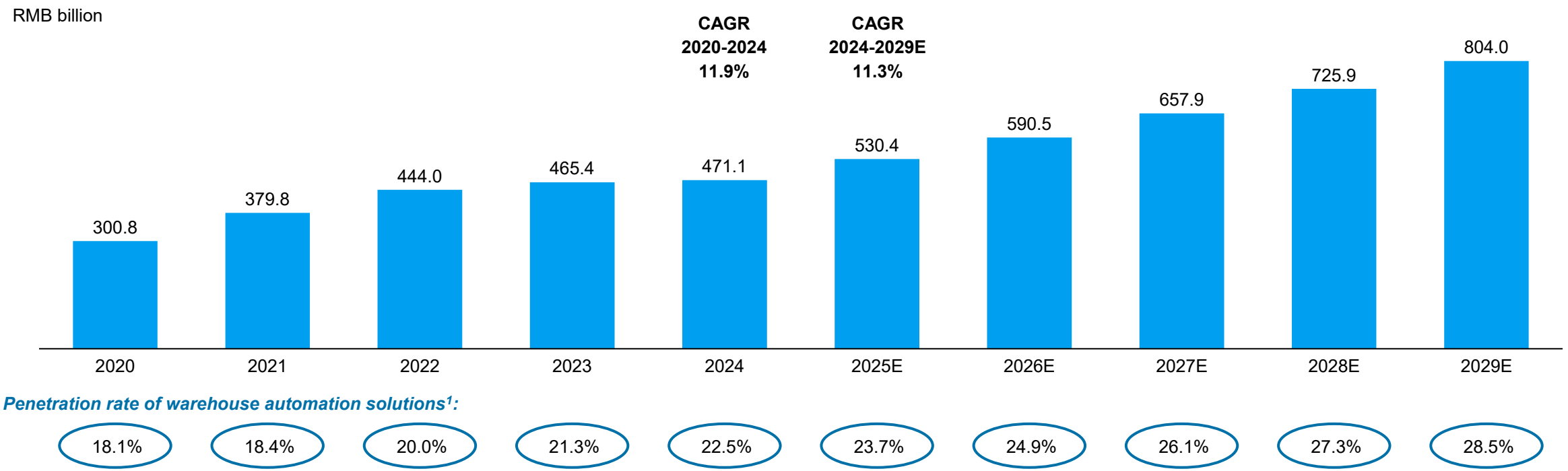
Comparison of AMR solutions and non-AMR solutions

	Non-AMR solutions	AMR solutions
Handling of Orders of Varying Sizes	• Non-AMR systems are usually optimized for specific types of orders, and handling anything outside of that range can lead to inefficiencies, errors, and delays.	• One of the standout features of AMR warehouse automation solutions is their ability to handle orders of varying sizes. • Whether it is a single-item order or a bulk shipment, AMRs can be programmed to efficiently manage the picking, packing, sorting, and transportation of orders, regardless of size or complexity. • This flexibility allows businesses to cater to a diverse range of customer requirements, from ecommerce operations with numerous small orders, to B2B logistics that may involve larger, more complex shipments.
Adaptation to Operational and Deployment Changes	• Fixed systems are rigid and designed for specific tasks, making them less capable of handling the variability and complexity of modern logistics operations. Any required changes often involve costly and time-consuming adjustments to the infrastructure.	• AMR warehousing automation solutions are inherently designed to adapt to a wide variety of operational changes with minimal disruption. • Unlike fixed automation systems such as conveyor belts or automated storage and retrieval systems (AS/RS), which require significant reconfiguration or downtime to adapt to new workflows, AMRs can be easily reprogrammed or redeployed to different tasks. • This dynamic adaptation is particularly valuable in environments where order profiles, product assortments, or process requirements frequently change; AMRs can seamlessly transit between tasks, such as moving from picking operations to replenishment duties, ensuring continuous optimization of resources.
Customization for Diverse Industry Requirements	• Fixed, non-AMR solutions are typically standardized, offering limited ability to tailor operations to specific industry requirements. Customizing these systems can be complex, costly, and time-consuming.	• AMRs can be easily customized to meet the specific needs of different industries. AMRs can be configured to deliver optimal performance in virtually any environment. This level of customization is facilitated by the flexibility of both the hardware and software components of AMR systems.
Scalability to Meet Growing Demands	• Traditional warehouse automation systems often require substantial investments in infrastructure to scale. For instance, expanding a conveyor system or adding new AS/RS units may involve significant capital expenditure, extensive planning, and potential operational downtime.	• AMR solutions offer high level of scalability. As a business grows or experiences seasonal demand spikes, additional AMRs can be introduced to the system without the need for major infrastructure changes. • The modular and highly standardized nature of AMR systems means that they can scale up (or down) in response to business needs, ensuring that the logistics operations remain efficient regardless of fluctuations in demand.

Source: CIC

Driven by the rapid progress in automation, international trade, and environmental sustainability, the market size of warehouse automation solutions is expected to reach RMB 804.0 billion in 2029.

Global warehouse automation solution market size, 2020-2029E



Key analysis

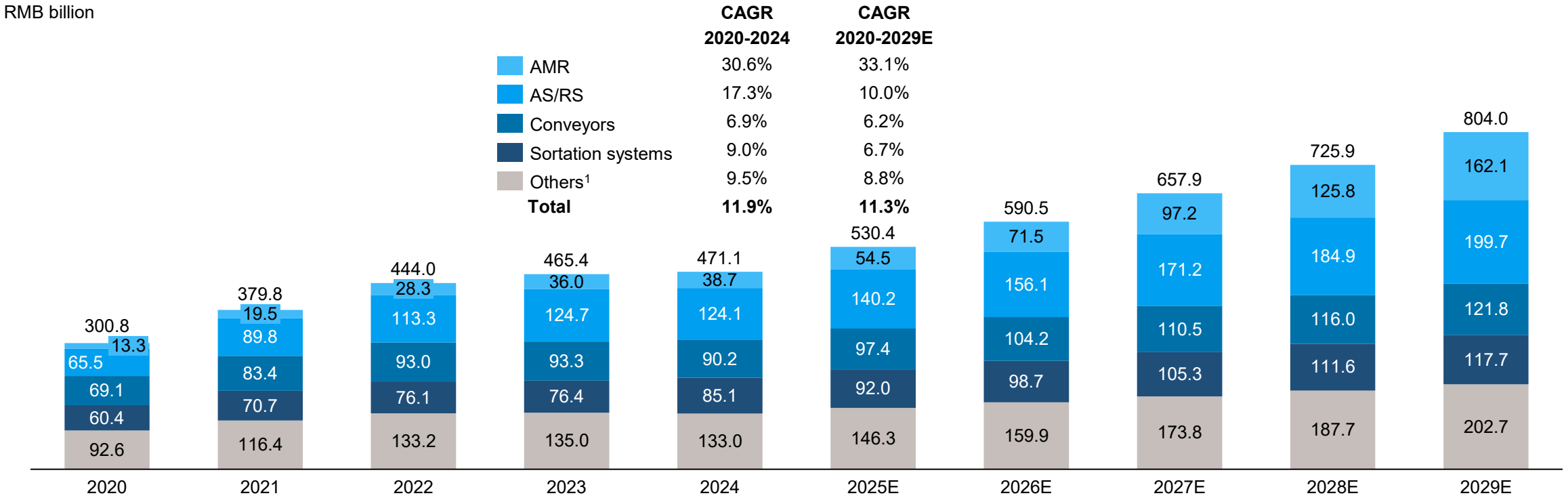
- Amid the global shift towards digitization and rapid advancements in automation technologies — driven by the expansion of global trade, the rise of e-commerce, and increasing demands for environmental sustainability — the global market for warehouse automation solutions has seen substantial growth. 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.

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: CIC

AMR solutions offer a more flexible and cost-effective alternative than other traditional solutions catering for new-era warehousing demands, poised to grow rapidly in the warehouse automation market.

Global warehouse automation solution market size, by major categories, 2020-2029E



Key analysis

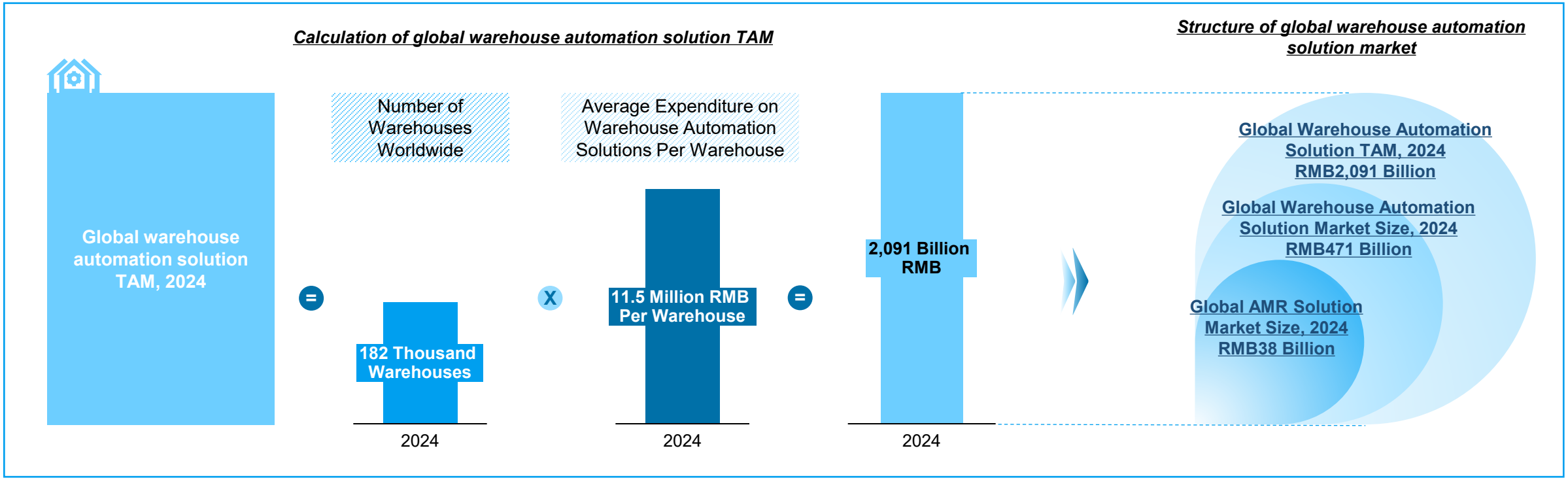
- Warehouse automation solutions encompass a wide range of warehouse operations, including picking, sorting, maintenance, and so on. Among the major automation solutions associating with the core operations of warehouses , AS/RS solutions hold the largest market share, accounting for 26.3% in 2024. In contrast, conveyors and sorting belts, which still rely heavily on manual labor, have a relatively smaller market presence. AMR solutions, on the other hand, offer a flexible and cost-effective solution across all stages of warehouse operations. Compared to traditional automation methods that require substantial upfront investment and large-scale equipment installations, AMR solutions provide greater adaptability and economic efficiency. As a result, AMRs are poised to increasingly replace conventional automation approaches, with their market share and size projected to grow rapidly.

Note[1]: Others primarily includes MRO services, palletizing and depalletizing equipment, and overhead systems.

Source: CIC

The global warehouse automation solution market holds tremendous potential, with TAM exceeding RMB 2 trillion in 2024.

Global warehouse automation solution TAM, 2024



Key Analysis

- 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 for warehouse automation solutions exceeded RMB2 trillion.

Source: CIC

Main drivers and market trends of global warehouse automation solution industry

Main drivers and market trends of global warehouse automation solution industry (1/2)

1 *Promising market potential*

- The proliferation of warehouses globally, coupled with the relatively sluggish adoption of automation in existing facilities, presents a significant opportunity for growth of warehouse automation solutions. As a critical component of the logistics supply chain, the number of warehouses has been on the rise, with the average warehouse size also increasing substantially. In 2024, the global warehouse count stood at approximately 180,000, reflecting a surge of over 50% compared to a decade prior, accompanied by a more than 30% expansion in average warehouse size during the same period. Warehouse operational efficiency is directly linked to a company's service responsiveness and cost control, serving as a vital indicator of its fulfillment capability and overall operational cost-effectiveness.

2 *Rapid rise of E-commerce and new retail*

- As E-commerce and innovative retail models proliferate worldwide, especially cross-border E-commerce, the demand for logistics has skyrocketed. To fulfill the escalating expectations for speedier and more accurate deliveries, logistics providers are rapidly embracing more efficient and technologically-advanced equipment. Warehouse automation solutions, equipped with cutting-edge automation and intelligence, significantly boost logistics processing capacity and delivery effectiveness, demonstrating remarkable adeptness in managing high-volume orders and complex logistics operations.

3 *Digital and intelligent transformation of the manufacturing industries*

- The digital and intelligent transformation sweeping the manufacturing industries has raised the bar for the logistics sector. Warehouse automation solutions have become indispensable for precise material handling and intelligent warehouse management throughout production. These cutting-edge systems not only dramatically boost operational efficiency but also lower costs, offering robust support for the industries' transformation and upgrade.

4 *Ageing population and labor cost challenges*

- Warehouse operating budgets are heavily burdened by labor costs, underscoring the pressing need to diminish dependency on manual labor. Warehouse automation solutions can effectively streamline repetitive, labor-intensive tasks, significantly reducing the proportion of labor costs within overall operations. This, in turn, bolsters the stability and sustainability of enterprise operations. Standardized and scalable automated solutions have the potential to enhance warehouse efficiency, positioning them for widespread adoption and implementation across diverse industries.

Source: CIC

Main drivers and market trends of global warehouse automation solution industry

Main drivers and market trends of global warehouse automation solution industry (2/2)

5 *Technology advancement*

- The incorporation of innovative technologies, including AI, robotics, IoT, and big data analytics, has substantially elevated the sophistication and efficiency of warehouse automation systems. For example, AI empowers more advanced decision-making capabilities, robotics enhances operational precision and productivity, IoT enables real-time connectivity and collaboration among devices, and big data equips businesses with deeper insights to optimize their logistics operations.

6 *Favourable government policies*

- Governments worldwide are actively promoting industrial automation and sustainability in the logistics sector, accelerating the progress of smart manufacturing and modern logistics systems. They have established detailed standards and guidelines for warehouse automation, enhancing industry standardization, while also offering incentives like financial subsidies and tax breaks to encourage businesses to invest in automation and intelligent technologies. Furthermore, international collaboration and technology exchanges are strongly advocated, fostering the global sharing of best practices and creating a powerful policy framework and collaborative platform to drive the rapid advancement of warehouse automation.

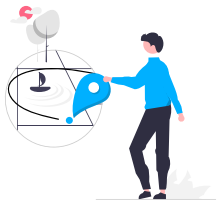
7 *Growing focus on ESG*

- Amid heightened global focus on carbon emissions, warehouse automation solutions are gaining notable recognition for their pivotal role in driving energy conservation and emissions reduction. These cutting-edge systems empower clients to substantially minimize their environmental footprint, lower operational costs, and enhance overall efficiency, all while bolstering employee well-being. Notably, leading warehouse automation providers are prioritizing energy efficiency and resource recycling in their design and manufacturing practices. This strategic approach not only aligns with prevailing sustainability trends but also reinforces corporate social responsibility, ultimately delivering long-term cost advantages for businesses.

Source: CIC

Table of contents

AMRs are robotics can autonomously navigate and operate, with advanced algorithms and technologies, they are becoming a crucial tool in warehouse automation.



- **Definition of AMR**
- 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.

Main structure of AMRs

Major Technologies

- QR code
- Laser SLAM
- Visual SLAM

Major Functions

- Inbound
- Outbound
- Picking
- Sorting
- Material transport

Core Algorithms

- Autonomous navigation
- Path planning
- Obstacle avoidance
- Task scheduling
- Decision-making

Basic Hardware

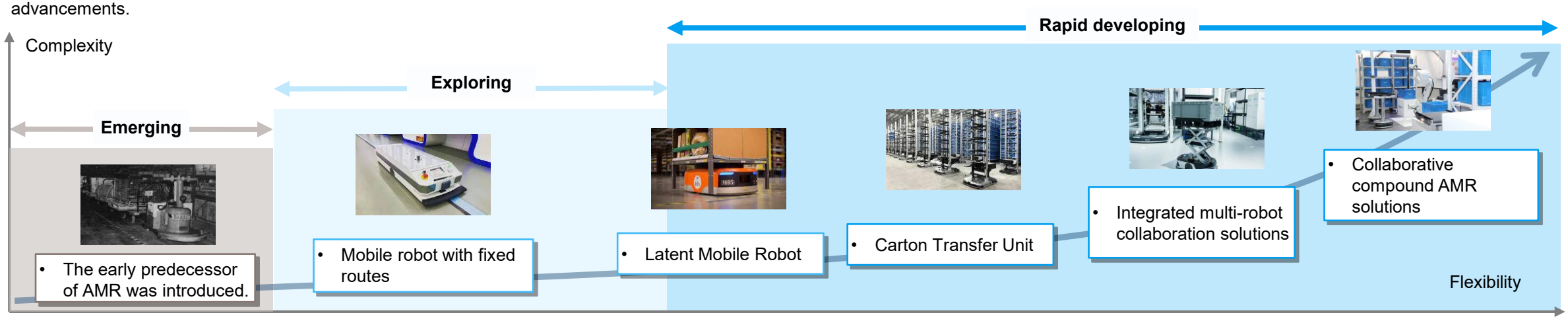
- Controllers
- Sensors
- Drive devices
- Structure components
- Industrial camera
- Communication interface
- ...

Source: CIC

AMR solutions are evolving towards greater intelligence, more flexible deployment, and broader industry applications.

Development history of global AMR solutions

- 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 (WMS) and enterprise resource planning (ERP) 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.



	1950s	2000	2016	2020
Main Drivers	• The growth of the manufacturing sector is driving increased demand for automation.		• The rise of E-commerce has set higher expectations for logistics efficiency, driving the need for more advanced solutions.	• In response to rising labor costs and the need for enhanced operational efficiency, automation continues to advance across various industries.
Key Technology	• Magnetic navigation		• QR code navigation • Laser SLAM navigation • Visual SLAM navigation	• Hybrid method navigation
Market Trends	• Primarily focused on material handling tasks • Operates on fixed routes • Lacks multi-robot collaboration		• Expanded functionality to logistics scenarios • Operates on flexible routes • Enhanced autonomous planning	• Enhanced flexibility and adaptability • Highly automated and intelligent

Source: CIC

The continuous evolving of AMR product forms has led to the optimization of solution effectiveness.

Overview of AMR product form evolution

Product form evolution

The early predecessor of AMR

- Evolved from simple tractors
- Transport goods by towing

Kiva robots

- Kiva-style latent mobile robots have become the typical form of AMRs in warehouse logistics.
- Transport goods by lifting and moving underneath the target items

Diverse forms of AMR

- To meet diverse handling needs across various scenarios, AMRs are becoming increasingly diversified in product form

Modification and optimization

- Building on mature product prototypes, modifications with various functional components are made to better meet specific scenario needs and improve efficiency

Structure complexity

Simple fixed structure → Modular structure with strong extensibility

Function integration

Single-function phase: Towing | Moving | Lifting

Multi-function phase: Four-way moving + Lifting | Multi-tote picking + Moving | Telescoping + Moving

Driving factors

1. Technology development
2. Demands from diverse downstream industries
3. Requirement for more flexibility and efficiency
4. Establishment of industry standards

Source: CIC

Developing from physical tracks to SLAM, AMR navigation technologies continuously enhance the automation and intelligence level of AMRs.

Development of AMR navigation technology

Early mobile robot navigation technologies were physical tracks and magnetic navigation, which depended on the installation of infrastructure and offered lower levels of automation.

QR code navigation

- By incorporating location information into QR codes affixed to the ground and integrating them with AMR's inertial navigation, traditional fully tracked guidance has been simplified to point-to-point navigation.

Widespread adoption of QR code technology

- In 2000, QR code became an ISO international standard (ISO/IEC 18004), ensuring standardization across various industries.

Online payment

Online ordering

⋮

Laser SLAM

- Laser SLAM technology utilizes laser sensors to scan the surrounding environment, constructing real-time maps while simultaneously determining the AMR's location within that map.

Development of SLAM technology

- SLAM technology employs sensors to collect environmental data, allowing devices to estimate their location and navigate without pre-defined maps.

Autonomous driving

Augmented reality

⋮

Visual SLAM

- Visual SLAM technology continuously captures camera images and extracts key features for matching, enabling AMRs to accurately calculate their position and orientation within the environment.

Combination of AI and computer vision

- Advancements in AI technologies, such as deep learning and LLM, significantly enhanced the accuracy of computer vision within complex environments.

Facial recognition

Robots development

⋮

✓ ***The advancement of AMR navigation technology is driven by the development and application of foundational technologies, continuously enhancing the automation and intelligence of AMRs.***

Source: CIC

The ongoing advancements in AMR power battery and charging technologies continuously enhance the endurance capabilities of both individual units and entire fleets.

Development of AMR power battery

Lead-acid batteries

+
- Lower energy density
- Lower cycle life

-
- ✓ Lower price
- ✓ Higher safety

- To meet the growing demand for AMR endurance, the selection of AMR power battery materials increasingly focuses on cycle life and energy density. **Lithium-ion batteries** are becoming the mainstream choice.

Lithium-ion batteries

+
- ✓ Higher energy density
- ✓ Higher cycle life

-
- Higher price
- Lower safety

Overview of major AMR power battery categories

	Energy density	Cycle life	Range	Low-temperature performance	Safety and stability
LiFePO4 batteries	• ~140 Wh/kg	• >3,500		• a temperature lower limit of -20℃	• peak electrothermal temperature>350℃
Ternary lithium-ion batteries	• ~240 Wh/kg	• >2,000		• a temperature lower limit of -30℃	• peak electrothermal temperature<200℃

High Low

Development of AMR charging technology

From manual to autonomous charging
- AMRs can now autonomously request charging, navigate to designated charging areas, and connect for recharging without any manual assistance throughout the entire process.

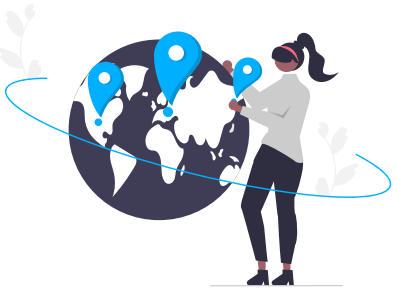
From wired to wireless charging
- AMRs can now charge wirelessly through inductive charging systems, eliminating the need for physical contact and freeing charging from the constraints of time and location.

From scheduled to opportunistic charging
- Opportunistic charging allows AMRs to recharge at any time during operation, rather than waiting for low battery levels, enhancing the flexibility of fleet charging arrangements.

Development of fast charging
- Fast charging technology reduces charging times, minimizes AMR downtime, ensuring more continuous operation.

Source: CMRA，CIC

The development of the AMR market in major countries and regions worldwide.



Favorable policies

01

The government has introduced dedicated policies to support robotic technology, fostering the development and application of AMRs

- **2021.12,** *14th Five-Year Plan for Robot Industry Development:* Promote the research and application of key products in industrial, service, and special robots.
- **2023.1,** *Robot+ Application Action Implementation Plan:* Advance the application of robotic technology across various industries, including warehouse automation.

02

Focusing on the safety of AMR solutions

- **ANSI/RIA R15.08 Series**
- Specifies safety requirements for industrial mobile robots, covering hazard identification, risk assessment, and design requirements.
- **UL 3100**
- Governs the safety of automated mobile platforms, ensuring they are safe for use in various environments, including warehouses. It outlines requirements for design and operational safety.

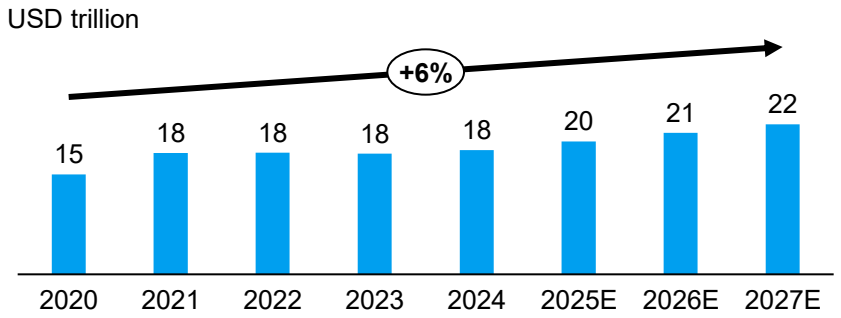
03

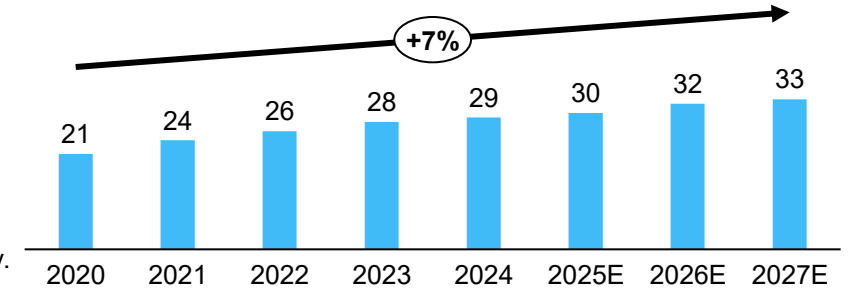
The robotics development strategy and rising automation demands in downstream industries are fueling AMR market growth

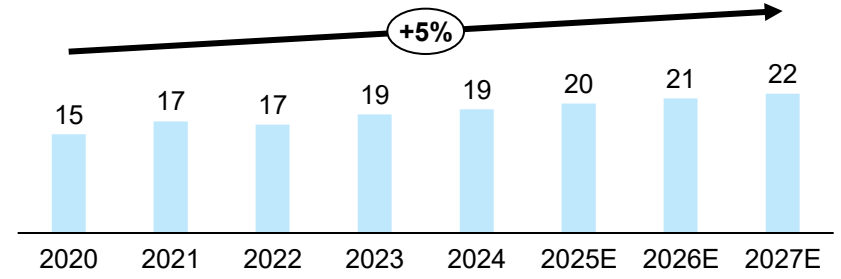
- **By 2025,** the European Commission will publish an EU-wide strategy paper to ensure synergy across the continent in the uptake of AI-powered robotics.
- **Since 2010,** the Germany Government had published a series of innovation policies on Industry 4.0, a strategy to drive the fourth revolution in manufacturing sector by technologies including machine automation.

Industry and economy development

Real GDP (Current US$), 2020-2027E







Source: Word Bank, CIC

AMR solution providers specialize in the R&D of AMR hardware and support software, building substantial technological expertise and experience, which leads to a strong competitive advantage.

Upstream: Component supply

- Batteries
- Drive & assembly
- Main control
- Navigation & sensing
- Functional components
- Structure parts

Midstream: Solution providers & System integrators

Solution provider

- **Specialized in AMR solutions**, with strong in-house R&D capabilities and extensive technical expertise.
- **Product design**: includes the research and development of AMR hardware and software.
- **Supply chain**: requires accumulated supplier resources to obtain a competitive price advantage.
- **Market resources**: includes customer acquisition channels and component resources.

System Integrator

- **Focus on integration**, tend to have relatively weaker AMR-specific technological capabilities.
- **System Integration**: integrates hardware and software from various providers.
- **Project Implementation**: material scheduling, on-site construction, and debugging.

Relationship between Solution providers and System integrators

Cooperation:
Solution providers and system integrators are **ecological partners**, able to jointly provide integrated solutions to meet customers' intelligent warehousing needs.

Competition:
In some cases, solution providers and system integrators may offer similar services, leading to **potential competition** in areas such as AMR product sales and system software provision.

Downstream: Application

- E-commerce and retail
- Fashion & FMCG
- 3PL
- Automobile manufacturing
- Photovoltaic
- Lithium battery
- Consumer electronics
- Home appliance manufacturing
- .....

- The AMR solution industry is comprised of an interconnected supply chain. Upstream, there are suppliers of critical components; midstream, AMR solution providers are responsible for robot manufacturing and system integration; downstream, various industries make use of these solutions. AMR solution providers play a pivotal role in driving the industry, not only by efficiently integrating upstream and downstream resources but also by leading technological innovation. These providers demonstrate exceptional capabilities in both software and hardware integration, addressing the complex and dynamic needs of the market. Their ability to design modular, scalable solutions also allows them to meet the needs of a wide range of businesses, from small warehouses to large, complex distribution centers.

Source: CIC

AMRs require various kinds of components, and the quality and price of key components significantly impact the performance and overall cost of AMR (1/2).

The price range and influence factors of AMR key components (1/2)

- 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.

Core Components	Price Range,2022-2024, RMB	Influence Factors	Major Suppliers
LiDar	600-10,000	• Prices depend on structure and performance. • Technological advancements and mass production are expected to lower costs. • Production capacity of AMR manufacturers and order demand also affect pricing.	PEPPERL+FUCHS 万集科技 WANJI TECHNOLOGY
3D Vision Sensors	500-6,000	• Prices vary based on application requirements. • Production capacity and order demand from AMR manufacturers influence costs.	ifm electronic
Reducer	400-1,000	• Prices depend on the type of reducer (RV or harmonic) reduction ratio, installation method, size, precision, and force. • Integrated designs are becoming more popular, making products more compact, secure, and easier to install, which could lead to lower costs. • Prices are influenced by the production capacity of AMR manufacturers and order demand.	Nabtesco SUMITOMO ELECTRIC

Source: CIC

AMRs require various kinds of components, and the quality and price of key components significantly impact the performance and overall cost of AMR (2/2).

The price range and influence factors of AMR key components (2/2)

Core Components	Price Range,2022-2024, RMB	Influence Factors	Major Suppliers
Motor	300-2,000	• Prices depend on the motor technical characteristics and customization level. • Integrated designs are becoming more popular, making products more compact, secure, and easier to install, which could lead to lower costs. • Prices are influenced by the production capacity of AMR manufacturers and order demand.	Kinco 步科
Drive Wheels	8,000-14,000	• Prices are influenced by application requirements and the complexity of performance and design.	凤凰动力 PHOENIX POWER
Controller	2,000-100,000	• Prices depend on the complexity of functions. • Some manufacturers develop their own controllers. • AMR-specific controllers with integrated navigation and motion control algorithms offer higher stability and protection levels compared to general industrial motion controllers, or PLCs. AMR-specific controllers are priced over RMB20,000.	KOLLMORGEN A REGAL REXNORD BRAND
Power Battery	1,500-5,000	• Prices are generally customized based on the specific needs of AMR manufacturers, including battery capacity, current, communication methods, design, and intelligence requirements.	CATL 宁德时代

Source: CIC

The AMR solution enhances warehouse workflows through intelligent automation, greatly improving both operational efficiency and accuracy.

Warehouse workflow		Traditional manual warehouse: Person to goods		AMR solutions: Goods to person		
Receiving and Unloading	Truck delivers into warehouse					
	Boxes unloaded, checked, unpacked and scanned		Operations use forklifts to unload goods		Driverless forklifts	✓ Minimizes the need for manual labor and accelerates the flow of goods into the warehouse
Storage	Items put away into storage and made available online		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
	Online order placed by customer					
Order Picking	Items picked from storage		Workers spend up to 70% of time walking to shelves to pick items with 6-10 miles a day		Goods-to-person AMRs bring items to workstations	✓ Significantly cuts down on walking time and allowing workers to focus on selecting and packing items quickly
Packing and Sorting	Items packed into boxes/parcels, labeled and scanned					
	Boxes/parcels are sorted (may be done later in the process at a separate sorting hub facility)		Workers sort the parcels		AMRs sort the parcels	✓ Streamlining the process and ensuring that items are organized for efficient loading into trucks
	Truck delivers into warehouse					

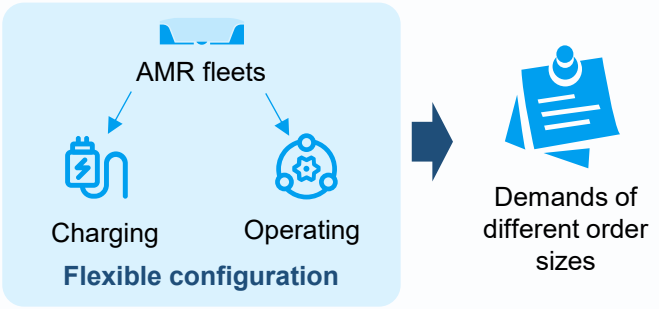
Source: CIC

AMR solutions meet customer needs through ROI, operation and customization. By bridging operational silos within factories and warehouses, AMRs facilitate flexible and intelligent warehousing operations.

Flexible deployment

Adapting to orders of varying sizes

- AMR fleets can be dynamically adjusted based on varying order size, optimizing resource allocation and maximizing order processing efficiency.



Adapting to operation adjustment

- Quickly adapts to operational and deployment adjustments, such as flexibly allocating the number of AMRs for inbound logistics and picking processes.

High extensibility

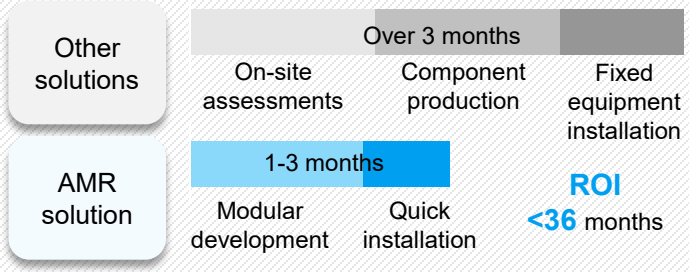
- Highly scalable and extensible, offering seamless expansion to meet growing operational needs.

Leading ROI speed

Reduced implementation cycle

- **Shortened development duration**: Leading AMR manufacturers have established modular development capability, significantly reducing development time.
- **Shortened installation process**: AMRs do not require extensive fixed equipment, resulting in shorter installation and testing times compared to other warehouse automation solutions.

Implementation cycle comparison:



Reduced investment costs

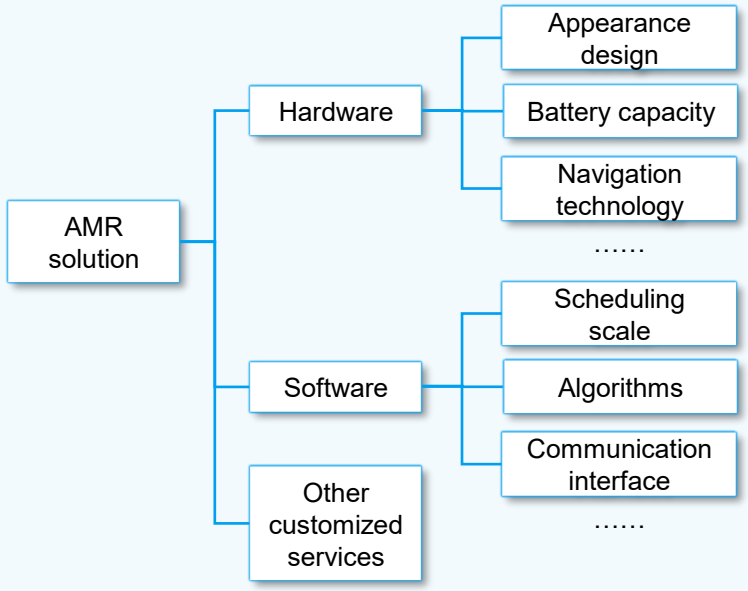
- The standardization and flexibility of AMR solutions significantly reduce investment costs for customers.

Highly customized

Precisely configured to meet the specific needs

- By adjusting hardware and software configurations, AMR solutions can be precisely tailored to meet the unique demands of various industries. From rapid picking and sorting in E-commerce to precise material handling in manufacturing, AMRs deliver customized solutions that ensure optimal performance across diverse environments.

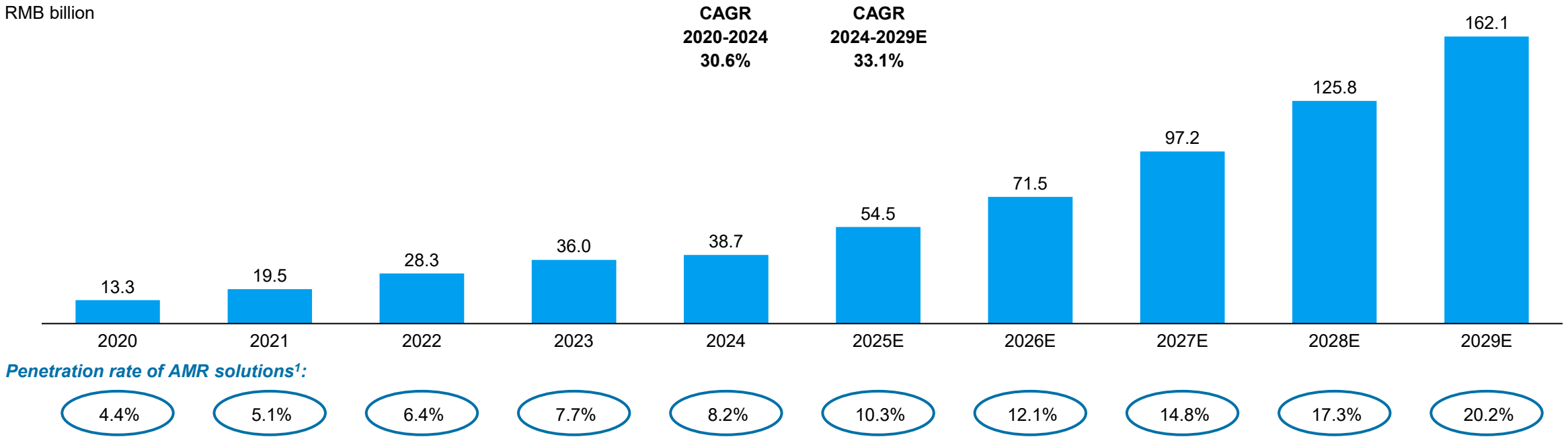
Example of customizable projects:



Source: CIC

Continuous technological advancements and expanding applications keep propelling the rapid growth of global AMR solutions market size and penetration rate within warehouse automation solutions.

Global AMR solutions market size and penetration rate, 2020-2029E



Key analysis

- 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 solutions 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 solutions 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.

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

Source: CIC

Main drivers and market trends of global AMR solution industry

Main drivers and market trends of global AMR solution industry

1 *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. 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.

2 *Global Labor Shortages and Rising Labor Costs Make AMR Solutions a Key Cost-Reduction Measure*

- Labor costs account for more than 50% of the operating budget for most warehouse facilities, making the need to reduce reliance on manual labor increasingly urgent for businesses. The global labor shortage, particularly in regions experiencing aging populations, exacerbates this challenge, driving the demand for automated solutions. 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.

3 *Rapid Technological Advancements Fuel AMR Solution Development*

- The integration of cutting-edge technologies such as AI, 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. For instance, AI enables more intelligent decision-making, robotics improves operational precision and efficiency, IoT facilitates real-time interconnectivity and interaction between devices, and big data helps companies better understand and optimize logistics processes with increased accuracy.

4 *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.

Source: CIC

Based on navigation technology paths, AMR solutions can be categorized into QR code navigation, visual SLAM navigation, and laser SLAM navigation solutions. (1/2)

Major navigation technology paths of AMR solutions (1/2)

QR Code Navigation

- Lay QR code on the ground, use an onboard camera to scan and interpret the QR code and obtain coordinates. Usually use with gyroscope based inertial navigation

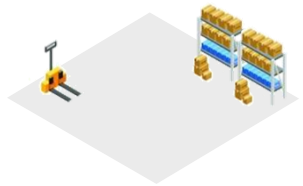
Pros	Cons
✓ Higher flexibility than magnetic navigation	! Prone to damage and wear
✓ Mature technology and accurate positioning	! Regular replacement and requirement
✓ Convenient installation and adjustment	

Highly Mature:
- widely adopted and well-developed

Low Maintenance Requirements:
- need regular replacement of QR code only

Environment Dependency:
- limited to indoor environment
- require a clear sight to QR codes
- less flexible in dynamic environment

Visual SLAM Navigation



- Gain real-time environmental information by high definition cameras, multi-lens cameras and other visual sensors, perceives the environment and create a simulated map

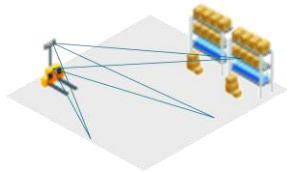
Pros	Cons
✓ Higher flexibility than magnetic navigation	! High cost
✓ High adaptability	! Require high technology support
✓ Convenient installation and adjustment	

Highly Mature:
- widely used in industrial and logistics application

Moderate to High Maintenance Requirements:
- need regular calibration and replacement

Environment Dependency:
- excellent in various environments
- struggle in high reflective surfaces space

Laser SLAM Navigation



- Emit lasers by laser sensors, and the receiver obtain the laser reflection, then calculate and build real positioning map based on the reflection by surrounding obstacles

Pros	Cons
✓ Higher flexibility than magnetic navigation	! Affected by lighting conditions
✓ High adaptability	
✓ Convenient installation and adjustment	! Relatively lower accuracy on mapping

Moderate Maturity:
- Improving with advanced computer vision and AI

Moderate to High Maintenance Requirements:
- mainly for camera systems and processing units

Environment Dependency:
- performs well in dynamic environments
- low dependence on external markers
- sensitive to environment

Low High

Source: CIC

Based on navigation technology paths, AMR solutions can be categorized into QR code navigation, visual SLAM navigation, and laser SLAM navigation solutions. (2/2)

Major navigation technology paths of AMR solutions (2/2)

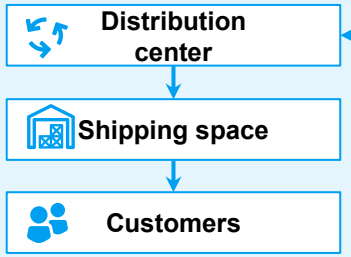
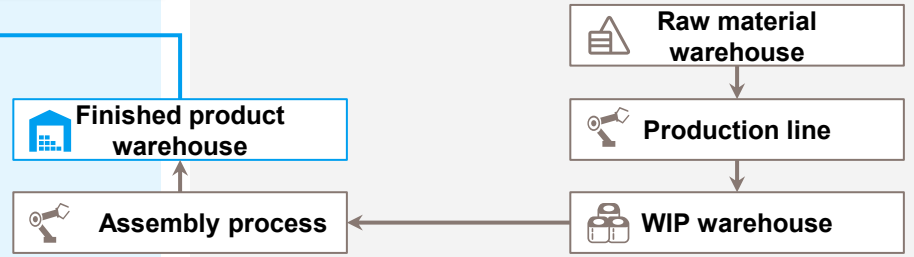
Classification	Navigation Accuracy	Obstacles Avoidance	Route Planning	Carry Capability
QR Code Navigation	±10mm • Inertial navigation is performed with the help of a gyroscope, and cumulative errors are corrected using QR codes on the ground, resulting in low error rates.	**Laser obstacle avoidance** • Can achieve stop-and-go functionality.	Combined with inertial navigation, the device can perform simple point-to-point path planning and operate autonomously.	100kg-1ton • The technology is well-developed and has already been applied in many scenarios; it is compatible with a wide range of platforms with varying carrying capacities.
Laser SLAM Navigation	±15mm，±1mm max • Use laser reflection for mapping and positioning. • Still affected by equipment, algorithms, and environment, with room for improvement.	**360° obstacle avoidance can be achieved without additional sensors.** • Detects and avoids obstacles actively.	**LiDAR-based mapping** allows **autonomous path planning** in the future. • Maps sync to servers, enabling **easy deployment of new devices**.	100kg-1ton • Non-forklift AMRs carry 100-500kg, forklifts can carry over 1ton.
Visual SLAM Navigation	±15mm • Camera-based positioning with low accuracy and stability. • Affected by lighting.	**360° obstacle avoidance can be achieved without additional sensors.** • Identifies obstacles and applies different avoidance strategies without sensor.	**Vision-based mapping** allows future **autonomous path planning**. • easy deployment with server sync.	<500kg • Used mainly in light-load scenarios due to immature technology, in factories or goods-to-person systems.

Low High

Source: CIC

Based on application scenarios, AMR solutions can be categorized into warehouse fulfillment and industrial material transport 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.

	Warehouse fulfillment	Industrial material transport
Main Application Scenarios	• Primarily serving tasks such as picking, sorting, and transporting goods within warehouse environments, enabling flexible and efficient movement of products. 	 • Focusing on material handling, AMRs are primarily applied in transport scenarios within production and manufacturing lines, enhancing operational efficiency.
Major Products	 LMR  CTU	 LMR  Smart forklift
Standardization Level of Products	After years of development, AMR products have evolved into a relatively standardized design and format.	After years of development, AMR products have evolved into a relatively standardized design and format.
Standardization Level of Solutions	In typical warehouse fulfillment applications, AMR operations are characterized by a high degree of process standardization. Tasks such as picking, transporting, and sorting are highly defined and repetitive. • The downstream customer market in these sectors is relatively concentrated, creating favorable conditions for the large-scale deployment of AMRs.	• In industrial production scenarios, AMRs need to be tailored to fit the specific requirements of different industries, production stages, and processes. This demands a higher degree of customization for the overall solution.
Downstream Industry Demands	• Widely applied across e-commerce, retail and FMCG sectors, where speed, accuracy, and scalability are paramount, the solutions also meet growing demand in raw material and finished goods warehouses within industries with a high degree of intelligent manufacturing.	• Industrial production and manufacturing

○ Low ● High

Source: CIC

Based on specific applications, AMR solutions can be categorized into shelf-to-person, tote-to-person, pallet-to-person, smart sorting, and smart moving.

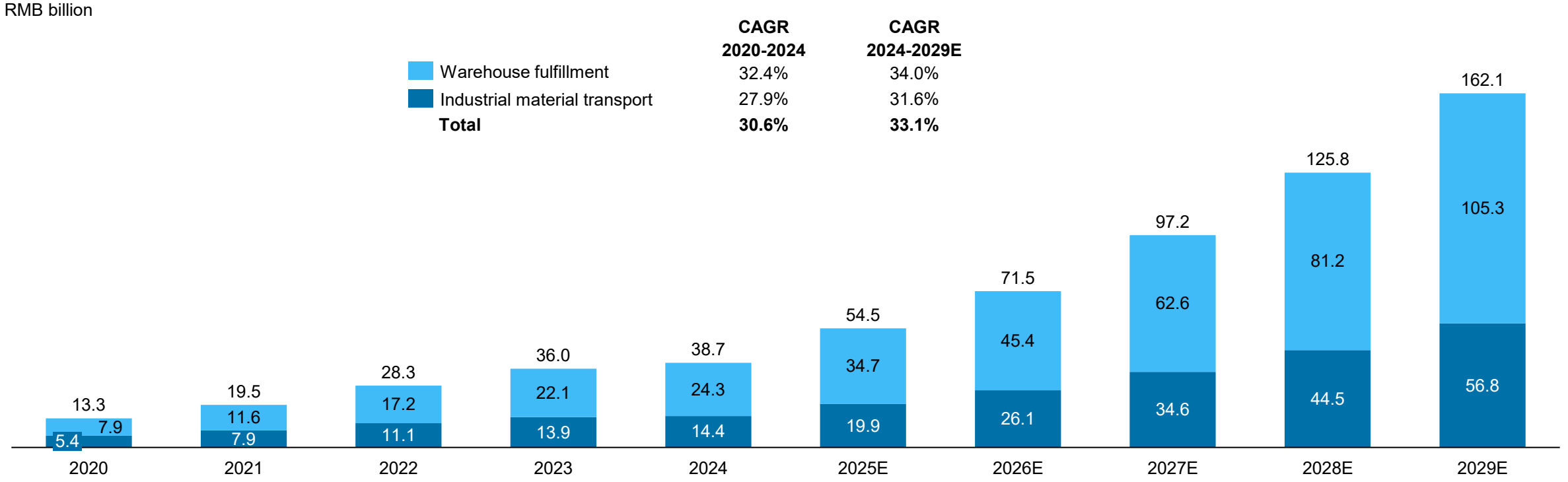
- To address the diverse needs of various warehousing environments — including storage density, handling speed, picking efficiency, and operational flexibility in sorting — leading AMR manufacturers continuously innovate and refine their solutions. Current mainstream solutions include shelf-to-person,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

	Shelf-to-Person	Tote-to-Person	Pallet-to-Person	Smart Sorting	Smart Moving
Main Application Scenarios	Warehouse fulfillment	Warehouse fulfillment	Warehouse fulfillment	Warehouse fulfillment	Industrial material transport
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.	• Automatically plans routes based on demand and delivers goods to the destination.
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	• Effectively manage product transportation process • Reduce the physical demands on staff while improving transport efficiency
Major Products	 LMR	 CTU	 Four-way Shuttle	 Sorting AMR	 LMR  Unmanned forklift
Typical Downstream Industry	Fashion and FMCG; 3PL	E-commerce and retail; Fashion and FMCG	Fashion and FMCG; 3PL	E-commerce and retail; 3PL	Automobile manufacturing; Consumer electronics and home appliance

Source: CIC

The warehouse fulfillment sector dominates the global AMR solution market. With growing demand from warehouse fulfillment scenarios, the market size is projected to reach RMB 105.3 billion by 2029.

Global AMR solutions market size, by application scenarios, 2020-2029E



Key analysis

- 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.
- Driven by rapid technological advancements, the global demand for automation and intelligence has surged dramatically. In response, downstream 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%.

Source: CIC

Main drivers and market trends of global warehouse fulfillment AMR solution industry

Main drivers and market trends of global warehouse fulfillment AMR solution industry

1 *The Rise of E-commerce Creates Significant Growth Opportunities for Warehouse Fulfillment Automation*

- 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.

2 *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.

3 *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.

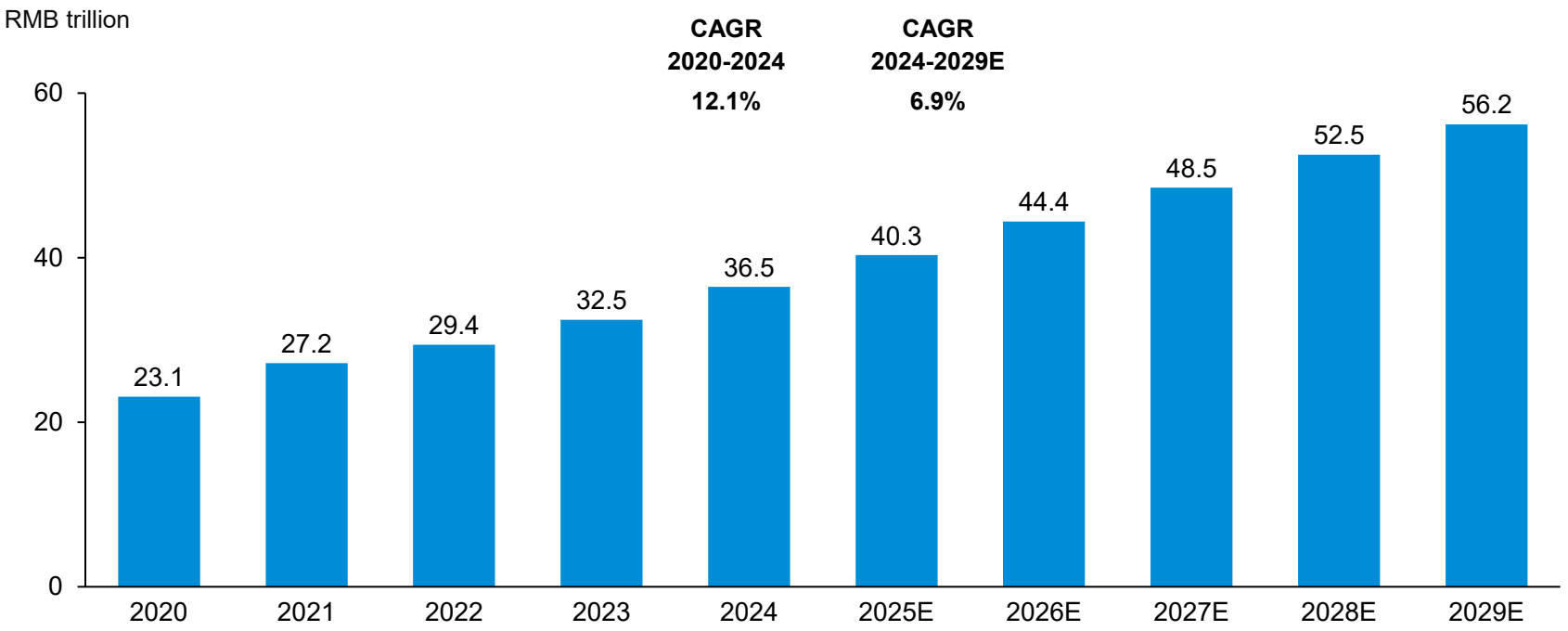
4 *Top Companies Strengthen Their Industry Leadership*

- 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.

Source: CIC

The rapid development of global E-commerce has led to a surge in demand for AMRs in warehousing fulfillment, to automate tasks such as picking and sorting, and efficiently complete order fulfillment.

Global E-commerce retail sales value, 2020-2029E



Key Analysis

- Faced with the rapidly growing E-commerce market, traditional logistics and warehousing methods fall far short of meeting industry demands. E-commerce enterprises handle vast and highly fluctuating volumes of parcels/commodities, with stringent time requirements, making the efficient processing of massive orders a new challenge. AMR solutions, with their flexible and reliable nature, powered by robust algorithms and advanced picking and storage strategies, empower enterprises to agilely respond to business fluctuations and market demands.

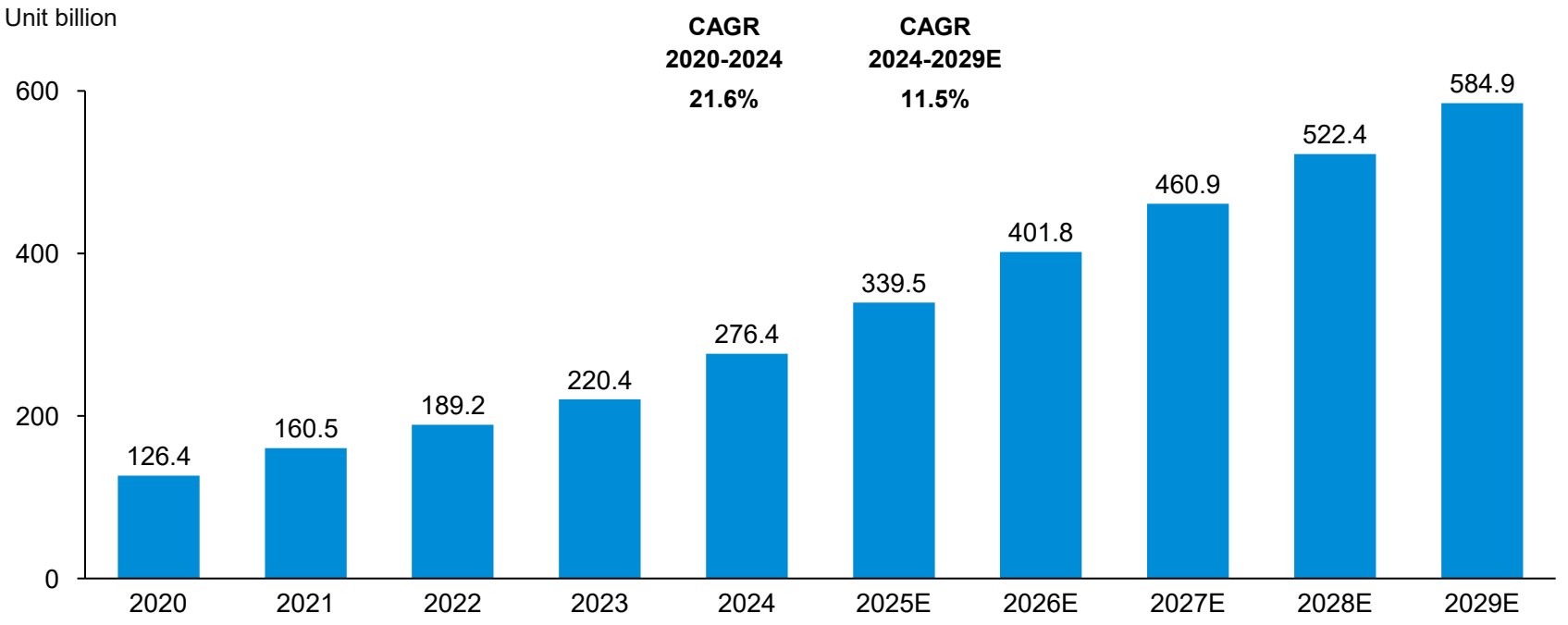
AMR applications: E-commerce

Operation Locations	• Self-operated warehouses of large-scale E-commerce companies • Warehouses operated by third-party E-commerce management platforms
Main Applications	• Perform consolidated picking for multiple items in a single order based on the order content • Sort the finished packages according to their destinations and deliver them to the dispatch area for subsequent shipment
Main Products	• Mainly through LMR and CTU

Source: CIC

Third-party logistics firms leverage flexible, scalable AMR solutions to tackle challenges, boosting picking efficiency and streamlining package sorting and dispatch for global parcel volumes.

Global logistics market size, in terms of parcel volume, 2020-2029E



Key Analysis

- Amid accelerating urbanization and diversified consumer demands, the surge in internet technology and E-commerce platforms has boosted global parcel volumes. Logistics firms confront multifaceted challenges, notably low space utilization, slow picking efficiency, and high labor costs, which are further compounded by the immense volume and diverse destinations of packages. AMR solutions, featuring high flexibility, scalability and efficiency, offer logistics firms an effective means to tackle these challenges.

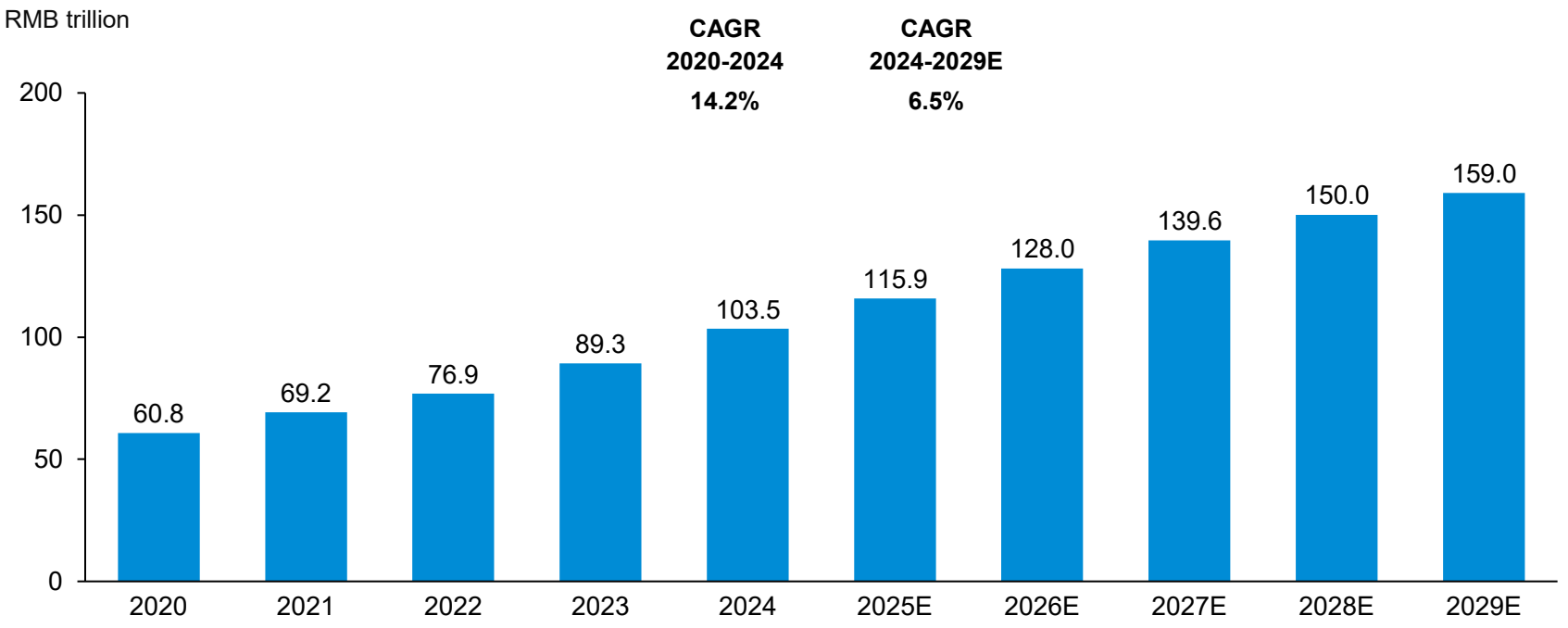
AMR applications: 3PL

Operation Locations	• Distribution warehouses of 3PLs
Main Applications	• Perform consolidated picking for multiple items in a single order based on the order content • Sort the finished packages according to their destinations and deliver them to the dispatch area for subsequent shipment
Main Products	• Mainly through LMR and CTU

Source: CIC

FMCG faces challenges of inefficient delivery and stock issues due to product features, which AMR solutions address by offering tailored strategies enhancing efficiency and warehouse capacity.

Global FMCG market size, in terms of sales value, 2020-2029E



Key Analysis

- The fast-moving consumer goods (FMCG) industry is characterized by a wide variety of products. This often results in delayed order feedback, inefficient delivery, and frequent stockouts or shortages, directly impacting consumers' shopping experiences. AMR solutions can offer holistic solutions with diverse strategy combinations tailored to different product categories and business models within the FMCG sector, and hereby enhance the efficiency as well as the warehouse capacity.

Note: the FMCG industry here mainly includes beauty and personal care, food and beverages, as well as household cleaning products, except for apparel & footwear.

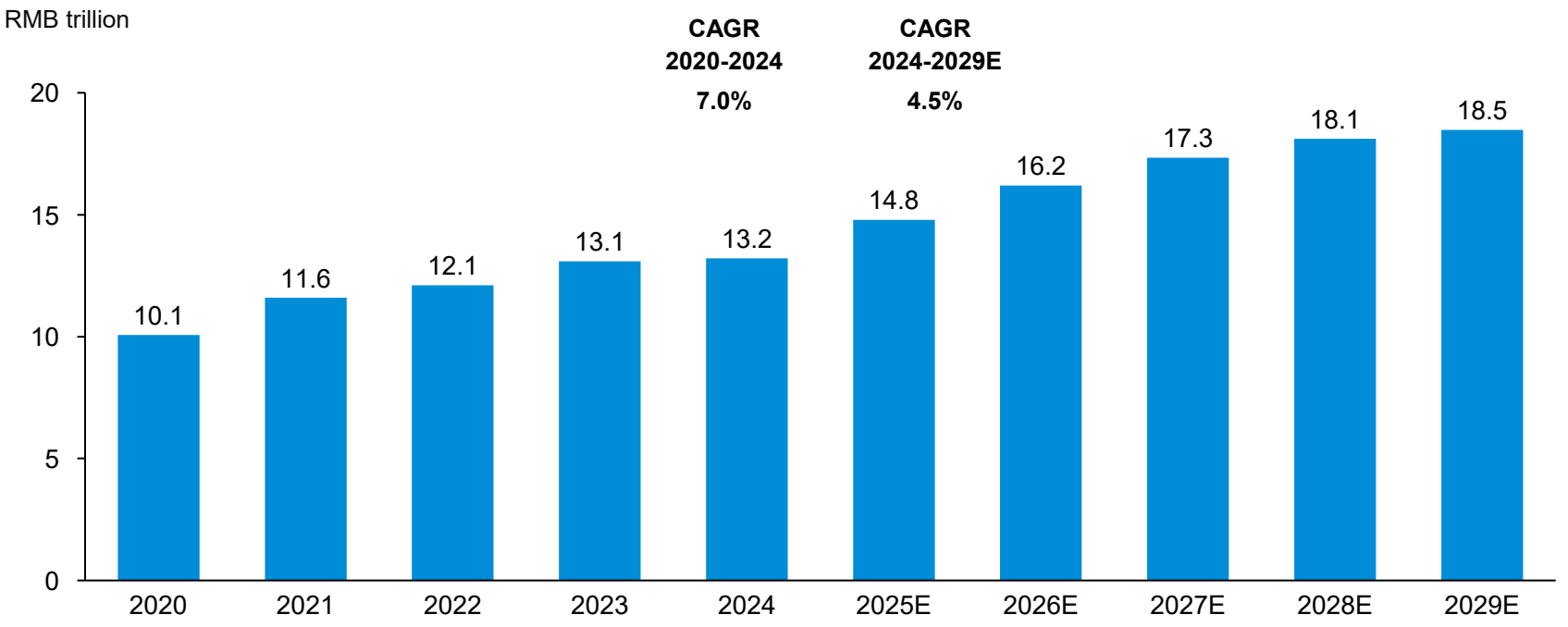
AMR applications: FMCG

Operation Locations	• B2C distribution warehouse • B2B distribution warehouse
Main Applications	• For B2C: Perform consolidated picking for multiple items in a single order based on the order content; Sort the finished packages according to their destinations and deliver them to the dispatch area for subsequent shipment • For B2B: Primarily focused on conducting order picking for stores
Main Products	• Mainly through LMR and CTU

Source: CIC

AMR solutions efficiently address apparel & footwear industry challenges, enhancing picking accuracy, meeting time demands, and optimizing labor efficiency.

Global apparel & footwear market size, in terms of sales value, 2020-2029E



Key Analysis

- The apparel & footwear industry faces large order volumes, significant business fluctuations, and high demands for picking timeliness and accuracy. With extensive offline store operations, the industry also grapples with rapid SKU changes, scattered replenishment orders, and stringent time requirements. AMR solutions efficiently cater to these industry characteristics, providing flexible, high-quality schemes that alleviate pain points during peak shipping and return seasons, enabling labor reduction and productivity enhancement.

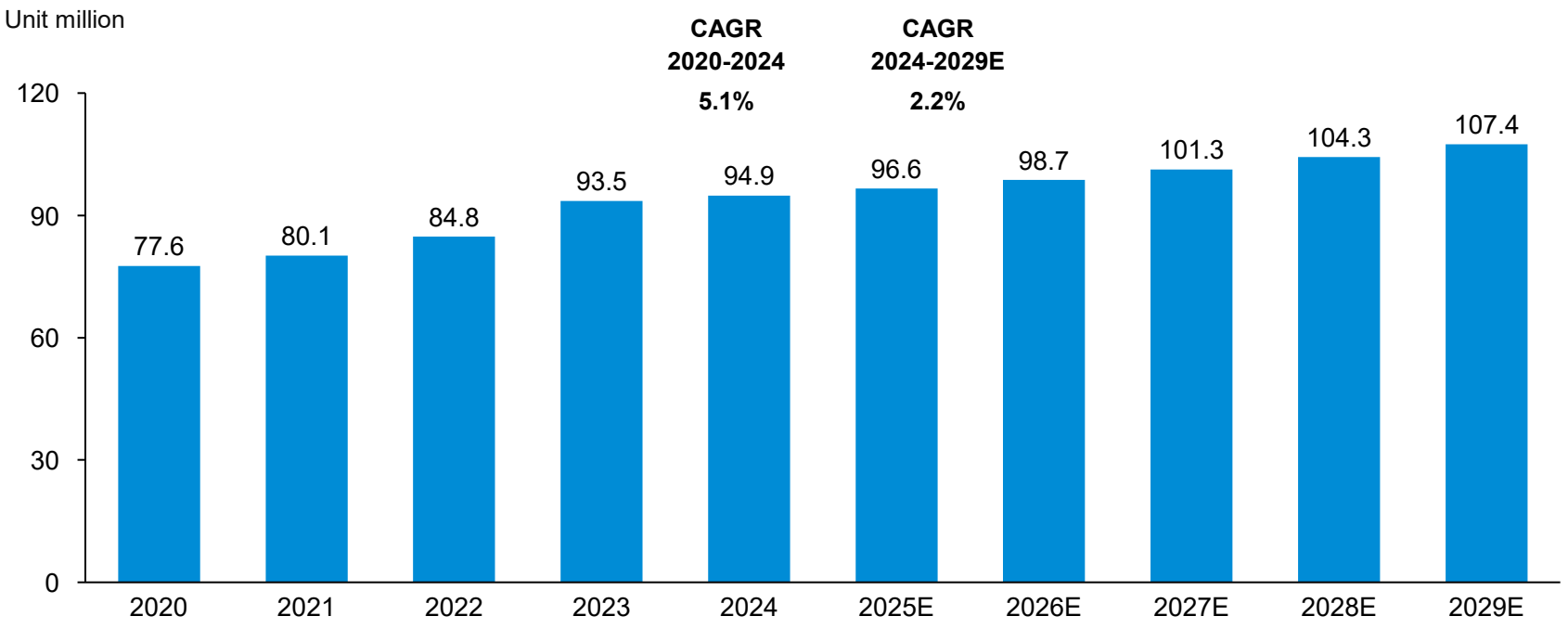
AMR applications: Apparel & Footwear

Operation Locations	• B2C distribution warehouse • B2B distribution warehouse
Main Applications	• For B2C: Perform consolidated picking for multiple items in a single order based on the order content; Sort the finished packages according to their destinations and deliver them to the dispatch area for subsequent shipment • For B2B: Primarily focused on conducting multi-batch, small-volume order picking for stores
Main Products	• Mainly through LMR and CTU

Source: CIC

The automobile industry, amidst high production volumes, flexible supply chains and operation pain-points, sees a growing need for AMR solutions in the warehouses of OEMs and spare parts.

Global automobile market size, in terms of production volume, 2020-2029E



Key Analysis

- The global automobile production volume is enormous, and the rapid development of new energy vehicles has brought about more incremental demand. Labor costs are rising year by year, and logistics efficiency fails to meet the high-frequency production pace. Manual handling and material delivery pose high risks and are incapable of work-in-process inventory management and data traceability. In line with the trend of automobile personalization and cost reduction and efficiency enhancement, flexible supply chains have emerged, driving the demand for AMR solutions in the global automobile.

Note: the vehicle industry here includes passenger vehicles and commercial vehicles.

AMR applications: Automobile

Operation Locations	• Automobile OEM • Auto spare parts distribution warehouse & production warehouse
Main Applications	OEM • Assembly workshop, painting workshop, welding workshop. Transport vehicle bodies and spare parts, such as steering wheels, door wiring, etc. Auto parts • Transport raw material and spare parts
Main Products	• Mainly through LMR

Source: CIC

Table of contents

In the global warehouse automation market, there are solution integrators represented by Daifuku, and solution providers specializing in product R&D represented by Geek+, jointly driving the industry growth.

Global leading warehouse automation solution providers, 2024

Company		Founding Year	Headquarter	Business Overview	Revenue, USD million, 2024
DAIFUKU Automation that Inspires	**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.	**5,632**
DEMATIC	**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.	**3,627**
symbotic	**Symbotic**	2007	USA	• Global leading warehouse automation company that specializing in warehouse management system based on automation and AI technology. This system can significantly increase warehouse storage density and picking efficiency while reducing operational costs.	**1,822**
SWISSLOG	**Swisslog**	1994	Swiss	• Global leading integrator of logistics systems for warehouses and distribution centers, specializing in automated storage and retrieval system (AS/RS) and conveyor solutions.	**740**
AutoStore	**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).	**683**
GreyOrange	**Grey Orange**	2011	India	• Global leading warehouse automation solution integrator specializing in AMR solutions, developing its self-owned AI software systems, capable of achieving automated warehousing, intelligent scheduling, real-time data analysis, and other functions. The hardware products in its solutions primarily come from external procurement.	**~400**
Geek+	**Geek+**	2015	China	• Global leading warehouse automation company that develops AMR solutions covering warehouse fulfillment and industrial material handling, offering both hardware devices and software platforms of its AMR solutions.	**[334]**[1]

Note[1]: the USD to CNY exchange rate is 1USD=7.2CNY.

Source: Annual reports, CIC

Geek+ is one of the world's largest AMR solution provider in the global AMR market in terms of revenue in 2024.

Top 4 Global leading AMR solution providers, 2024

- The global AMR solutions market remains relatively fragmented, with the top four players accounting for only approximately 23.5% of the total market share by revenue in 2024. 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.

Company	Founding Year	Headquarter	Business overview	Revenue[1], RMB million, 2024	Market share, 2024
Geek+	2015	China	• Global leading warehouse automation company that develops AMR solutions covering warehouse fulfillment and industrial material handling, offering both hardware devices and software platforms of its AMR solutions.	2,409	6.2%
Company A	2016	China	• 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.	2,793	7.2%
Company B	2015	France	• 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.	2,202	5.7%
Company C	2014	USA	• 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 "Robotics-as-a-Service" subscription model, primarily targeting warehousing and fulfillment operations. Company C is a privately owned company.	1,705	4.4%

Note[1]: Revenue only includes income that is related to the provision of AMR solutions.

Source: Annual reports, CIC

For each of the past six consecutive years including 2024, Geek+ has been the world's largest AMR solution provider in the global warehouse fulfillment AMR market in terms of revenue.

Top 4 Global leading AMR solution providers, 2024

- 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 revenue, representing 9.0% of the global market. Geek+ has shown remarkable market penetration and cutting-edge 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.

Company	Warehouse fulfillment AMR, RMB million						Market share, 2024
	2019	2020	2021	2022	2023	2024	
Geek+	322	460	717	1,304	1,903	2,183	9.0%
Company A	53	82	175	297	439	491	2.0%
Company B	166	242	501	572	1,296	1,982	8.1%
Company C	90	234	496	735	1,135	1,449	6.0%

Note: The Company's revenue includes revenue generated from RaaS.

Source: company reports, CIC

Geek+ offers the world's most extensive range of warehouse fulfilment AMR solutions and pioneers a lot, covering a wide variety of use cases and technical approaches.

Top 4 Global leading AMR solution providers, 2024

Company	Offering Coverage, by solution								
	Shelf-to-Person	*Description*	Tote-to-Person	*Description*	Pallet-to-Person	*Description*	Smart sorting	*Description*	Smart moving
Geek+ Geek+	✓	• The world's 1st AMR all-in-one Shelf-to-Person solution in Oct. 2021	✓	• The world's 1st Tote-to-Person solution featuring two different types of robots in April 2019	✓	• The world's 1st Pallet-to-Person solution featuring four-way shuttle in March 2022	✓	• Launched in Nov. 2017 • The world's 1st flexible sorting solution that operates without the need for a steel platform in Dec. 2017	✓
Company A	✓	• Basic shelf-to-person solutions with standalone features	✓	• Launched in Dec. 2022	N/A		✓	• Launched in Nov. 2016	✓
Company B	N/A		✓	• Launched in Dec. 2017	N/A		N/A		N/A
Company C	N/A		N/A		N/A		N/A		✓

Note: Company C currently has launched two new products: A "smart moving" solution, and a "Person-to-Goods" solution, primarily designed for Brownfield environments, meaning the renovation of older warehouses. Notably, these solutions do not fall under the same categorization in terms of product functionality or target environments as illustrated by the table above. Company A, Company B, and Company C did not launch AMRs Pallet-to-person solutions that move in all four directions (the "four-way shuttle") as of the Latest Practicable Date.

Source: public information, CIC

Geek+ developed the world's first robotic general technology platform Robot matrix with one of the widest range of algorithm types and the largest cluster scheduling scales among its Peers.

Top 4 Global leading AMR solution providers, 2024

Company	Technology stack		Other cutting-edge tech innovations				
	Robotic general technology platform	Software suite (incl. WMS/WES/RMS/IOP)	Algorithm types	Heterogeneous and cross-domain algorithm	Cluster Scheduling Scales[1]	Laser-Vision Fusion SLAM Navigation	Low-code customization
Geek+	✓	✓	25	✓	1,100+	✓ • Launched in Jan. 2018	✓
Company A	✓	✓	20+	✓	325+	✓ • Launched in Nov. 2018	✓
Company B	N/A	N/A	N/A	N/A	<100	N/A	N/A
Company C	N/A	N/A	N/A	N/A	<100	N/A	N/A

Note: It is compared in terms of the maximum AMRs operating meanwhile in deployed warehouse fulfillment scenarios

Source: CIC

Geek+ has firmly established itself as a clear leader within the global AMR market, dominating across several key operating metrics.

Top 4 Global leading AMR solution providers[1]

Company	Accumulative number of AMRs shipped, Unit	Accumulative number of projects deployed	Accumulative number of end customers served		Number of countries and regions covered	Number of spare parts centers worldwide
			Total	Warehouse fulfillment		
Geek+	~56,000	1,400+	~800 • >60 Fortune 500	>180 >260 >110	~40	12
Company A[2]	~100,000	2,000+	2,000+ • <50 Fortune 500	<10 <10 <10	N/A	<10
Company B	<10,000	100+	~30 • <15 Fortune 500	<10 <10 <10	~12	0
Company C	~14,000	200+	~90 • <20 Fortune 500	<30 <50 <30	~18	0

Note: 1. As of December 30 2024; 2. Unlike Geek+, Company A's AMRs are primarily used in industrial material transport.

E-commerce 3PL FMCG

Source: CIC

Empowered by Robot Matrix, Geek+ has pioneered various advanced functions in its AMRs.

Function performance comparison of global leading AMR, 2024

Latent Mobile Robot	Geek+	Achieved by competitors?
Min Height	195mm	Very few
Load Capacity	600-1200kg	N/A
Speed (Unloaded)	2.5m/s	Very few
Precision	<±10mm，±1°	N/A
Navigation	SLAM/QR Code	N/A
Battery Charging C-Rate	3C-5C	Very few
Low-temperature Charging	>-10° c	Very few
Safety & Certification	Single-machine PLD	Few
	System PLD	None
Map Area	>50km2	Very few
Carton Transfer Unit		
Lift Height	11,075mm	Very few
Load Capacity	40kg	Few
Speed	1.8m/s	Few
Take-up Efficiency	60 boxes/h	Very few
Precision	<±10mm，±1°	N/A
Navigation	SLAM/QR Code	N/A
Battery Charging C-Rate	3C-5C	Very few
Low-temperature Charging	>-10° c	Very few
Safety & Certification	Single-machine PLD	Few
	System PLD	None
Light Carton Moving Robot		
Lifting Speed（Full Loaded）	1.1m/s	None
Load Capacity	40kg	N/A
Speed	4.5m/s	None
Arc Trajectory	Supportive	Very few
Precision	<±10mm，±1°	N/A
Navigation	SLAM/QR Code	N/A
Battery Charging C-Rate	3C-5C	Very few
Low-temperature Charging	>-10° c	Very few
Safety & Certification	System PLD	None

- ✓ Geek+'s AMR solutions has demonstrated industry-leading performance in terms of compatibility, storage density, throughput and cost-effectiveness.
- ✓ Geek+'s AMRs have industry leading performance in moving speed and endurance.
- ✓ Geek+'s AMRs demonstrate industry leading robot control and scheduling technology.
- ✓ With an average positioning accuracy of less than ±10mm (±1°), Geek+'s SLAM technology equips Geek+'s AMRs with one of the most advanced positioning capabilities in the industry.
- ✓ Geek+ sets industry safety benchmarks with P800R and P500R series, which are the first in the industry to receive North American ETL certification.

Very few　Few　None

Source: public information, CIC

Key successful factors for Global AMR solution providers (1/2)

Key successful factors for Global AMR solution providers (1/2)

1 *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.

2 *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.

3 *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.

Source: CIC

Key successful factors for Global AMR solution providers (2/2)

Key successful factors for Global AMR solution providers (2/2)

4 ***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.

5 ***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 user 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.

Source: CIC

Verifications

- Geek+ is the global leader in autonomous mobile robots providing efficient, reliable, and flexible warehousing and order fulfillment solutions.
- Founded in 2015, Geek+ has achieved clear leadership in the global warehouse fulfillment AMR market. This remarkable success is underpinned by Geek+'s long-standing commitment to innovation, where every solution is crafted with cutting-edge technology and driven by visionary business models, as discussed in more detail below in this submission.
- Geek+ stands as a dominant force in the global AMR market, a critical segment within the broader global warehouse automation industry.
- Geek+'s AMRs introduce a groundbreaking approach to warehouse automation by providing a level of flexibility that traditional systems—reliant on fixed, rigid equipment—simply cannot achieve.
- Geek+'s AMR solutions are highly modularized, allowing it to provide highly flexible solutions tailored to customer needs.
- Geek+'s technology innovations, commitment to product quality and long-term reliable service are well recognized and widely accepted by approximately 809 end customers worldwide, making the company the warehouse fulfillment AMR solution provider with the largest global customer base, according to CIC.
- Geek+ has the widest global presence among the world's AMR solution providers. As of the end of 2024, Geek+ has shipped approximately 56,000 AMRs across approximately 40 countries and regions worldwide.
- In 2024, the repurchase rate for Geek+'s key account customers reached approximately 82%, far surpassing the industry average, according to CIC. Repurchase rate is a metric to track and measure the company's ability to retain customers of its AMR solutions and increase their purchases over time. Geek+'s repurchase rate for a given period is calculated by dividing (i) the order intake generated in that period from those customers who purchased from us in both the current period and any prior period, by (ii) the total order intake generated in the current period from all customers.
- Geek+ has consistently been at the forefront of pioneering technologies redefining logistics automation. Geek+ has achieved several industry firsts, setting new benchmarks in leading technologies in the global AMR market.
- Geek+ developed the world's first robotic general technology platform. As a modular and configurable platform, Robot Matrix provides a comprehensive suite of ready-to-use technologies as the foundation essential for the research and development of AMRs.
- Geek+ offered the most comprehensive software system in the AMR market. Geek+ Software Suite stands out from similar software systems offered by its Peers because, unlike competing systems, which generally only support interfaces with WMS and IT systems, the Geek+ Software Suite is specifically designed for superior flexibility and compatibility. It integrates rapidly and seamlessly with customers' existing business systems, including their ERP platforms. This robust compatibility with ERP systems allows for a smooth and efficient integration into customers' operational platforms, enabling businesses to optimize their supply chain and logistics operations without the need for extensive adjustments.
- Geek+ is actively developing high-performance optimization algorithms designed for intelligent logistics and manufacturing applications. These algorithms are engineered for high execution speed and efficiency.
- Geek+ has introduced a suite of advanced algorithms, setting a new standard in the AMR market. Geek+ is among the first to deploy these comprehensive algorithms, enhancing the performance and capabilities of its automation solutions.
- Geek+ delivers one of the industry's most diverse and innovative ranges of AMR solutions, covering a variety of use cases and technical approaches. These offerings form a comprehensive suite of transformative solutions that provide significant value to customers.
- Being the first to introduce these technologies or solution sets a benchmark for the entire industry. For example, Geek+'s innovations, such as the PopPick System (an advanced iteration of Geek+'s Shelf-to-Person solution) and the RoboShuttle Solution, establish new standards in warehouse automation.
- Geek+ developed the world's first all-in-one AMR Shelf-to-Person picking solutions with two types of robots - named "PopPick" to convey the idea of swiftly bringing the goods to the human picker - that combine picking and storing totes, shelves, and pallets optimizing warehouse efficiency.
- Geek+ developed the world's first RoboShuttle Tote-to-Person solution featuring two different types of robots with a high degree of personalization; this advanced solution is built around Rob Shuttle, a robot developed specifically for retrieving totes from storage racks and transporting them to designated locations.
- IOP offers application performance monitoring to track metrics like response times and errors, as well as a custom report designer for creating tailored charts and layouts.
- IOP includes alert configuration tools to set up proactive notifications when critical thresholds are reached, keeping users informed of important developments.

Source: CIC

Verifications

- Geek+ developed the world's first AMR solution that integrates Sky-Storage & Ground-Pick solution, known as "SkyPick" solution; "Sky-Storage" means the goods are stored on upper levels of the warehouse, and "Ground-Pick" means the goods are then picked at ground level where workers or robotic systems select items to fulfill orders; Geek+'s SkyPick Solution seamlessly integrates both processes to increase storage capacity and operational efficiency.
- Geek+ is the world's first AMR solution provider to launch a model that integrates cross-docking and goods collection, successfully deploying its PopPick solutions in an intelligent warehouse in August 2024.
- Geek+ is among the world's first AMR solution providers to introduce a robotic picking system in November 2017.
- Geek+ is one of the world's first AMR solution provider to introduce the cutting-edge laser and vision fusion SLAM navigation technologies, equipping its AMRs with one of the most advanced positioning capabilities in the industry.
- The largest industries benefiting from warehouse fulfillment AMRs are E-commerce, 3PL, and fast-moving consumer goods. The number of customers these solution providers serve highlights their competitiveness in the market.
- Geek+ is the world's largest AMR solution provider in the E-commerce, FMCG and 3PL sectors in terms of revenue in 2024.
- Geek+'s P-series robots, the main robot used in the PopPick System, have distinct advantages compared to the Peers' AMR solutions.
- Geek+'s Tote-to-Person Picking Solution sets industry-leading standards in the utilization of storage volume and picking efficiency.
- The RS-series robots used in Geek+'s RoboShuttle owns several advantages when compared to robots used in similar offerings by its Peers.
- The X-series robots in Geek+'s SkyPick Pallet-to-Person Solution have the most utilized use of vertical space in warehouses.
- Geek+ launched one of the world's first robotic flexible sorting solution.
- Geek+'s robotic flexible sorting solution has a sorting efficiency 10 times more efficient than manual processing and it leads the industry in automation, efficiency, flexibility, and ROI.
- The F-series robots in Geek+'s moving solution have the highest charging efficiency compared to the robots used by its Peers.
- Geek+ has developed industry-leading vision perception technologies based on 2D/3D cameras, coupled with a robust vision algorithm platform.
- Geek+ Software Suite is the industry leading systems that improves warehouse operation efficiency compared to manual picking.
- Geek+ Software Suite is built with robust information security mechanisms throughout, ensuring high reliability with a 99.99% uptime, much advanced than the software system developed by the Peers.
- Geek+'s WES has been successfully implemented across over 1,000 customers, making it a leading system as compared to competing systems developed by the Peers.
- Geek+ owns the industry-leading IOP in various aspects.
- Geek+ is the earliest Chinese AMR solution provider to achieve international commercialization.
- Geek+ has set a new industry standard for after-sales service efficiency with shorter average response time than Peers.
- The cost of Geek+'s picking robots is only half or even less compared to traditional tote-carrying robots, making them a cost-effective solution for automated warehousing.
- Geek+'s RoboShuttle offers a one-stop solution for storing and picking items of various sizes, addressing the pain point with traditional tote-based robot solutions when it comes to handling medium to large items.
- RS-series robots used in Geek+'s RoboShuttle own several advantages when compared to the core robots used in similar offerings by its Peers. Firstly, the RS-series robots can work with higher shelving units, maximizing the use of vertical space in warehouses and improving storage efficiency. Additionally, these robots have higher battery efficiency and faster movement speeds, enhancing overall operational productivity.
- Geek+ is the world's first in the AMR market to introduce a flexible sorting solution that operates without the need for a steel platform. Introducing a flexible sorting solution that operates without a steel platform is significant because it reduces costs, speeds up deployment, and offers greater scalability and adaptability, allowing businesses to optimize space and operations more effectively.
- Geek+'s robotic flexible sorting solution leverages its advanced S-series robots and other intelligent devices to optimize traditional warehouse operations, such as sorting and order processing, in warehouses and distribution centers.

Source: CIC

Verifications

- The sorting efficiency achieved by Geek+’s robotic flexible sorting solution is 10 times more efficient than manual processing, with rapid deployment times enabling quick returns on investment.
- Geek+’s robotic flexible sorting solution leads the industry in automation, efficiency, flexibility, and ROI.
- Geek+'s ongoing partnerships with UPS highlight its exceptional customer satisfaction and retention, reflected in repurchase rates that far exceed industry standards.
- Leveraging years of technological mastery and profound industry insights, Geek+ has developed a groundbreaking, full-stack technology infrastructure that seamlessly unites hardware, software, and algorithms. This cutting-edge infrastructure is anchored by three core technology platforms, driving the creation of intelligent mobile robots, sophisticated software management systems, and powerful hardware solutions—each meticulously designed to revolutionize warehousing fulfillment and industrial material handling.
- Geek+ has secured cutting-edge advantages in core AMR technologies, including positioning and navigation, visual perception, decision-making and planning, servo control, data platforms, and multi-robot cluster scheduling.
- Geek+ has utilized Robot Matrix to efficiently develop specific AMR solutions tailored to different industries and scenarios.
- Geek+'s RoboShuttle offers a one-stop solution for storing and picking items of various sizes, addressing the pain point with traditional tote-based robot solutions when it comes to handling medium to large items.
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- Geek+'s RoboShuttle offers a one-stop solution for storing and picking items of various sizes, addressing the pain point with traditional tote-based robot solutions when it comes to handling medium to large items.
- Compared with the conventional SLAM technology, Geek+’s laser-vision fusion SLAM technology is enhanced by a deep learning framework and extensive data from real-world scenarios.
- Geek+ has developed industry-leading vision perception technologies based on 2D/3D cameras, coupled with a robust vision algorithm platform, according to CIC. The platform’s adaptability and accuracy make it a leader in fields such as warehousing logistics, intelligent manufacturing, and commercial applications.
- Geek+ adheres to strict safety standards and collaborates with leading safety solution providers like SICK and PILZ.
- Geek+'s RMS system can manage the simultaneous scheduling of over 1,100 robots in warehouse fulfillment scenario, the highest among its Peers.
- Consistent with the industry norm, Geek+ primarily relys on our distributors to promote and sell Geek+ products to rapidly scale our business presence in different geographic areas in a cost-effective manner.

Source: CIC

Verifications

- Geek+’s simulation platform on Geek+ Software Suite supports the design and simulation of various picking scenarios, with a simulation error of less than 5%, placing it at an industry-leading level.
- As a testament of its performance and technology advancement, Geek+ Software Suite has been successfully implemented in over 1,000 customer projects worldwide, surpassing industry average.
- Geek+ Software Suite owns a leading customer base as compared to the software system developed by Geek+’s Peers.
- Geek+ Software Suite improves warehouse operation efficiency by three times compared to manual picking.
- Geek+ Software Suite is built with robust information security mechanisms throughout, ensuring high reliability with a 99.99% uptime, much advanced than the software system developed by the Peers.
- Geek+ Software Suite is selected as the first AMR software system by approximately 500 industry leaders worldwide to support their business.
- Geek+ Software Suite offers flexibility to accommodate a wide range of customer needs, one of the most challenging aspects of warehouse automation.
- Geek+'s RMS system can manage the simultaneous scheduling of over 1,100 robots in warehouse fulfillment scenario, the highest among its Peers.
- Geek+ leads the industry in several key areas. For example, its system features real-time monitoring and alert capabilities that promptly identify and resolve issues, reducing downtime and boosting operational efficiency.
- Geek+'s algorithm service platform responds to customer needs in the fastest and most convenient way.
- Geek+ has distinguished itself from competitors by having a global focus from the very beginning. In 2017, Geek+ launched its first overseas service project, making it the earliest Chinese AMR solution provider to achieve international commercialization.
- By consistently delivering premium-quality solutions across the globe, Geek+ has solidified its reputation as a leading global brand in the AMR industry.
- Unlike many of its peers that initially concentrate on local or regional markets, Geek+ strategically targeted the global market early on.
- Over the years, Geek+ has built the broadest global service network among the world’s AMR solution providers.
- Geek+ offers an unparalleled level of service, with technicians available to be on-site within 24 hours to assess and confirm repair plans, no matter where the customer is located. Additionally, Geek+’s robust service network enables the fastest possible delivery of replacement parts, often within just one day.
- Geek+’s speed and responsiveness are also evidenced by an average project deployment cycle of just 1 to 3 months, which is among the fastest in the industry.
- A key differentiator for Geek+ is the highly modular nature of its AMR products.
- Geek+ is the earliest Chinese AMR solution provider to achieve international commercialization.
- Sports Endeavors operates in the sport sector in the U.S. and provides customized products, fulfilling orders on a one SKU per item basis. During peak sales periods, such as major promotions, Sports Endeavors faced challenges with scattered picking for numerous small orders. In such times, non-AMR systems often lead to inefficiencies and delays when handling varying order sizes, making it difficult for Sports Endeavors to adapt to diverse customer needs.
- S&S Activewear, a prominent U.S.-based wholesale distributor of apparel and accessories.
- Traditional non-AMR solutions rely on fixed systems like conveyor belts or AS/RS, which are rigid and designed for specific tasks. Adjusting these fixed systems to accommodate new workflows or operational changes often entails costly and time-consuming modifications to the infrastructure.
- In the PRC market, particularly within the manufacturing sector, there are high demands for hardware configurations. Each customer typically has a unique production process and specifications for their production lines, which often require customization in mechanical, electronic, and operational aspects.
- In contrast to fixed, standardized non-AMR solutions, Geek+’s AMR solutions can be easily tailored to meet the unique needs of various industries. The flexibility of Geek+’s AMR solutions allows for efficient adaptations to these specific needs, demonstrating their capability to effectively serve diverse industry requirements.
- ASKUL, a well-known supplier of office products in Japan.
- The foregoing s return policy is generally consistent with the market norms.

Source: CIC

Verifications

- Geek+'s AMR solutions enhance operational efficiency, reduce labor costs, and enable warehouses to respond more dynamically to fluctuating demands, ultimately empowering businesses to meet the challenges of modern logistics with greater agility and effectiveness.
- Companies like Swisslog, Kuka, and GreyOrange are primarily system integrators, meaning they typically purchase AMR products from solution providers like Geek+ rather than developing and manufacturing their own AMR products. Their role as integrators limits their competitive standing compared to companies that possess in-house AMR development capabilities.
- Amazon (which owns Kiva Systems) is not considered a Peer because its AMR solutions are largely for internal use and follow a non-market strategy. As such, Amazon does not compete directly with other AMR providers in the open market.
- Due to the advanced performance of Geek+’s solutions, customers may start by implementing one solution in a single warehouse and then expand to adopt more solutions across multiple warehouses as their business scales.
- By staying attuned to the latest industry trends, R&D results, and customer feedback, Geek+ is dedicated to delivering innovative and efficient AMR solutions.
- By prioritizing R&D, Geek+ focuses on developing pioneering technology solutions in key areas such as AMR development, intelligent warehouse management, robot control software, and robotic hardware. This proactive approach enables Geek+ to create innovative, high-performance AMR solutions that set new industry standards. In particular, Geek+'s strategy emphasizes the advancement of its proprietary technology platforms, such as the Robot Matrix, designed to deliver high-quality AMRs with exceptional performance.
- Customers choose Geek+'s AMR solutions for their superior performance, cutting-edge technology, and seamless integration with customers’ existing systems.
- Geek+ has established a strong global brand presence, helping it attract new customers worldwide. Its collaboration with numerous benchmark customers sets industry standards, encouraging other clients to follow suit and adopt Geek+'s innovative solutions for their own operations.
- Geek+'s PopPick Shelf-to-Person Solution is an advanced system designed to streamline and optimize warehouse operations.
- Early pallet storage systems relied on either costly but efficient stacker cranes or low-density, labor-intensive forklifts with beam racks. There is growing demand for both high-density storage and flexible throughput.
- Unlike some competitors who see minimal overseas revenue, Geek+ has not only expanded geographically but has focused heavily on international sales from the outset.
- Other Chinese competitors typically generate only around 17% of their revenue from international deliveries, with some like Hikrobot drawing less than 10% from overseas markets, primarily through Chinese clients’ overseas operations.
- As many other Chinese AMR providers struggle to gain meaningful international footholds, Geek+ continues to demonstrate its capability to deliver large-scale automation solutions across global markets, further establishing itself as a leader.
- Large-scale customers, such as Fortune 500 companies or multinational enterprises, require highly customized and complex solutions that push the boundaries of technology. Geek+’s focus on these customers ensures it is constantly developing AMRs and logistics solutions that meet highly demanding operational requirements. The challenges presented by these customers force Geek+ to innovate, solving problems that smaller, less demanding customers wouldn’t present. By targeting large-scale customers, Geek+ can deploy cutting-edge solutions that act as benchmarks for the rest of the industry. These large-scale implementations demonstrate the effectiveness and scalability of its innovations, which in turn attract other high-value customers and reinforce its leadership position. This creates a virtuous cycle of innovation, where each new large-scale deployment raises the standard for the next.
- Unlike the rigid, non-AMR warehouse automation solutions, Geek+ offers unique AMR solutions with “superb flexibility” (高柔性) that rigid, non-AMR warehouse automation solutions cannot match. “Superb Flexibility” means that Geek+’s solutions are highly adaptable, capable of handling a wide range of scenarios, and can be easily adjusted as business needs evolve, making them suitable for fast-changing and dynamic environments.
- Geek+ focuses primarily on warehouse fulfillment (as opposed to industrial material transport) because warehousing operations are more standardized across industries, allowing for scalable and replicable solutions. This standardization, especially driven by the growth of E-commerce, offers a significant opportunity for rapid market expansion and dominance.
- Geek+’s Chinese competitors typically generate only an average of 17% of their revenue from international deliveries, with some drawing less than 10% from non-domestic markets, primarily through Chinese customers’ overseas operations.

Source: CIC

Verifications

- Geek+ has been the world's largest warehouse fulfillment AMR solution provider in terms of revenue in 2024, which is the sixth consecutive year we have maintained this leading position.
- Geek+'s technology innovations, commitment to product quality and long-term reliable service are well recognized and widely accepted by approximately 770 end customers worldwide, making us the warehouse fulfillment AMR solution provider with the largest global customer base.
- Traditional warehouse solutions rely heavily on manual labor who spend 70% of time in walking to shelves to pick goods.
- Geek+ is the world's first AMR solution provider to offer an innovative, all-in-one PopPick Solution.
- Geek+'s PopPick Shelf-To-Person Solution leads the industry in terms of compatibility, throughput efficiency, storage capacity, and overall operation effectiveness as compared to the solutions of its peers.
- Geek+ is the world's first AMR solution provider to offer Geek+ Tote-to-Person Picking Solution featuring RS-series and P-series robots with a high degree of personalization, which is designed to optimize the efficiency of box-based picking operations. It's ideal for industries that require high storage density with moderate throughput.
- Geek+ Tote-to-Person Picking Solution sets industry-leading standards in the utilization of storage volume.
- Geek+ is the first in the world to launch the Geek+ Pallet-to-Person Picking Solution, a high-density, high-throughput integrated storage and picking system which increases both storage capacity and operational efficiency. It's ideal for bulk operations where quick access to large quantities is essential.
- Geek+ Pallet-to-Person Picking Solution offers industry-leading storage capabilities, with the highest storage height reaching up to 28 meters.
- Geek+ adopted one of the world's first robotic flexible sorting solution, namely our FleetSort Solution.
- Geek+'s robotic flexible sorting solution leads the industry in automation, efficiency, flexibility, and ROI.
- Geek+ is one of the leaders in the global AMR solution market that introduces laser-vision fusion SLAM navigation technology that equips our AMRs with one of the most advanced positioning capabilities in the industry.
- Geek+'s AMRs have industry leading performance in moving speed and endurance, with a 4.5 m/s maximum no-load speed and a work duration of over eight hours under rated conditions.
- The P-series robots have a maximum no-load speed of 2.6 meters per second and a full-load speed of 2 meters per second, well above the industry average level.
- Geek+'s AMRs demonstrate industry leading robot control and scheduling technology as compared to AMRs developed by its peers.
- Geek+ designed and developed the world's first robotic general technology platform, Robot Matrix, to empower the development of high-quality and high-performance AMRs.
- Geek+ have developed the most comprehensive software suite in the AMR market, comprising a collection of modular software solutions designed to support efficient, reliable, and flexible robot-based smart warehousing.
- Geek+'s Hyper+ Core Algorithms support one of the widest ranges of algorithm types and the largest cluster scheduling scales.
- Geek+ has the broadest global presence in the global AMR market, with operations, partnerships, and deployments spreading across over 40 countries and regions as of the end of 2024.
- 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 warehouses expand and the variety of goods increases, traditional management methods struggle to handle complex inventory control and precise logistics coordination.
- 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.
- The 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.

Source: CIC

Verifications

- 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.
- 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.
- In 2017, Geek+ became the first AMR solutions provider to export our AMR solutions to Japan.
- In 2022, Geek+ achieved leading global market share in AMR.
- Geek+'s technology innovations, commitment to product quality and long-term reliable service are well recognized and widely accepted by approximately 806 end customers worldwide, making Geek+ the warehouse fulfillment AMR solution provider with the largest global customer base.
- Geek+ realized the widest global presence among the world's AMR solution providers
- Geek+ is the first to introduce the PopPick Solution and the Geek+ Tote-to-Person Picking Solution.
- As of June 30, 2024, Geek+ has the largest global customer base in the warehouse fulfillment AMR solution market.
- In 2024, the repurchase rate for Geek+'s key account customers reached approximately 84.3%, far surpassing the industry average.
- Geek+'s PopPick Solution is an industry-leading solution in terms of compatibility, throughput efficiency, storage capacity, and overall operational effectiveness.
- Leveraging our PopPick Solution, Geek+ became the world's first AMR solution provider to launch a model that integrates cross-docking and goods collection
- Geek+'s ongoing partnerships with UPS highlight its exceptional customer satisfaction and retention, reflected in repurchase rates that far exceed industry standards.
- Geek+ Tote-to-Person Picking Solution sets industry-leading standards in the utilization of storage volume.
- Geek+ Tote-to-Person Picking Solution achieves a new industry-leading picking efficiency of over 800 totes per hour per station, surpassing the performance of similar systems provided by its peers.
- RS-series robots used in Geek+ Tote-to-Person Picking Solution own several advantages when compared to the core robots used in similar solutions. First, the RS-series robots can operate with taller shelving units, maximizing vertical space in warehouses and improving storage efficiency. Additionally, these robots feature higher battery efficiency, enhancing overall operational productivity.
- The X-series robots in the Geek+ Pallet-toPerson Picking Solution maximize vertical space utilization in warehouses, significantly improving storage efficiency.
- Geek+ has utilized Robot Matrix to efficiently develop specific AMR solutions tailored to different industries and scenarios.
- Geek+ is one of the leaders in the global AMR solution market that introduced laser-vision fusion SLAM navigation technology that integrates LiDAR/RGBD cameras and inertial navigation.
- With an average positioning accuracy of less than ±10mm (±1°), Geek+'s SLAM technology equips our AMRs with one of the most advanced positioning capabilities in the industry.
- Geek+ Software Suite stands out from similar software systems in the market, which typically only support interfaces with WMS and IT systems.
- Geek+'s simulation platform on Geek+ Software Suite supports the design and simulation of various picking scenarios, with a simulation error of less than 5%, placing it at an industry-leading level.
- Geek+ Software Suite is designed to meet the diverse and often complex requirements of warehouse automation, one of the most difficult challenges in warehouse automation.
- Geek+'s RMS can schedule over 1,100 robots simultaneously in warehouse fulfillment, the highest among the peers.
- Geek+ leads the industry in several key areas. IOP features real-time monitoring and alert capabilities that promptly identify and resolve issues, reducing downtime and boosting operational efficiency. The system also excels in data integration and analysis, offering users comprehensive insights for informed AMR decision-making and optimizing operations.

Source: CIC

Verifications

- IOP provides low-code customization that allows quick and flexible adaptation to specific business needs in warehouse fulfillment. IOP integrates with various alert notification channels, including Microsoft Teams, email, and on-site alarm systems, ensuring timely communication of any issues. The platform also includes operational KPI visualization to track the daily performance of core business processes, facility monitoring and analysis through reports and dashboards, and an Alerts Workbench for efficient alert management.
- 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.
- 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.
- 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 “Robotics-as-a-Service” subscription model, primarily targeting warehousing and fulfillment operations. Company C is a privately owned company.
- Geek+ has one of the widest industry coverages in the global AMR market, as well as the world’s largest AMR solution provider in the e-commerce, FMCG and third-party logistics sectors in terms of revenue in 2024.
- In 2017, Geek+ successfully delivered its first project in Japan, becoming one of the earliest Chinese warehousing robotics company to export overseas.
- In 2017, Geek+ introduced its robotic smart moving system based on laser-vision fusion SLAM navigation technology and achieved its flexible sorting system for medium and large parcels, a first in the industry.
- In 2018, Geek+ first introduced the RaaS business model for warehousing robots in China, alleviating peak and trough issues in clients’ warehouse operations through shared services.
- Geek+ offered the most extensive range of warehouse fulfilment AMR solutions in the industry, covering a wide variety of use cases and technology approaches.
- Geek+’s technology innovations, commitment to product quality and long-term reliable service are well recognized and widely accepted by approximately 770 end customers worldwide, making it the warehouse fulfillment AMR solution provider with the largest global customer base.
- In the six months ended June 30, 2024, the repurchase rate among our key account end customers reached approximately 90%, far surpassing the industry average.
- IOP leads the industry in several key areas. IOP features real-time monitoring and alert capabilities that quickly detect and address issues, minimizing downtime and enhancing operational efficiency. The system excels in data integration and analysis, providing comprehensive insights that help optimize operations. Additionally, IOP offers low-code customization, enabling rapid and flexible adaptation to specific business needs in warehouse fulfillment. The platform tracks daily performance across core business processes, facility monitoring, and analysis, delivering valuable reports and dashboards to support ongoing improvements.
- Geek+ derives over 70% revenue from non-domestic markets in 2024, its Chinese competitors typically generate only an average of 17% of their revenue from international deliveries, with some drawing less than 10% from non-domestic markets, primarily through Chinese customers’ overseas operations.
- As of June 30, 2024, Geek+ held 1,735 patents (including 954 registered patents and 781 pending applications) and other intellectual property, one of the highest in the market.
- In the six months ended June 30, 2024, the repurchase rate among Geek+’s key account customers reached approximately 90%, far surpassing the industry average.
- Robot Matrix is the world’s first proprietary AMR robotic general technology platform.
- Geek+’s Chinese competitors typically generate only an average of approximately 20% of their revenue from non-domestic markets, with some drawing less than 10% from non-domestic market, primarily through Chinese customers’ overseas operations.
- Geek+ emerges as the game-changer in the industry, offering efficient, reliable and flexible AMR solutions that help businesses maintain operational efficiency and meet evolving market demands. As the global market leader, we pioneered a range of advanced AMR solutions,
- Empowered by Robot Matrix, we have launched a comprehensive matrix of AMRs with great breadth and versatility that conform to the latest technological developments with more advanced functions compared to peers.
- Hyper+ Core Algorithm is one of the most advanced algorithms in the AMR market.
- AMR distributors generally purchase products based on sales demand, and Geek+’s inventory turnover for unsold products through distributors is generally consistent with industry standards.

Source: CIC

Verifications

- When compared to similar algorithms developed by our competitors, our Hyper+ Core Algorithms support one of the widest ranges of algorithm types and the largest cluster scheduling scales.
- By collaborating with those industry leaders, we design and deliver large-scale projects that set new industry standards, showcase our capabilities and solidify our reputation in the AMR market.
- As mid- and small-sized customers often adopt similar solutions as these key players, our partnerships with established customers reinforce our market leadership and allow us to further expand our market share.
- Our customers may begin with one solution in a certain market, then adopt more of our solutions across their warehouses in different countries as their businesses scale.
- Our competitive strengths include: (1) global AMR leader and pioneer focused on warehouse fulfillment; (2) widest market presence and largest customer base with strong loyalty; (4) robust technology platform for sustained innovation.
- Our success is rooted in the development and application of cutting-edge technologies, setting us apart from peers. For example, we are a pioneer in AMRs, leveraging advanced laser and vision fusion SLAM technology. Additionally, our industry-first innovations, such as the PopPick Solution and Geek+ Tote-to-Person Picking Solution, redefine warehouse automation, achieving superior storage density and throughput.
- We offer one of the most extensive and diverse AMR portfolios in the market, according to CIC. Through our diverse and innovative portfolio, we empower various operational demands, enhancing productivity and operational efficiency in warehousing operation.
- We provide modular and flexible AMR solutions adaptable to diverse industries and evolving operational needs. This agility ensures seamless deployment, reduced infrastructure changes, and optimized workflows, setting a new standard for scalability and cost-efficiency in warehouse automation.
- These achievements highlight our sustained commitment to innovation, positioning us as a leader in transforming the global AMR solutions industry.
- Global AMR solution market is a competitive and rapidly evolving market.
- As a global leader in AMR solutions, we face intense competition, making it critical to invest heavily in areas — from R&D to sale and marketing — that underpin our long-term success.
- These investments were critical to maintaining our technological edge and leadership in the global AMR market. Our focus on continuous innovation ensures that we meet evolving customer needs and differentiate ourselves from competitors.
- The consistent narrowing of losses, coupled with substantial market demand for AMR solutions, positions us as a leading player with significant long-term growth potential.
- As a pioneer in the AMR industry, we operate in a highly competitive market shaped by rapid technological advancements and increasing global demand for warehouse automation and efficient logistics solutions. Intensifying competition from established global corporations and agile domestic players poses challenges as they expand their technological capabilities and product offerings. The fast-paced innovation in the AMR sector offers significant opportunities but requires us to stay aligned with industry trends and customer needs.
- The AMR solution industry is characterized by constant changes and developments, including rapid technological evolution, frequent introductions of new products and services, continual shifts in customer demands and constant emergence of new industry standards and practices.
- We primarily compete in the global AMR solution market, which is characterized by high competition and constant changes, including rapid technological evolution, frequent introductions of new solutions, continual shifts in customer demands and periodic emergence of new industry standards and practices. The competitive landscape of this market is subject to ongoing evolution as it is heavily affected by the general economic conditions of such market and the competitive advancements in technology. Despite high barriers to entry, there will be evolving uncertainties over the competitive nature of these markets as new entrants may establish themselves. We also face fierce competition from other technologically advanced AMR providers whose activities directly affect and shape the pace of competition. Under this global competitive environment, the global AMR solution market is particularly competitive, and the demand for AMR solutions may be volatile. Factors affecting competition include, among others, technological innovation, product quality and safety, product pricing, sales efficiency, manufacturing efficiency, government support, policy tailwind, quality of services and branding. Increasing competition may lead to, among other things, lower product unit sales, decreased pricing and phase-out of government subsidies.
- In fast-paced industries subject to rapid technological change, our technology platforms and algorithms must be continually updated to remain competitive in the market to continually deliver effective solutions to our customers.
- The current global AMR solution market represents a significant opportunity for our AMR solutions.

Source: CIC

Verifications

- 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.
- Although we have successfully grown demand for our AMR solutions thus far, this is dependent on the trend toward the AMR solutions as key component of the warehouse automation industry.
- However, this interest in our industry is dependent on general economic development, particularly in advanced industrialized economies.
- We have observed a growing interest in AMRs across various industries, driven largely by advancements in technologies, as well as the increasing emphasis on automation to optimize operational efficiency.
- Given the fast pace of which the technologies of AMR solution industry have been and will continue to be developed; New technologies in the AMR solution industry could render our existing or future technologies obsolete or unattractive, thereby limiting our ability to recover related R&D costs, which could result in a decline in our revenues, profitability and market share.
- We compete with many other companies for engineers and R&D professionals with meaningful experience in designing and developing solutions, as well as for skilled marketing, operations and support service professionals, and we may not be successful in attracting and retaining the professionals we need.
- Since our industry is characterized by high demand and intense competition for talent and labor, we can provide no assurance that we will be able to attract or retain qualified staff or other highly skilled employees that we will need to achieve our strategic objectives. Labor costs have increased with the economic development of developing countries and labor shortage and inflation around the world.
- Maintaining strong relationships with our suppliers is essential to ensure prompt, cost-efficient deliveries, while also preserving our competitive position and negotiating leverage relative to our peers.
- The technology underlying our AMR solutions is inherently complex and may contain material defects or errors, particularly when new services or products are first introduced, when new features or functionalities are released.
- Our pricing models face challenges from evolving market changes. As the market for our solutions grows, as our competitors introduce new solutions that compete with ours or reduce their prices.
- The global AMR solution industry and the industry sectors in which we provide our AMR solutions are subject to the regulatory oversight of a number of governmental authorities, including but not limited to the National Development and Reform Commission of China.
- The industry in which our business operates is characterized by a large number of patents, some of which may be of questionable scope, validity or enforceability. As a result, there is a significant amount of uncertainty in the industry regarding patent protection and infringement.
- Hindered by inefficiencies, unreliability, high operational costs and inflexibility, traditional unautomated warehouse solutions and current rigid warehouse automation solutions are facing significant challenges to keep up with the fast-paced demands of modern commerce, particularly as labor costs rise and the workforce shrinks.
- Inefficiency: Traditional warehouse solutions rely heavily on manual labor who spend 70% of time in walking to shelves to pick goods, according to CIC. In addition, manual operations typically require wide aisles and ample space for workers and usually lead to inefficient layout and space management, which limits the overall warehouse space utilization.
- Unreliability: Labor intensive warehouse solutions increase the risk of human errors, which may result in incorrect order processing, as well as inventory misplacement and delays.
- High operational costs: Rising global wages, combined with increasing labor shortages due to factors like an aging workforce, are significantly driving up operational costs. Businesses are incurring higher expenses to recruit, train and retain workers. Additionally, the need for extra staffing during peak period further escalates costs, making it difficult to maintain efficiency and profitability in warehouse process.
- Inflexibility: Rigid warehouse automation solutions are designed for specific tasks, making them less capable of handling the variability and complexity of modern logistics operations. Any required changes often involve costly and time-consuming adjustments to the infrastructure.
- Through our focus on researching high-performance, high-speed optimization algorithms, we have developed one of the most advanced algorithms in the AMR market, namely our Hyper+ Core Algorithms that consist of traffic management and task allocation, warehouse management and supply chain algorithms.
- We strategically targeted the global market early on. This global mindset has enabled us to establish a strong international presence with over 70% of total revenue generated from non-domestic market outside Chinese mainland in 2024.
- We have firmly established ourselves as a leader within the global AMR market providing efficient, reliable, and flexible AMR solutions empowering warehouse fulfillment.
- As of June 30, 2024, we have the largest global customer base in the warehouse fulfillment AMR solution market, serving approximately 770 end customers across various geographic regions and industry verticals, including over 60 Fortune 500 customers.

Source: CIC

Verifications

- We revolutionized the warehouse automation by introducing AMRs that bring a level of flexibility that traditional systems — reliant on fixed, rigid equipment — simply cannot achieve. With advanced mobility and modular design, our diverse range of AMRs can meet specific operational needs and handle items of varying sizes.
- Such modularity allows us to craft solutions that are fine tuned to the specific operational needs of each customer, while competitors mostly offer standardized, one-size-fits-all solutions.
- Achieving this demonstrates our expertise in both AMR hardware and software systems, including WES and RMS, and supporting algorithms to automate and optimize logistics operations. With our comprehensive capabilities, we enable customers to execute complex logistics tasks, empowering them to meet the demands of modern supply chains more efficiently.
- We have developed a full-stack technology architecture anchored by three proprietary technology platforms.
- Our R&D focus is on developing market-pioneering technology solutions in areas such as innovative AMRs, intelligent warehouse management, robot control and management software, robot design, robotic hardware and the development and design of warehouse facilities.
- We are committed to enhancing our Geek+ brand as an international market leader with quality products and services, as well as established market reputations.
- This strategy will allow us to capture the industry shift toward integrated AMR solutions featuring key software capabilities. With our robust software capabilities, we are well-positioned to capitalize on this trend.
- PopPick Solution is an advanced system designed to streamline and optimize warehouse operations.
- We developed the world's first all-in-one PopPick Solution using its P-series robots and PopPick workstations — named "PopPick" to emphasize the swift movement of goods to the human picker.
- Compatibility: PopPick Solution is designed for full compatibility with small, medium, and large inventories, and it can seamlessly work with bin, shelf, and pallet storage systems.
- Throughput Efficiency: With advanced AMR technology, PopPick Solution can increase warehouse picking efficiency to up to 580 totes per hour, doubling throughput capacity.
- Storage Capacity: PopPick Solution is engineered to minimize bin spacing to as little as 2 centimeters and achieves a delivery speed of approximately 6.2 seconds per bin.
- Operational Effectiveness: PopPick Solution supports all scenarios and product categories, offering a maximum throughput capacity that is more than three times the industry standard.
- Our P-series robots offer several distinct advantages over competing AMRs:
- Slimmer Profile: Our P-series robots are designed to be thinner, optimizing the use of vertical space in warehouses.
- Smaller Turning Diameter: These robots have a smaller turning diameter, reducing aisle space requirements and increasing overall warehouse utilization.
- Higher Speed: The robots operate at higher speeds, enhancing the efficiency of warehouse operations.
- Faster Charging and Longer Endurance: With quicker charging times and improved battery life, our P-series robots can operate longer and more efficiently, increasing overall utilization.
- In August 2024, we expanded our collaboration with a major U.S. third-party logistic provider by implementing PopPick Solution at its velocity smart warehouse. This initiative aims to tackle the surge in order volumes, particularly during peak e-commerce events like Black Friday, through technological innovation.
- Our Geek+ Tote-to-Person Picking Solution is widely recognized in the market.
- The RS robots are capable of reaching heights of up to 11 meters, allowing the system to increase storage capacity by up to five times.
- The Geek+ Tote-to-Person Picking Solution also offers a one-stop solution for storing and picking items of various sizes, overcoming a common challenge faced by traditional tote-based robot systems when handling medium to large items. This adaptability ensures that the solution can meet the evolving needs of businesses and accommodate a wide range of operational requirements. This makes the Geek+ Tote-to-Person Picking Solution more versatile, enhancing its capability to handle different operational demands.
- The RS-series robots used in our Geek+ Tote-to-Person Picking Solution own several advantages when compared to the core robots used in similar solutions. First, the RS-series robots can operate with taller shelving units, maximizing vertical space in warehouses and improving storage efficiency. Additionally, these robots feature higher battery efficiency, enhancing overall operational productivity.
- The Geek+ Tote-to-Person Picking Solution is well-suited for industries that demand high storage density with moderate throughput, such as retail, footwear, grocery, pharmaceutical, and certain manufacturing sectors.
- In July 2024, we launched a Tote-to-Person solution for a major European pharmacy chain to handle the surge in e-commerce. The system was implemented in our customer's new smart warehouse, focusing on pharmaceuticals and cosmetics, supporting processes from order initiation to dispatch.

Source: CIC

Verifications

- We are the first in the world to introduce the Geek+ Pallet-to-Person Picking Solution, a high-density, high-throughput integrated storage and picking system that features the combination of our X-series four-way shuttle and P800 robots.
- The Geek+ Pallet-to-Person Picking Solution is suitable for high-density storage and efficient picking across multiple industries, including manufacturing, retail, fashion, FMCG, third-party logistics, pharmaceutical distribution, and cold chain logistics.
- In August 2023, we and an established PRC automaker implemented the Geek+ Pallet-to-Person Picking Solution at one of its manufacturing bases in China. This advanced system, tailored for the operation of automotive parts warehouses, automates the entire process from storage to order picking.
- We were also the first in the AMR market to introduce a flexible sorting solution that operates without the need for a steel platform, according to CIC. This innovation is significant because it reduces deployment costs, accelerates implementation, and provides greater scalability and adaptability, enabling businesses to optimize space and operations more effectively.
- We partnered with a leading European e-commerce delivery solutions provider to successfully deploy our fully flexible intelligent sorting solution at its distribution center in Spain.
- For instance, our smart moving solutions is able to serve the upstream and downstream segments of the new energy industries, such as automotive, lithium battery, and photovoltaic industries, along with their upstream material supply sectors.
- In June 2022, we and an established industrial solution provider improved the logistics at one of its factories by implementing a multi-robot smart moving solution.
- Our AMR solutions are consisted of a suite of modular components, such as advanced AMRs, powerful warehouse facilities and proprietary software designed for easy integration, customization, and deployment.
- This approach provides the flexibility to configure solutions specific to each customer’s needs, offering greater adaptability compared to rigid, one-size-fits-all systems commonly found in the market.
- We have created a comprehensive technology platform, Robot Matrix, that consolidates common development processes and features across industries, allowing it to accommodate diverse business processes and requirements.
- Robot Matrix is our proprietary AMR robotic general technology platform, designed to empower the development of high-quality, high-performance AMRs.
- Empowered by Robot Matrix, we have launched a wide spectrum of AMRs that conform to the latest technological advancements and the strictest safety standards.
- SLAM enables a robot to start from a location within a given environment and determine its own position and orientation. SLAM technology is suitable for high-complexity, large-area applications in commercial areas, manufacturing plants, and logistics warehouses.
- The platform’s adaptability and accuracy make it a leader in fields such as warehousing logistics, intelligent manufacturing, and commercial applications.
- Geek+ Software Suite supports a wide range of industry-standard protocols both domestically and internationally, allowing third parties the flexibility to access and develop secondary applications. Additionally, unlike competing systems, the Geek+ Software Suite is designed for superior flexibility and compatibility, integrating rapidly and seamlessly with customers’ existing business systems. This robust compatibility allows for a smooth and efficient integration into customers’ operational platforms, enabling them to optimize supply chain and logistics operations without the need for extensive adjustments.
- Geek+ Software Suite enables full utilization of robot resources, thus preventing scheduling deadlock or congestion. It further improves warehousing efficiency through automated tally and a combination of push/pull picking.
- This minimizes concerns about fulfillment interruptions due to equipment failures. The rapid recovery tool enables system restarts and task recovery within 10 minutes.
- Our strong R&D capabilities have allowed us to develop numerous market-pioneering AMR solutions and technology platforms. By maintaining a solid focus on research and technological advancement, we continue to lead the AMR sector, pushing the boundaries of automation with solutions that meet a wide range of warehouse and logistics needs.
- Together, their leadership ensures us to remain at the forefront of AMR innovation.
- Many of our R&D team members come from leading technology firms and possess deep expertise in both technology architecture and algorithm development, ensuring seamless integration of hardware and software in our AMR solutions.
- This ongoing investment in R&D reflects our commitment to innovation and maintaining a competitive edge in product development and intellectual property protection.

Source: CIC

Verifications

- Over the years, we have built a geographically diverse and extensive customer base.
- Unlike many of our China-based peers that initially concentrate on local or regional markets, we strategically targeted the global market early on — this global mindset has enabled us to establish a strong international presence, with operations, partnerships, and deployments in key markets around the world. Our first-mover advantage in non-domestic market has allowed us to secure a strong market position and build deep relationships with customers.
- Consistent with the industry norm, we rely on our channel partners to promote and sell Geek+ products to rapidly scale our business presence in different geographic areas in a cost-effective manner.
- For example, after successfully deploying our Geek+ Shelf-to-Person Picking Solution at the logistics centers of a leading e-commerce company in South Korea, we introduced our FleetSort Solution to further enhance their operational efficiency.
- As a leader in the AMR industry, we operate in a competitive environment driven by rapid technological advancements, an increasing demand for warehouse automation, and a growing global market for efficient supply chain and logistics solutions. Since our inception, we have established ourselves as an early mover in the AMR space, gaining recognition and success not only within China but across non-domestic market. This global presence underscores our commitment to delivering high-quality, innovative AMR solutions that empower companies worldwide to optimize their logistics operations.
- However, as global interest in automation rises, competition has intensified, drawing both long-established international corporations and dynamic domestic players into the field. We currently face competition from companies with strong brand reputations, cutting-edge technologies, and well-rounded product offerings.
- The accelerating pace of technological innovation in the global AMR market presents significant opportunities for us, alongside unique challenges. Staying aligned with evolving industry trends and customer expectations is crucial. Our strategy must remain adaptable, as any delay in product development or misalignment in business focus with market needs could potentially slow growth or reduce our market share, particularly as competitors continue to expand their technological capabilities.
- By proactively focusing on research, development, and customer-centric innovations, we believe we are well-positioned to strengthen its market leadership and continue offering leading AMR solutions that redefine the future of automated logistics.
- Many of our customers, particularly in e-commerce, retail, and logistics, tend to concentrate their order placements toward the end of the calendar year.
- Order intake, a key measure used to assess our performance, demonstrating our strong market momentum.
- The consistent narrowing of losses, coupled with substantial market demand for AMR solutions, positions us as a leading player with significant long-term growth potential.
- As the global market leader, our advanced and flexible AMR solutions uniquely position us to capitalize on this growth and achieve profitability.
- We offer a series of AMR solutions to empower warehouse fulfillment and industrial material transport, dramatically enhancing supply chain efficiency while reducing reliance on manual labor.
- The global demand for warehouse automation, particularly through AMRs, is a primary driver of our performance. As traditional warehouse models face limitations — such as labor dependency, rising costs, and the need for flexibility to support high-order volumes — AMRs have emerged as a transformative solution. AMR solutions are increasingly chosen by businesses as a more flexible alternative for warehouse automation, supporting rapid industry growth and expanded adoption across sectors.
- We are strategically positioned in this high-growth market, offering AMR solutions that enhance operational efficiency, reduce manual labor reliance, and support flexible logistics.
- The rapid growth in e-commerce and FMCG and the global expansion of digital trade continue to amplify the need for automated solutions across supply chains. As companies seek to respond to rising consumer expectations for faster delivery and accurate, real-time inventory management, demand for AMR solutions is expected to grow exponentially. With our established leadership in the global AMR solutions market, we are well-positioned to capitalize on the steady increase in AMR adoption, further supporting our expansion and ability to capture market share.
- To maximize the benefits of this expanding market, we intend to continue to innovate, refining our AMR solutions to deliver best-in-class performance, flexibility, and scalability.
- The warehouse automation industry is rapidly evolving, driven by continued technological advancements. As one of the global leaders in AMR technology, we have continued to invest in research and development to retain our competitive edge and meet complex customer demands.
- Domestic market is a more competitive environment compared to our non-domestic market.
- The labor costs in non-domestic market are typically higher, which drives stronger demand for advanced AMR solutions. Additionally, customers in non-domestic market often have a higher willingness to pay for advanced AMR solutions, particularly when these solutions offer greater functional complexity and customization to meet their operational needs. Compared to the domestic market, non-domestic market exhibit relatively lower competition and a higher demand for faster investment returns for business utilizing AMR solutions.

Source: CIC

Verifications

- Repurchase rate represents the percentage of order intake derived from customers who have previously placed orders with the company.
- During the nascent stage of the AMR industry, substantial R&D investments are required to advance technology, intensive efforts are needed to educate potential customers on the benefits of AMR adoption, and the highly competitive landscape demands significant upfront expenditures in sales, marketing, and global expansion. As a result, incurring losses is a natural and expected part of scaling a business in this sector.
- The global AMR solutions market is highly competitive. This competitive environment places pressure on AMR providers to innovate, invest in marketing, and maintain competitive pricing, delaying the break-even point.
- As a relatively new warehouse automation solution, AMR providers must invest heavily in sales and marketing to educate the market and acquire customers. These resources are allocated not only for customer acquisition but also to promote awareness and acceptance of AMR technologies among potential customers and system integrators. In industries where robotics has not yet been widely adopted, significant customer education is required. These upfront investments in market education and development often exceed early-stage revenues, contributing to short-term losses and delaying profitability.
- AMR solutions are highly R&D-intensive, requiring substantial upfront investments in hardware and software development to create competitive products and services. These include innovations in areas such as computer vision, sensor fusion, path planning, mechanical design, and battery technology. These investments are necessary to optimize and integrate technologies that meet market demands, requiring significant financial and time commitments. In the AMR industry, the product development cycle is long —typically spanning years from prototyping to production, particularly for companies in their startup and early development stages. Substantial upfront investments in R&D and product enhancement are required. While revenues may grow, much of it is reinvested into further product development, such as creating robots for more complex environments. Continuous product updates and iterations to meet evolving customer needs also extend the R&D cycle. Additionally, early-stage AMR companies often incur substantial upfront costs to scale manufacturing and optimize supply chains. This prolonged development process means revenues from AMR solutions often lag behind significant initial investments, resulting in early-stage losses.
- 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.
- 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.
- 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.
- 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.
- To maximize the benefits of automation, downstream 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.
- 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.

Source: CIC

Verifications

- 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.
- In 2024, global e-commerce transaction value surged to over RMB30 trillion.
- 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.
- Geek+'s delivery cycle and revenue recognition practices align with market norms for AMR providers, with many industry peers adopting similar policies and reporting comparable inventory turnover days.
- In the AMR industry, especially in sectors like warehouse automation, the value proposition is often tied to the quality, features, and scalability of the solution, rather than sheer volume. In the broader robotics and automation sector, the value of a solution is often not directly proportional to its volume. For example, higher-margin, technologically advanced solutions may contribute more to revenue than basic, low-cost units.
- Geek+'s AMR solutions are typically high-tech, customized, and optimized for specific business needs, enabling the company to command premium prices compared to mass-market, low-cost alternatives.
- The development and delivery of localized AMR solutions across diverse markets will enable customers to better adapt the technology to unique regional demands, ensuring operational efficiency and market relevance.
- The industry sectors where the demand for automation and AMRs is projected to grow rapidly, particularly in areas where operational efficiency and scalability are critical, include e-commerce, retail, FMCG, new energy and manufacturing.
- The average number of types of AMRs per project is not a commonly used or industry-standard indicator for evaluating the business of AMR companies.
- It is a common practice in the AMR solutions industry for solution providers to reach end customers through channel partners. Additionally, some channel partners may allocate parts of a single project to multiple partners to collaboratively fulfill end customers' requirements.
- Geek+ is a pioneer in introducing the "goods-to-person" concept. Goods-to-person solutions include shelf-to-person, tote-to-person, pallet-to-person, and smart sorting systems, where warehouse fulfillment automation ensures that items are delivered directly to workers or workstations, eliminating the need for workers to travel to retrieve items themselves.
- As of December 31, 2024, Geek+ held 1,867 patents (including 1,059 registered patents and 808 pending applications) and other intellectual property, one of the highest in the market, according to CIC.
- Compared to the industry average of more than 3 months, full system deployment of Geek+'s solutions can be completed within one to three months, allowing businesses to quickly adapt to changing demands.
- Over the years, the AMR solution industry has undergone a dramatic transformation, driven by breakthroughs in leading technologies in perception, navigation and autonomous coordination technologies. Customers demand solutions that not only map complex layouts in real time, but also adapt quickly to new workflows, safety protocols and complex warehousing environments. AMR companies must evolve their technologies and offerings quickly, and only those who can iterate their research and development roadmaps will meet the expectations of today's AMR solution industry.
- Geek+ primarily competes in the global AMR solution market, where success depends on the ability to develop AMRs that seamlessly navigate complex environments, adapt to dynamic workflows, and integrate with enterprises' own management ecosystems.
- In contrast, the industry average - without SLAM technology - typically exceeds ±10mm.
- The industry average for the maximum number of AMRs that can be scheduled simultaneously is below 300.
- Compared with Geek's solutions, the AMR solution of one of Geek's competitors (Company B), which features only one type of robot, falls short of the comprehensive capabilities provided by our solutions.

Source: CIC

Verifications

- Geek+’s Pallet-to-Person solution can increase storage efficiency by over five times, saving 60% of aisle space compared to traditional forklifts, and maximize warehouse capacity by up to 500%.
- Geek+’s AMRs have industry leading performance in moving speed and endurance, with a 4.5 m/s maximum no-load speed — significantly higher than the industry average maximum no-load speed of less than 2 m/s — and a work duration of over eight hours under rated conditions.
- Compared to the industry average of more than 3 months, full system deployment of Geek+’s solutions can be completed within one to three months, allowing businesses to quickly adapt to changing demands.
- According to CIC, with an average positioning accuracy of less than ±10mm (±1°), Geek+’s SLAM technology equips our AMRs with one of the most advanced positioning capabilities in the industry. In contrast, the industry average - without SLAM technology - typically exceeds ±10mm.
- According to CIC, Geek+’s RMS system can manage the simultaneous scheduling of over 5,000 robots in warehouse fulfillment scenario, the highest in the market. According to the same source, the industry average for the maximum number of AMRs that can be scheduled simultaneously is below 300.
- According to CIC, in 2024, Geek+ occupied a 9.0% market share in the overall global warehouse fulfillment AMR solution market and approximately 1% market share of the global warehouse automation solution market.
- Geek+ is among the leading global AMR solution providers to implement laser-vision fusion SLAM technology, integrating LiDAR and RGBD camera sensors, enabled in part by the positioning and environmental awareness capabilities built into Robot Matrix. For more information about Robot Matrix.
- According to CIC, it is consistent with industry practice to define key account end customers based on cumulative order value exceeding a meaningful threshold.
- According to CIC, in 2024, approximately 10% of the global AMR solutions deployed are dedicated to e-commerce use cases.
- In 2024, the global average hourly wage stood at RMB80, reflecting a 30% rise over the past decade. Meanwhile, China’s average hourly wage surged to RMB50, more than doubling from its level 10 years prior, while the U.S. hourly wage averaged RMB250, making a 40% increase from a decade prior.
- 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.
- 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.
- 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.
- The Geek+ Shelf-to-Person Picking Solution achieves a picking efficiency of up to 400 units per hour per workstation (with one operator), significantly higher than the industry average of less than 180 units, and delivers a picking accuracy of 99.99%, compared to the industry average of below 99.90%.
- Geek+ Tote-to-Person Picking Solution features a storage height of up to 12 meters, exceeding the industry average of less than 10 meters, and supports a minimum aisle width of 1,000 mm, compared to the industry average of over 1,100 mm.
- With Geek+’s Pallet-to-Person solution, storage efficiency is increased by over five times, saving 60% of aisle space compared to traditional forklifts, and maximizing warehouse capacity by up to 500%, according to CIC.
- Geek+’s AMR solutions deliver a significant reduction in labor costs, typically achieving a short payback period of within 12-36 months, while the industry average is more than 24 months. By comparison, competitors such as Company A and Company B recorded payback periods of 30 to 36 months and over 36 months, respectively.

Source: CIC

Verifications

- The competitive dynamics in the global AMR solution market evolve as quickly as customer automation budgets and technology breakthroughs. While building a reliable AMR platform requires deep expertise robotics, perception and motion planning, creating high technical barriers to entry.
- Under this global competitive environment, the global AMR solution market is particularly competitive, and the demand for AMR solutions can changes quickly and sharply with new budget cycles or breakthroughs. Factors affecting competition include, among others, advancements in AI-driven autonomy, real-time environmental mapping, multi-sensor fusion, and adaptive path planning; interoperability with customers' existing automation infrastructure; product quality and safety; product pricing; sales efficiency, manufacturing efficiency, government support, policy tailwind, quality of services and branding. Manufacturing precision, supply chain resilience, and proprietary algorithm optimization also shape competitive positioning of AMR companies.
- Maintaining a competitive position in the AMR industry requires continuous innovation in navigation algorithms, real-time environmental perception, multi-sensor fusion, and adaptive decision-making.
- The industry is shaped by rapid technological shifts, such as advancements in edge computing and human-robot collaboration.
- Enterprises demand AMRs with greater autonomy, precision, and integration capabilities.
- If Geek+'s AMR solutions do not meet rising expectations, such as interoperability with customers' existing warehouse management systems, advanced perception capabilities, or compliance with evolving safety standard.
- Against the backdrop of the ongoing restructuring of global supply chains and the rapid advancement of automation technologies, AMR solutions have emerged as a pivotal technology for enhancing warehousing fulfillment efficiency, reducing operational costs, and fortifying flexible logistics capabilities. Spurred by the growth of global trade, e-commerce and the digital and intelligent transformation of manufacturing, AMR solutions are swiftly penetrating major global markets, including North and Central America, Europe, Latin America, and the Middle East and Africa regions, each of which exhibits growth potential shaped by distinct industrial structures and policy environments.
- North and Central America: Driven by sustained manufacturing growth, the rapid development of e-commerce, and an escalating demand for warehouse efficiency, the penetration rate of AMR solutions in North and Central America has surged from approximately 4% in 2020 to nearly 7% in 2024. With the continuous upgrading of global supply chains and the strengthening of regional trade, demand is anticipated to persistently rise, with penetration projected to reach around 19% by 2029.
- Mexico: As a pivotal trade hub connecting North and Latin America, Mexico's nearshoring strategy has attracted a multitude of multinational corporations. Its expanding manufacturing base, coupled with a surge in e-commerce penetration from under 5% in 2019 to nearly 15% in 2024, has dramatically increased the demand for warehousing automation. Government initiatives aimed at upgrading manufacturing and logistics infrastructure further bolster the deployment of AMR solutions, positioning Mexico to lead the region in AMR adoption growth.
- Puerto Rico: As a strategic outpost for the United States in the Caribbean, Puerto Rico supports both domestic consumption and re-export trade. The government has prioritized improving connectivity at various transshipment hubs and developing logistical capabilities to stimulate medium-term growth. Consequently, the demand for warehouse automation and AMR solutions is expected to grow.
- Costa Rica: As a logistics hub in Central America, Costa Rica's demand for warehouse automation is primarily driven by its food processing and export sectors. Government support for economic diversification and industrial upgrading, along with a rapidly expanding e-commerce market, will continue to fuel the penetration of AMR adoption.
- Dominican Republic: With a burgeoning manufacturing sector, particularly in textiles, apparel, and food processing, the Dominican Republic is witnessing a rising demand for warehouse capacity and automation. AMR solutions are gradually gaining traction, and its penetration is expected to increase steadily.
- Europe: Europe leads globally in warehouse automation, supported by robust technical capabilities and a dense network of automation equipment providers. In Western Europe, developed countries such as Germany and France are at the forefront of the global market for warehouse automation and AMR solutions. The regional AMR penetration exceeded 4% in 2020, surpassed 8% in 2024, and is projected to reach around 22% by 2029. This growth is primarily driven by manufacturing upgrades, the expansion of e-commerce, and the escalating demand for enhanced logistics efficiency. Meanwhile, Central and Eastern Europe, along with countries like Georgia and Azerbaijan, are emerging as important logistics hubs, brimming with significant growth potential. Although developing countries currently exhibit a relatively low penetration rate of AMR solutions, they are brimming with abundant development opportunities in this domain.
- Georgia: Georgia holds a crucial geographical position as one of the transportation hubs connecting Europe and Asia. In recent years, its economy has maintained steady growth, and the logistics industry has gradually developed. With the increase in trade volume and the rise in warehousing demand, the need for AMR solutions has started to emerge. It is expected that the penetration growth of AMR solutions in Georgia will lead the way among European developing countries, and the penetration rate will continue to rise in the future.

Source: CIC

Verifications

- Azerbaijan: As a key link in the Trans-Caspian transport corridor, Azerbaijan is actively developing its non-oil economy, striving to achieve economic transformation, and continuously increasing policy support to build itself into an important international logistics hub. As a result, warehousing demand is constantly growing. It is anticipated that the penetration rate of AMR solutions will continue to increase with the support of policies and the construction of the logistics hubs.
- Slovenia: Located in south-central Europe, Slovenia boasts significant logistical and strategic advantages. It connects the Mediterranean with global maritime trade routes, with road density higher than the EU average. Slovenia is gradually emerging as an important logistics and transportation hub in Europe. With the flourishing development of warehousing and logistics management, numerous international logistics companies have established branches here, indicating a high acceptance of advanced warehousing technologies. The penetration rate of AMR solutions in Slovenia is at a leading level among regional developing countries and will continue to grow along with the development of the logistics industry.
- Bosnia and Herzegovina: Bosnia and Herzegovina is experiencing a gradual economic recovery, with growth driven by manufacturing and tourism. Trade volumes are increasing, and as internet penetration and e-commerce acceptance rise, demand for warehouse automation is gradually emerging, providing a new growth point for the penetration of AMR solutions.
- Latin America: Latin America has vast economic growth potential. With the rapid development of e-commerce and manufacturing, demand for AMR solutions is rising. In 2020, the penetration rate of AMR solutions in Latin America was only around 1% and reached approximately 2% by 2024. Benefiting from ongoing urbanization, the expanding scale of e-commerce, and continuous innovation from technology providers, the penetration rate is expected to accelerate and reach around 5% by 2029, indicating a vast market development space.
- Brazil: As one of the largest economies in Latin America, Brazil sees strong warehouse demand across industries. Meanwhile, in 2024, the transaction size of Brazil's e-commerce exceeded RMB25 billion, making it the largest e-commerce market in the region. Investments in logistics infrastructure continue to fuel the growth of e-commerce, with mainstream e-commerce platforms constantly establishing new logistics and distribution centers, placing high demands on warehousing efficiency and delivery speed. AMR solutions can help enterprises improve warehousing operational efficiency and reduce inventory errors, meeting the rapid development needs of the e-commerce market. It is expected that the penetration rate of AMR solutions in Brazil will continue to lead the regional development.
- Argentina: As one of the largest economies in South America with extensive free trade and trade agreements, Argentina is actively upgrading cross-border logistics infrastructure. To actively cope with the challenges of cross-border trade, the Argentine government is taking proactive measures to improve the cross-border logistics environment and increase the construction of smart warehousing. Warehousing construction emphasizes flexibility and efficiency to adapt to rapidly changing market demands, providing new growing opportunities for the increasing demand for AMR solutions in Latin America. It is expected that its penetration rate will continue to outperform the Latin American average.
- Chile: Chile occupies a strategic geographical position, serving as one of the pivotal trade hubs in South America. Its well-established logistics infrastructure lays the foundation for the deployment of AMR solutions. Furthermore, the government has made substantial investments in infrastructure projects, offering strong support for the development of e-commerce and cross-border e-commerce, and has attracted numerous e-commerce platforms to set up operations. In 2024, the number of e-commerce users in Chile exceeded 10 million. With a young population structure and relatively high per capita disposable income, the e-commerce market is full of vitality. As e-commerce expands and the manufacturing industry upgrades, the demand for flexible AMR solutions has emerged, and it is expected that the penetration rate of these solutions will continuously rise.
- Middle East and Africa: In 2020, the penetration rate of AMR solutions in the Middle East and Africa region stood below 0.5%. However, as the e-commerce development surged across the region, the demand for AMR solutions has been increasing. By 2024, the regional penetration rate of AMR solutions reached approximately 1%. While economic development remains uneven across the region, countries like South Africa are driving accelerated adoption of AMR solutions. It is expected that by 2029, the regional penetration rate will further increase to approximately 4%, signaling growing market potential.
- South Africa: As Africa’s largest economy and most advanced logistics market, South Africa holds strong potential for warehouse automation. With an internet penetration rate exceeding 70%, it also serves as a key catalyst for the growth of e-commerce in Africa. Free-trade policies and burgeoning international trade further stimulate cross-border e-commerce. Given the escalating expectations for delivery speed and service quality, AMR solutions play a pivotal role in enhancing warehouse efficiency and logistics precision. 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.

Source: CIC

Verifications

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

Verifications

Main Regional AMR Penetration Rate, 2020-2029E

Region	2020	2024	2029E
Asia Pacific	~6%	~12%	~25%
North and Central America[1]	~4%	~7%	~19%
Europe[2]	~4%	~8%	~22%
Latin America[3]	~1%	~2%	~5%
Middle East and Africa[4]	~0.5%	~1%	~4%

Note: 1. In North and Central America, the AMR penetration rates in Mexico, Puerto Rico, Costa Rica, and the Dominican Republic lag behind the regional average, as the adoption of warehouse automation and AMR solutions started later than in other developed countries in the region. 2. In Europe, developing countries such as Georgia, Azerbaijan, Slovenia, and Bosnia and Herzegovina currently show relatively low AMR penetration rates compared to developed nations, although Georgia and Azerbaijan are emerging as key logistics hubs with strong growth potential. 3. In Latin America, Brazil and Argentina, being the largest economies and e-commerce markets in the region, are expected to lead in AMR penetration and regional development. 4. In the Middle East and Africa, South Africa is anticipated to remain one of the most advanced AMR markets in the region, with its penetration rate continuing to rise ahead of the regional average.

Source: CIC

China Insights Consultancy

Industry Report on Global Autonomous Mobile Robot Solution Industry