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Industry Report on the Global and China's Cobot Markets

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CIC Introduction, Methodologies, and Assumptions

China Insights Consultancy ("CIC") is commissioned to conduct an analysis and report of the global and China's cobot markets. The report commissioned has been prepared by China Insights Consultancy independent of the influence of the Company or any other interested party.

CIC is a market research and consulting company founded in Hong Kong and engaged in the provision of professional consulting services across multiple industries. We have agreed to pay a fee of RMB0.4 million to CIC in connection with the preparation of the CIC Report. We have extracted certain information from the CIC Report in this section, as well as the "Summary," "Risk Factors," "Business," and "Financial Information" sections, and elsewhere in this prospectus to provide our potential investors with a more comprehensive presentation of the industries where we operate. Unless otherwise noted, all data and forecasts contained in this section derive from the CIC Report.

The information and data collected by CIC have been analyzed, assessed, and validated using CIC's in-house analysis models and techniques. Primary research was conducted via interviews with key industry experts and leading industry participants. Secondary research involved analyzing data from various publicly available data sources, such as the National Bureau of Statistics of PRC and various industry associations. The information and data collected by CIC have been analyzed, assessed, and validated using CIC's in-house analysis models and techniques.

The market projections in the CIC Report are based on the following key assumptions:

(1) the overall social, economic, and political environment in China is expected to remain stable during the forecast period;

(2) related key industry drivers are likely to continue driving growth in the robot market during the forecast period, such as the advancement of technology and infrastructure, supportive policies, and increasing downstream demands; and

(3) there will be no extreme force majeure or unforeseen industry regulations in which the market may be affected in either a dramatic or fundamental way during the forecast period.

Terms and Abbreviations (1/3)

3C	Refers to the categories of electronic products related to Computers, Communication devices, and Consumer Electronics.
3D Vision	Technology that uses 3D cameras to capture spatial coordinates within a field of view, creating a three-dimensional representation of the environment, which is robust against environmental and lighting variations and provides richer data than 2D imaging.
Absolute positioning accuracy	The precision with which a robot can move to a specific point in its workspace relative to a fixed coordinate system.
AGV	Automated Guided Vehicle, mobile robots equipped with electromagnetic or optical guidance systems for traveling along a prescribed path, featuring safety protection and various loading and unloading functions. These are driverless transport vehicles used in industrial applications, powered by rechargeable batteries.
AMR	Autonomous Mobile Robot, an intelligent robot capable of autonomous navigation and movement within its environment.
ARM architecture	A family of reduced instruction set computing architectures for computer processors.
Articulated robots	Articulated robots are robots with jointed arms allowing for flexibility and precise movement.
Artificial Intelligence (AI)	Artificial intelligence.
Axis or axes	Indicates a degree of freedom, where increasing the number of axes allows the cobot to access a greater amount of space by giving it more degrees of freedom.
CE	Conformité Européenne, a regulatory standard that verifies certain products are safe for sale and use in the European Economic Area.
Collaborative robots (Cobots)	Robots with operational robotic arms intended for direct human-robot interaction or collaboration within a shared space or where humans and robots are operating in proximity.
Controllers	Systems connected to the robot in order to control the movements of the robots.
CRIA	China Robotics Industry Alliance, a non-profit social organization founded by enterprises and institutions engaged in robotics industry research and development, production and manufacturing, and application services, universities and colleges, scientific research institutes, user units, and other related organizations in 2013.
Cycle time	The time it takes a cobot to complete one full cycle of its programmed task.
Degree of freedom	Refers to the count of independent axis of motion that a robotic system can autonomously manipulate to perform tasks.
DELTA	Also known as a parallel robot with a triangular structure, where the end-effector is at the bottom, connected to the robot by three mechanical arms that link universal joints on the robot and the end-effector.
Encoders	Electromechanical devices designed to convert mechanical motion into electrical signals, which can provide feedback on angular velocity and displacement.
Flexible Manufacturing	A production approach that relies on highly flexible manufacturing systems to produce a variety of products in small batches, allowing for quick transitions between different products.
Gear Reducers	Mechanical devices used to reduce the speed of a motor or power source and increase its torque output.

Terms and Abbreviations (2/3)

GGII	Gaogong Robotics Industry Research Institute. Established in 2008, its research covers every aspect of the robotics industry chain, including industrial robots, collaborative robots, mobile robots, among others. GGII conducts field visits and telephone surveys of over 500 companies across the industry chain each year, and therefore has amassed a vast amount of market information and industry data.
Harmonic Gear Reducer	A type of precision reducer used in robotics, especially for lighter load joints, which uses a wave generator to induce controlled elastic deformation in a flexible gear that meshes with a rigid gear.
HMI	Human-Machine Interaction, which refers to the methods of communication and interaction between humans and machines, including but not limited to visual and tactile forms of communication. In the field of robotics, HMI technology is particularly important as it involves how to enable robots to better understand and respond to human commands.
IFR	International Federation of Robotics, a specialized non-profit organization established in 1987. With 90 members, including national robotics associations, research and development institutions, robot suppliers, and integrators, the IFR serves as a global hub for the robotics community, indirectly representing over 3,000 organizations.
Industrial Robots	Automated, reprogrammable, multipurpose machines designed for industrial automation, capable of moving along programmed paths for tasks such as handling, assembly, and joining.
ISO	International Organization for Standardization, responsible for developing and publishing standards.
I/O control	Input/output control
Kinematic calibration and compensation technology	Refers to a set of methods and procedures used to ensure the accurate and precise movement of mechanical systems, particularly those found in robotics and automated machinery.
Maximum tool speed	Refers to the maximum speed that the robot's end-effector can reach when performing a task.
MIR	Marketing Intelligence Resource. Founded in 2008, it has many years of research experience in robotics, automation, and intelligent manufacturing industries. With a global perspective, its research primarily focuses on markets in China, Japan, Southeast Asia, as well as Europe and the United States.
Mordor Intelligence	Founded in 2014, Mordor Intelligence has worked with more than 6,000 organizations in over 20 industries, providing accurate data and actionable insights.
Motion Controller	A device specifically designed to manage the movement of robots, processing commands and generating signals to precisely control the robot's joints or actuators.
Non-contact detection distance	Refers to the distance at which the cobot can detect the approach of a person or object.
Parameter compensation	The process of adjusting for inaccuracies in a robot's model by calibrating and correcting its parameters to ensure precise and reliable operation.
R&D	Short of research and development.
Repeat positioning accuracy (Repeatability)	Refers to the accuracy of the robot end to reach the same target position repeatedly in multiple movements.
Robot Controller	An electrical system that controls the functions of a robot, typically consisting of a control cabinet and a teach pendant for user interaction.

Terms and Abbreviations (3/3)

Safeskin	Proactive safety through the use of pre-touch detection by recognising the proximity of people or objects using the principle of self-capacitance detection.
Safety speed	Refers to the speed that should not be exceeded by the end run in order to meet the collision force requirements in a human-computer collaboration scenario
SCARA	Selective compliance assembly robot arm, which refers to the cobot's ability to move freely and maintain stiffness in three axes while being compliant in the final axis.
Sensors	Devices that detect and respond to physical stimuli.
Servos	The controller for the joint motors in cobots, which enables high-precision control of position, velocity, and acceleration, ensuring that collaborative robots maintain high repeatability and accuracy when performing complex tasks. Additionally, it can precisely control output torque, allowing cobots to apply appropriate force when executing tasks such as assembly and gripping.
Shipment volume (Cobot shipment volume)	The total unit number of cobots delivered from cobot manufacturers to customers. The cobot shipment volume is a commonly used metric to measure the market size of the cobot industry as it directly reflects the actual market demand.
Teleoperation	Refers to the operation of a system or machine at a distance.
Torque Sensor	A device that measures and converts torque into an electrical signal, allowing for the monitoring and control of rotational force in mechanical systems.
Trajectory control	The process of commanding a robot to follow a specific path through its workspace.

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Definition and Classification of the Robots (1/2)

Definition and Classification of the Robots

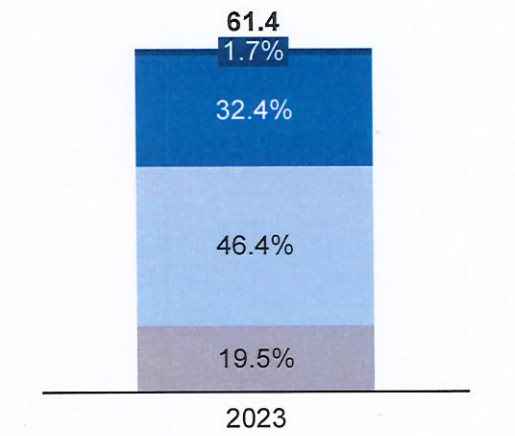
Definition of Robots

- Robots are machines capable of semi-autonomous or fully autonomous operations, with the ability to perceive, make decisions, and execute tasks. As robots have become increasingly flexible and adaptive with enhanced degree of freedom, they are taking on a broader range of tasks. Robots can be classified into four categories.

Classification of Robots, By purpose

		By mode of motion: Stationary robotic arms	By mode of motion: Mobile robots
Cobots	• Cobots are robots with operational robotic arm intended for direct human-robot interaction or collaboration within a shared space or where humans and robots are in proximity for the improved performance of tasks and automation process. The key features of cobots includes safety standards, ease of use, higher flexibility, and their inherent ability to collaborate with human workers. Cobots are widely adopted in many industries, such as industrial, commercial, medical and healthcare, scientific research and education sectors.	◕	◔
Traditional Industrial Robots	• Traditional industrial robots are automated, programmable robots used in dedicated industrial workplaces, often restricted by safety barriers as they are not designed for direct human interactions. It is more bulky and heavier as compared with other robots.	◕	◔
Service Robots	• Service robots are robots designed to perform functional tasks for humans or equipment, excluding industrial automation applications. Service robots can be categorized into domestic service robots and professional service robots.	◔	◕
Other Specialized Robots	• Other specialized robots are used in specialized fields such as the military, aerospace, medical, and agriculture sectors, designed for specific tasks. Specialized robots are typically controlled by human operators under special conditions.	◔	◕

Market size of the global robots, measured by revenue*, categorized by robot purpose , 2019-2028E



*Note: Percentage of robot arm or mobility in certain category, from low ◔ to high ◕

Source: ISO, IFR, China Insights Consultancy

Definition and Classification of the Robots (2/2)

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Classification of Robots, By structure

	By form	By load	Degrees of freedom
Operational robotic arms	Articulated robot arms	Light load (<7kg)	Four-axis and below
		Medium load (7-12kg)	Five-axis
	SCARA	Heavy load (12-20kg)	Six-axis
		Super heavy load (20-30kg)	
	DELTA	Extra heavy load (>30kg)	Seven-axis

	By form	By degree of automation
Mobile robots	Wheeled mobile robot	AGV
	Tracked mobile robot	AMR
	Legged mobile robot	Other mobile robots

Hybrid Robot

Classification of Robots, by Mode of Movement

Mode of Movement	Technical Difficulties	Advantages	Main Applications			Main Robot Types	Price Range*
			Industrial	Commercial	Other Scenarios		
Robot with operational arm	• High-precision position control and force control. • Integration of complex components and control algorithms.	• High accuracy and speed. • More degrees of freedom. • Operates a in three-dimensional space.	• Palletizing • Loading/unloading • Sorting • Welding • Assembly • Other processing	• Unmanned retail • Assisted meal preparation	• Medical and healthcare • Scientific research and education	• Cobots • Industrial Robots • Service Robots • Other Specialized Robots	◑
Wheeled or tracked mobile robot	• Navigation and path planning. • Energy efficiency and endurance duration.	• Simple structure and low energy consumption.	• Transportation • Cleaning	• Delivery • Guiding • Cleaning	• Medical and healthcare • Military	• Industrial Mobile Robots • Service Robots • Other Specialized Robots	◔
Legged mobile robot	• Dynamic balance. • Integration of complex components and control algorithms.	• Adaptability to complex terrains and flexible movement.	*Few application scenarios due to high unit price*			• Industrial Robots • Other Specialized Robots	◕

Price range from low ◔ to high ◕

**Note: Price range is measured by average load of each product category.*

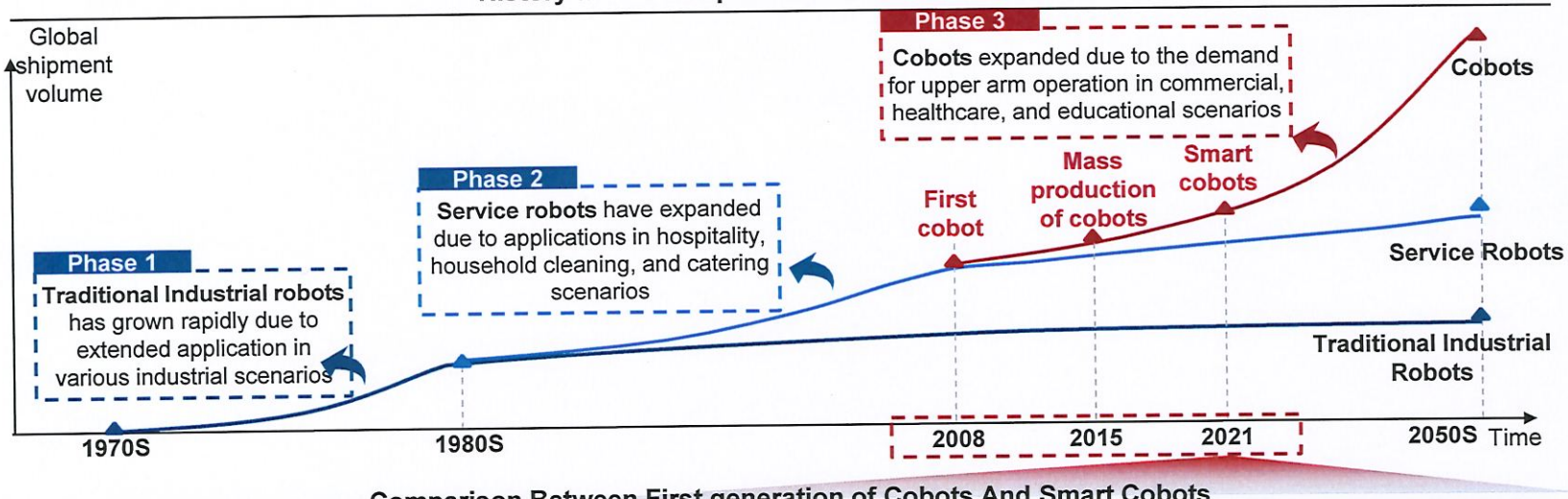
Key analysis

The development of robots is gradually freeing humans from routine work. With the growing degree of freedom and adaptive ability robots demonstrate, the types of work they can undertake are likewise increasing. Whereas the previous generation of robots liberated humans by improving mobility (i.e., leg function), the newest generation of robots achieves this goal by improving handling ability (i.e., hand function). At the same time, with the advancement of AI, the intelligent processing power (i.e., brain function) of the new generation of robots is being elevated to a new level, increasing the complexity of tasks available to robot handling.

Source: IFR, China Insights Consultancy

History and Development of Robots and Cobots

History and Development of Robots and Cobots



Comparison Between First generation of Cobots And Smart Cobots

	Key events of development of cobots	Feature technology	Applications	
			Industrial senerio	Service senerio
First generation of Cobots	• In **2008**, Denmark's UR Robotics has launched the world's first human-machine cobot, eliminating the need for safety fences. • Around **2015**, a number of specialized cobot companies were established both domestically and internationally, and traditional industrial robot companies started to adopted cobot product lines	• Anti-collision safety technology	• Automobiles and components • 3C Electronics industry • Semiconductor industry • Mechanical manufacturing	*Few application scenarios due to lack of intelligence*
Smart Cobots	• In **2014**, KUKA unveiled its first 7-axis lightweight and sensitive robot LBR iiwa, forming the second-generation cobot. • In **2020**, smart cobots with vision sensors has reached a milestone of 10 thousand units shipment, signifying the commercialization of smart cobots. With development of embodied AI, the commercialization of smart cobots will continue in the following years.	• Machine vision, such as SLAM • Machine learning • Speech recognition • Artificial Intelligence	• Automotive industry • 3C Electronics Industry • Semiconductor industry • Mechanical manufacturing	• Commercial sectors • Healthcare sectors • Scientific research and educations sectors

Key analysis

The first generation of cobots was introduced in 2008 primarily for manufacturing purposes, addressing the safety challenges of human-robot collaboation and demonstrating high adaptability to various production lines. In 2015, a number of companies specialized in cobot development started to emerge in both China and abroad, and traditional industrial robot companies also began building cobot production lines. In 2020, smart cobots with vision sensors reached a milestone of 10 thousand units shipment, demonstrating their commercialization and showcasing greater flexibility and versatility. With the development of AI, smart cobots are expected to be commercialized more extensively in the foreseeable future, with a wider variety of applications.

Source: China Insights Consultancy

Market size of the global robots, by revenue*, categorized by robot type

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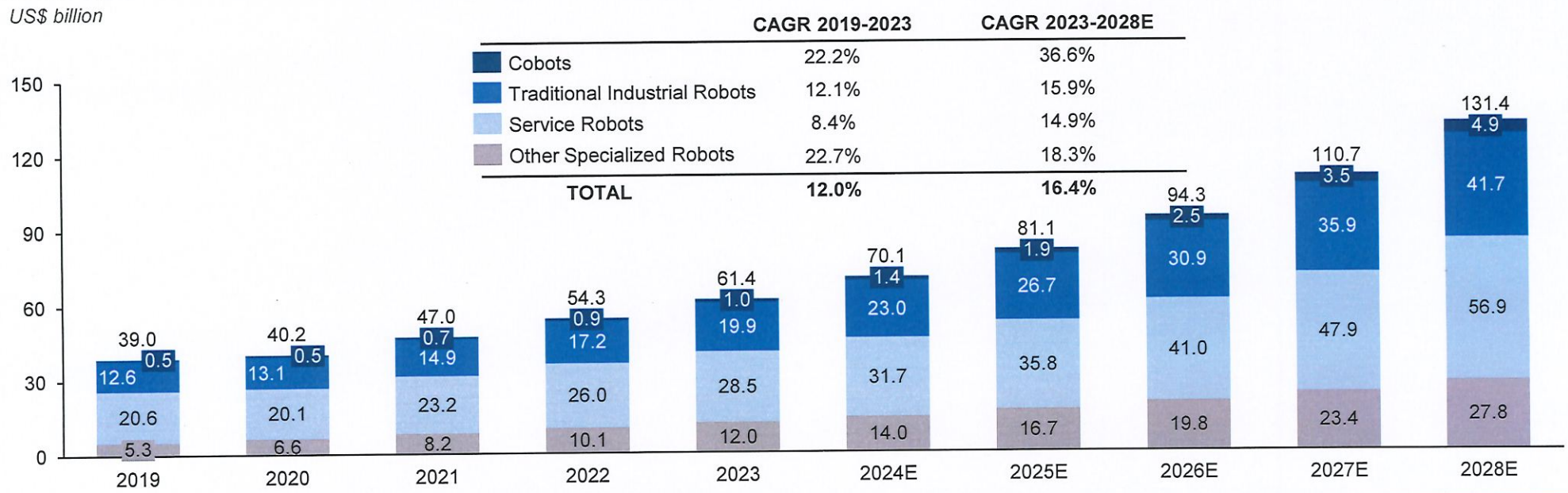
Market size of the global robots, by revenue*, categorized by robot type , 2019-2028E



Key analysis

- The market size of the global robots has grown from US$39.0 billion in 2019 to US$61.4 billion in 2023, representing a CAGR of 12.0% between 2019 and 2023. The market size is expected to reach US$131.4 billion in 2028, representing a CAGR of 16.4% between 2023 and 2028.
- With the advancement of cobots, significant improvements in flexibility, safety, ease of deployment, and cost-effectiveness have led to a rapid growth in the market for cobots. It is projected to increase from US$1.0 billion in 2023 to US$4.9 billion by 2028, with a CAGR of 36.6%, indicating a high-speed expansion.
- The development of the global cobot industry is at a rather nascent stage, whose market size accounted for less than 2% of the global robot industry in terms of revenue in 2023.

**Note: It refer to the revenue generated from robots sold by manufacturers to the integrators/agents, which equals to the product of robots' shipment volume and factory prices.*

Source: Mordor intelligence, IFR,, China Insights Consultancy

Typical applications of Cobots, by degree of freedom

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Typical applications of Cobots, by degree of freedom

	Four-axis cobots	Six-axis cobots	Seven-axis cobots
Typical applications	• Four-axis cobots are used in applications such as adhesive application, material handling, inspection and testing, and assembly of small components. • They are also widely used in the 3C industry for handling, sorting, and assembling small parts.	• Six-axis cobots are extensively used in complex applications such as loading and unloading on production lines, material and palletizing. • They streamline automated operations in confined spaces within production lines and are well-suited for labor-intensive environments. • They are also widely used in commercial and healthcare sectors.	• Seven-axis cobots are often deployed in applications such as medical surgical assistance, intricate precision manufacturing, and research.

Key analysis

- In 2023, six-axis and four-axis cobots accounted for 53.2% and 40.9% of the market shares as measured by shipment volume, respectively, while seven-axis cobots have a market share of 17.7%. The world's first cobot was a six-axis cobot. Six-axis cobots are expected to continue to take the lead in the industry in the foreseeable future, which is expected to take up 62.8% of the total market share in 2028.
- The six-axis design offers ample flexibility and precision to meet the needs of most industrial applications while maintaining the advantages of cost-effectiveness and ease of programming, effectively replicating the motion range of the human arms. The shipment volume distribution by payload in 2023 indicates a strong preference for light payload and medium payload cobots, with light payload and medium payload cobots accounting for a global market share of 65.0% and 25.0%, respectively.

Source: China Insights Consultancy

Comparative Analysis of the Cobots and other Robots

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Comparative Analysis of the Cobots, Traditional Industrial Robots, and Service Robots

	Cobots	Traditional Industrial Robots	Service Robots
Typical use cases	• Various scenarios such as industrial, commercial, medical and healthcare, and scientific research and education	• Industrial scenarios such as automotive manufacturing, characterized by fixed assembly lines, high speed, heavy loads, long reach, and minimal need for human interaction.	• Non-industrial scenarios such as educational, logistics, reception, food delivery, vacuum and floor cleaning
Structure and function	• Equipped with robotic arm, emphasis on upper body operations	• Equipped with robotic arm, emphasis on upper body operations	• NOT equipped with robotic arm, emphasis on the lower body movement, including wheeled, tracked, or legged mobile platform
Execution, flexibility and interaction	• Strong execution capability with flexibility • More interaction with human through graphical programming with drag-and-drop functionality	• Strong execution capability • Limited interaction with human	• Moderate execution capability • Moderate interaction with human, mainly through voice interaction and touch screen operation
Load and precisions	• Emphasizing low self-weight with integrated joints, flexibility and safety • With rated loads typically under 20kg, and generally not exceeding 30kg	• High rigidity, prioritizing precision and speed • With a wide range of rated loads, typically ranging from 20kg to 1,000kg for medium to heavy loads	• Lightweight design with mobility • Low self-weight
Technical difficulties	• High-precision position control and force control. • Integration of complex components and control algorithms • Collision avoidance and Human-robot interaction techniques	• High precision position control and moderate force control. • Integration of complex components and control algorithms	• Navigation and path planning • Energy efficiency and endurance duration • Human-robot interaction techniques
Safety	• Human-robot collaboration with features enabling safe co-working in the same shared space	• Requires a physical barrier, such as a fence, to ensure safety by separating humans from machinery	• High security with obstacle avoidance function, ensuring no harm when interacting with human
Price	◕	◕	◔

Note: Price range from low ◔ to high ◕

Source: China Insights Consultancy

Industry Chain Analysis of the Global Cobot Market

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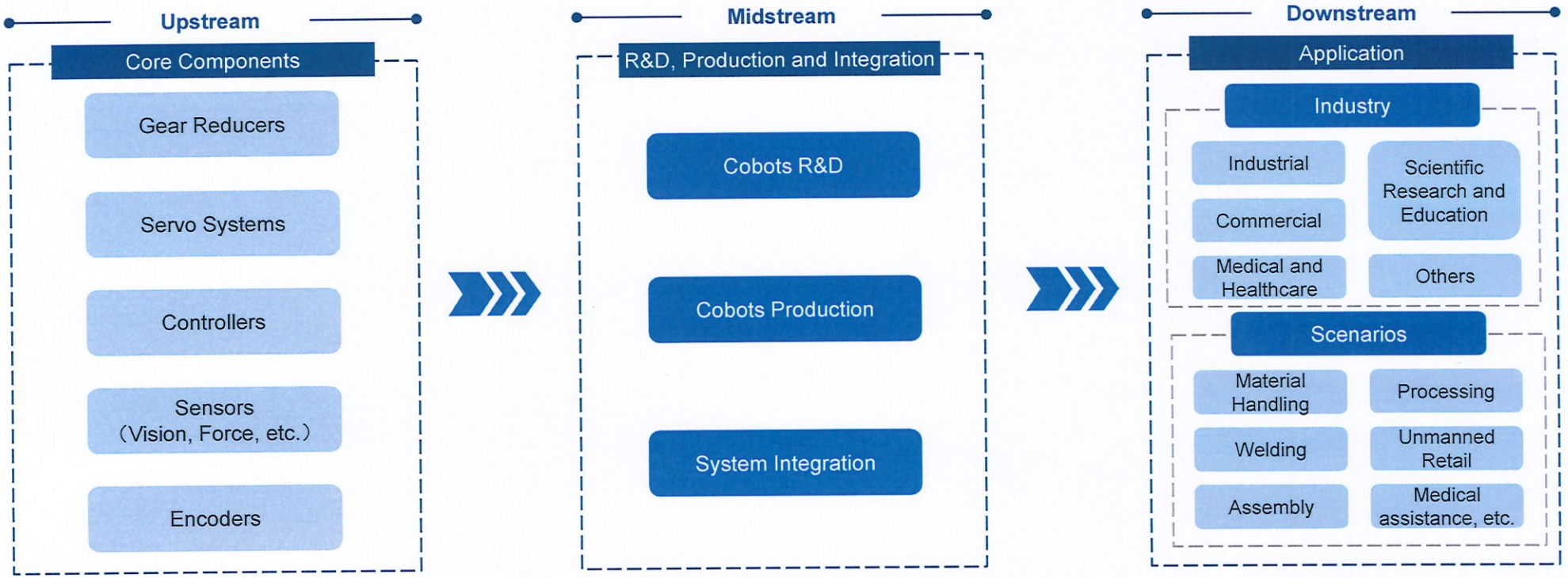
Industry chain analysis of the global cobot market



Key analysis

- The cobot industry chain is primarily divided into three major segments, i.e., manufacturers for key components of cobots, cobot companies and integrators, and end users. The following table sets forth the details of these industry participants.

Notes: Cobot manufacturers do not usually participate in this process, as such process requires substantial resources, while cobot integrators fill this gap with specialized design, engineering and programming resources.

Source: China Insights Consultancy

Overall Analysis of Application Pain Points in the Downstream Industries of Cobots

1 Limitations in application scenarios	• Pain points in task precision and flexibility limit the widespread use of cobots. These hurdles arise from task complexity, varied work environments, programming intricacies, and safety concerns. Cobots struggle with minor adjustments or adapting to sudden changes. Addressing these limitations is crucial to expanding cobot adoption and enhancing its use across industries.
2 Cobot intelligence levels remain insufficient	• Cobots still lack the necessary intelligence to manage tasks in complex environments. They struggle with real-time decision-making and problem-solving in unstructured settings, which limits their adaptability. Pain points such as interpreting visual or tactile feedback for tasks like quality inspection and human-machine interactions are complex, and cobots often struggle to interpret and respond accurately to human gestures and commands. Addressing cobots' intelligence limitations is needed to improve their effectiveness in dynamic work environments beyond their current use in automating routine tasks.
3 High cost of core components and limited mass production	• Cobot development is hampered by expensive core components and constraints in mass production. The intricate technology needed for ensuring safe human-machine interaction, along with substantial research and development costs, contributes to these high expenditures. Moreover, the assembly procedures and reliance on complex supply chains exacerbate difficulties in achieving economies of scale. Cobots' core components routinely account for most of the overall cost. For example, servo systems, gear reducers, controllers, and sensors comprise over 80% of the total cost for a six-axis 5kg cobot.

Source: Trading Economics, China Insights Consultancy

Pain Point Analysis and Advantages of Cobots in Different Application Scenarios for Downstream Industry Clients (1/3)

		Pain Point	Advantages of Cobots
Industrial	Material Handling	• Human-Machine Collaboration Safety: Addressing the safety concerns surrounding frequent human presence around machine tools and ensuring safety in human-machine collaboration. • Rapid Deployment: With a wide variety of machined parts, there is a need to swiftly switch production by quickly integrating process data for different model types and efficiently interfacing with machine tool equipment through rapid communication. • Deployment Space: Narrow passages around machine tools necessitate installations in relatively confined spaces.	• Flexible and Adaptive: Cobots are capable of sharing workspaces without safety enclosures, adapting seamlessly to diverse production environments, and quickly adjusting to various production needs, including small-batch, multi-variety production. • Enhanced Production Efficiency: Particularly beneficial for small-scale or customized production settings, cobots eliminate the need for additional safety infrastructure and enhance production efficiency without altering existing production line layouts. • Human-Robot Safety Collaboration: Equipped with intelligent sensors and collision detection features, cobots ensure safe interaction with human workers, fostering effective teamwork while maintaining safety standards. • Versatile Application: Cobots excel in diverse production scenarios such as gluing and inspection, providing comprehensive automation solutions for the 3C electronics industry. • Intelligent Integration: Cobots possess intelligent characteristics and seamlessly integrate with other equipment and systems, enhancing production efficiency and quality control. • Rapid Deployment and Low Costs: With flexible programming and operation, cobots offer rapid deployment at low costs, simple operation, and quick responsiveness to production line changes, meeting the need for setting up workstations promptly.
	Welding	• Quick Deployment: For tasks like laser welding gas stove pipelines, need to work in coordination with fixed fixtures and laser welding heads to swiftly set up welding workstations. • Safety: Human assistance is required for product loading and unloading, while robots conduct fast and precise welding • Multi-Station Mobile Operations: Operations entail swift movement across multiple stations.	
	Assembly	• Complex Deployment Process: Traditional assembly line robots often require extensive time and resources for deployment, especially when integrating with existing fixtures and machinery. • Safety: Conventional assembly line robots typically operate within enclosed safety cages, limiting their flexibility and requiring additional safety precautions when human interaction is necessary.	
	Processing	• Trajectory Control: Precision and stability are crucial for cutting components such as dashboards. • Rapid Deployment: The complex programming and debugging during line changes lead to lengthy deployment cycles.	

Source: China Insights Consultancy

Pain Point Analysis and Advantages of Cobots in Different Application Scenarios for Downstream Industry Clients(2/3)

		Pain Point	Advantages of Cobots
Commercial Retail	Assisted Meal Preparation	• Food preparation in the catering industry involves complex and varied tasks, requiring strict adherence to hygiene standards and food safety regulations, with kitchen environments susceptible to factors like temperature, humidity, and fumes.	• Efficient Food Preparation: Cobots streamline complex tasks, ensuring adherence to hygiene standards and food safety regulations in variable kitchen conditions. • Contactless service: Cobots offer safe sorting and delivery options, eliminating disease transmission risks associated with human contact during traditional delivery methods. • Automated Inventory Management: Cobots inventory tasks, saving time and reducing human error, while also improving checkout speed and efficiency, and handling cleaning and maintenance duties.
	Contactless Service	• Traditional delivery methods may involve personnel contact, posing risks of disease transmission, high labor costs, dependency on workers' hours and efficiency, and inconsistent service quality.	
	Smart Retail	• Inventory management and shelf restocking typically require significant manpower and time, with low checkout speed and efficiency, as well as tedious cleaning and maintenance tasks.	
Medical and Healthcare	Physiotherapy and Rehabilitation	• Professional medical guidance and assistance are necessary but limited in availability and costly, while rehabilitation therapy requires high precision and consistency, constrained by time and capacity limitations for manual treatment.	• Precision and Consistency: Cobots ensure precise and consistent rehabilitation therapy, overcoming human limitations and time constraints. • Manpower Shortages: Cobots automate repetitive tasks in healthcare settings, such as surgical assistance and laboratory automation, addressing shortages in manpower resources and allowing healthcare professionals to focus on specialized patient care.
	Medical assistance	• Medical institutions often encounter shortages in manpower resources, particularly for tasks involving repetitive labor such as surgical assistance and laboratory automation, patient transport, medication delivery, and meal service.	

Source: China Insights Consultancy

Pain Point Analysis and Advantages of Cobots in Different Application Scenarios for Downstream Industry Clients(3/3)

		Pain Point	Advantages of Cobots
Scientific Research and Education	Scientific Research	• Scientific research often requires conducting numerous experiments, some of which may need to be conducted continuously for extended periods. • With a high degree of precision and accuracy in tasks such as sample handling or measurement and may involve hazardous substances or dangerous environments. • Student participation in laboratories and research projects may be limited by the availability of resources, time, and guidance.	• Experiment Assistance: Collaborative robots offer high precision in tasks like sample handling and measurements, reducing errors and improving experimental reliability. They can operate continuously in hazardous environments, minimizing human risk. • Resource Expansion: Collaborative robots expand laboratory resources, providing students with more practical opportunities. They enhance experiment scope and efficiency, maximizing students' learning potential. • Personalized Teaching: Collaborative robots offer tailored teaching assistance, creating interactive environments and adjusting content based on student feedback, improving teaching quality and learning outcomes. • Hands-on Experience: Collaborative robots provide hands-on experience, helping students gain practical skills and participate in real-world scientific research, enhancing their career competitiveness.
	Higher Education		
	Vocational Education	• Traditional skill training often requires significant investment in manpower, resources, and finances, resulting in high costs, while students have limited practical opportunities in schools or training institutions, making it difficult to gain real-world work experience.	
	K-12 Education	• Traditional teaching methods may struggle to meet the individualized learning needs of students, lack sufficient engagement and interactivity in classroom instruction, and face limitations in resources and support, potentially compromising teaching quality and effectiveness in certain schools and regions.	

Source: China Insights Consultancy

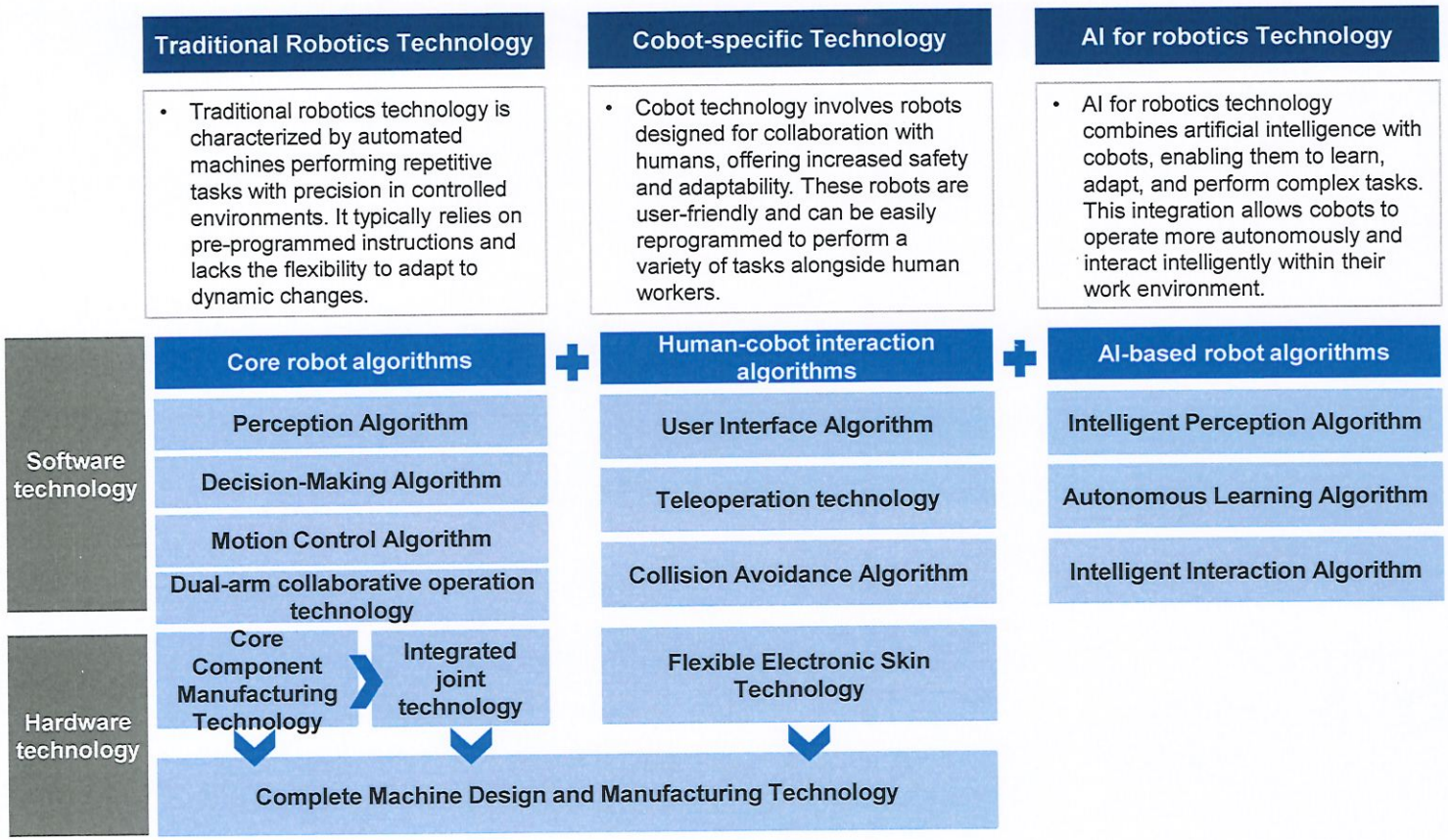
Key Technology Analysis of the Cobots (1/2)

Category	Key technology	Analysis
Core robot algorithms	Perception algorithm	• It enables robots to sense and interpret their environment through sensory inputs. They process data from cameras, lidars, tactile sensors, and other sensors to provide the robot with an understanding of its surroundings. Examples of perception algorithms include sensor fusion algorithms, visual demonstration learning technology.
	Decision-making algorithm	• It is responsible for planning and executing actions based on the robot's perception of the environment and its objectives.
	Motion control algorithm	• It manages the robot's physical movement, ensuring precise and smooth motion of its actuators and joints. Examples of motion control algorithms include kinematic full parameter compensation algorithm, continuous trajectory control algorithm, force control algorithm.
	Dual-arm collaborative operation technology	• It refers to an advanced control strategy that enables a pair of robotic arms to work in unison, sharing information and coordinating their movements for efficient and precise task execution.This technology broadens the applicability of cobots to scenarios that demand intricate synchronization and flexibility.
Human-cobot interaction algorithms	User interface algorithm	• For cobots with touch screens, graphic programming with drag-and-drop teaching functionality, or other interactive interfaces, these algorithms manage the interaction flow and user inputs.
	Teleoperation technology	• It allows users to operate cobots remotely in complex or hazardous environments, with force feedback capabilities, achieving high real-time performance and operational transparency.
	Collision avoidance algorithm	• It ensures that the cobot stops or adjusts its trajectory when a human is in close proximity in order to prevent collisions.
AI-based robot algorithms	Intelligent perception algorithm	• It takes the capabilities of perception algorithms a step further by using machine learning and deep learning to improve the robot's ability to interpret complex sensory data and adapt to new situations. It provides a higher level of understanding and context awareness, allowing the robot to make more informed decisions and interact more naturally with its environment.
	Autonomous learning algorithm	• It refers to a set of computational methods that enable a system to improve its performance on tasks through experience without being explicitly programmed, which is particularly important for advancing the capabilities of robots to operate autonomously, learn new skills, and handle unpredictable situations.
	Intelligent interaction algorithm	• It allows for seamless and intuitive communication between humans and machines, such as speech recognition, gesture recognition, and force sensing.
Hardware technologies	Core component manufacturing technology	• It involves the production of essential components such as gear reducers, servo systems, controllers, and sensors. Advanced manufacturing techniques improve the quality, precision, and reliability of these components, enhancing the overall performance of cobots.
	Flexible electronic skin technology	• It provides tactile feedback and environmental perception. This technology enables cobots to interact with objects and humans more intuitively and safely in shared workspaces.
	Integrated joint technology	• It integrates torque output, transmission, and control into a single joint, featuring a decoupled design for easy maintenance and a double-bearing structure to enhance operational stability.
	Complete machine design and manufacturing technology	• It includes the design and fabrication of the entire robot system, integrating various components into a cohesive and functional unit. Efficient design methodologies and manufacturing processes optimize robot performance while minimizing production costs.

Source: China Insights Consultancy

Key Technology Analysis of the Cobots (2/2)

Mapping of cobot technologies



Key analysis

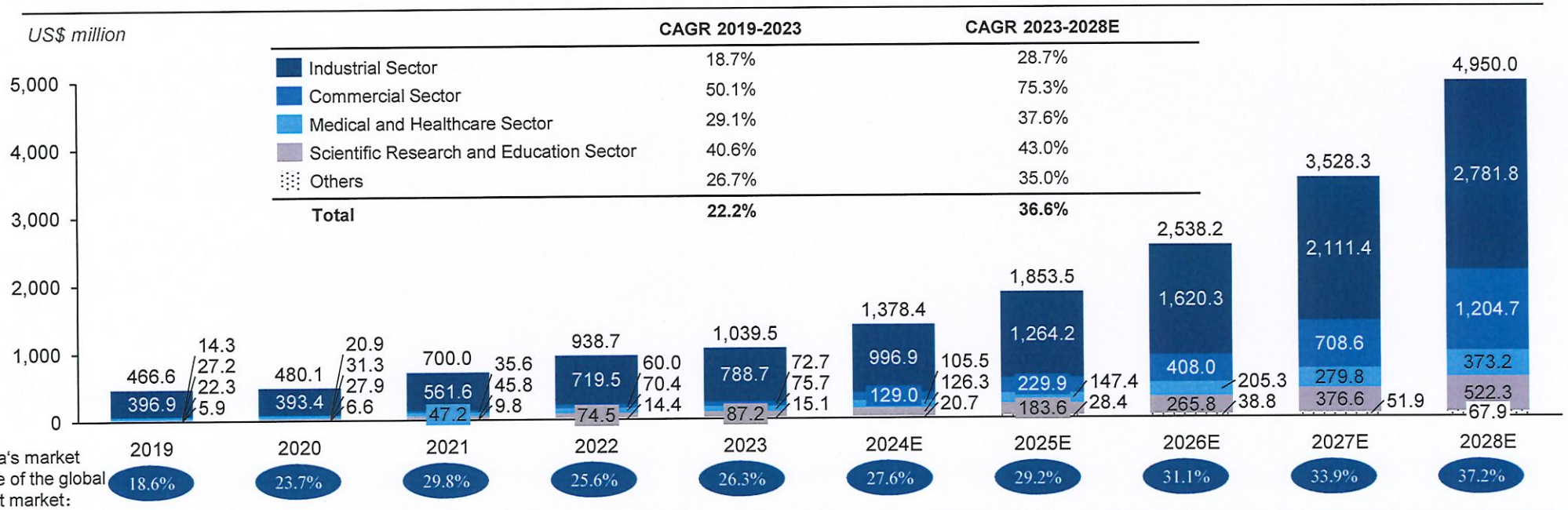
- Key technologies primarily consist of cobot algorithms and hardware technologies. Cobot
- algorithms enable robots to sense, decide and act with precision. For example, human-cobot interaction algorithms ensure safe and efficient collaboration between humans and cobots. In addition, hardware technologies are the physical foundation for cobots.
- Looking ahead, AI's function in advancing both algorithms and hardware technologies is pivotal. AI-based robot algorithms could further unlock the potential of cobots in more application scenarios, enabling more sophisticated motion control, more advanced safety measures, and more intuitive human-cobot interaction. AI-based robot algorithms could empower cobots with the ability to learn from demonstrations, adapt to varying conditions, and collaborate effectively with humans in shared workspaces. For example, a cobot on a factory floor can learn to assemble a product by perceiving a worker's movements and autonomously adjust its actions when introduced to a new component, improving workflow efficiency and safety.
- Technology advancements have made cobots more affordable and implementable, which has made them an increasingly attractive option for enterprises of all sizes, regardless of their financial resources and technical expertise.
- With the proliferation of AI technologies.cobots are expected to possess generalized learningand become capable of handling more complex, adaptive functions, which will further drive customerdemand across various industries

Source: China Insights Consultancy

Market size of the global cobots by revenue, categorized by downstream industry sectors

CIC 灼识咨询 China Insights Consultancy

Market size of the global cobots by revenue, categorized by downstream industry sectors, 2019-2028E



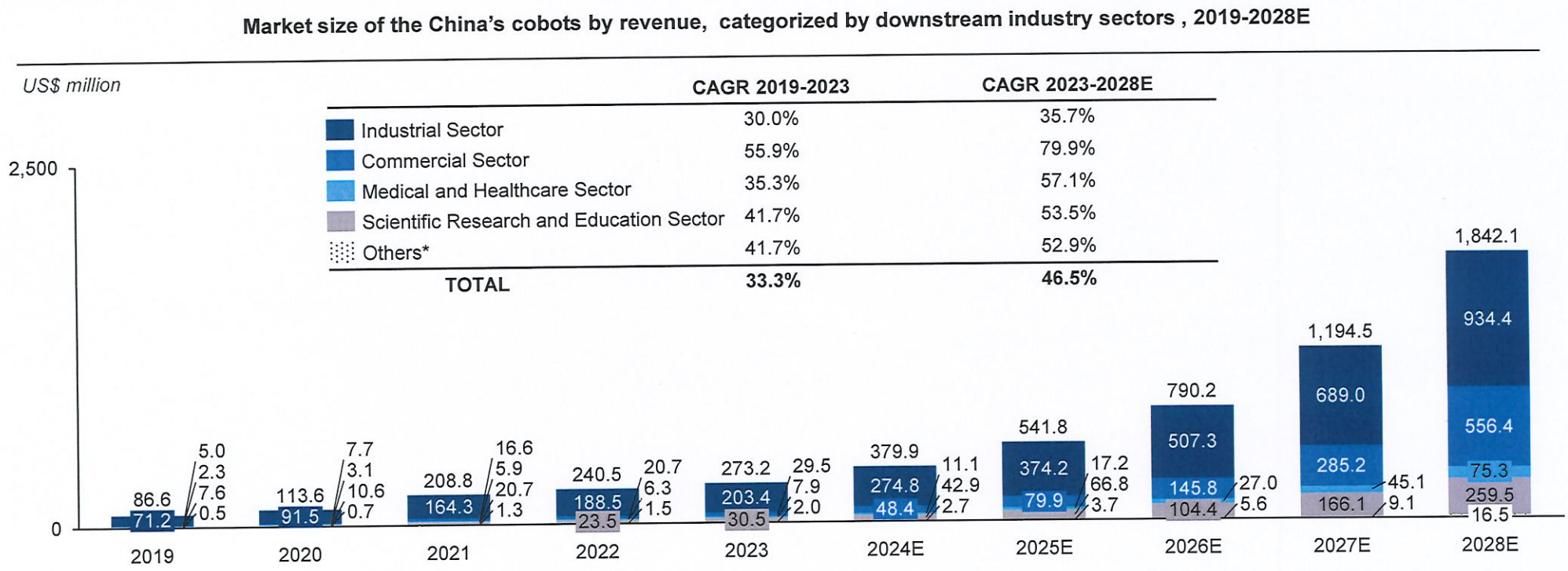
Key analysis

- The global cobot industry as measured by sales revenue has grown from US$466.6 million in 2019 to US$1,039.5 million in 2023, at a CAGR of 22.2%. The global cobot market experienced a slowdown in growth between 2022 and 2023 in view of the weaker-than-expected recovery of the global economy after the COVID-19 pandemic, a high-interest-rate financial environment that restrained some manufacturers' investment intentions, geopolitical conflicts, and a slow reshaping of supply chains in the post-pandemic era. However, it is expected that the market will grow exponentially from 2024 onwards, with the market size projected to reach US$4,950.0 million in 2028, at a CAGR of 36.6% from 2023 to 2028. The rapid growth of the cobot market is primarily driven by several key factors. The Federal Reserve's decision to lower interest rates is instrumental in reducing global financing costs, which in turn stimulates investment and consumer spending, providing momentum for the global economic recovery. Concurrently, the field of general AI technology is experiencing explosive growth. The integration of AI and machine vision technologies not only greatly enhances the performance of cobots but also contributes to economies of scale, reducing costs and making cobots more affordable. Additionally, labor shortages and rising labor costs due to an aging population have resulted in an increase demand for automation. As a result, commercial sectors are increasingly adopting cobots for use cases such as unmanned retail, assisted meal preparation, and other services to improve economic efficiency.

Notes: Others include agricultural sector, entertainment sector and specialized sector.

Source: Mordor intelligence,, IFR,, China Insights Consultancy

Market size of the China's cobots by revenue, categorized by downstream industry sectors



Key analysis

- The market size of the China's cobots has grown from US$88.9 million in 2019 to US$281.0 million in 2023, representing a CAGR of 33.3%% between 2019 and 2023. The market size is expected to reach US$1,917.4 million in 2028, representing a CAGR of 46.8% between 2023 and 2028.
- The rapid growth of the cobots market is propelled by advancements in the commercial sector, technological iteration, expansion into diverse scenarios, and improved cost-effectiveness. Projections indicate a substantial increase from US$37.4 million in 2023 to US$631.8 million by 2028, reflecting a high-speed expansion with a CAGR of 76.0%.

Notes: Others include agricultural sector, entertainment sector, specialty sector, etc.

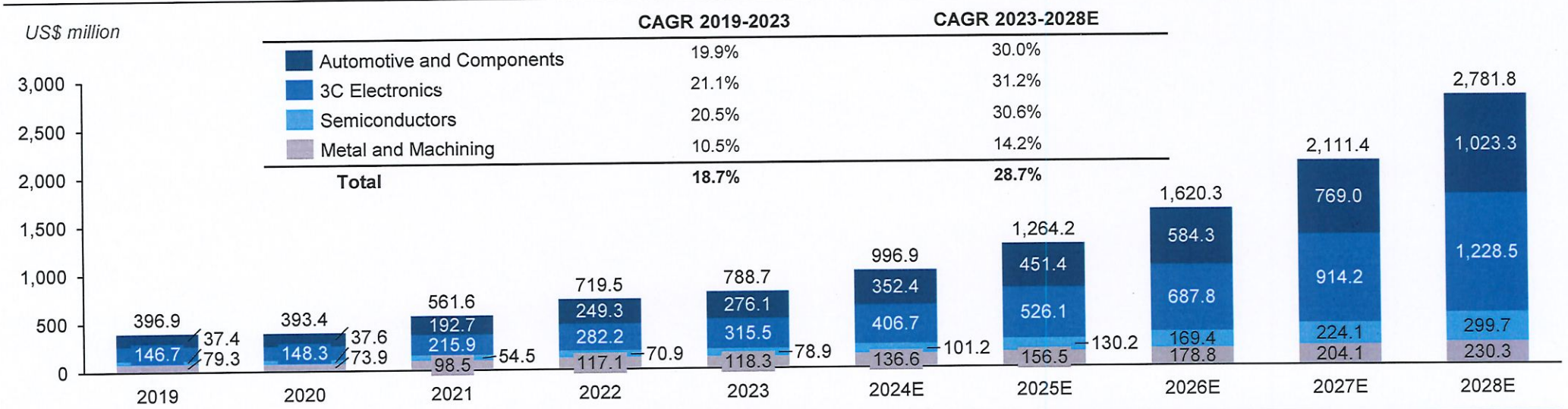
Source: Mordor intelligence,, IFR,, China Insights Consultancy

Market drivers of the Global Cobot Industry

Favorable policies promoting research and applications of cobots	• Many countries are introducing policies to provide both macro-level guidance and concrete support for the development of cobots in terms of technology, funding, and applications. Certain policies issued by the Chinese government have positive impact on our business, including (1) the 14th Five Year Plan for the Development of China's Robot Industry which seeks to promote breakthroughs in core robot technologies and high-end products and (2) the Implementation Plan for "Robot+" Application Action which aims to expand the use of robots manufacturing, agriculture, and healthcare, fostering the digital transformation of the economy and society. In particular, the 14th Five Year Plan for the Development of China's Robot Industry fosters breakthroughs in core robotic technologies, providing cobot companies like us with the impetus for technological upgrades and product innovation; the Implementation Plan for "Robot+" Application Action promotes the application of robots across various industries and accelerates the digital transformation and business expansion of cobot companies, providing cobot companies like us with broader market opportunities.
Aging population and rising labor cost	• As population ages, the workforce shrinks in proportion to the overall population, putting pressure on labor supply, reducing the pool of available workers, and driving up labor costs. The projected working-age population will decrease by 10% in OECD countries on average by 2060, while the proportion of population aged 65 and above globally is projected to increase from 10% in 2022 to 16% by 2050. The global labor participation rate declined from 71.2% in 2018 to 65.1% in 2022. As a result of the shortage of labor force, a 19% increase in global income from 2019 to 2023 further drove up labor costs, creating a significant demand for automation solutions such as cobots in various industries to address labor shortages and cost challenges.
Advancements in smart cobots	• Smart cobots, with advanced technology such as AI and vision sensors, are enhancing human-robot interactions. New interaction methods like manual drag teaching, voice control, and motion capture are also emerging. The global market of the smart cobots is expected to grow from US$0.4 billion in 2023 to US$3.6 billion in 2028, at a CAGR of 58.1%. Technologies such as machine vision and AI touch are equipping cobots with abilities to "see" and "touch," making cobots capable of performing more complex tasks. The economic benefit of artificial labor costs that can be collaborated by smart cobots globally is projected to reach US$19.6 billion in 2028.

Market size of the global industrial cobot by revenue, categorized by industrial market segments

Market size of the global industrial cobot by revenue, categorized by industrial market segments, 2019-2028E



Key analysis

- The global cobot market size for the industrial sectors has grown from US$396.9 million in 2019 to US$788.7 million in 2023, representing a CAGR of 18.7% between 2019 and 2023. The market size is expected to reach US$2,781.8 million in 2028, indicating a CAGR of 28.7% between 2023 and 2028.
- With the rapid growth of advanced manufacturing and automation, cobots can be utilized in various application scenarios, such as handling, welding, assembly, and processing.

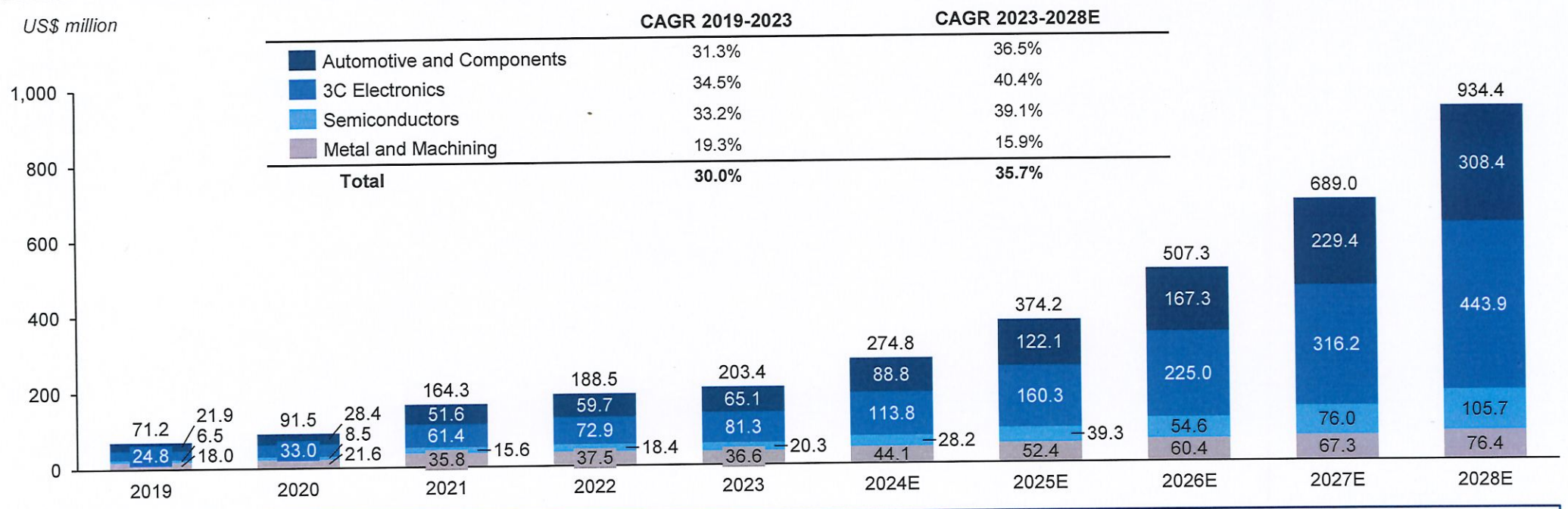
Notes: 1) In the automobile and components industry, cobots are widely deployed in the manufacturing process. Specific use cases include windshield adhesive application, screwdriving in smart cockpits, inspection for engines and vehicle bodies, and material handling for various automotive components. 2) In the 3C electronics industry, cobots are applied in the manufacturing processes of component assembly, final product assembly, testing and packaging. 3) In the semiconductor industry, cobots are applied in production, manufacturing, handling, and inspection processes. This includes tasks such as wafer handling, wafer inspection, chip testing, sorting, and packaging. 4) In the metal and machining industry, cobots are applied in cutting, forming, welding, and parts inspection.

Source: Mordor Intelligence,, IFR, China Insights Consultancy

Market size of the China's industrial cobot by revenue, categorized by industrial market segments

灼识咨询 China Insights Consultancy

Market size of the China's industrial cobot by revenue, categorized by industrial market segments, 2019-2028E



Key analysis

- The China's cobot market size for the industrial sectors has grown from US$71.2 million in 2019 to US$203.4 million in 2023, representing a CAGR of 30.0% between 2019 and 2023. The market size is expected to reach US$934.4 million in 2028, indicating a CAGR of 35.7% between 2023 and 2028.

Source: Mordor Intelligence,, IFR, China Insights Consultancy

Market Drivers of the Global & China's Industrial Cobots

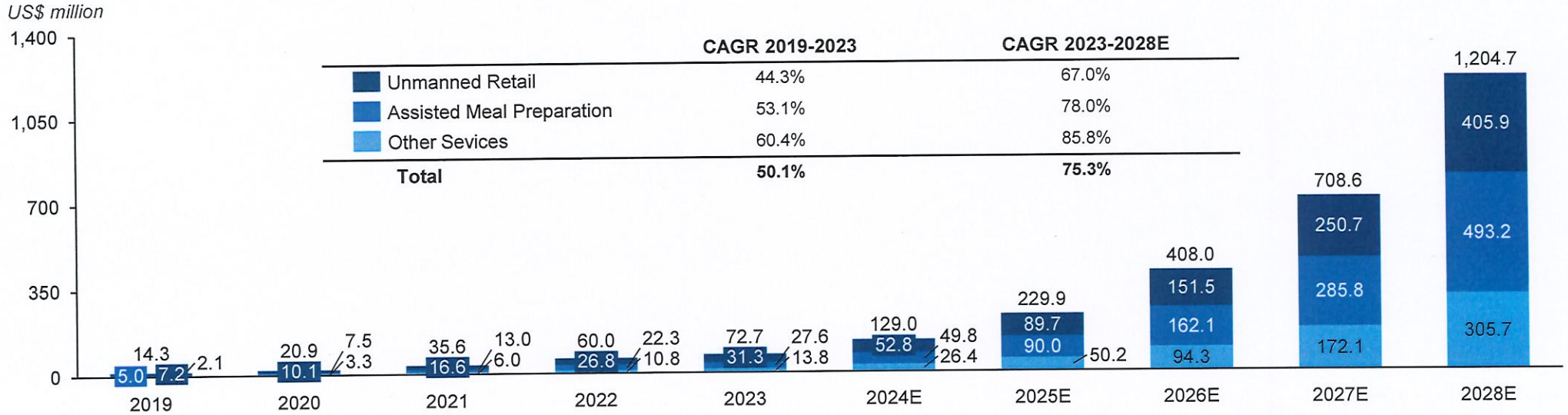
Diversifying Industrial Demands	• Industrial cobots are increasingly handling tasks including assembly, packaging, inspection, and material handling across industrial sectors such as automotive, 3C electronics, and semiconductor. The rapid growth of the downstream markets is an important support to ensure the rapid expansion of the global industrial cobot industry. The sales volume of global new energy vehicle is expected to increase from 14.6 million in 2023 to 38.2 million in 2028, with a CAGR of 21.2%, driven by carbon neutrality policy, autonomous driving advancements, and consumer demand for upgrades. Similarly, the global AR/VR market is expected to increase from US$47.6 billion in 2023 to US$146.7 billion in 2028, with a CAGR of 25.2%, driven by hardware upgrades, application diversification, and cost reductions. Additionally, the global automotive semiconductor market is expected to increase from US$67.0 billion in 2023 to US$115.2 billion in 2028, with a CAGR of 11.5%, driven by AI-driven chip demand, technological innovations, and electrification and intelligent development of vehicles.
Industrial Automation and Intelligent Upgrading	• With the fourth industrial revolution, automation and intelligent upgrading have become pivotal to manufacturing's evolution. Industrial cobots excel at executing high-precision, repetitive tasks and are designed to safely work alongside humans, enhancing production line efficiency and reducing costs. With the growing demand for intelligent and flexible manufacturing, the application scope and demand for industrial cobots will continue to expand.
Global Labor Shortage	• By 2030, a projected deficit of 85.0 million workers worldwide is expected to drive industrial cobot demand. Aging populations in developed countries and rising inflation rates have caused a general increase in labor costs. As labor costs continue to increase and labor markets tighten, factories are turning to industrial cobots to enhance production efficiency and reduce operational costs.

Source: China Insights Consultancy

Market size of the global commercial cobot by revenue, categorized by commercial market segments

灼识咨询 China Insights Consultancy

Market size of the global commercial cobot by revenue, categorized by commercial market segments, 2019-2028E



Key analysis

- The global cobot market size for the commercial retail sectors has grown from US$14.3 million in 2019 to US$72.7 million in 2023, representing a CAGR of 50.1% between 2019 and 2023. The market size is expected to reach US$1,204.7 million in 2028, indicating a CAGR of 75.3% between 2023 and 2028. Cobots are expected to enhance operational flexibility, reduce labor costs, and improve service quality in commercial retails.
- Cobots are expected to be widely applied in the fields of assisted meal preparation and smart retail with their increasing deployment in diverse settings including restaurants, home services, unmanned supermarkets, coffee shops, and malls, which indicates further growth potential.

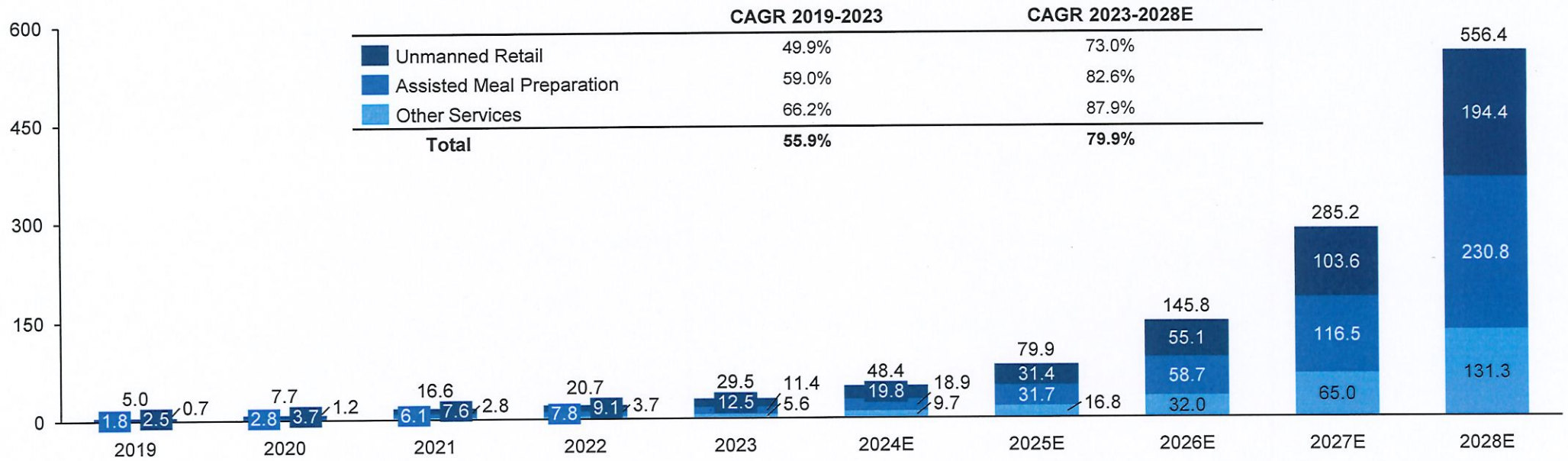
Notes: 1) In the catering industry, cobots are used for assisting staffs in meal preparation, such as making pancakes, cooking noodles, creating latte art, brewing tea drinks and making ice cream. 2) In the unmanned retail industry, cobots are applied in item sorting and delivery in the unmanned stores, hotels, pharmacies and warehouses, or deployed as unmanned vending machines in commercial spaces such as shopping malls and supermarkets. 3) In other services industries, cobots can be used in the innovative scenarios such as refueling and charging in the gas stations and e-commerce photography.

Source: Mordor Intelligence,, IFR, China Insights Consultancy

Market size of the China's commercial cobot by revenue, categorized by commercial market segments

灼识咨询 CIC China Insights Consultancy

Market size of the China's commercial cobot by revenue, categorized by commercial market segments, 2019-2028E



Key analysis

- The China's cobot market size for the commercial sectors has grown from US$5.0 million in 2019 to US$29.5 million in 2023, representing a CAGR of 55.9% between 2019 and 2023. The market size is expected to reach US$556.4 million in 2028, indicating a CAGR of 79.9% between 2023 and 2028.

Source: Mordor Intelligence,, IFR, China Insights Consultancy

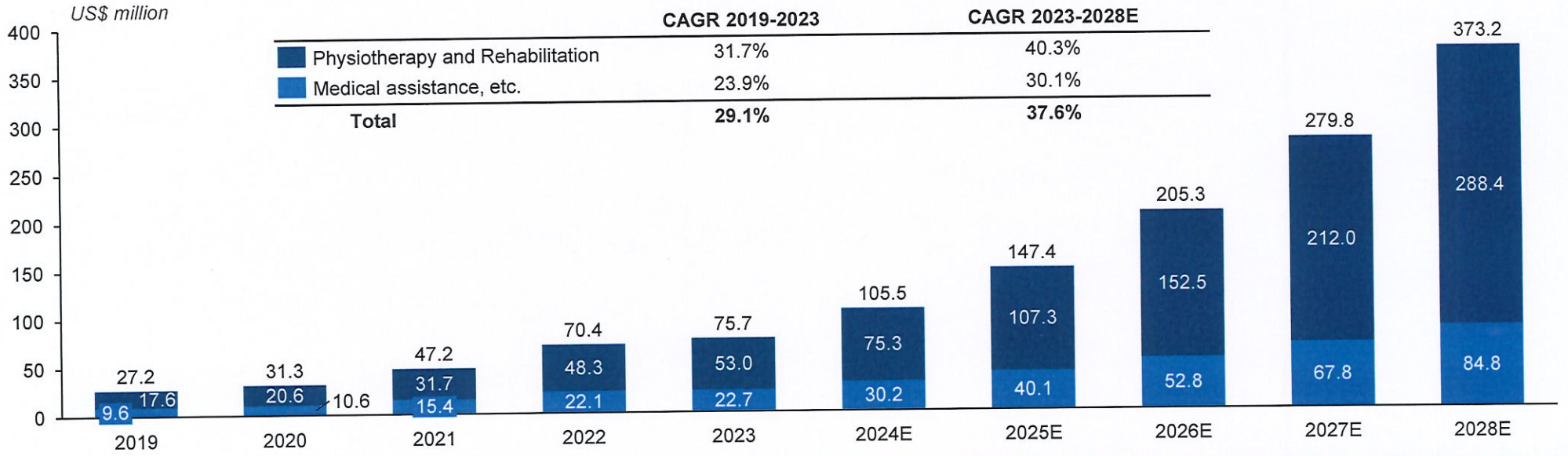
Market Drivers of the Global & China's Commercial Cobots

Commercial Digitalization and AI+	• The integration of commercial digitalization and AI has elevated the technological standards of new retail formats, enabling unmanned retail. These innovations have enhanced transaction efficiency and curtailed labor costs. In 2023, the global unmanned retail market reached US$72.8 billion, and is expected to grow to US$229.6 billion by 2028, at a CAGR of 25.8% between 2023 and 2028. Unmanned retail emerges as a novel retail model that economizes on human resource costs, signaling a promising developmental outlook.
Increasing Labor Costs	• A 3.6% increase in the global Total Labor Cost (TLC) per worker in 2023 due to rising wages has driven up labor costs significantly. This upward trend in labor expenses is accelerating the adoption of commercial cobots as businesses seek operational efficiency enhancements while reducing labor costs. The shift towards automation offers a strategic solution for companies to maintain competitiveness in an increasingly cost-sensitive environment.

Source: China Insights Consultancy

Market size of the global medical and healthcare cobot by revenue, categorized by medical and healthcare market segments

Market size of the global medical and healthcare cobot by revenue, categorized by medical and healthcare market segments, 2019-2028E



Key analysis

- The global cobot market size for the medical and healthcare sector has grown from US$27.2 million in 2019 to US$75.7 million in 2023, representing a CAGR of 29.1% between 2019 and 2023. The market size is expected to reach US$373.2 million in 2028, indicating a CAGR of 37.6% between 2023 and 2028. As society ages and caregiver costs rise, physiotherapy and rehabilitation will become important areas for the development of cobots in the medical and healthcare sectors.

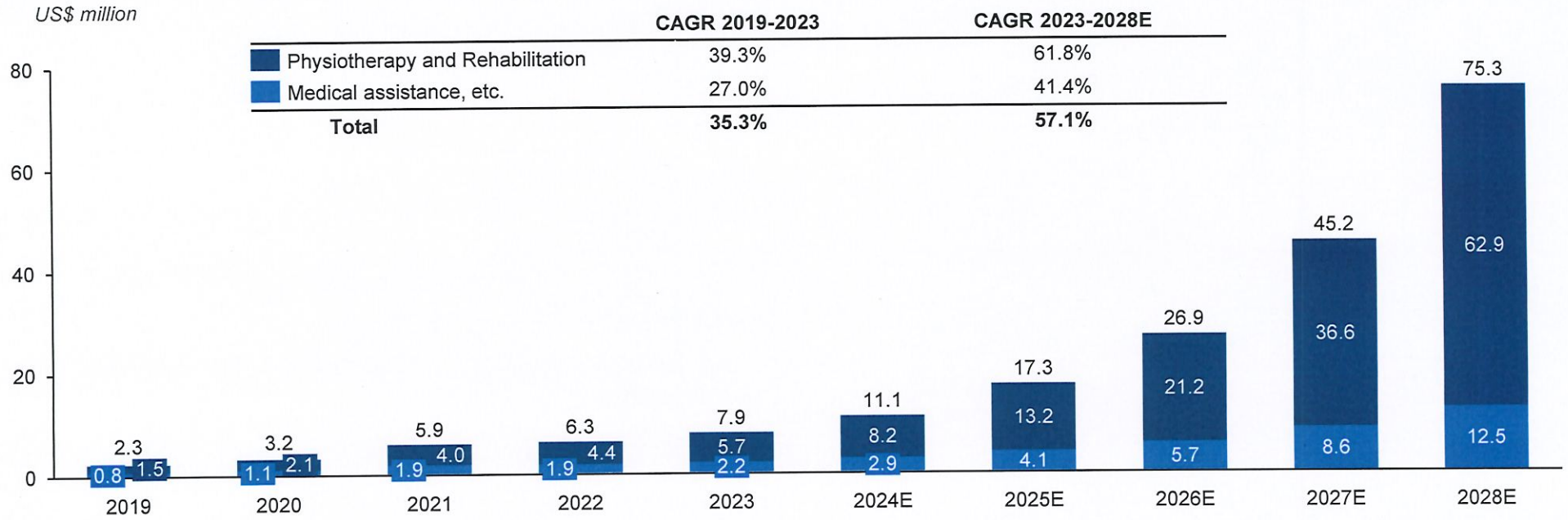
Notes: 1) Cobots are used for moxibustion physiotherapy and physical rehabilitation. 2) Cobots are used for surgical assistance and laboratory automation, such as drug development and testing as well as blood testing.

Source: Mordor Intelligence,, IFR, China Insights Consultancy

Market size of the China's medical and healthcare cobot by revenue, categorized by medical and healthcare market segments

灼识咨询 CIC China Insights Consultancy

Market size of the China's medical and healthcare cobot by revenue, categorized by medical and healthcare market segments, 2019-2028E



Key analysis

- The China's cobot market size for the medical and healthcare sector has grown from US$2.3 million in 2019 to US$7.9 million in 2023, representing a CAGR of 35.3% between 2019 and 2023. The market size is expected to reach US$75.3 million in 2028, indicating a CAGR of 57.1% between 2023 and 2028.

Source: Mordor Intelligence,, IFR, China Insights Consultancy

Market Drivers of the Global & China's Medical and Healthcare Cobots

Expanding Healthcare Market

- In 2023, the global digital healthcare market reached US$224.2 billion, and is expected to grow to US$784.3 billion by 2028, at a CAGR of 28.5% between 2023 and 2028. The development of the global digital healthcare industry is driven by the growing popularity of digital healthcare, and the continuous penetration of digital technologies such as cloud computing and artificial intelligence in the medical field. Meanwhile, the global shortage of medical service personnel against the backdrop of an aging population and the growing demand for automation equipment in the healthcare service industry will drive the rapid expansion of the global medical and healthcare cobot industry.

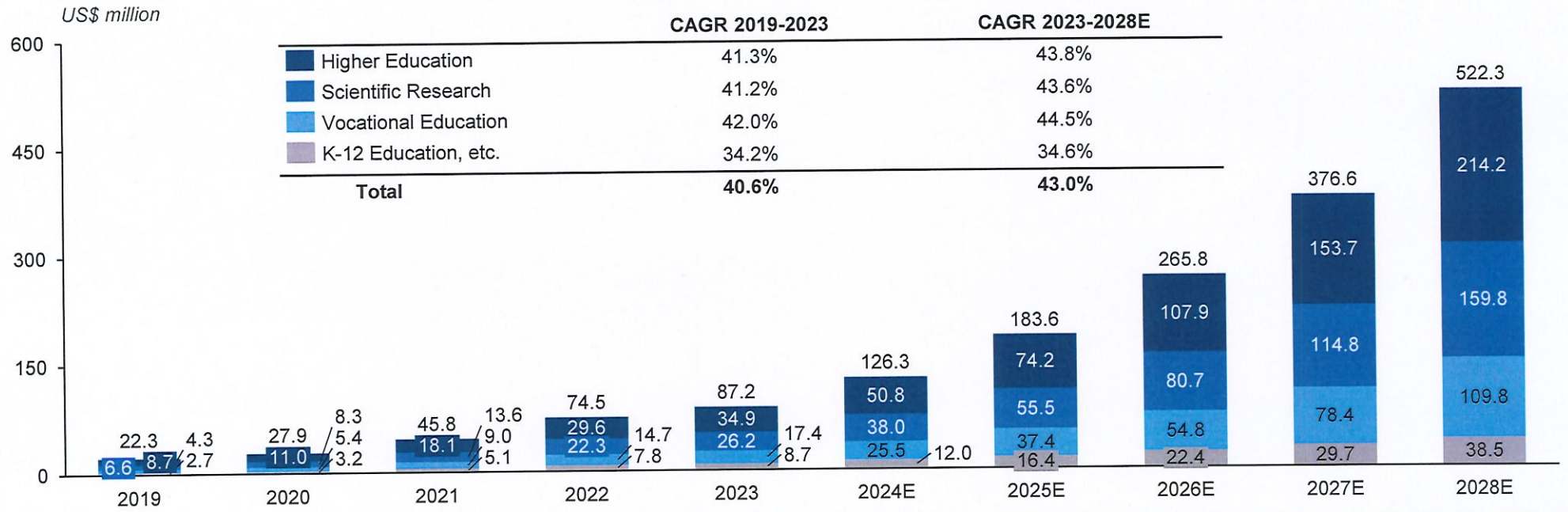
Aging Population

- In 2023, the global population aged 65 and above reached 761.0 million, and is expected to grow to 1.6 billion by 2050. China's demographic is aging rapidly, with the number of people aged 65 and above surpassing 220.0 million in 2023, accounting for 28.9% of the global population in that age group. This trend is intensifying the demand for elderly care, signaling a profound societal shift. The development of medical and healthcare cobots is poised to benefit from these trends, offering round-the-clock assistance, alleviating staffing shortages in elderly care and enhancing the quality of care through automated and precise services.

Source: China Insights Consultancy

Market size of the global scientific research and education cobot by revenue, categorized by scientific research and education market segments

Market size of the global scientific research and education cobot by revenue, categorized by scientific research and education market segments, 2019-2028E



Key analysis

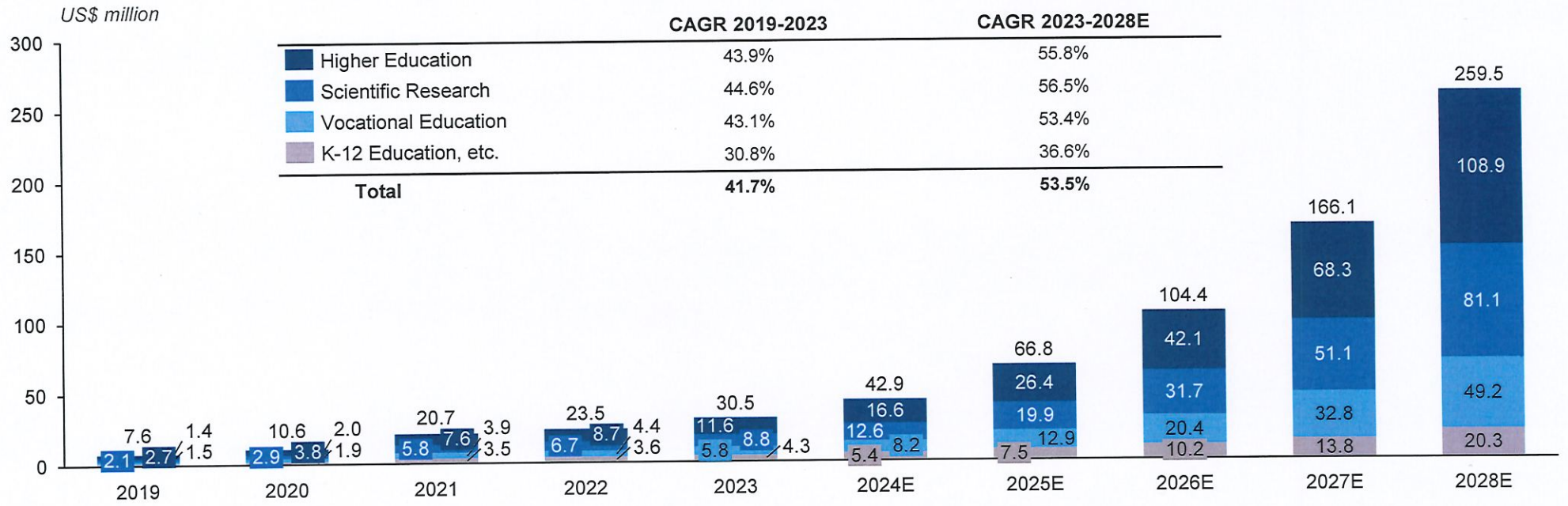
- The global cobot market size for the scientific research and education sector has grown from US$22.3 million in 2019 to US$87.2 million in 2023, representing a CAGR of 40.6% between 2019 and 2023. The market size is expected to reach US$522.3 million in 2028, indicating a CAGR of 43.0% between 2023 and 2028. Cobots are extensively utilized in the fields of scientific research and education due to their ability to offer hands-on practical experience, which is highly valued in vocational training. Additionally, the focus on emerging and high-potential areas of robotics and AI in scientific research makes cobots an indispensable tool for exploration and learning in these cutting-edge domains.

Notes: Cobots are used in scientific research and education for industry-academia-research integration projects (產學研一體化項目), STEAM education, research assistance and training simulations.

Source: Mordor Intelligence,, IFR, China Insights Consultancy

Market size of the China's scientific research and education cobot by revenue, categorized by scientific research and education market segments

Market size of the China's scientific research and education cobot by revenue, categorized by scientific research and education market segments, 2019-2028E



Key analysis

- The China's cobot market size for the scientific research and education sector has grown from US$7.6 million in 2019 to US$30.5 million in 2023, representing a CAGR of 41.7% between 2019 and 2023. The market size is expected to reach US$259.5 million in 2028, indicating a CAGR of 53.5% between 2023 and 2028.

Source: Mordor Intelligence,, IFR, China Insights Consultancy

Market Drivers of Global & China's Scientific Research and Education Cobots

Digital Transformation of Education

- Driven by the increasing demands for higher education quality and efficiency, the growth of personalized learning needs, and the in-depth application of digital technology in the field of education, the digital transformation and upgrading of the education industry is accelerating. In 2023, the global digital education market reached US$19.7 billion, and is expected to grow to US$66.7 billion by 2028, at a CAGR of 28.0% between 2023 and 2028. Higher vocational education places greater emphasis on practical experience accumulation, and university courses in AI and robotics also require robotic equipment as an important teaching aid. Therefore, the demand for cobot products in training laboratories is expected to continue to grow. Meanwhile, the progressive integration of AI courses in K-12 and higher education is broadening the role of cobots in educational settings. Beyond being practical teaching tools, they also foster STEM education and encourage interdisciplinary dialogue.

Continuously Improving Research Capabilities

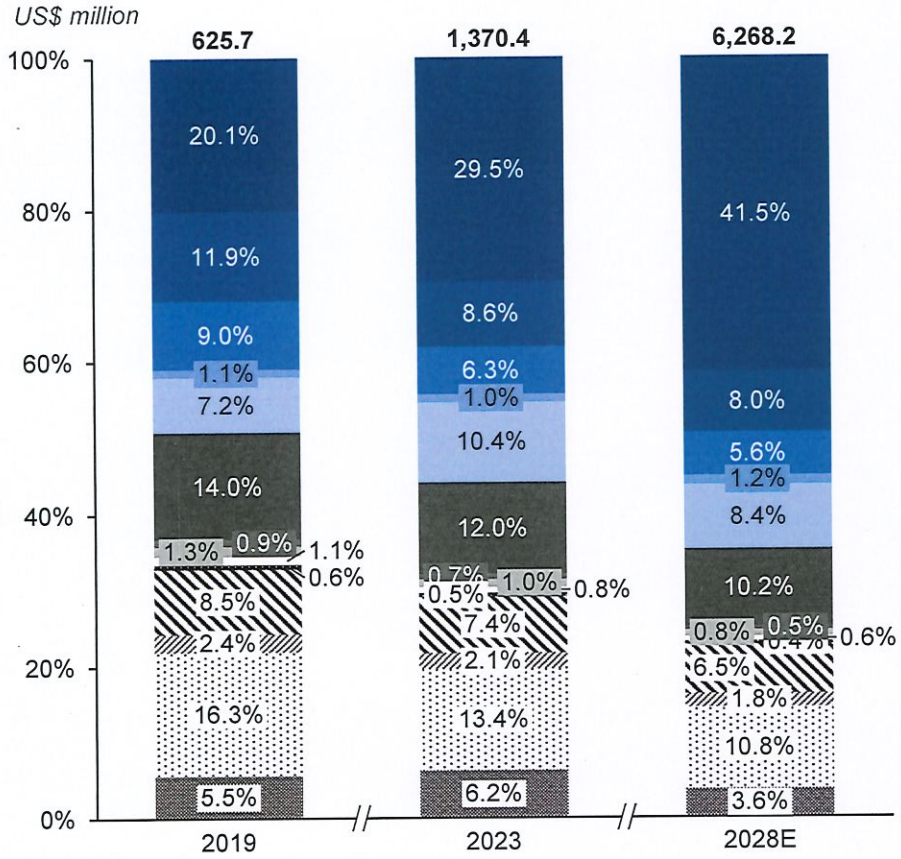
- In 2023, the global research investment reached approximately US$2.3 trillion. AI is vigorously advancing the transformation of research paradigms, and it is expected that the scale of global research investment will continue to grow. Given the high precision, repetition, and extensive data processing and collection inherent in scientific research tasks, cobots can assist with accomplishing these tasks more accurately and swiftly. Therefore, more cobots will be applied to scientific research in the future, promoting the development of global scientific research, as they are intertwined with the progress of AI.

Source: China Insights Consultancy

Market size of the Global Cobots categorized by end-use country (2/2)

灼识咨询 CIC China Insights Consultancy

Market size of the global cobots, measured by installation value, categorized by end-use regions, 2019-2028E



	CAGR 2019-2023	CAGR 2023-2028E
China	33.8%	45.1%
Japan	12.4%	33.5%
South Korea	11.1%	32.4%
Southeast Asia	20.4%	40.1%
Other Asian-Pacific countries	33.3%	29.8%
the United States	17.2%	31.2%
Canada	15.2%	24.6%
Mexico	14.4%	30.0%
Brazil	12.5%	30.6%
Other South American countries	14.4%	29.3%
Germany	17.5%	32.0%
France	17.5%	31.4%
Other European countries	15.7%	29.9%
Other countries and regions	25.2%	21.8%
Total	**21.7%**	**35.5%**

Note: Installation value=installation volume end-market selling price. Country/region division is based on the location of end use purchasers.*

Key analysis

- The growth of the global cobot market is attributed mainly to the demand from major economies such as China, Japan, South Korea, Germany, and the United States. Moreover, China and the Asia-Pacific region are the fastest-growing market segments. China stands out with a projected CAGR of 45.1% between 2023 and 2028, suggesting a substantial potential for the cobot market and indicating that it will continue to be a key driver of growth in the global landscape.

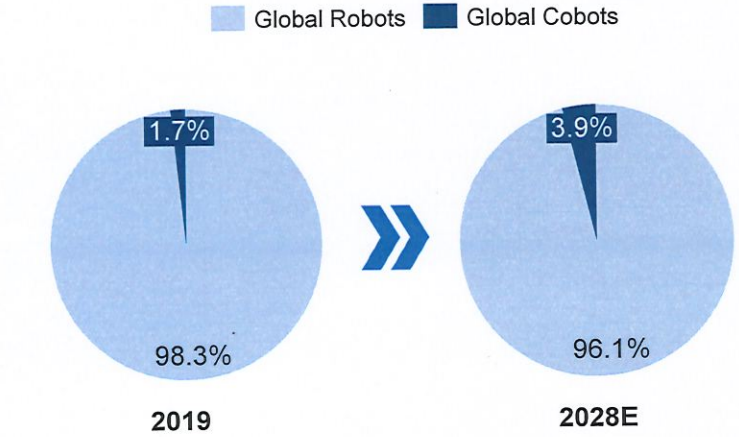
Source: IFR, China Insights Consultancy

Development Trends Analysis of the Global Cobot Market (1/4)

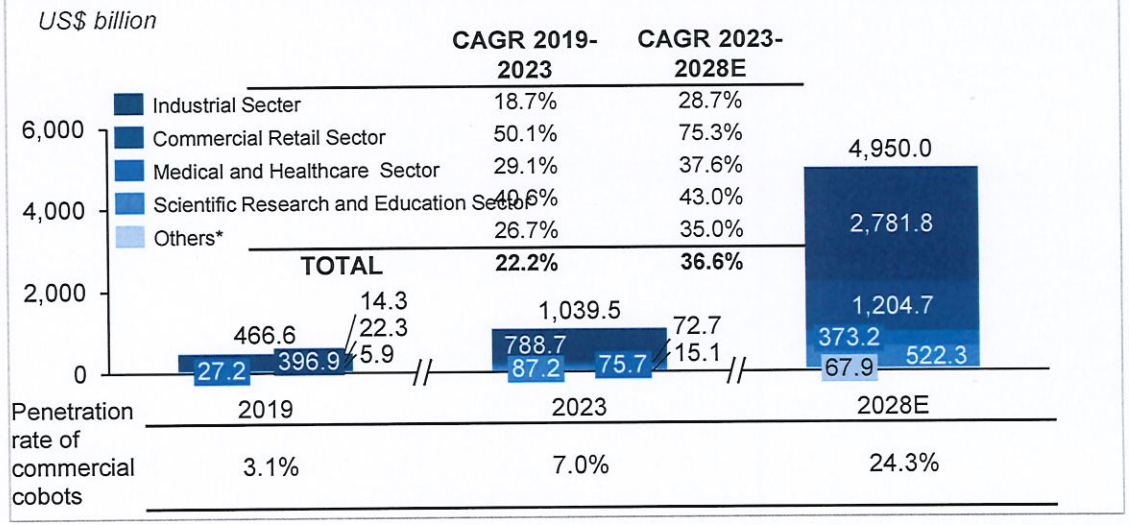
1 Diversification of downstream use cases

- The downstream use cases in the global cobot market are becoming increasingly diversified, driven by industry-specific demands, customization for various applications and integration with AI technologies. Enhanced safety measures have enabled closer human-robot collaborations, expanding global market reach. In commercial settings, customized cobots are increasingly used for inventory management, shelf stocking, unmanned retail, assisted meal preparation and other services. The global cobot market for commercial sectors experienced rapid growth, reaching a value of US$72.7 million in 2023, and is expected to reach US$1,204.7 million by 2028, at a CAGR of 75.3%.
- Cobots are being customized to meet the needs of diverse industries like industrial, healthcare, scientific research, education, and especially commercial, where we're witnessing a rapid surge in adoption. Specifically in commercial, tailored cobots are increasingly deployed for tasks like inventory management, shelf stocking, assisted meal preparation, and contactless service. The market for commercial cobots was valued at US$14.3 million in 2019 and is projected to reach US$1,204.7 million by 2028. The penetration rate has increased from 3.1% to 24.3% from 2019 to 2023.

Penetration rate of cobots in global robots, measured by revenue, 2019-2028E



Market Size of the Global Cobots, measured by revenue, 2019-2028E



Notes: Others include agricultural, entertainment and specialty cobots

Source: IFR, China Insights Consultancy

Development Trends Analysis of the Global Cobot Market (2/4)

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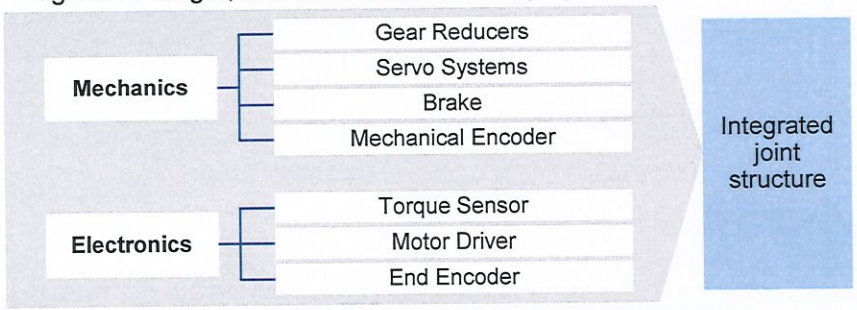
2 Integrating lightweight designs with automated production

- Drive and control integration technology has advanced the development of cobot joints towards more compact, integrated, and intelligent designs. This has facilitated the application of cobots in a broader range of fields. Technologies such as intelligent perception and integrated joint design have propelled the trend towards greater flexibility and automation. These advancements have enhanced cobot safety, usability, and flexibility and enabled them to adapt to the ever-changing demands of production and various working environments.
- The integration of AI into cobots is propelling the development of smart cobots that are more versatile and adaptive than ever before. Smart cobots with AI perception and decision-making ability are empowered to perform complex tasks with greater autonomy, make intelligent decisions based on real-time data, and collaborate seamlessly with human workers in various settings, from manufacturing floors to healthcare facilities. This evolution results in a new generation of cobots that can engage in a wider range of functions, adapt to dynamic work environments, and significantly enhance the efficiency and innovation of the industries they serve.

Integrated Joint Design Technology of cobots

- Cobots typically employ integrated joint design, incorporating components, within the robot joint, making each joint a compact control unit. With development of drive and control integration technology, the integrated joints becomes smaller in volume, lighter in weight, and more flexible for deployment.



Drive and control integration technology

More flexible and automated production with cobots

Intelligent Perception Technology	• Through the integration of information from multiple sensors, cobots can achieve proactive perception more effectively.
Autonomous Cognition Technology	• With enhanced capabilities for anomaly handling, it enables dexterous operations and autonomous control.
Human-Machine Interaction Technology	• Simplifies the process of robot teaching and operation, making robot operation more intelligent.
Collision Detection Technology	• Improves the safety of human-robot collaboration.

Source: China Insights Consultancy

Development Trends Analysis of the Global Cobot Market (3/4)

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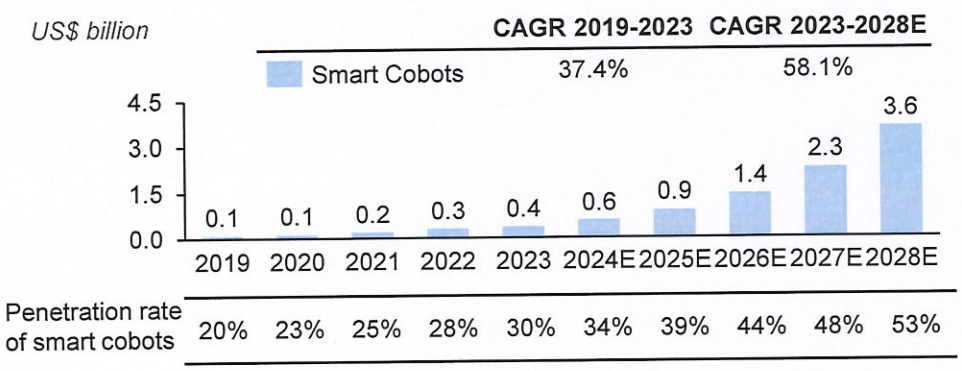
3

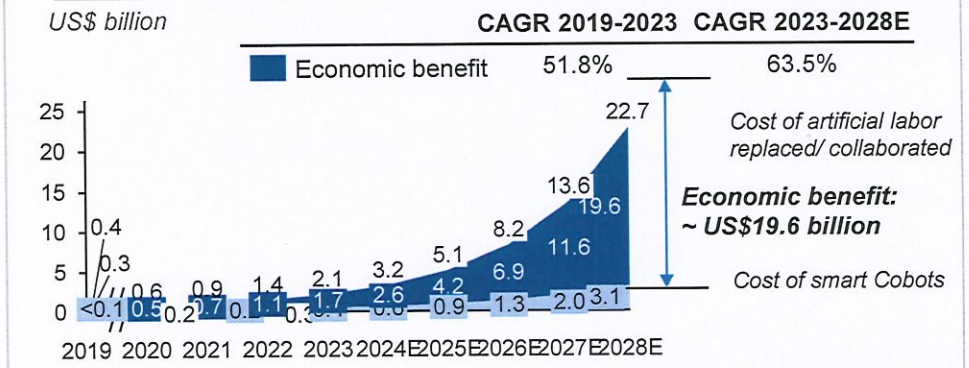
Integration of AI into cobots

- The integration of AI into cobots is driving the development of smart cobots that are more versatile and adaptive than before. Smart cobots with AI perception and decision-making ability are empowered to perform complex tasks with greater autonomy, make intelligent decisions based on real-time data, and collaborate seamlessly with human workers in various settings, from manufacturing floors to healthcare facilities. This evolution results in a new generation of cobots that can engage in a wider range of functions, adapt to dynamic work environments, and significantly enhance the efficiency and innovation of the industries they serve.

Market size of the global smart cobots, measured by revenue, 2019-2028E



Economic benefit calculation of the labor cost of artificial labor that can be collaborated by smart cobots globally, measured by potential revenue size, 2019-2028E



**Notes: The penetration rate of smart cobots refers to the proportion of cobots equipped with intelligent hardware and software such as vision sensors and AI algorithms, relative to the total number of cobots. This is calculated separately for industrial, commercial, and other scenarios.*

***Notes: The economic benefit is the difference between the cost of labor replaced/collaborated by the intelligent cobots and the cost of the cobots themselves. The cost of labor replaced/collaborated is calculated based on the number of workers that a single intelligent cobot can replace multiplied by the average annual labor cost. The cost of the intelligent cobots is calculated based on the installed base of the cobots multiplied by the sum of the purchase price depreciated over five years and the maintenance and operational costs.*

Source: IFR, China Insights Consultancy

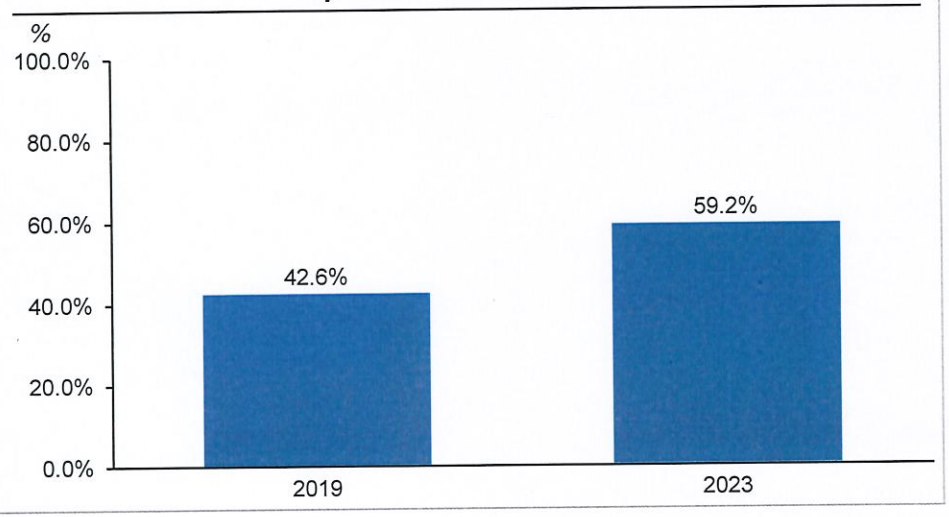
Development Trends Analysis of the Global Cobot Market (4/4)

4

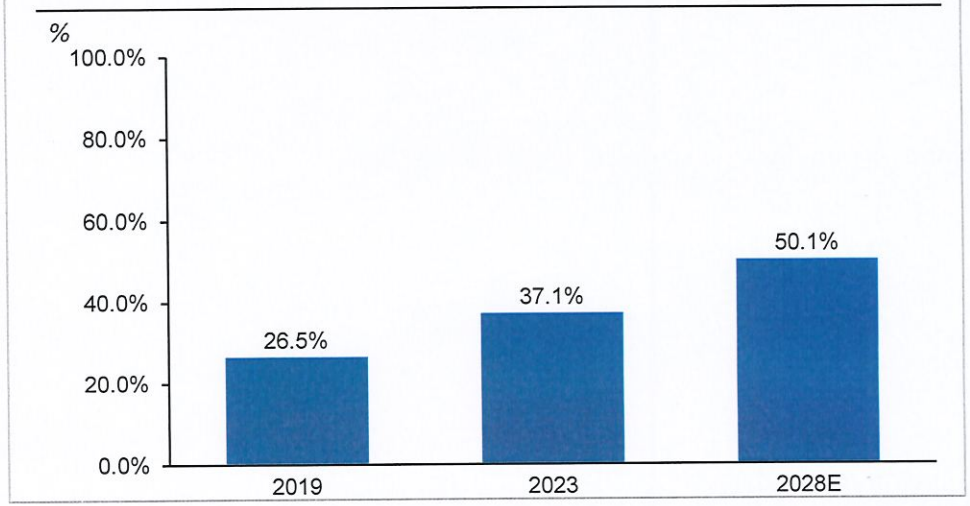
China's cobot industry drives global expansion

- The escalating export volume of Chinese cobots underscores China's growing dominance in the global cobot market, reflecting key industry trends. Bolstered by technological advancements and favorable policies, China has improved domestic production, boosting competitiveness and cost-effectiveness. Chinese cobots, known for their quality and affordability, are gaining significant traction in international markets. Projections suggest that China's share of global cobot shipment volume is expected to increase from 37.1% in 2023 to 50.1% in 2028.

The market share of Chinese manufacturers in global*, by global shipment volume 2019-2023



The market share of Chinese cobots in global, by shipment volume 2019-2028

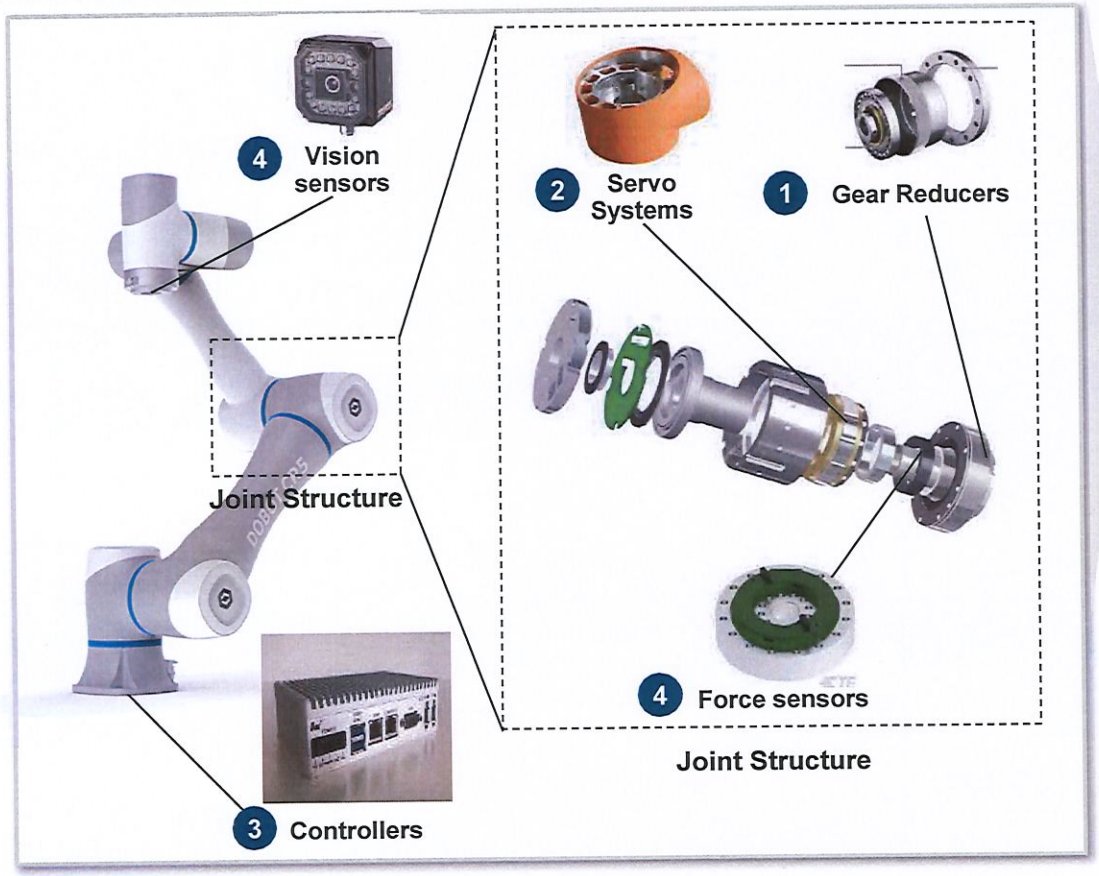


Notes: The market share of Chinese manufacturers refers to the percentage of Chinese manufacturers among the top 20 global cobot manufacturers by shipment volume.

Source: China Insights Consultancy

Analysis of Core Components of Cobots

Core Components of Cobots

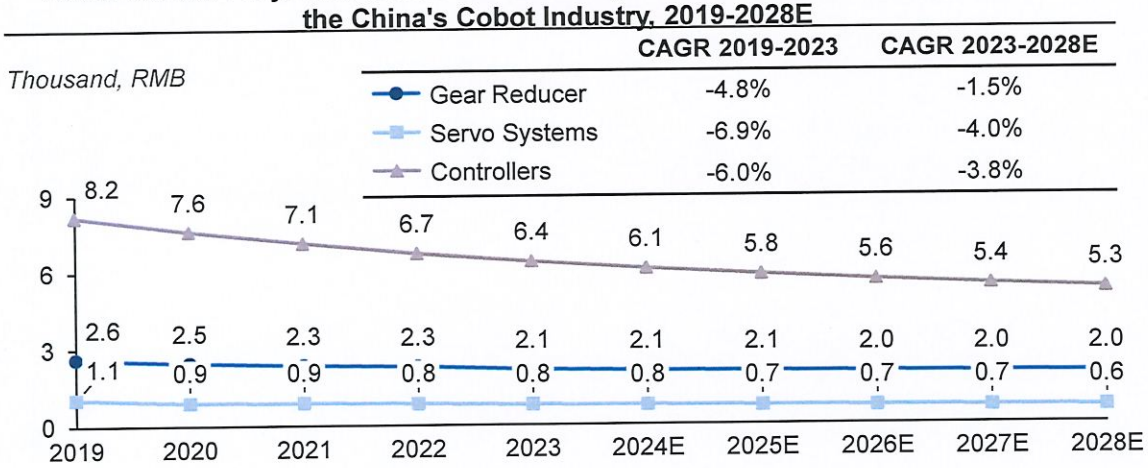


1	Gear Reducers	• A transmission component consisting of multiple gears, used to change torque and load capacity to achieve precise control.
2	Servo Systems	• Including servo motors, it controls the operation of mechanical components, converting voltage signals into torque and speed to drive controlled objects, and is a key factor affecting the performance of the machine.
3	Controllers	• A controller dedicated to controlling the motion of motors, motion control technology is part of the core competitiveness of cobot products.
4	Sensors	• **Force sensors:** Utilizes multidimensional force and torque sensors to perceive the external environment and provide feedback information. • **Vision sensors:** Assists cobots in achieving functions such as positioning, navigation, grasping, gripping, and autonomous obstacle avoidance.

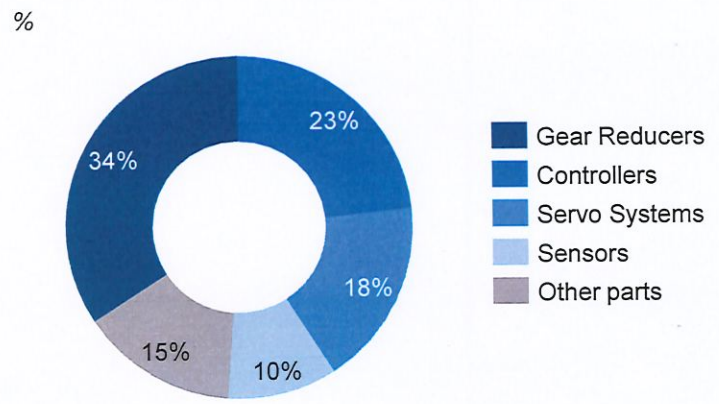
Source: China Insights Consultancy

Historical and Projected Trends of the Average Price of the Core Components in the China's Cobot Industry

Historical and Projected Trends of the Average Price of the Core Components in the China's Cobot Industry, 2019-2028E



Cost structure of Cobots' Core Components, Using a Six-axis 5kg Load Cobot as an Example, 2023



Key analysis

- Gear reducers, servo systems, and controllers are core components of Cobots, the cost of those three parts accounts for more than 70% of the overall material cost of Cobots. The average price of core components in the China's Cobot shows a downward trend. As technology advances and market competition intensifies, the overall cost of Cobots is showing a downward trend. Especially in terms of hardware and deployment costs, the trend of cost reduction is more pronounced with the accelerated localization process and simplified deployment methods.
- For instance, a six-axis cobot with a 5kg payload comprises six gear reducers, six servo systems, one motion controller, sensors and other components.
- The gear reducers, motion controllers, servo systems, sensors, and other components account for 34%, 23%, 18%, 10%, and 15% of the total cost, respectively.
- Increasing the number of axes in a cobot typically raises the cost of components like gear reducers and servo systems, as each additional axis requires dedicated gear mechanisms and motor controls for precise movement. Similarly, enhancing the payload capacity increases the costs for gear reducers and other structural components, as it requires stronger materials and more powerful motors to support the heavier load.
- Cobot prices are influenced by factors such as degrees of freedom, payload, branding and use cases. Cobots with higher degrees of freedom and greater payloads are typically priced higher, but other factors can also impact the price. For example, the price for four-axis cobots typically ranges from RMB3,000 to RMB50,000, while the price for cobots with six or more axes ranges from RMB20,000 to RMB200,000, primarily due to higher component costs. The pricing for integrated cobots is subject to the complexity of integration, customization and application. The specific needs of each project also influence the pricing. As a result, there is no standard pricing range or fixed criteria that generally apply to integrated cobots.

Source: CRIA, MIR, China Insights Consultancy

Market drivers of the China's Cobot Industry

Policies and the establishment of special funds encouragement	• Policies such as the "14th Five-Year Robot Industry Development Plan" and the notice on the implementation of the "Robot +" application action are aimed to promote breakthroughs in core robot technology and high-end products and develop China into a global hub for robot technology innovation, high-end manufacturing, and integrated applications by 2025. Meanwhile, the Beijing Municipal Government has established a RMB10 billion robot industry fund. These policies will help the collaborative robot industry occupy a more favorable position in the high-end manufacturing and integrated application markets both domestically and internationally.
Expanding depth and breadth of application scenarios in downstream industry sectors	• Cobots are seeing growing use in industrial sub-sectors that require flexible manufacturing, such as automotive parts manufacturing, 3C electronics, semiconductor manufacturing, intelligent logistics, packaging and printing, medical devices, and food processing. • With the advantages of human-machine collaboration and flexible production, cobot use is expanding to commercial services and retail, and the depth and breadth of downstream industry application scenarios also continue to grow.
Upstream core components overcoming technical challenges and shortcomings	• The core elements of cobots include reducers, servo systems, controllers, and sensors, which directly determine their performance, reliability, and load capacity. In recent years, the performance of domestic servo systems has improved. Reducers have broken through key technologies such as design principles, structural design, material optimization, processing and assembly processes, heat treatment, and process testing. Sensors and controllers have also been independently developed.
Modularization and biomimicry improving safety and flexibility standards	• With the growth of the flexible manufacturing industry, the update speed of automobiles and electronic products has greatly accelerated, and human-machine collaborative robot production lines can be deployed faster, with reduced costs during replacement. Moreover, cobots combining biomimetic principles can complete more refined actions and expand their application scenarios in industries such as medical care, education and training, and search and rescue. • Breakthroughs in intelligent, flexible operation technology have made significant progress in modular and biomimetic aspects of collaborative robot human-machine cooperation technology, further expanding cobot application scenarios.

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2 **COMPETITIVE LANDSCAPE OF THE GLOBAL COBOT INDUSTRY**

3 APPENDIX (Global and China's Macroeconomic Overview)

Ranking of the Top Market Players in the Global Cobot Industry (1/2)

灼识咨询 China Insights Consultancy

Ranking and market share of the top five market players in the global cobot industry, 2023

Ranking	Company	Overview	Listing status	Geographical coverage of products	Global cobots shipment volume, 2023 (units in ten thousands)	Market share (%)
1	Universal Robots(1)	• Established in 2005, headquartered in Denmark. It launched the world's first cobot in 2008 and focuses on the development and commercialization of cobots that enable automation upgrades in the industrial sector.	• Acquired by a publicly-listed company in the U.S.	• China and over 50 overseas countries and regions	1.6	14.8
2	**Our Company**	• **Established in 2015, headquartered in Shenzhen, China. Our Company is a company that specializes in the development, manufacturing and commercialization of cobots.**	• **Applied for listing on HKEX**	• **China and over 80 overseas countries and regions**	**1.4**	**13.0**
3	AUBO	• Established in 2015, headquartered in Beijing, China. It is a high-tech enterprise specializing in the research, development, production, and sale of cobots.	• Not listed	• China and over 50 overseas countries and regions	0.8	7.4
4	Elephant Robotics	• Established in 2016, headquartered in Shenzhen, China. It focuses on the development and manufacturing of cobots as well as the development of relevant platform software.	• Not listed	• China and over 50 overseas countries and regions	0.7	6.5%
5	JAKA	• Established in 2014, headquartered in Shanghai, China. It focuses on the research, development, manufacturing, and sales of cobots, as well as the integration of cobot systems.	• Applied for listing on SSE STAR Market	• China and over 50 overseas countries and regions	0.5	4.6
	Sub-total				**5.0**	**46.3**
	Others				**5.8**	**53.7**
	Total				**10.8**	**100.0**

Key analysis

- Manufacturers in the global cobot industry can be largely categorized into two groups. The first group is manufacturers of traditional industrial robots who have entered the cobot industry leveraging their experience in traditional industrial robot development. The second group comprises emerging manufacturers dedicated to the development and commercialization of cobots since their inception. In addition, the global cobot industry is dominated by market players from a few key countries, including China, Japan, Germany, the United States, and Denmark, among others. Notably, Chinese manufacturers have been growing rapidly in recent year, benefiting from a more comprehensive product matrix and cost advantages.
- The global cobot industry is relatively concentrated, with the top five market players accounting for approximately 46.3% of the market share in 2023 in terms of global cobot shipment volume. Notably, four of those leading players are Chinese manufacturers, underscoring the significant role that China is playing in shaping the global market landscape. In 2023, we ranked second among all market players in the global cobot industry and ranked first among all Chinese cobot companies, each measured by global cobot shipment volume. We rank seventh in the global cobot industry with a global market share of 3.6% in terms of global revenue generated from cobots in 2023. Our revenue has grown at a CAGR of 28.3% between 2021 and 2023, outpacing the industry average.
- The following table sets forth the ranking of the top five market players in the global cobot industry in terms of global cobot shipment volume in 2023.

(1) Universal Robots focuses on the development and commercialization of cobots that can be used in a wide range of industrial production environments. It commercially launched the world's first cobot in 2008, making it a well-recognized cobot brand in the industry.

Source: Annual reports, expert interviews, GGII, MIR, China Insights Consultancy

Ranking of the Top Market Players in the Global Cobot Industry (2/2)

CIC 灼识咨询 China Insights Consultancy

Ranking and market share of the top ten market players in the global cobot industry, 2023

Ranking	Company	Overview	Listing status	Global revenue generated form cobots, 2023 (in US$ million)	Market share (%)
1	Company A	• Established in 2005, headquartered in Denmark. It launched the world's first cobot in 2008 and focuses on the development and commercialization of cobots that enable automation upgrades in the industrial sector.	• Acquired by a publicly-listed company in the U.S.	303.8	29.2
2	Company B	• Established in Japan in 1976. It focuses on the field of factory automation and is one of the world's largest professional CNC system manufacturers and one of the top four industrial robot companies globally.	• Listed on JPX	103.5	10.0
3	Company C	• Established in 2015, headquartered in Beijing, China. It is a high-tech enterprise specializing in the research, development, production, and sale of cobots.	• Not listed	55.3	5.3
4	Company D	• Established in Switzerland in 1988. It is a technology leader in the fields of electrification and automation and one of the top four industrial robot companies globally.	• Listed on SIX Swiss Exchange、Stockholm Sstock Exchange、NYSE	48.4	4.7
5	Company E	• Established in Germany in 1898. It is a global supplier of intelligent automation solutions and one of the top four industrial robot companies globally.	• Listed on Frankfurt Stock Exchange	40.8	3.9
6	Company F	• Established in 2015, it is the only cobot manufacturer based in Taiwan. It offers cobots with embedded visual systems, software and application-based solutions to the market.	• Approved for public issue	38.9	3.7
7	**Our Company**	• **Established in 2015, headquartered in Shenzhen, China. Our Company is a company that specializes in the development, manufacturing and commercialization of cobots.**	• **Applied for listing on HKEX**	**37.9**	**3.6**
8	Company G	• Established in 2014, headquartered in Shanghai, China. It focuses on the research, development, manufacturing, and sales of cobots, as well as the integration of cobot systems.	• Applied for listing on SSE STAR Market	36.1	3.5
9	Company H	• Established in South Korea in 2015. It is dedicated to the production of cobots using its proprietary technology and stands as a leading company in the South Korean cobot market.	• Listed on KRX	32.7	3.1
10	Company I	• Established in Japan in 1915. It is a leading industrial robot company in the Americas. It provides automation products and solutions for virtually every industry and robotic application, including arc welding, assembly, coating, dispensing, material handling, material cutting, etc.	• Listed on JPX	28.0	2.7
	Sub-total			**725.3**	**69.8**
	Others			**314.2**	**30.2**
	Total			**1,039.5**	**100.0**

Key analysis

- The following table sets forth the ranking of the top 10 market players in the global cobot industry in terms of global revenue generated from cobots in 2023. The major market players in the global cobot industry in terms of global revenue include Universal Robots, FANUC, KUKA, ABB, and AUBO.

Source: Annual reports, expert interviews, China Insights Consultancy

Comparison of the Top Five Market Players in the Global Cobot Industry (1/2)

灼识咨询 China Insights Consultancy

Comparative analysis of product indicators, 2023

Company	Axis models of cobots	Payload capacity of six-axis cobots[1]					
		<3kg	3-7kg (excluding 7kg)	7-12kg (excluding 12kg)	12-20kg (excluding 20kg)	20-30kg (excluding 30kg)	≥30kg
Our Company	Four-axis and six-axis	√	√	√	√	√	×
Universal Robots	Six-axis	×	√	√	√	√	√
AUBO	Six-axis	×	√	√	√	√	√
Elephant Robotics	Four-axis and six-axis	√	×	×	×	×	×
JAKA	Six-axis	√	√	√	√	×	×

Key analysis

- As of the Latest Practicable Date, we offered a total of 27 cobot models in four series with payload capacity ranging from 0.25kg to 20kg, among which 22 were six-axis models and five were four-axis models, representing one of the most extensive product portfolios in the global cobot industry. Besides, Magician is the world's first desktop-level cobot for educational settings.
- The company offers the most extensive product portfolio in the global cobot industry, catering to numerous use cases in manufacturing, retail, healthcare, STEAM education, scientific research settings and many more.

(1) The payload capacity of six axis is chosen for the comparison, as major comparable companies generally offer six-axis cobots. Cobots can be categorized into light payload (<7kg), medium payload (7-12kg), heavy payload (12-20kg), super heavy payload (20-30kg) and extra heavy payload (>30kg). Specifically, the light payload cobots for the commercial sector typically feature a payload capacity of less than 3kg, which are classified as a distinct category. The selected payload range for the above comparison aligns with the industry classification.

Source: Annual reports, Expert interviews, China Insights Consultancy

Comparison of the Top Five Market Players in the Global Cobot Industry (2/2)

CIC 灼识咨询 China Insights Consultancy

Comparative analysis of technical indicators[1], 2023

Company	Repeat positioning Accuracy (mm)	Absolute positioning accuracy (mm)	Non-contact detection distance (cm)	Payload-to-weight ratio
Our Company	**±0.02**	**0.229**	**15 cm[2]**	**0.2**
Universal Robots	±0.03	~0.5	/	0.2
AUBO	±0.02	~0.5	/	0.2
JAKA	±0.02	~0.5	/	0.2

Key analysis

- In the cobot industry, performance standards focus on five key dimensions: accuracy, stability, reliability, flexibility, and safety. Key technical indicators include repeat positioning accuracy, absolute positioning accuracy, non-contact detection distance and payload-to-weight ratio. These performance indicators, as listed by cobot manufacturers in the market, subtly influence the way end-users evaluate and select cobot products. The smaller the repeat positioning accuracy value, the higher the precision of the cobot when performing the same task repeatedly. Similarly, the smaller the absolute positioning accuracy value, the more accurate the cobot can achieve the desired position when executing tasks. Additionally, the non-contact detection distance reflects the distance at which the cobot can detect objects without physical contact. The greater the non-contact detection distance, the higher the reliability and safety of the cobot in human-robot interaction. Furthermore, a higher payload-to-weight ratio indicates greater safety and flexibility of the cobot.
- Our cobots have achieved an absolute positioning accuracy of 0.229 mm and a repeat positioning accuracy of ±0.02 mm, with each parameter representing a leading standard in the global cobot industry. At the same time, our proprietary flexible e-skin technology, SafeSkin, allows our cobots to detect approaching objects 15 cm away while operating at a 1 m/s safety speed during the human-robot interaction.

(1) The above comparison is based on six-axis cobot models with a payload of 5 kg, which are commonly offered by major comparable companies as a mainstream model in the market. Elephant Robotics only offers cobots of a payload up to 2kg and is therefore not included in the comparison.

(2) This is primarily achieved through our propriety flexible e-skin technology.

Source: Annual reports, Expert interviews, GGII, MIR, China Insights Consultancy

Key Success Factors of the Global Cobot Industry

Key success factors of the global cobot industry, 2023

Leading research and development strength and technology	• Experienced research and development teams are adept at identifying and leveraging cutting-edge technology trends. An innovative research and development team, coupled with advanced technologies and know-how of the application scenarios, facilitates the development of new products, enhances product competitiveness, and influences market trends.
Product diversification for various use cases	• An extensive product matrix enhances a company's ability to adapt its cobots to various end-user use cases, meet personalized customer needs, and increase market share and industry influence.
High cost-performance ratio	• Companies must ensure product excellence while controlling costs in order to offer competitive pricing for customers. A high cost-performance ratio reflects a cobot company's comprehensive strengths in research and development, production, and supply chain management.
Strong channel expansion capabilities	• Effective channel expansion capabilities enable companies to swiftly respond to market changes, establish extensive sales and service networks, and build strong relationships with local distributors and integrators, which is crucial for market penetration and brand promotion.

Source: China Insights Consultancy

Entry Barriers to the Global Cobot Industry

Entry barriers to the global cobot industry, 2023

Entry barriers	Key analysis
Research and development investment costs	• Developing cobots requires significant investment in research and development, as well as substantial financial resources. The emergence of 5G communication and AI technologies is driving cobots into niche applications and enhancing their perceptive capabilities. This means manufacturers must invest heavily in technological advancements to develop new products and improve existing ones, ensuring they maintain market leadership.
Technological accumulation	• The cobot industry is characterized by high technological barriers that require extensive experience and accumulated knowledge. Established manufacturers benefit from years of technological development in core components like gear reducers, servo systems, and controllers, creating significant entry barriers for new players. Without this deep industry knowledge, new entrants struggle to produce competitive products and align them with specific market needs.
Talent requirements	• Success in the cobot industry demands a diverse talent pool with expertise in mechanics, electronics, control systems, and algorithms. Leading companies have already built robust research and development teams and talent pipelines. In contrast, newcomers must invest heavily in attracting and developing skilled professionals to build an effective workforce.
Scenarios know-how	• Cobot companies rely on a wealth of project experience and client case studies to thrive. This experience helps companies understand customer requirements and refine product designs to fit the end user's scenario. New entrants, lacking practical project experience and industry insights, face significant challenges in establishing themselves in the market.

Source: China Insights Consultancy

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Appendix (1/4)

- ARM architecture enabled the company to build cobots featuring smaller sizes, better compatibility, lower power consumption, flexible customization and high scalability, which aligns with the cobot industry evolution
- The Company's first-to-market AI-empowered cobot platform, X-Trainer, boasts high-quality data collection, low latency delivering 140% improvement in end-to-end response speed, and significantly more efficient generalized learning than comparable systems.
- X-Trainer, the AI learning capabilities stand out with high-quality data collection and remarkably low latency, which translate into a 140% improvement in end-to-end response speed over comparable systems.
- The company is the first in the global cobot industry to commercialize AI-empowered cobots.
- The company is an early adopter in the advanced cobot technology development, capitalizing on its industry leading intelligent perception and interaction technology and AI capabilities.
- Notably, the company is among a few cobot companies in China, that have developed a proprietary force-feedback-enabled teleoperation interface, which features a bilateral force feedback control architecture and achieves high real-time performance and transparent remote robot control.
- The Company's cobots can detect the approach of objects within a 15 cm range, the highest among all similar commercialized cobots, while operating at a safety speed of 1 m/s during the human-robot interaction, well above the industry standard of 0.25 m/s, setting a new industry benchmark for safety and efficiency.
- The Company has developed a proprietary non-contact collision prevention technology, featuring wearable flexible e-skin technology, SafeSkin, which detects the approach of objects within a 15 cm range, the highest among all similar commercialized cobots, and responds rapidly by either ceasing movement or taking evasive action to effectively prevent the imminent collisions.
- The SafeSkin technology is suitable for high-speed, heavy-load use cases, which significantly improves the safety speed of the Company's cobots to 1 m/s, well above the industry average which typically limits the safety speed to 0.25 m/s.
- The Company is one of few global players with proprietary full-stack technologies spanning the entire cobot development cycle, including cobot design and manufacturing, key components development, controller system development, key algorithm formulation and iteration, versatile cobot deployment for different tasks, and AI capabilities development.
- As the development of the global cobot industry is at a rather nascent stage, cobot distributors rarely develop sub-distributors to further distribute cobot products.
- Revenue seasonality is generally applicable to the cobot industry, due to the following reasons: (1) certain customers in the cobot industry, including many customers from the industrial and education application settings, tend to schedule their purchase of equipment towards their fiscal year end to maintain better control over their annual capital expenditure and realize their annual budget; and (2) customers in the cobot industry tend to demand completing order delivery before year end to avoid shipment disruptions and other logistic issues caused by holidays at the beginning of a new year.
- Cobots are robots with operational robotic arm intended for direct human-robot interaction or collaboration within a shared space or where humans and robots are in proximity for the improved performance of tasks and automation process. The Company's cobot products fall within an acceptable sector of a Specialist Technology Industry as defined under Chapter 18C of the Listing Rules, on the basis that (1) for the Company's cobots excluding those primarily designed for educational settings under Magician Series, they involve the robotic engineering, computer software and machines for the improved performance of tasks and automation processes, which satisfy the definition of robot technology according to Chapter 18C of the Listing Rules, and (2) for cobots under Magician Series, they are sensor-driven, WiFi-enabled and programmable products, which satisfy the definition of smart product designs according to Chapter 18C of the Listing Rules.
- Cobots in industrial settings enhance tasks like material handling, processing, welding, palletizing, and assembly, boosting safety, precision and efficiency in automation process, as well as economic benefits. For tasks like palletizing, for example, manual handling is not only inefficient but also poses safety risks. In contrast, using cobots offers greater load capacity and safer operations. For tasks such as assembly work, cobots far surpass humans in both efficiency and precision due to its machinery sensors and high precision movements. Cobots also offer significant cost savings over manual labor or traditional machinery. The economic benefit of artificial labor costs that can be collaborated by smart cobots globally is projected to reach US$19.6 billion in 2028.
- The Company's export volume of cobots has consistently ranked first in China for six consecutive years.
- The Company's export volume of cobots ranked first in China for six consecutive years from 2018 to 2023.

Appendix (2/4)

- The Company's cobot products fall within an acceptable sector of a Specialist Technology Industry as defined under Chapter 18C of the Listing Rules on the following basis. (1)The Company's Magician Series cobot products, designed for application scenarios in educational settings, are sensor-driven, WiFi-enabled and programmable products, and thus fall within the definition of smart product designs, and (2) all of the Company's product series other than the Magician series involve the engineering of robots, computer software and machines for the improved performance of tasks and automation processes.
- The distributors in cobot industry, which is still at anearly stage of development, are generally different with the distributors intraditional industry, in particular they usually initiate orders when theyreceive requests from end customers. In view of the nature of coboproducts, which is relatively durable and not a consumer product, the salesare typically project-based transactions.
- Denso, Bosch and Stäubli belong to the industrial robot industry, and their cobot products only account for a small part among all types of products they offered.
- Driven by labor shortages and an aging population, it is expected that starting in 2026, cobots with embodied AI functions which equipped with wheels and single-arm or dual-arm configurations will be primarily deployed in the fields of research and education (including laboratory automation, teaching assistance and research support), industrial setting (such as material handling, palletizing and loading/unloading), and commercial setting (such as 24-hour retail stores). According to the same source, in view of the advancement of AI technologies and the decrease in the manufacturing costs for cobots, the global market of cobots with embodied AI functions is expected to increase significantly and reach over RMB20 billion in 2028.
- United Arab Emirates is experiencing rapid growth in education technology market, mainly driven by government support and digital transformation, leading to a huge market potential of robot education. Establishing overseas subsidiaries in these countries can improve our localization, provide localized product display, training and after-sales services to local customers, which could further improve our brand awareness in such countries. The cobot markets in Thailand, Mexico and United Arab Emirates are all in nascent stage of development with a limited number of market players, providing new entrants in such markets with great opportunities. (1) Thailand's cobot market size has grown from US$2.4 million in 2019 to US$5.1 million in 2023, at a CAGR of 20.6%, and is expected to reach US$27.6 million by 2028, at a CAGR of 40.4% from 2023 to 2028. The Thai government has implemented the Thailand 4.0 new economic development model, which intends to, among others, upgrade the country's industrial structure, improving manufacturing capabilities and achieving international standards. Thailand has become a key region for the development of industrial manufacturing enterprises, with industry leaders setting up factories in the country, which is expected to drive demand for cobots; (2) Mexico's cobot market size has grown from US$8.4 million in 2019 to US$14.3 million in 2023, at a CAGR of 14.4%, and is expected to reach US$53.1 million by 2028, at a CAGR of 30.0% from 2023 to 2028. Mexico has attracted many renowned multinational corporations to established their own factories, including corporations in automobile, electronics, pharmaceutical and other manufacturing industries; and (3) the cobot market size in United Arab Emirates has grown from US$0.4 million in 2019 to US$1.4 million in 2023, at a CAGR of 33.4%, and is expected to reach US$6.2 million by 2028, at a CAGR of 34.3% from 2023 to 2028.
- The Company's total expected annual production capacity of 35,000 units is adequate and not excessive in view of, among other things, the expected global annual cobot production capacity of over 300,000 units in 2025.
- The Company has become one of few in the global cobot industry, that have developed proprietary full-stack technologies that cover all the key aspects in the cobot development cycle, encompassing cobot design and manufacturing, key components development, controller system development, key algorithm formulation and iteration, versatile cobot deployment for different tasks, and AI zcapabilities development.
- The Company is an early adopter in the advanced cobot technology development as the Company is the first in the global cobot industry to commercialize AI-empowering platform in April 2024. Underpinned by the deep learning and imitation technologies, X-Trainer is notable for its generalized learning abilities, which is significantly more efficient in skill acquisition than other robots with similar generalized learning abilities. The Company's AI learning capabilities stand out with high-quality data collection and significantly low latency with a 24 Hz frequency for image reception and inference, coupled with a 250 Hz dual-arm motion generation, which translate into a 140% improvement in end-to-end response speed over comparable systems.
- The Company's proprietary flexible e-skin technology, SafeSkin, enables its cobots to detect approaching objects 15 cm away while operating at a 1 m/s safety speed, four times the 0.25 m/s industry standard, significantly improving the efficiency without sacrificing safety in human-cobot interaction.

Appendix (3/4)

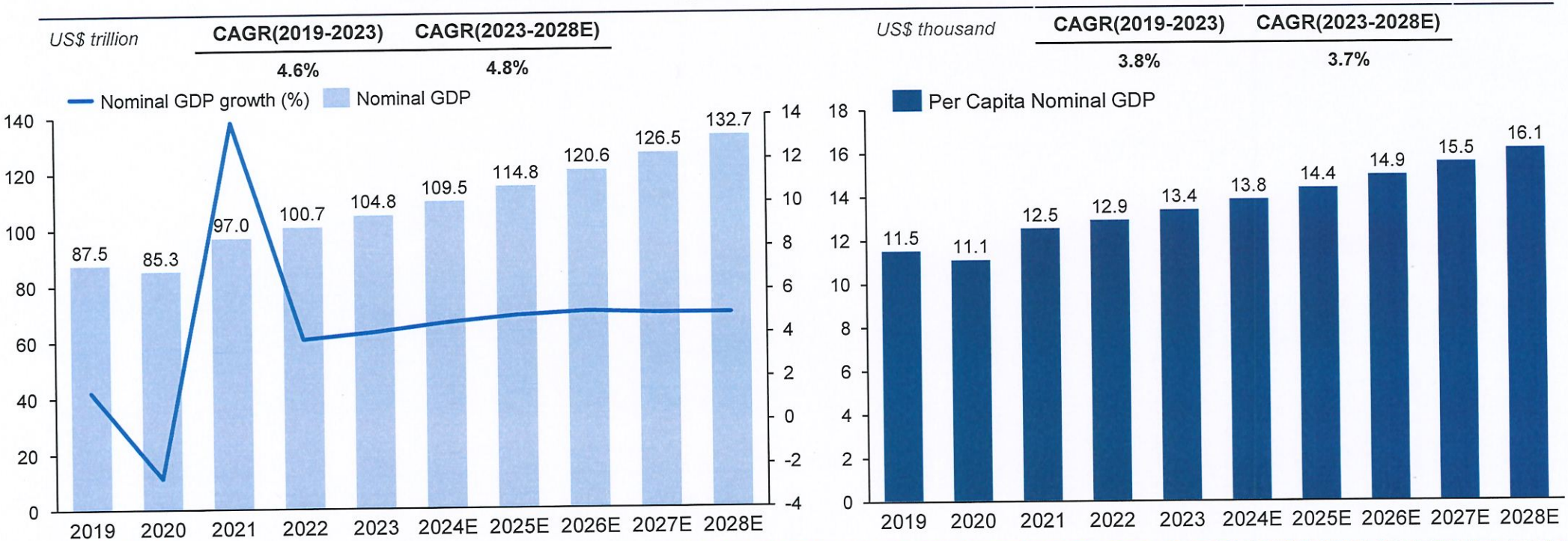
- The Company was the first in the global cobot industry to apply non-contact collision prevention technologies (非接觸碰撞預防技術) to cobots with our proprietary wearable flexible e-skin (可穿戴電子柔性皮膚), SafeSkin. Additionally, the Company was the first in the global cobot industry to commercialize AI-empowered cobots by launching X-Trainer in April 2024.
- The Company was among the first in China's cobot industry to introduce integrated drive-control technology (驅控一體技術) and accomplished integrated multi-motor servo control technology (多軸一體伺服技術).
- The Company is an early adopter in the advanced cobot technology development as the Company is the first in the global cobot industry to commercialize AI-empowering platform in April 2024. Underpinned by the deep learning and imitation technologies, X-Trainer is notable for its generalized learning abilities, which is significantly more efficient in skill acquisition than other robots with similar generalized learning abilities. The Company's AI learning capabilities stand out with high-quality data collection and significantly low latency with a 24 Hz frequency for image reception and inference, coupled with a 250 Hz dual-arm motion generation, which translate into a 140% improvement in end-to-end response speed over comparable systems.
- As of the Latest Practicable Date, the Company had the largest number of registered patents in the global cobot industry. The Company's gross profit margin in 2021, 2022 and 2023 was 50.5%, 40.8% and 43.5%, significantly above the industry average.
- The Company insisted on in-house design and development of key components, as such strategy has allowed the Company to retain control over the design and quality of components, eliminate reliance on outside suppliers, and effectively reduce cobots' production costs, profit margin considerably higher than the industry average during the period from 2021 to 2023.
- The global cobot integrator market is highly fragmented, dominated by numerous small to medium-sized integrators with industry-specific and regional experiences. It is estimated that there are
- over 50 thousand cobot integrators globally. Cobot integrators generally operate in small scale, primarily due to their focuses on certain integration fields for cobots to perform specific tasks, such as welding, material handling and palletizing. Cobot integrators rely on their specific integration expertise and business relationships with downstream customers, which, to certain extent, limit their expansion to large scale operations. As a result, the global cobot integrator market remains dispersed with no clear competitive hierarchies.
- The Company's proprietary flexible e-skin technology, SafeSkin, enables our cobots to detect approaching objects 15 cm away while operating at a 1 m/s safety speed during the human-robot interaction, four times the 0.25 m/s PRC national standard (based on the comparison between our six-axis cobot models with a payload of 5 kg and GB 11291.1, a PRC national standard for robots for industrial environments, which sets forth the safety requirements of 0.25 m/s).
- The Company offered one of the most extensive product portfolios in the global cobot industry, catering to numerous use cases in manufacturing, retail, healthcare, STEAM education, scientific research settings and many more.
- The cobot industry is characterized by evolving technologies, increasing competition, changing industry standards, and changing market demands, among others.
- The Company has strategically launched a breadth of product portfolio that covers the most extensive selections of cobots innthe global cobot industry, according to the CIC Report, in payload capacity ranging from 0.25kg to 20kg,naxis models with four or six axes, and use cases in manufacturing, retail, healthcare, STEAM education,nscientific research settings and many more, catering to our customers' diverse needs.
- China's lightweight models of six-axis industrial cobot market had a shipment volume of approximately 5.9 thousand units in 2023, which is expected to reach 14.4, 19.3 and 25.6 thousand units in 2026, 2027 and 2028, respectively. China's lightweight models of six-axis commercial cobot market had a shipment volume of approximately 2.2 thousand units in 2023, which is expected to reach 8.2, 12.4 and 16.6 thousand units in 2026, 2027 and 2028, respectively.
- The Company's total expected annual production capacity of 35,000 units is not excessive in view of, among other things, the expected global annual cobot production capacity of over 300,000 units in 2025. The increase in the Company's production capacity is warranted by the future market demand for cobots, as all the major sectors in the cobot industry show strong growth momentum.
- Driven by labor shortages and an aging population, it is expected that starting in 2026, cobots with embodied AI functions which equipped with wheels and single-arm or dual-arm configurations will be primarily deployed in the fields of research and education (including laboratory automation, teaching assistance and research support), industrial setting (such as material handling, palletizing and loading/unloading), and commercial setting (such as 24-hour retail stores). In view of the advancement of AI technologies and the decrease in the manufacturing costs for cobots, the global market of cobots with embodied AI functions is expected to increase significantly and reach over RMB20 billion in 2028.

Appendix (4/4)

- The Company's development of the flexible e-skin technology, which has achieved a safety speed four times the industry standard, significantly improving the efficiency without compromising safety in human-robot interaction.
- The rapid growth of the cobot market is primarily driven by several key factors. Technology Advancements including AI integration not only improves cobot capabilities, but also brings about economies of scale, which has reduced costs and made cobots more affordable. Additionally, labor shortages and rising labor costs due to an aging population have resulted in an increasing demand for automation.
- The motor system composed of motors and encoders is the core power unit of cobots and is the key to optimizing cobots' payload and movement accuracy.

Global economy is expected to steadily grow with CAGR of 4.8% during 2023 to 2028

Global nominal GDP and global per capita nominal GDP, 2019-2028E



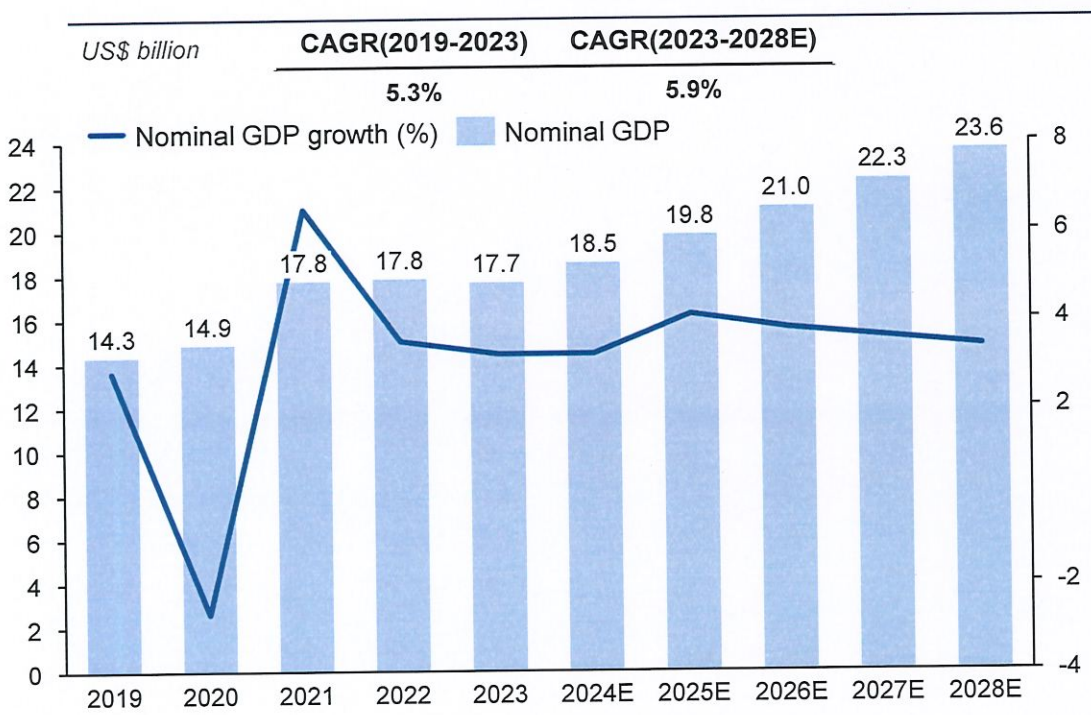
Analysis

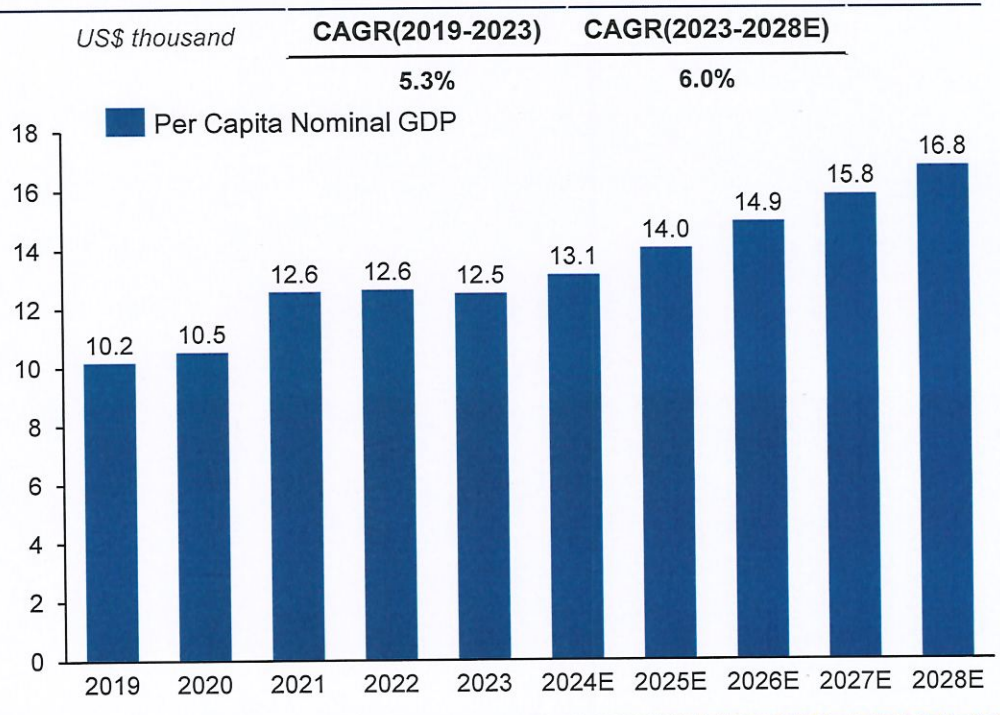
- Global economy reflected by nominal GDP had a decline in 2020 due to Covid-19, but was recovered in 2021, with its nominal GDP increasing from US$87.5 trillion in 2019 to US$97.0 trillion in 2021. Global nominal GDP is moreover expected to continue growing to reach US$132.7 trillion in 2028.
- Global per capita nominal GDP has also increased, with its increasing from US$11.5 thousand in 2019 to US$ 13.4 thousand in 2023, and is expected to grow steadily to reach US$ 16.1 thousand in 2028 with CAGR of 3.7% during 2023 to 2028.

Source: International Monetary Fund, China Insights Consultancy

China's economy has experienced significant growth over the past several years, and its nominal GDP is expected to steadily grow with CAGR of 5.9% during 2023 to 2028

Nominal GDP in China and China's Per Capita Nominal GDP, 2019-2028E





Analysis

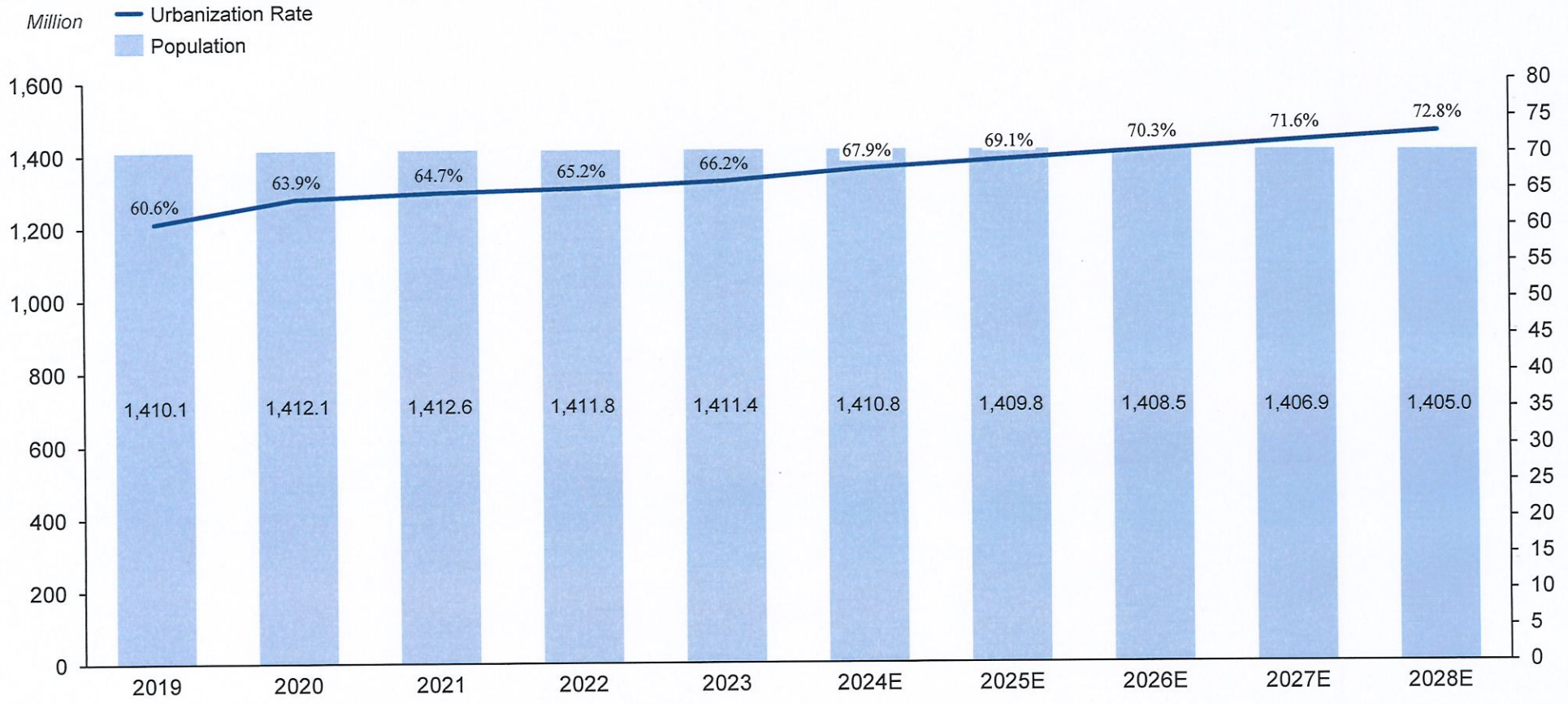
- China's economy has experienced significant growth over the past several years, with its nominal GDP increasing from US$14.3 billion in 2019 to US$17.8 billion in 2022. China's nominal GDP is moreover expected to continue growing to reach US$23.6 billion in 2028.
- China's per capita nominal GDP has also increased, with its increasing from US$10.2 thousand in 2019 to US$12.5 thousand in 2023, and is expected to grow steadily to reach US$16.8 thousand in 2028 with CAGR of 6.0% during 2023 to 2028.

Note: excluding Hong Kong, Macao, and Taiwan regions

Source: International Monetary Fund, China Insights Consultancy

The population of China is expected to be stable at around 1.4 billion since 2023, while the urbanization rate will increase continually, reaching 72.8% by 2028

Population and Urbanization Rates in China, 2019-2028E



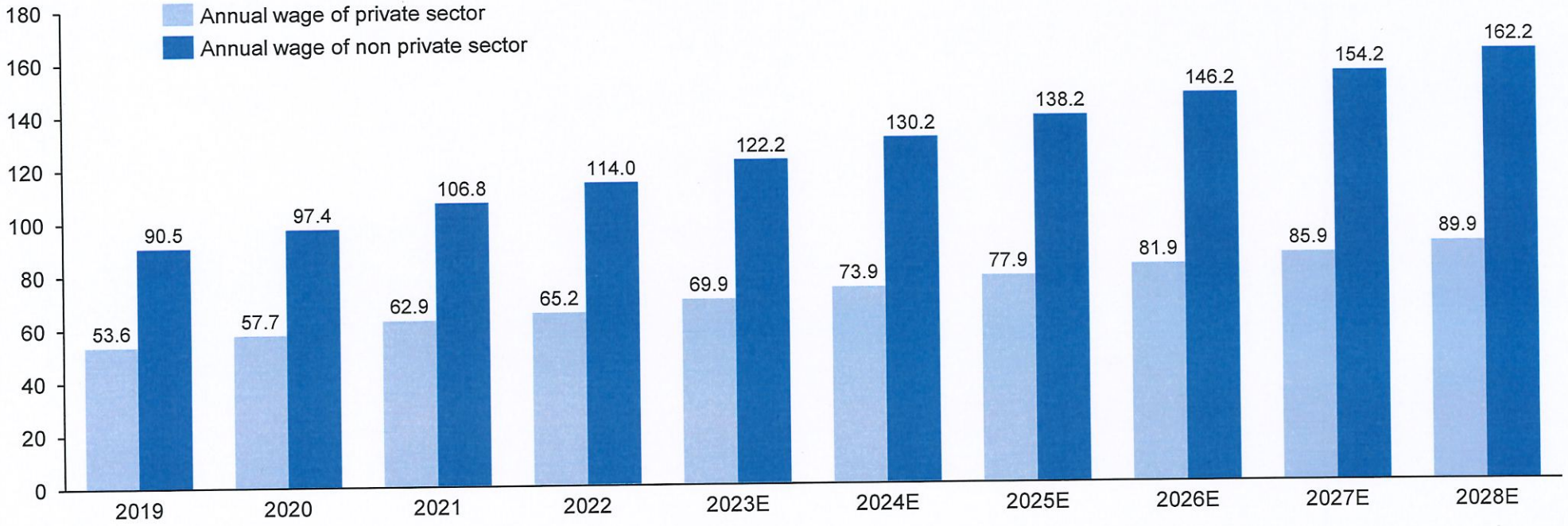
Note: excluding Hong Kong, Macao, and Taiwan regions

Source: WTO, UNCTAD, China Insights Consultancy

China's average wage of urban employees in private and non private sectors has increased from 2019 to 2023, and is expected to reach RMB89.9 thousand and RMB162.2 thousand respectively by 2028

Average Wage of Urban Employees in China, 2019-2028E

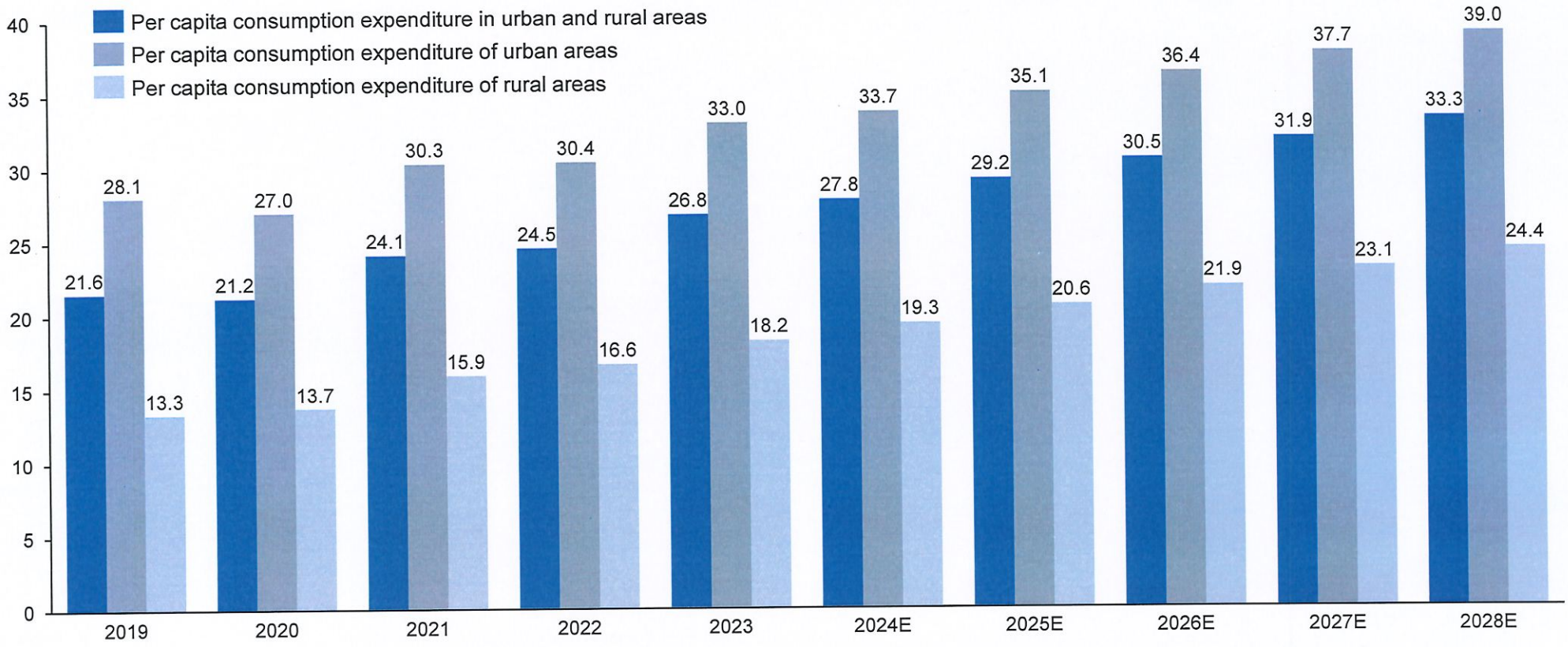
RMB Thousand



Source: WTO, UNCTAD, China Insights Consultancy

China's per capita consumption expenditure in urban and rural areas has increased from 2019 to 2023, and is expected to reach RMB33.3 thousand in 2028

Per Capita Consumption Expenditure in China, Urban and Rural Areas, 2019-2028E



Source: WTO, UNCTAD, China Insights Consultancy

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