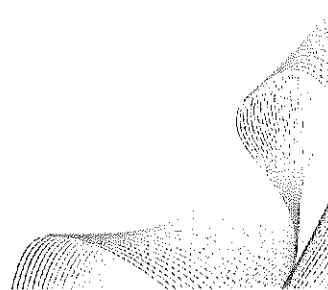
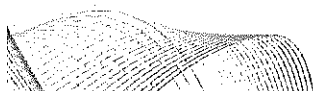


Industry Report of Global X-by-wire Solutions Industry

PISEN



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CIC Introduction, Methodologies and Assumptions

In connection with the Global Offering, we engaged CIC, an independent market research consultant, to conduct an analysis of, and to prepare a report about global X-by-wire solutions industry. The CIC Report has been prepared by CIC independent of the influence of our Group and other interested parties. We have agreed to pay CIC a total fee of RMB900,000 for the preparation and use of the CIC Report, and we believe that such fees are consistent with the market rate. CIC is a consulting firm founded in Hong Kong and provides professional industry consulting services across multiple industries. CIC's services include industry consultancy services, commercial due diligence and strategic consulting.

CIC conducted both primary and secondary research using a variety of resources. Primary research involved interviewing key industry experts and leading industry participants. Secondary research involved analyzing data from various publicly available data sources. The market projections in the commissioned report are based on the following key assumptions: (i) given China's enduringly stable political system, effective social governance and robust economic foundation, it is anticipated that the overall social, economic and political environments in China will remain stable during the forecast period; (ii) according to the National Bureau of Statistics of China, key economic indicators such as gross Domestic Product ("GDP"), industrial added value, and urbanization rate have shown an upward trend in China over the past decade. Therefore, we believe that the economic and industry development in China is likely to maintain a steady growth trajectory during the forecast period, accompanied by continuing urbanization; (iii) related key industry drivers such as rising consumer demand for enhanced driving experience, advancements in intelligent driving solutions creating essential demand, maturity of supply chain driving down production costs, continuous advancements of core software and hardware technologies, and favorable policy and regulatory support throughout the forecast period; and (iv) there will be no extreme force majeure event or unforeseen industry regulation that may significantly or fundamentally affect the relevant market and industry.

Unless otherwise specified, all data and forecasts contained in this section are derived from the consultancy report of CIC. The Directors, upon acting with reasonable prudence, confirmed that there has been no occurrence of adverse change in the overall market information that would subject the data to significant restrictions, contradiction or negative effects since the date of the consultancy report.

Terms and Abbreviations

Terms	Definition
actuator	a mechanical or electromechanical device that converts electrical, hydraulic, or pneumatic energy into physical motion or force to execute specific actions based on signals from a control system 执行器
AI	artificial intelligence ” 人工智能
brake-by-wire	an X-by-wire system where braking is primarily controlled electronically, reducing or eliminating the need for conventional mechanical or hydraulic linkages, thereby enabling advanced safety features, redundancy, and integration with autonomous driving systems 线控制动
C2C	cell-to-chassis, an automotive design architecture where battery cells are structurally integrated into the vehicle chassis, improving structural efficiency and energy density 电芯到底盘
CAGR	compound annual growth rate, a measure used to express the mean annual growth rate of an investment, market, or metric over a specified multi-year period, assuming the profits are reinvested at the end of each period 复合年增长率
domain controller	a high-performance electronic control unit that centrally handles the coordination computing for multiple subsystems (e.g., braking, steering, suspension) within a specific domain of the vehicle, supporting advanced coordination and integration 域控制器

Terms	Definition
driving assistance solution	including solutions enabling Level 0 to Level 2+ automation, which are defined as systems that provide drivers with environmental perception, risk warnings, and partial automated operation support while requiring continuous driver monitoring and readiness to take over 驾驶辅助解决方案
EHB	electro-hydraulic braking, a brake-by-wire system that replaces traditional mechanical linkages with electronic control and hydraulic actuation. 电子液压制动
electronic brake booster	an advanced braking system that uses electronic controls to amplify braking force, improving response time and integration with intelligent driving systems 电控制动助力器
EMB	electromechanical brake, a brake system actuated by electric motors, enabling precise and rapid braking response, eliminating the need for permanent hydraulic components 电子机械制动系统
EPB	an electronically controlled parking brake system electric parking brake, ensuring safe and reliable parking brake engagement if the primary system suffers a partial failure 电子驻车制动
EPS	electric power steering, a steering system that uses electric motors to assist the driver, eliminating the need for permanent hydraulic systems and enabling integration with steer-by-wire technology 电动助力转向系统
ESC	electronic stability control, a system that improves vehicle stability by detecting and reducing loss of traction, automatically applying brakes to individual wheels as needed. 电子稳定控制系统

Terms	Definition
EV(s)	• electronic vehicle(s), vehicles that are powered entirely or partially by power sources, comprising battery electric vehicles, plug-in hybrid electric vehicles, and fuel cell vehicles, among others 电动汽车
LIDAR	• the abbreviation for "Light Detection and Ranging", a remote sensing method that uses light to measure the distance or range of objects 激光雷达
OEM(s)	• automotive original equipment manufacturer(s) 主机厂
R&D	• research and development 研究与开发
intelligent vehicle	• vehicles equipped with Level 1 or above level driving assistance solutions 智能汽车
SBW	• steer-by-wire, a system that removes the permanent mechanical steering linkages with electronic controls, allowing for advanced steering functions and integration with autonomous driving systems 线控转向
X-by-wire	• a technology that replaces traditional mechanical or hydraulic vehicle control systems (such as steering, braking or acceleration) with electronic controls, enabling precise, rapid and programmable motion execution 线控

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1. Overview of Automotive Chassis Industry

Automotive chassis serve as the fundamental platform that supports the powertrain, body and electrical systems, and are the core actuation system for power transmission, driving safety, handling stability and ride comfort. Classified by functions, automotive chassis primarily comprise three actuation control subsystems: braking, steering and suspension, which are respectively responsible for vehicle deceleration and parking, directional control, and body support with road impact absorption.

From a technology evolution perspective, automotive chassis have been undergoing a structural transformation from mechanical control to X-by-wire control. Earlier-generation automotive chassis were predominantly based on purely mechanical and hydraulic structures, including mechanical braking systems consisting of brake pedals, vacuum boosters, hydraulic lines and calipers; mechanical steering systems comprising steering wheels, steering columns and rack-and-pinion mechanisms; and passive suspension systems incorporating coil springs, shock absorbers and stabilizer bars. These systems rely entirely on mechanical linkages and hydraulic lines for physical connections, resulting in relatively slow response times and limited control precision, making it difficult to achieve dynamic coordination under complex operating conditions.

As the process of vehicle electrification and intelligence advance, the limitations of mechanical chassis architectures have become increasingly apparent. First, they are unable to meet the millisecond-level command response and high-precision closed-loop control required by autonomous driving. Moreover, the electrification trend imposes significantly higher demands on chassis lightweighting, space utilization and platform-based development, while complex mechanical structures are difficult to adapt to battery layout and modular design. Against this backdrop, automotive chassis are accelerating toward full X-by-wire control, replacing conventional mechanical and hydraulic connections with electronic signals to enable digital control of multi-directional vehicle motion and cross-domain coordination, thereby enhancing overall vehicle performance.

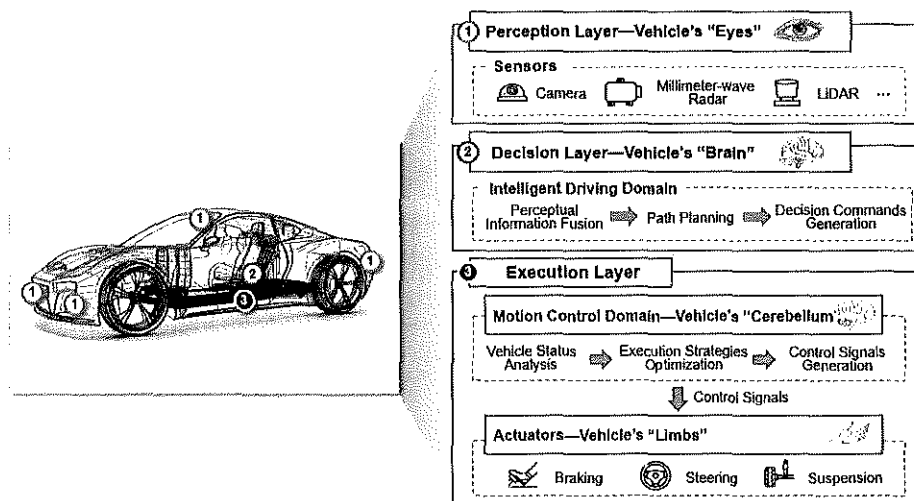
2. Development Trends of Global and China's Automotive Industry

2.1 Automotive intelligence advances towards full-domain integration, with X-by-wire technologies reshaping the intelligent driving execution system

As automotive electrical/electronic (E/E) architecture evolves towards centralized computing, automotive intelligence aims for the deep synergy between systems. Vehicles are expected to become intelligent agents with full-domain integration, reconstructing the closed loop of "perception-decision-execution" to achieve human-like environmental perception accuracy and dynamic response coordination. This enables the real-time analysis of complex scenarios and coherent action outputs, and provides consumers with a more intelligent and efficient driving experience.

The integration of intelligent driving domain and motion control domain holds prominent priority and inherent necessity. Intelligent driving domain, acting as vehicle's "brain", generates decision commands by fusing perceptual information from multiple sensors with AI algorithms. Motion control domain, acting as "cerebellum", combines decision commands from the "brain" with real-time vehicle status to optimize execution strategies and transmits control signals to actuators for the precise control. X-by-wire solution reduce latency through electronic signal transmission, perform real-time correction via electronic closed-loop control, and continuously optimize control performance through iterative software algorithms, thereby better addressing the real-time, precise, and personalized requirements of automated driving for vehicle's execution system.

Chart 2-1: Synergic Control Architecture of the "Brain" and "Cerebellum" in Intelligent Vehicles



Source: CIC

2.2 Automated driving continues to develop, with X-by-wire technologies forming a crucial support

As vehicles evolve towards automated driving, the core focus is to achieve human-machine decoupling. Vehicle systems must gradually reduce their reliance on driver control and enable real-time dynamic decision-making and command execution in more open and complex scenarios. Vehicles must also feature enhanced safety to handle unexpected failures that may occur during the automated driving process. Consequently, this creates essential requirements for the vehicle's execution system in terms of fully autonomous control, millisecond-level response, and high fault tolerance.

The motion control system is a critical component in coordinating vehicle control and the fundamental guarantee for driving safety. By replacing mechanical and hydraulic linkages with electronic signals, the X-by-wire solution can transfer the complete control of driving commands and vehicle operations to algorithms. Meanwhile, it reduces critical actions response time to millisecond level and achieving control precision down to centimeter level. Furthermore, it ensures system safety through multiple redundancy designs and incorporate advanced software algorithms to support functions such as actuator health status monitoring. Consequently, the X-by-wire solution serves as the key enabler for achieving automated driving.

2.3 Market share of Chinese domestic brands vehicles steadily rises, with the demand for the localization of X-by-wire technologies accelerating

In recent years, the influence of Chinese domestic brands vehicles has been on the rise. Chinese domestic OEMs have prioritized automotive intelligence as a strategic focus, leveraging their capabilities in customized software development and rapid responsiveness to keep pace with market demands and technological trends. By adopting cost-effective intelligent solutions and continuously iterating on functional experiences, they have created differentiated advantages, thereby enhancing the market competitiveness of their vehicle models. In 2025, the sales volume of intelligent vehicles from Chinese domestic brands reached 12.5 million units and is projected to grow to 28.8 million units by 2030. The corresponding market share in China's intelligent vehicles industry is also expected to increase from 54.5% in 2025 to 88.2% in 2035, demonstrating that Chinese domestic brands vehicles have become a key force in leading the intelligence transformation of China's overall automotive industry. Furthermore, leading Chinese domestic OEMs are actively pursuing overseas expansion strategies, driving the export sales volume of all Chinese domestic brands vehicles to grow from 0.6 million units in 2020 to 4.9 million units in 2025 with a CAGR of 54.6%. This figure is projected to reach 8.3 million units by 2030, laying a vital

foundation for the rapid enhancement of China's position in the global automotive industry.

Meanwhile, Chinese domestic OEMs are accelerating the development of secure and controllable localized supply chain to ensure delivery stability and cost competitiveness. The X-by-wire solution is the core component that guarantees vehicle control and performance experience, however, its localization rate (referring to the collective market share in terms of sales volume held by domestic providers within the industry) was only 29.8% in 2025, which is still at a relatively low level compared to approximately 100.0% for EV batteries and over 95.0% for LiDAR's in driving assistance solutions, creating an urgent demand for domestic substitution. Notably, leading technology giants are now crossing over into the intelligent vehicles sector. Their inherent technological genes and ecosystem-rebuilding capabilities are profoundly changing the traditional automotive industry landscape, fostering a more open industry ecosystem. Compared with overseas solution providers, domestic X-by-wire solution providers have formed natural synergistic advantages with these technology giants via flexible cooperation models and rapid responsiveness. Through deep collaboration, both parties achieve efficient coordination in R&D and system integration, jointly advancing the integrated innovation of X-by-wire solutions with intelligent driving solutions and automotive E/E architectures. This also enhances the competitiveness of domestic providers and accelerate domestic substitution.

2.4 Automotive electrification focuses on efficiency improvement, with X-by-wire technologies empowering electrical architecture upgrades

Electrification is a key direction for the green transformation of the automotive industry. The global sales volume of EVs increased from 2.9 million units in 2020 to 22.4 million units in 2025 with a CAGR of 51.1%, and is projected to reach 50.3 million units by 2030. As competition intensifies and demand for faster recharging and longer driving ranges grows, the industry has shifted its focus from scale expansion to enhancing technical competitiveness and product performance, such as high-voltage electrical platform to improve vehicle energy efficiency. This drives EVs from traditional low-voltage to high-voltage electrical architectures, and accelerates their transition towards a stage of high-quality development.

The X-by-wire solution is key to enhancing EV performance by supporting automotive electrification through structural innovation. Its high-voltage compatibility allows seamless integration with EV platforms without the need for additional conversion or modification, facilitating a more rapid realization of high-voltage electrification upgrades for EVs. The X-by-wire solution precisely controls the power

system through electronic signals, optimizes regenerative braking efficiency, effectively extends driving range, and further strengthens performance and competitiveness.

3. Analysis of Global and China's X-by-wire Solutions Industry

3.1 Definition of X-by-wire solutions

X-by-wire solutions are solutions that provide precise execution, intelligent coordination, and safety redundancy for vehicle motion control. They utilize advanced E/E architectures, X-by-wire execution technologies, sensor fusion technologies, and control algorithms to achieve high-precision control of vehicle motion through core systems such as brake-by-wire, steer-by-wire and suspension-by-wire. They also enable multi-system coordinated management through motion controllers. X-by-wire solutions are not entirely new products independent of the automotive chassis. Rather, they are an advanced implementation approach of chassis actuation control subsystems that has emerged through technological evolution to replace the traditional mechanical approach. The chassis actuation control subsystems are integral components of vehicles and will not be eliminated, as what evolves is the underlying technology implementation approach. At present, no more advanced technology or product has yet emerged to replace X-by-wire solutions within automotive chassis.

3.2 Core modules and technological evolution of X-by-wire solutions

X-by-wire solutions mainly consist of key modules such as brake-by-wire, steer-by-wire, suspension-by-wire, and motion controllers. Among these, brake-by-wire, steer-by-wire, and suspension-by-wire respectively achieve precise control along the X, Y, and Z axes of the vehicle motion. The motion controller is responsible for the centralized management and coordinated control of each module, ensuring the efficient operation and performance optimization of the entire X-by-wire solution.

3.2.1 Core modules for controlling the XYZ directions of vehicles

According to "SAE J670-2022 Vehicle Dynamics Terminology" issued by the Society of Automotive Engineers, and "GB/T 40429-2021 Taxonomy of Driving Automation for Vehicles" jointly issued by the State Administration for Market Regulation and the Standardization Administration of China, the X and Y axes are parallel to the ground plane. The X-axis points from the vehicle's center towards the front (longitudinal direction), the Y-axis points from the vehicle's center towards the left side (lateral direction), and the Z-axis points upwards (vertical direction).

- **Brake-by-wire solutions.** Brake-by-wire solutions control the motion along the vehicle's X-axis (longitudinal direction), managing deceleration, parking, and ensuring braking safety and precision for fast response and improved safety. ESC solution was originally developed for fuel-powered vehicles. Leveraging its mature hydraulic architecture, independence from high-voltage power supplies, and

seamless compatibility with vacuum-assisted braking systems, ESC solution delivered regulatory-compliant vehicle stability control at a relatively controllable cost. However, when directly applied to NEVs, it may encounter a series of engineering challenges. Specifically, there is an increased complexity of software logic and calibration for ESC solution for NEVs, driven by differences in powertrain and energy sources. Fuel-powered vehicles rely on the engine to provide a stable vacuum source, and braking energy is dissipated as heat through friction without recovery. Consequently, ESC is only required to modulate hydraulic pressure to prevent wheel lock-up and skidding, without the need for real-time interaction with the powertrain. In contrast, NEVs lack an engine and a stable vacuum source, moreover, the drive motor acts as a generator during braking to recover energy. Total braking force must be synthesized from both electric braking and hydraulic braking. Accordingly, ESC must go beyond hydraulic pressure modulation to coordinate the distribution of these two braking outputs in real time with the electric drive system, ensuring that the deceleration rate aligns with the driver's intent while maximizing energy recovery. Currently, Electric Hydraulic Brake (EHB) solutions are the mainstream technology, replacing the vacuum booster with an electronic brake booster to control hydraulic actuator for precise adjustments of braking force. EMB solutions, a future development, eliminate hydraulic actuator, relying entirely on electronic signals to connect the pedal and actuator, offering even faster response speeds.

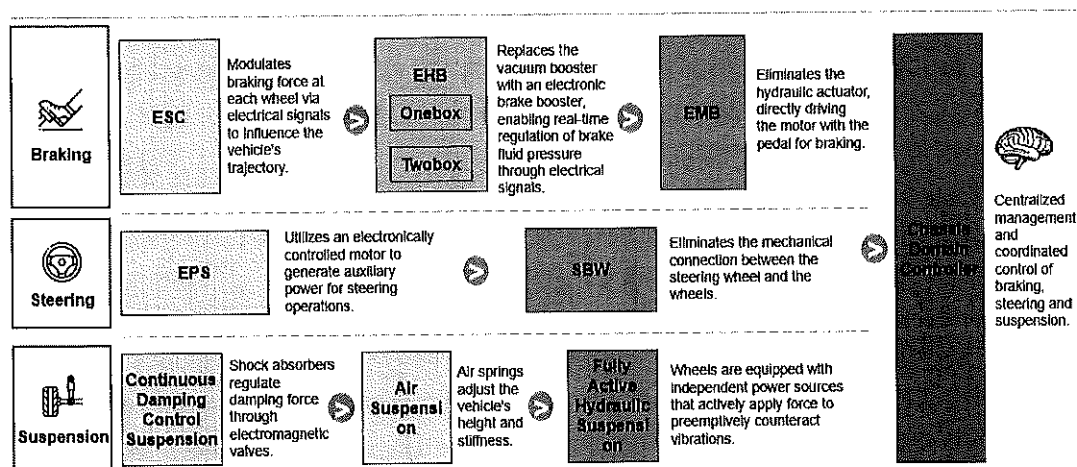
- **Steer-by-wire solutions.** Steer-by-wire solutions control motion along the vehicle's Y-axis (lateral direction), managing steering angle and direction for flexible, precise, and stable control. Steer-by-wire solutions evolved from EPS solutions by eliminating the mechanical connection between the steering wheel and the wheels, using electronic signals to control steering. Due to factors such as technological maturity, regulatory standards, and high requirements for system redundancy and safety, steer-by-wire solutions have not yet achieved large-scale mass production, and EPS solutions remain the current mainstream technological path.
- **Suspension-by-wire solutions.** Suspension-by-wire solutions control the motion along the vehicle's Z-axis (vertical direction) motion, managing shock absorption and support to balance driving comfort. They evolved from semi-by-wire suspensions solutions (including continuous damping control suspension solutions and air suspension solutions) using air springs and electronically controlled shock absorbers to adjust damping, height, and stiffness for improved comfort and stability. Due to high costs and technical complexity, suspension-by-wire solutions

are mainly adopted in high-end models, with semi-by-wire suspension solutions being the mainstream in the market.

3.2.2 Motion controllers

Motion controllers are modules that enable the centralized control and hardware-software separation for X-by-wire solutions such as brake-by-wire, steer-by-wire, and suspension-by-wire solutions. They are usually used to ensure the efficient and coordinated cooperation of a vehicle's lateral, longitudinal, and vertical motion control.

Chart 3-1: Technological Evolution of Core Modules in X-by-Wire Solutions



Source: CIC

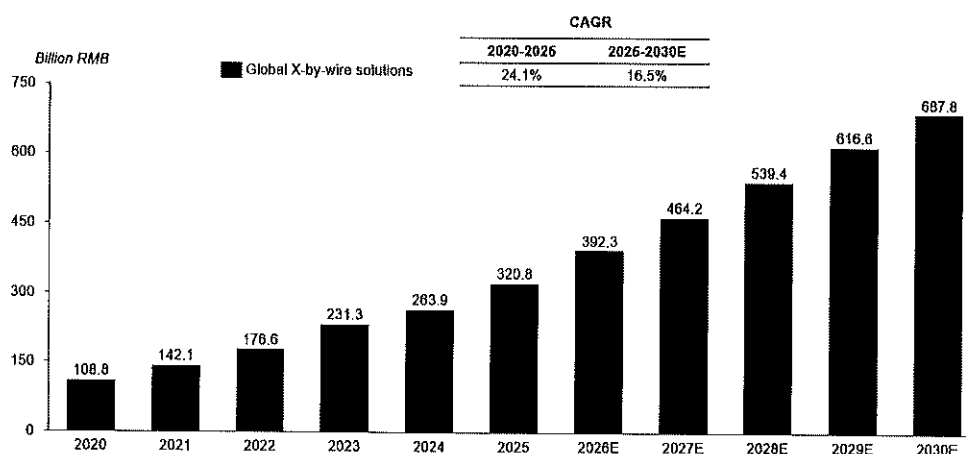
However, new-generation X-by-Wire solutions including EMB, SBW and fully active hydraulic suspension may face certain uncertainties in large-scale commercialization. First, the related technologies are still at an early stage, and their safety and reliability have yet to be thoroughly validated under a broader range of operating conditions, leading to trust concerns among OEMs and consumers. Second, the deployment of high-precision sensors, redundant architectures and higher-performance computing chips drives up material costs and product prices, while the complexity of hardware structures extends R&D and validation cycles, limiting the adoption of such solutions in mass-market vehicle models. Furthermore, although relevant technical standards and market-access regulations have been progressively introduced, detailed rules for system-level reliability verification and software-hardware interface specifications remain incomplete. Meanwhile, the liability framework and commercial regulatory pathway for Level 3 and above autonomous driving are still undefined. Without large-scale deployment of high-level autonomous driving, EMB and SBW may lack essential application scenarios, and their pace of mass commercialization may be slower than anticipated.

3.3 Market size of global and China's X-by-wire solutions industry

3.3.1 Analysis of market size of global and China's X-by-wire solutions industry

As automotive electrification and intelligence deepen, X-by-wire solution, as a key carrier for the vehicle's execution system, is experiencing rapid technological development. The continuous global upgrades in vehicle safety and control standards are prompting OEMs to accelerate the deployment of X-by-wire solutions in new models to better meet consumer demand for intelligent control, safety, and comfort. Therefore, the global X-by-wire solutions industry has achieved rapid growth in recent years. In terms of revenue, the corresponding market size grew from RMB108.8 billion in 2020 to RMB320.8 billion in 2025, with a CAGR of 24.1%, and is projected to reach RMB687.8 billion by 2030 with a CAGR of 16.5% during the period.

Chart 3-2: Market Size of Global X-by-wire Solutions Industry, in terms of Revenue, 2020-2030E



Note:

- (1) The market size of X-by-wire solutions refers to the combined market size of brake-by-wire, steer-by-wire, suspension-by-wire, and motion controllers that are installed in intelligent vehicles.

Source: International Organization of Motor Vehicle Manufacturers, CIC

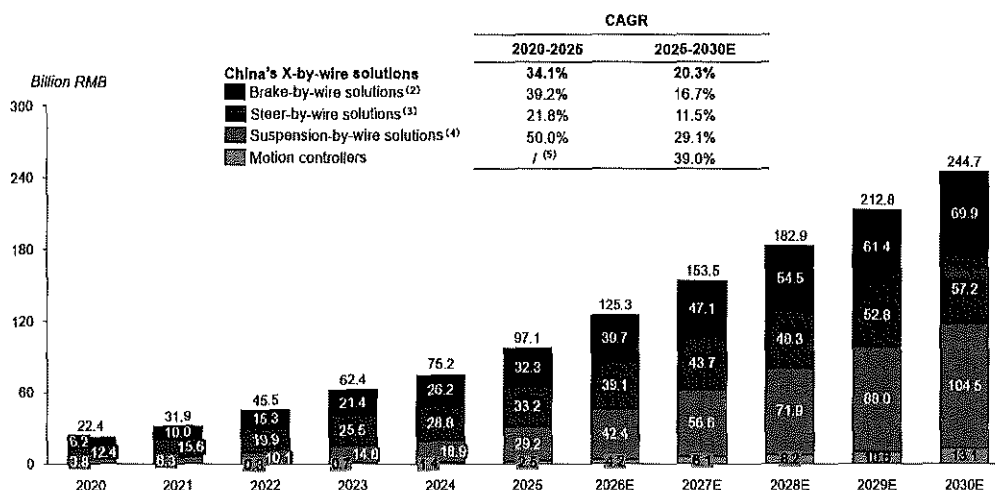
China is the world's largest market for intelligent vehicles, and its steady development has laid a solid foundation for the promotion and application of X-by-wire solutions. In terms of revenue, the market size of China's X-by-wire solutions industry grew from RMB22.4 billion in 2020 to RMB97.1 billion in 2025 with a CAGR of 34.1%. As the level of automotive intelligence advances, the demand is expected to further

increase. The market size of China's X-by-wire solutions industry is projected to continue to grow to RMB244.7 billion by 2030 with a CAGR of 20.3% from 2025 to 2030.

- **Brake-by-wire solutions.** The market of brake-by-wire solutions has grown rapidly. ESC initially emerged as a proven solution for fuel-powered vehicles. It delivers mandated stability control at a controllable cost, and has remained the standard configuration for a majority of fuel-powered vehicles. In 2020, the market size of ESC solution for fuel-powered vehicles in China was RMB7.9 billion. Benefiting from these advantages, the market remained relatively stable over the following years, standing at RMB7.3 billion in 2025. Looking ahead, as fuel-powered vehicles continue to be displaced by NEVs, and as more advanced brake-by-wire solutions see declining costs and increasing penetration, the market is expected to decline to RMB2.1 billion by 2030. Currently, the penetration rates of Onebox and Twobox solutions are steadily increasing, replacing traditional hydraulic braking solutions to become the mainstream solutions. In terms of revenue, the market size of China's brake-by-wire solutions grew from RMB6.2 billion in 2020 to RMB32.3 billion in 2025 with a CAGR of 39.2%. In the future, brake-by-wire solutions are expected to expand, driven by cost reductions from technological progress, increased localization, and mass production of new-generation, higher-performance solutions such as EMB to meet market demand for automated driving. The market size of China's brake-by-wire solution is projected to grow to RMB69.9 billion by 2030 with a CAGR of 16.7% from 2025 to 2030. Particularly, Onebox solutions have rapidly gained prominence with their integrated design that provides a balance of cost and performance advantages. In terms of revenue, the market size of China's Onebox solutions grew from RMB1.1 billion in 2020 to RMB22.0 billion in 2025 at a CAGR of 81.3%. Moving forward, coupled with continuously improving cost-effectiveness, and their structural and efficiency advantages which are better aligned with the requirements of autonomous driving, its corresponding market size is expected to continue to expanded rapidly to RMB47.0 billion by 2030, with a CAGR of 16.4% from 2025 to 2030.
- **Steer-by-wire solutions.** EPS solutions are mature in technology and have become the mainstream steer-by-wire solution, driving steady growth in the market. In terms of revenue, the market size of China's steer-by-wire solutions grew from RMB12.4 billion in 2020 to RMB33.2 billion in 2025 with a CAGR of 21.8%. In the future, the large-scale implementation of new-generation solutions such as SBW is expected to improve vehicle steering precision and become a key technology for intelligent vehicles, propelling continuous growth of the market. The market size of China's steer-by-wire solutions is projected to grow to RMB57.2 billion by 2030 with a CAGR of 11.5% from 2025 to 2030.

- Suspension-by-wire solutions.** Increasing consumer demand for comfort is driving suspension-by-wire solutions to become a standard feature in mid-to-high-end vehicle models, with semi-by-wire suspension solutions currently being the mainstream. In terms of revenue, the market size of China's suspension-by-wire solutions grew from RMB3.8 billion in 2020 to RMB29.2 billion in 2025 with a CAGR of 50.0%. As localization increases and costs decrease, suspension-by-wire solutions are expected to penetrate mass-market vehicle models. The mass production of full suspension-by-wire solutions is also expected to drive continued market expansion. The market size of China's suspension-by-wire solutions is projected to grow to RMB104.5 billion by 2030 with a CAGR of 29.1% from 2025 to 2030.
- Motion controllers.** The trend towards integrated automotive E/E architectures, and the evolution of motion control systems towards X-by-wire and coordinated control are driving the development of motion controllers. In terms of revenue, the market size of China's motion controllers reached RMB2.5 billion in 2025. In the future, motion controllers are expected to achieve high-efficiency signal transmission and precise coordinated control among various subsystems, providing stable support and accelerating the transition towards higher automotive intelligence. The market size of China's motion controllers is projected to grow to RMB13.1 billion by 2030 with a CAGR of 39.0% from 2025 to 2030.

Chart 3-3: Market Size of China's X-by-wire Solutions Industry, by Solution Type, in terms of Revenue, 2020-2030E



Notes:

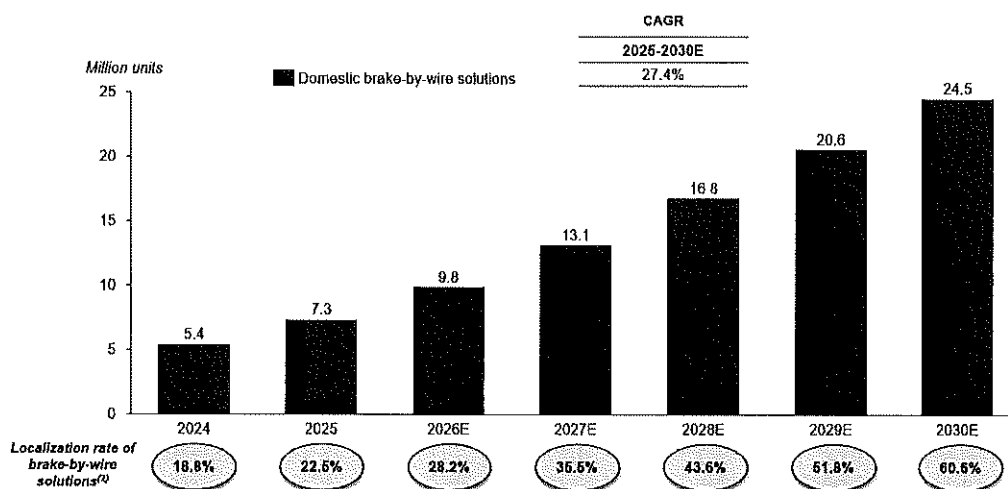
- (1) *The market size of X-by-wire solutions refers to the combined market size of brake-by-wire, steer-by-wire, suspension-by-wire, and motion controllers that are installed in intelligent vehicles.*
- (2) *The market size of brake-by-wire solutions includes the market sizes of hydraulic braking, Onebox, Twobox, and EMB solutions.*
- (3) *The market size of steer-by-wire solutions includes the market sizes of EPS and SBW solutions.*
- (4) *The market size of suspension-by-wire solutions includes the market sizes of continuous damping control suspension, air suspension, and fully active hydraulic suspension solutions.*
- (5) *Motion controllers were first mass-produced in China in 2022, accordingly, the CAGR for the period from 2020 to 2025 is not available.*

Source: China Passenger Car Association, CIC

3.3.2 Analysis of market size of domestic X-by-wire solutions industry

China's X-by-wire solutions industry exhibits significant differentiation in localization across different modules. Within the X-by-wire solution, brake-by-wire solution possesses the highest technological barriers and development difficulty. Consequently, China's brake-by-wire solutions industry has long been dominated by leading overseas companies, making it the sub-segment with the lowest localization rate in China's X-by-wire solutions industry. In 2025, the sales volume of domestic brake-by-wire solutions in China's market reached 7.3 million units with a localization rate of only 22.5%. The technical complexity of steer-by-wire and suspension-by-wire solutions is relatively lower. Domestic providers have achieved breakthroughs in core technologies through independent R&D, strengthening their capabilities. Accordingly, the localization rates for steer-by-wire and suspension-by-wire solutions in China's market have already exceeded 35.0% and 49.0%, respectively, in 2025, signaling that the independent supply chains for these solutions are maturing.

As domestic brake-by-wire solution providers achieve breakthroughs in core technology R&D, product reliability validation, and cost control, domestic solutions are rapidly transitioning from technological catch-up to market substitution. The sales volume of domestic brake-by-wire solutions in China's market is projected to reach 24.5 million units by 2030 with a CAGR of 27.4% from 2025 to 2030. The localization rate is expected to increase to 60.6% in 2030, indicating a vast market space for localization.

Chart 3-4: Sales Volume of Domestic Brake-by-wire Solutions⁽¹⁾, 2024-2030E

Notes:

- (1) The sales volume of domestic brake-by-wire solutions refers to the total sales volume of brake-by-wire solutions (including products such as ESC, electronic brake booster, Onebox and EMB) for all vehicles from domestic solutions providers.
- (2) The localization rate of brake-by-wire solutions refers to the collective market share in terms of sales volume held by domestic providers within the industry.

Source: CPCA, CIC

3.4 Growth drivers of global and China's X-by-wire solutions industry

- **Rising consumer demand for enhanced driving experience.** X-by-wire solutions can optimize braking and steering feel through algorithms, reduce noise vibration, and enhance the perception of safety with redundant designs. This is prompting OEMs to upgrade these solutions from optional configurations to standard features in vehicle models, thus accelerating the adoption of X-by-wire solutions.
- **Advancements in intelligent driving solutions create essential demand.** Currently, products related to vehicle perception and decision-making systems, such as LIDAR and intelligent driving algorithms, have undergone multiple iterations and are relatively mature in technology. However, the motion control system, serving as the core carrier of the execution layer, has lagged in development, becoming a key bottleneck in realizing the closed loop of "perception-decision-execution". With the continuous advancement of automated driving, the

motion control system must be upgraded to offer millisecond-level response and high safety redundancy.

- **Maturity of supply chain drives down production costs.** With the gradual standardization, further improvements in cross-segment collaborative mechanisms, and the continuous expansion of production capacity of upstream components for X-by-wire solutions, the material and production costs of X-by-wire solutions are expected to decrease. This cost reduction is also expected to drive an increase in the penetration rate of X-by-wire solutions.
- **Continuous advancements of core software and hardware technologies.** At the hardware level, sensor accuracy, actuator response speed, and stability have significantly improved. Meanwhile, software algorithms are continuously optimized for precise coordination of systems such as braking and steering. The combined advancements of both software and hardware enhance the overall reliability and consistency of the X-by-wire solutions, laying a solid technological foundation for their large-scale commercialization.
- **Favourable policy and regulatory support.** Governments worldwide have introduced a series of policies to provide a clear policy guidance and standard framework for the X-by-wire solutions industry.
 - In 2020, the PRC government released the “New Energy Vehicle Industry Development Plan (2021-2035)”, which explicitly stated the necessity to prioritize breakthroughs in core EV technologies including X-by-wire execution systems, setting a clear direction for the industry’s development. Meanwhile, relevant authorities are also actively promoting the establishment of standards, such as discussing and issuing the recommended standard “GB/T 43947-2024 General Technical Requirements for X-by-wire of Low Speed Automated Vehicles”, to regulate the industry’s development.
 - In Europe, the United Nations Economic Commission for Europe initiated discussions in 2018 to include EMB solutions in the UN Regulation No. 13 agenda. The draft amendment of standards for EMB solutions was completed in 2024 and submitted for review, and the related regulation is expected to be formally published in 2025, clearing regulatory hurdles for the large-scale application of EMB solutions in Europe.

3.5 Future trends of global and China’s X-by-wire solutions industry

- **Continuous improvements in intelligence and integration.** X-by-wire solutions are advancing towards greater intelligence and integration with closer collaboration

between sensors, actuators, and controllers for efficient data exchange. This allows for more precise and swift adjustments that improve vehicle performance across various conditions and laying a solid foundation for automated driving. Moreover, X-by-wire solution are integrating more functional modules, with core components achieving further mechanical decoupling and redundant integration reducing product size and weight to meet OEM's demands for lightweight and modular solutions.

- **Full-domain coordinated control becomes a key technological focus.** By integrating control logic and centralizing management, signal transmission and coordinated control are optimized, enhancing response speed and control precision. Simultaneously, X-by-wire solution achieves deeper cross-domain fusion with the intelligent driving domain, powertrain domain, and others, providing stronger support for the intelligent development of vehicles.
- **Accelerating global expansion in tandem with OEMs.** Global X-by-wire solution providers are expanding their operations overseas in tandem with the globalization of OEMs. Specifically, domestic X-by-wire solution providers are leveraging their close partnerships with domestic OEMs to venture into overseas markets following their global expansion initiatives. By supplying components for export models, they are entering overseas markets such as Southeast Asia and South America, gradually accumulating international client resources and brand recognition. In the future, they are expected to engage directly with overseas OEMs, further promoting domestic X-by-wire solutions in the global market.
- **Technology transferability supports product portfolio expansion in X-by-wire solutions.** Leading brake-by-wire solution providers are expanding into steer-by-wire and suspension-by-wire solutions, building a full-stack supply capability for core X-by-wire solutions. This multi-product synergy enhances their service value to OEMs. As the most technologically challenging segment, mass production of brake-by-wire solutions possess core technological capabilities that can be transferred to steer-by-wire, suspension-by-wire, and other related fields.
- **Software and algorithms defined motion control system becomes a core competency.** Software and algorithms in X-by-wire solutions integrate multi-dimensional information such as vehicle speed, road conditions, and intelligent driving commands. Through algorithm optimization, these solutions adapt execution strategies to balance safety, energy consumption, and personalization. Providers that master core software algorithms can establish a technological barrier, gaining a competitive edge and market dominance.

- **AI-powered fusion and prediction reshape execution logic of X-by-wire solutions.** X-by-wire solutions fuse real-time data from multiple sensors such as steering angle, torque, and wheel speed, and deeply couple this with AI prediction algorithms. This enables them to proactively perceive and manage potential driving risks in advance, achieving millisecond-level active pre-emptive control and upgrading the motion control execution logic from reactive response to intelligent prediction.

3.6 Competitive landscape of global and China's X-by-wire solutions industry

3.6.1 Participants in China's X-by-wire solutions industry

China's X-by-wire solutions industry includes both overseas and domestic providers. Overseas providers have traditionally led the market due to their first-mover advantage. In recent years, with the rapid development of the industry, domestic providers are gradually displacing these traditional leaders through technological breakthroughs, rapid response, and customized services. Consequently, their collective market share is expected to keep growing.

Domestic providers can be divided into those with OEM backgrounds and independent third-party solution providers. Solutions providers with OEM backgrounds are established with resources from specific OEMs, focusing R&D and product iterations on the model planning of the particular OEM, typically providing brake-by-wire solutions solely for the models under that OEM. Independent third-party solution providers operate independently through market-based mechanisms without being tied to a specific OEM, offering solutions across various OEMs' models. By accumulating mass production experience across different scenarios, they continuously optimize their products, develop the capability to respond quickly to diverse customer needs, and also leverage a broader customer base for economies of scale and improved cost-effectiveness.

Table 3-1: Introduction of Major Domestic and Overseas X-by-wire Solution Providers in China

Company name	Type of the solution provider	Introduction
Company A	Domestic solution provider with OEM backgrounds	A non-listed company founded in 2019 and headquartered in Guangdong Province, China. It is a wholly owned subsidiary of a leading Chinese EV OEM that focuses on the design and manufacturing of comprehensive automotive solutions, including brake-by-wire solutions, steer-by-wire solutions, and thermal management solutions.
Company B	Domestic independent third-party solution provider	A listed company founded in 2004 and headquartered in Anhui Province, China. It focuses on the design and manufacturing of automotive braking solutions and intelligent driving solutions, including brake-by-wire solutions, electronic control units, and advanced driving assistance solutions.
Company C	Domestic solution provider with OEM backgrounds	A non-listed company founded in 2020 and headquartered in Jiangsu Province, China. It is a wholly owned subsidiary of an established Chinese OEM focuses on the design and manufacturing of comprehensive automotive solutions, including brake-by-wire solutions, and vehicle body and chassis components.

Company D	Domestic independent third-party solution provider	A non-listed company founded in 2013 and headquartered in Beijing, China. It focuses on the design and manufacturing of automotive electronic control systems and intelligent driving solutions, including brake-by-wire systems, steer-by-wire systems, and electronic parking brakes.
Company E	Overseas independent third-party solution provider	A non-listed company founded in 1886 and headquartered in Germany. It focuses on the design and manufacturing of energy construction solutions, consumer goods and comprehensive automotive solutions including chassis and brake-by-wire solutions.
Company F	Overseas independent third-party solution provider	A listed company founded in 1871 and headquartered in Germany. It focuses on the design and manufacturing of comprehensive automotive solutions including autonomous driving solutions, smart cabin solutions and brake-by-wire solutions.
Company G	Overseas independent third-party solution provider	A non-listed company founded in 1915 and headquartered in Germany. It focuses on the design and manufacturing of comprehensive automotive solutions including suspension-by-wire solutions, brake-by-wire solutions and other chassis solutions

Company H	Overseas independent third-party solution provider	A listed company founded in 1962 and headquartered in Korea. It focuses on the design and manufacturing of brake-by-wire solutions, brake calipers and steering solutions.
Company I	Overseas independent third-party solution provider	A non-listed company founded in 2001 and headquartered in Japan. It focuses on the design and manufacturing of brake-by-wire solutions, electronic parking brakes and brake calipers.
The Group	Domestic independent third-party solution provider	A non-listed company founded in 2016 and headquartered in Shanghai, China. It focuses on the development, production and sales of the core components of X-by-wire systems, including brake-by-wire systems.
Company J	Domestic independent third-party solution provider	A non-listed company founded in 2009 and headquartered in Beijing, China. It focuses on the design and manufacturing of suspension-by-wire solutions, brake-by-wire solutions, electronic parking brakes and brake calipers.
Company K	Overseas independent third-party solution provider	A non-listed company founded in 1994 and headquartered in Shanghai, China. It is a joint venture formed between a leading overseas automotive component supplier and a leading domestic automotive component supplier. It focuses on the design and manufacturing of steer-by-wire solutions.

Company L	Domestic independent third-party solution provider	A listed company re-established in 2010 and headquartered in the United States. It focuses on the design and manufacturing of steering solutions, brake-by-wire solutions, driveline systems and software solutions.
Company M	Overseas independent third-party solution provider	A listed company founded in 2006 and headquartered in Japan. It focuses on the design and manufacturing of automotive steering solutions, drivetrain components, and machine tools.

Source: CIC

3.6.2 Ranking of brake-by-wire solution providers in China

In 2025, the total sales volume of China's brake-by-wire solutions was 32.5 million units. Currently, domestic solutions, known for their cost-effectiveness and product performance, accounted for 7.3 million units, achieving a localization rate of 22.5%. In 2025, the Group's sales volume of brake-by-wire solutions reached 736.2 thousand units, ranking sixth among all domestic and overseas brake-by-wire solution providers with a market share of 2.3%. Meanwhile, it also ranked third among all domestic solution providers and second among all domestic independent third-party solution providers with a market share of 10.1%.

Table 3-2: Ranking of Brake-by-wire Solution Providers in China, in terms of Sales Volume of brake-by-wire solutions, 2025

Ranking	Solution providers	Sales volume (Thousand units)	Market share ⁽¹⁾ (%)
1	Company E	~14,500.0	44.7%
2	Company F	~4,200.0	12.9%
3	Company A	~2,200.0	6.8%
4	Company B	~1,400.0	4.3%

5	Company G	~1,200.0	3.7%
6	The Group	736.2	2.3%
7	Company I	~730.0	2.2%
8	Company H	~650.0	2.0%
9	Company C	~400.0	1.2%
10	Company D	~350.0	1.1%
Sub-total		~26,366.2	81.2%

Table 3-3: Ranking of Domestic Brake-by-wire Solution Providers in China, in terms of Sales Volume of brake-by-wire solutions, 2025

Ranking	Solution providers	Provider type	Sales volume (Thousand units)	Market share ⁽¹⁾ (%)
1	Company A	Solution provider with OEM backgrounds	~2,200.0	6.8%
2	Company B	Independent third-party solution provider	~1,400.0	4.3%
3	The Group	Independent third-party solution provider	736.2	2.3%
4	Company C	Solution provider with OEM backgrounds	~400.0	1.2%
5	Company D	Independent third-party solution provider	~350.0	1.1%
Sub-total			~5,806.2	15.7%

Note:

(1) The market share is calculated by dividing a solution provider's total sales volume of brake-by-wire solutions (including ESC, electronic brake booster, Onebox and EMB) by the collective sales volume of brake-by-wire solutions from all solution providers.

Source: CIC

In 2025, the market size of China's brake-by-wire solutions reached RMB32.3 billion. In terms of revenue from brake-by-wire solutions, the Group ranked seventh among all overseas and domestic brake-by-wire solution providers, third among all

domestic solution providers, and second among all domestic independent third-party solution providers with a market share of 1.9% in the same year.

Table 3-4: Ranking of Brake-by-wire Solution Providers in China, in terms of Revenue of brake-by-wire solutions, 2025

Ranking	Solution providers	Provider type	Revenue (Billion RMB)	Market share ⁽¹⁾ (%)
1	Company E	Overseas independent third-party solution provider	~14.7	45.6%
2	Company F	Overseas independent third-party solution provider	~3.8	11.8%
3	Company A	Domestic solution provider with OEM backgrounds	~3.1	9.6%
4	Company B	Domestic independent third-party solution provider	~2.2	6.8%
5	Company G	Overseas independent third-party solution provider	~1.6	5.0%
6	Company H	Overseas independent third-party solution provider	~1.0	3.1%
7	The Group	Domestic independent third-party solution provider	0.6	1.9%
8	Company I	Overseas independent third-party solution provider	~0.5	1.6%
9	Company C	Domestic solution provider with OEM backgrounds	~0.4	1.2%
10	Company J	Domestic independent third-party solution provider	~0.2	0.7%
Sub-total			~28.1	87.3%

Table 3-5: Ranking of Domestic Brake-by-wire Solution Providers in China, in terms of Revenue of brake-by-wire solutions, 2025

Ranking	Solution providers	Provider type	Revenue (Billion RMB)	Market share ⁽¹⁾ (%)
1	Company A	Solution provider with OEM backgrounds	~3.1	9.6%
2	Company B	Independent third-party solution provider	~2.2	6.8%

3	The Group	Independent third-party solution provider	0.6	1.9%
4	Company C	Solution provider with OEM backgrounds	~0.4	1.2%
5	Company J	Independent third-party solution provider	~0.2	0.7%
Sub-total			~6.5	20.2%

Note:

(1) The market share is calculated by dividing a solution provider's revenue of brake-by-wire solutions in China by the market size of China's brake-by-wire solutions.

Source: CIC

In 2025, the market size of ESC solution for fuel-powered vehicles reached RMB7.3 billion. In terms of revenue from ESC solution for fuel-powered vehicles, the Group ranked fifth among all overseas and domestic brake-by-wire solution providers, and first among all domestic solution providers with a market share of 1.9% in the same year. In recent years, domestic providers are gaining increasing competitive advantages in project acquisition, steadily driving the localization rate of ESC solution for fuel-powered vehicles. Against this backdrop, the Group is well-positioned to sustain its industry leadership and further expand its market share by leveraging its mature technology capabilities and extensive customer base.

Table 3-6: Ranking of Brake-by-wire Solution Providers in China, in terms of Revenue of ESC solutions for Fuel-powered Vehicles, 2025

Ranking	Solution providers	Provider type	Revenue (Billion RMB)	Market share ⁽¹⁾ (%)
1	Company E	Overseas independent third-party solution provider	~3.3	44.9%
2	Company F	Overseas independent third-party solution provider	~1.5	20.4%
3	Company I	Overseas independent third-party solution provider	~0.5	6.8%
4	Company G	Overseas independent third-party solution provider	~0.2	2.7%
5	The Group	Domestic independent third-party solution provider	0.1	1.9%
Sub-total			~5.6	76.7%

Note:

(1) The market share is calculated by dividing a solution provider's revenue of ESC solution for fuel-powered vehicles in China by the market size of ESC solutions for fuel-powered vehicles in China.

Source: CIC

3.6.3 Ranking of steer-by-wire solution providers in China

The market size of China's steer-by-wire solutions has increased from RMB12.4 billion in 2020 to RMB33.2 billion in 2025 with a CAGR of 21.8%, and is expected to increase to RMB57.2 billion in 2030 at a CAGR of 11.5%. In terms of revenue from steer-by-wire solutions, the top five solution providers collectively held a market share of 76.3%. As of the end of 2025, the Group's steer-by-wire solutions were still under development and had not yet achieved mass production. The Group expects to commence the mass production of steer-by-wire solutions in 2027, with initial revenue contribution anticipated thereafter.

Table 3-7: Ranking of Steer-by-wire Solution Providers in China, in terms of Revenue of Steer-by-wire solutions, 2025

Ranking	Solution providers	Provider type	Revenue (Billion RMB)	Market share ⁽¹⁾ (%)
1	Company K	Overseas independent third-party solution provider	~9.4	28.3%
2	Company L	Domestic independent third-party solution provider	~6.0	18.1%
3	Company G	Overseas independent third-party solution provider	~4.3	13.0%
4	Company M	Overseas independent third-party solution provider	~3.6	10.9%
5	Company H	Overseas independent third-party solution provider	~2.0	6.0%
Sub-total			~25.3	76.3%

Note:

(1) The market share is calculated by dividing a solution provider's revenue of steer-by-wire solutions in China by the market size of China's steer-by-wire solutions.

Source: CIC

3.7 Entry barriers and key success factors of China's X-by-wire solutions industry

- **Long-term technical accumulation for high safety and reliability requirements.** As a core system for vehicle control, X-by-wire solution demands extremely high safety and reliability. Overcoming challenges such as coordinated control, failure protection, and redundancy involves intricate electronic interactions, precise responses, and multi-layered safety designs, establishing significant technological barriers. Such capabilities require long-term R&D accumulation.
- **Deeply integrated customer collaboration foundation.** X-by-wire solutions directly impact driving safety, leading OEMs to engage in long-term joint testing and validation with providers. Switching providers often involves complex system architecture migration, making OEMs favor stable, long-term partnerships. New entrants face challenges in gaining market recognition and overcoming high transition costs, making it difficult to swiftly gain customer trust and enter the supply chain.
- **Strong supply chain management capabilities.** X-by-wire solutions rely on core components such as high-precision chips, automotive-grade sensors, and high-reliability actuators. Leading solution providers have established stable supply chain through long-term partnerships and strategic reserves, enabling them to manage risks such as raw material price fluctuations and capacity constraints.
- **High-standard manufacturing and mass production capabilities.** X-by-wire solutions demand high precision, consistency, and reliability in production, making automated production lines key for efficient and precise manufacturing. Leading providers possess intelligent, high-precision assembly lines to control errors at the micron level, ensuring stable output of high-precision products. Mass production capabilities are also crucial, as they enable stable deliveries and process optimization to reduce costs.
- **Cross-domain fusion and ecosystem adaptability.** The X-by-wire domain must be deeply compatible with the intelligent driving domain and the vehicle E/E architecture. Leading providers establish technical integration by participating in the early stages of an OEM's vehicle definition.

- **Capital barriers.** X-by-wire solution providers need to continuously invest capital in the synergistic development of software and hardware, as well as in the iterative optimization of technology. At the same time, to meet the demands of mass production, capital investment is required to acquire high-precision assembly equipment and build automated production lines.

4. Trend of Migrating and Reusing X-by-wire Technologies in Robotics and Low-altitude Economy Sectors

4.1 Analysis of the applicability of X-by-wire technologies in the robotics and low-altitude economy sectors

Robotics and the low-altitude economy sectors, as emerging growth poles in the global technology industry, are developing rapidly with expanding application scenarios. Both sectors have a high demand for technologies such as motion control and safety redundancy, which align closely with the core technical features of X-by-wire solutions in the automotive industry. This combination of development space and technological demand is attracting X-by-wire solution providers to enter these related fields through technology migration.

4.1.1 Technical adaptability: Complex motion and aerial attitude control

In the automotive sector, X-by-wire technologies use electronic signals to adjust actuators for steering and braking based on road conditions, achieving precise vehicle control. This dynamic control has significant cross-scenario migration value. In robotics, X-by-wire technologies can integrate motion sensor data to precisely control joint angles and path, meeting the demand for complex and precise motion executions. In the low-altitude economy, X-by-wire technologies can adjust aircraft attitude by processing sensor data to swiftly generate adjustment commands, fulfilling stability for low-altitude aircraft.

4.1.2 Architectural reuse: Extending the application scenarios of electronic control systems

The electronic control system built upon X-by-wire technologies in the automotive sector exhibits high reliability and real-time responsiveness, processing sensor data and driving actuators to ensure stable vehicle operation. This system, with efficient data processing and execution, has strong cross-domain reusability. In robotics, it integrates perceptual data to improve control response and stability. In the low-altitude economy, the ground travel segments of “land-air dual-use” vehicles, such as flying cars, can directly reuse this electronic control system architecture. Through parameter adaptation, it can meet the control requirements for functions such as steering and braking, substantially reducing R&D costs and cycles.

4.1.3 Design migration: Migrating safety redundancy design

To ensure driving safety in the automotive sector, X-by-wire technologies employ multiple safety designs, such as sensor and controller redundancy to handle failures

and maintain stability. This multi-dimensional redundancy is adaptable to various scenarios. In robotics, it addresses potential issues such as sensor failures or actuator jams through data validation and backups, improving fault tolerance. In the low-altitude economy, the solution can be upgraded to enhance aircraft fault tolerance in extreme weather or signal interference, ensuring operational safety in the air.

4.2 Total addressable market of X-by-wire technologies in the robotics and low-altitude economy sectors

X-by-wire technologies possess core advantages such as high-precision motion control and safety redundancy, aligning well with the demands of robotics and low-altitude economy, enabling cross-domain migration. With the widespread application of robots across industries, and the rise of new business models in the low-altitude economy, such as drone logistics and flying cars, combined with continuous technological innovation and strong policy support, the total addressable market for X-by-wire technologies in these emerging scenarios is vast. It is projected that by 2030, the global total addressable market for X-by-wire technologies in the robotics and low-altitude economy sectors is expected to reach RMB238.9 billion.

X-by-wire solution providers are deeply rooted in the automotive sector, having accumulated core technologies in areas such as motion control software algorithms and safety redundancy design, with their products featuring both quality stability and cost-effectiveness. By reusing existing platforms and mass production experience, leading providers can quickly adapt to robotics and low-altitude economy sectors, gaining a strong position in these emerging markets.

Appendix

The Group's Leading Market Position

- The Group is the first Chinese company to commercialize electronic brake booster solution (NBS solution) for operated L4 autonomous vehicles in 2018.
- The Group is the first Chinese company to supply proprietary electronic brake booster solution (NBS solution) to leading Chinese EV OEMs.
- The Group is among the top three domestic brake-by-wire solution providers in terms of brake-by-wire solution sales volume in China in 2025.
- The Group is the second-largest domestic independent third-party brake-by-wire solution provider in terms of brake-by-wire solution sales volume in China in 2025.
- The Group is the world's first to mass-produced ESC redundant EPB solution.
- The Group is among the first in China to mass produce a single-stage transmission NBC solution, improving efficiency by up to 15%.
- The Group is among the first in China to release 48V EMB solution.
- In early 2024, the Group achieved mass production of its upgraded ESC solution, being the industry's first ESC solution capable of supporting the removal of electric parking pawl for the entire vehicle, reducing weight and improving system integration for OEMs.
- In terms of brake-by-wire solution sales volume in China in 2025, the Group is among the top three domestic brake-by-wire solution providers, and the second-largest domestic independent third-party brake-by-wire solution provider.
- As China's leading expert in X-by-wire-based intelligent driving motion control, the Group is committed to advancing this transformation through an open and collaborative approach, working closely with upstream and downstream partners across the entire automotive value chain.
- The Group's collaboration with a leading Chinese autonomous driving technology company promoted the development of China's first L4 autonomous minibus, representing the first adoption of brake-by-wire technology in this vehicle category.
- The Group is the first to achieve mass production of China's electronic brake booster solution (NBS solution).

- The Group is the first in the world to integrate braking-by-wire and steer-by-wire solution into C2C integrated platforms.
- The Group is the recipient of the First Prize for Scientific and Technological Invention from the China Society of Automotive Engineers, one of the industry's most prestigious award.
- The Group ranks among China's top three domestic brake-by-wire solution providers and is the second-largest domestic independent third-party provider, in terms of brake-by-wire solution sales volume in China in 2025.
- The Group's customer base has achieved 100% coverage of the top five Chinese domestic OEMs, ranked by sales volume of passenger vehicle in 2025.
- The Group achieved production efficiency that exceeded the industry average.
- Being the first domestically developed intelligent electronic brake booster solution in China, the Group's NBS solution has been recognized under the Shanghai Major Industrial Foundation Enhancement Projects (上海市工业强基重大专项) and the Shanghai Pilot Free Trade Zone Special Development Project (上海自由贸易试验区专项), and had been deployed in China's first L4 autonomous passenger bus.
- The Group's R&D expenses as a percentage of operating expenses exceed the industry average.
- The Group ranked the third among all domestic brake-by-wire solution providers and second among all domestic independent third-party solution providers, in terms of the sales volume of brake-by-wire solutions in China in 2025, accounting for a 8.7% market share.
- Each of the Group's solutions fall within an acceptable sector of a Specialist Technology Industry, including Electric and Autonomous Vehicles and Advanced Transportation Technology under Advanced Hardware and Software as defined under Chapter 18C of the Listing Rules.
- The Group is one of the few suppliers in China capable of providing integrated brake-by-wire chassis solutions.

Industry Norm

- The China Society of Automotive Engineers (CSAE) is one of the most authoritative academic organizations in China's auto industry.
- It is common for domestic providers in the X-by-wire solutions industry to have high customer concentration, resulting from the high concentration of major downstream OEMs, as well as the long validation cycles required by OEMs.
- The X-by-wire market is experiencing explosive growth.
- The Group's order volumes in the second half of each year consistently exceeded those in the first half. This pattern aligns with broader industry trends, where mass production by OEMs tends to peak in the fourth quarter.
- High customer concentration is common among domestic providers in the X-by-wire solutions industry, with the support of relevant industry data (e.g. sales concentration level of peer companies, quantitative data demonstrating the "high concentration of major downstream OEMs", "long validation cycles required by OEMs").
- It is common for domestic providers in the X-by-wire solutions industry to have high customer concentration, mainly as a result of the downstream OEM market being dominated by a small number of large automobile manufacturers, coupled with the long validation cycles required by OEMs.

Other Industry-Related Statements

- The market size of motion control solutions for humanoid robots in China increased from RMB0.01 billion to RMB0.6 billion in 2024, and is expected to increase to RMB29.0 billion in 2030 with a CAGR of 93.1% from 2024 to 2030. The market size of motion control solutions for low-altitude aircrafts in China, including electric vertical take-off and landing aircrafts (eVTOL) and unmanned aerial vehicles (UAV), increased from RMB2.7 billion in 2020 to RMB6.1 billion in 2024 with a CAGR of 22.2%, and is expected to increase to RMB21.8 billion by 2030 with a CAGR of 23.7% during that period.
- The Company's major customers, being leading Chinese OEMs, have no significant vehicle exports to the U.S., and therefore the Company's exposure to indirect tariff effect is immaterial.
- The Company's major customers, leading Chinese OEMs, have no significant vehicle exports to the United States.

- The Company's major customers, primarily leading OEMs in China, make no significant vehicle exports to the U.S. and do not consider U.S as a major target market for their products.
- The development and mass production of X-by-wire technologies require substantial capital investment and long lead times, and may not achieve large-scale commercial success in the short term due to uncertainties in technology maturity and safety concerns, high costs, long validation cycles and evolving regulatory and industry frameworks.
- The typical product lifecycle of each of our brake-by-wire solution is approximately fifteen years from research and design, mass production and validation to usage and decommission that spans across ten to fifteen years.
- Based on data from China Automobile Dealers Association Automotive Market Research Branch (“中国汽车流通协会乘用车市场信息联席分会”), during the Track Record Period, in terms of sales volume, China's automobile export to the U.S. consistently accounted for less than 2.5% of its total automobile exports. This indicates that Chinese OEMs have minimal sales exposure to the U.S. market, rendering the automotive OEMs customers, primarily domestic OEMs, have immaterial sales exposure to the U.S.
- However, the scale and pace of growth in the X-by-wire market remain highly uncertain due to challenges in technology, costs and evolving regulatory regimes when scaling up commercialization.